





INSTALLATION RESTORATION PROGRAM

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

CAPE ROMANZOF LRRS, ALASKA

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

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ABBREVIATIONS AND ACRONYMS

4.4.0	Alaska Administrative Code
AAC	Alaska Department of Environmental Conservation
ADEC	Air Force Center for Environmental Excellence
AFCEE	
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
Су	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
РАН	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

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.

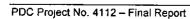
1.3 Technical Report Organization

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.

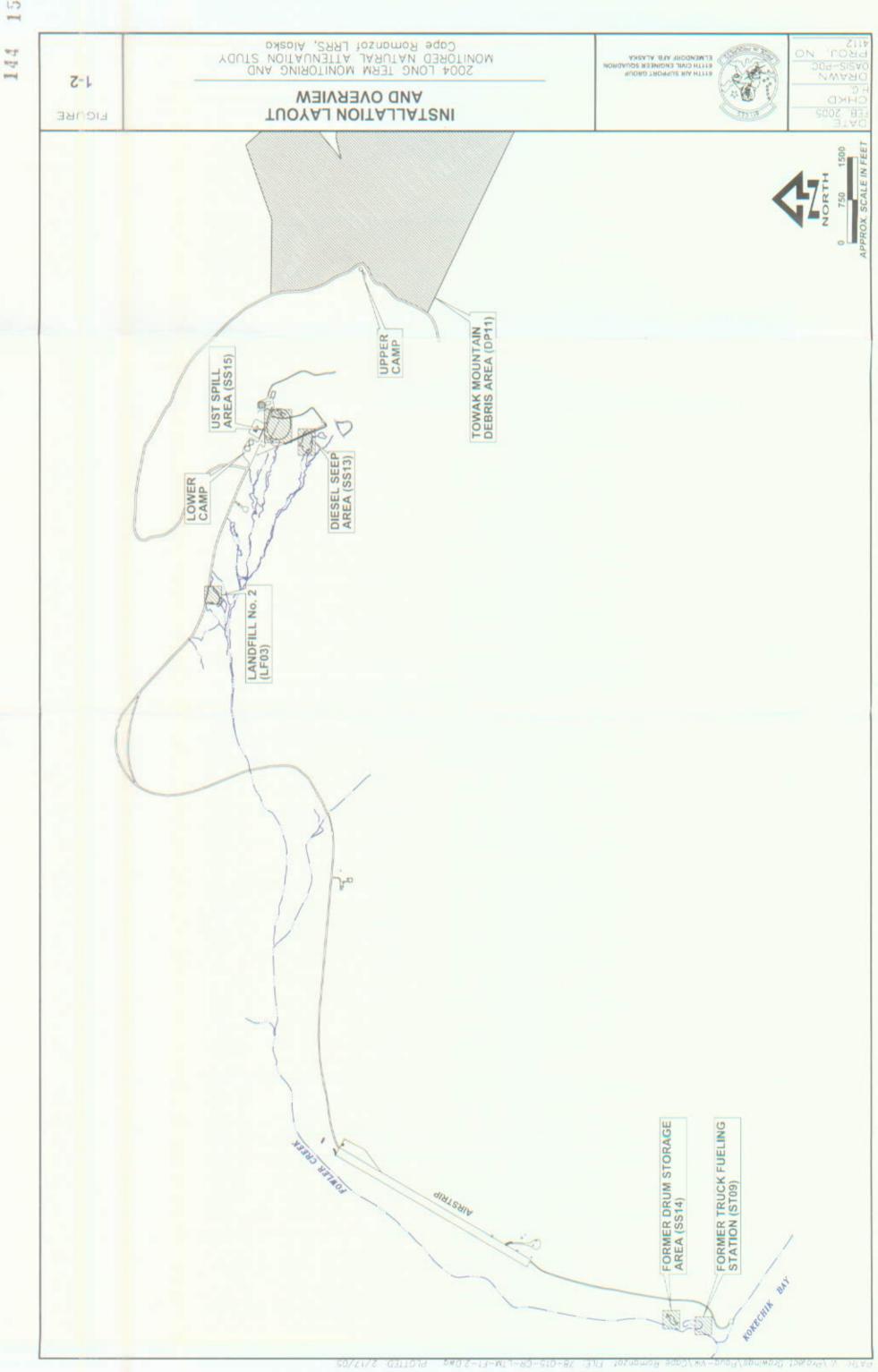
Table 1-1 Technical Report Organization

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1.3 -



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.

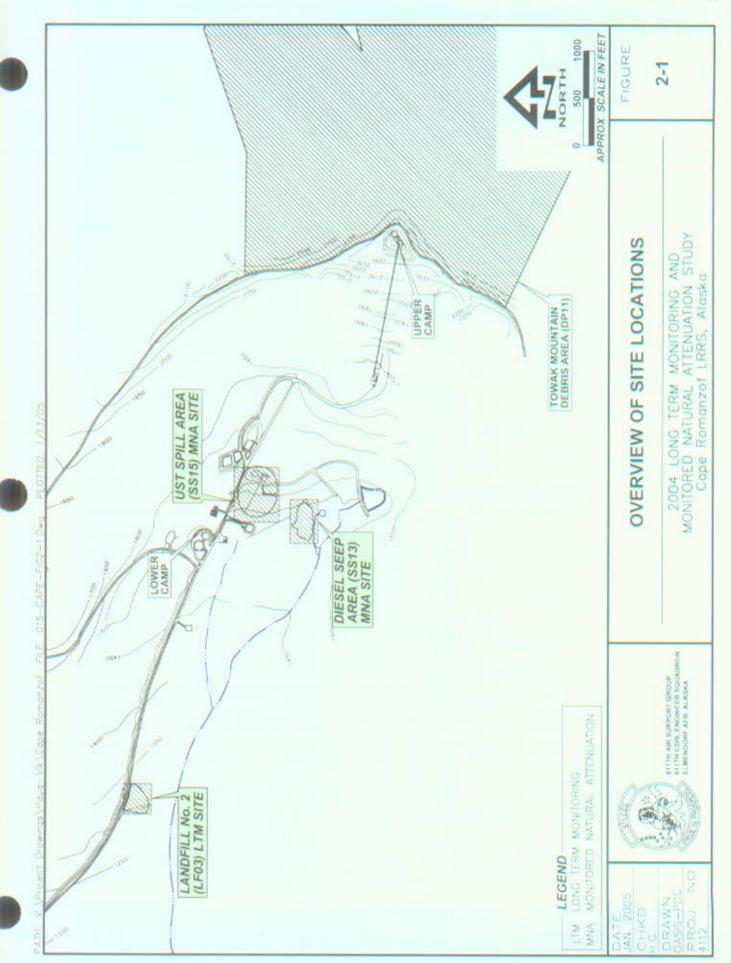
2.3.2 LF03 Surface Water

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.





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.

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	inspection scope
	Sediments: SS-1, SS-2, and SS-3	BTEX, DRO, PAH, PCBs	
DRO = diesel ra GRO = gasoline		PCBs = polychlorinated biphen RRO = residual range organics TAH = total aromatic hydrocart concentrations TAqH = total aqueous hydrocar PAH concentrations	oons = sum of BTEX

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

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.

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	ТАН	602 or 8021B	0.500 μg/L to 2.00 μg/L	
SS13	HpAT	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 v There is no Air Force Cer Excellence PQL requirem coupled plasma – mass s Definitions: μg/L = micrograms per liter BTEX = benzene, toluene, ethy	iter for Environmental ent for iron by inductively pectroscopy (ICP-MS).	et. GRO = gasoline range mg/L = milligrams per PCBs = polychlorinate PQL = practical quantu RRO = residual range TAH = total aromatic h concentrations	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	

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

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	
LF03 F055 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		concentratio	ge organics tic hydrocarbons = sum of BTEX ons ous hydrocarbons = sum of BTEX and PAH ons	

concentrations

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.

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

Table 3-4 Field Parameters Measurement Methods

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.

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.

Table 3-5	Monitoring Well Information at SS13 in 2004
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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).

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 instatled in 2004 under separate contract for BNCI. Well was inspected in June and August, 2004, and was dry both times. 2-incl well

Table 3-6Monitoring Well Information at SS15 in 2004

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.

Well ID	Total Well Depth ¹	Water Level Depth		
(units)	(feet)	(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.

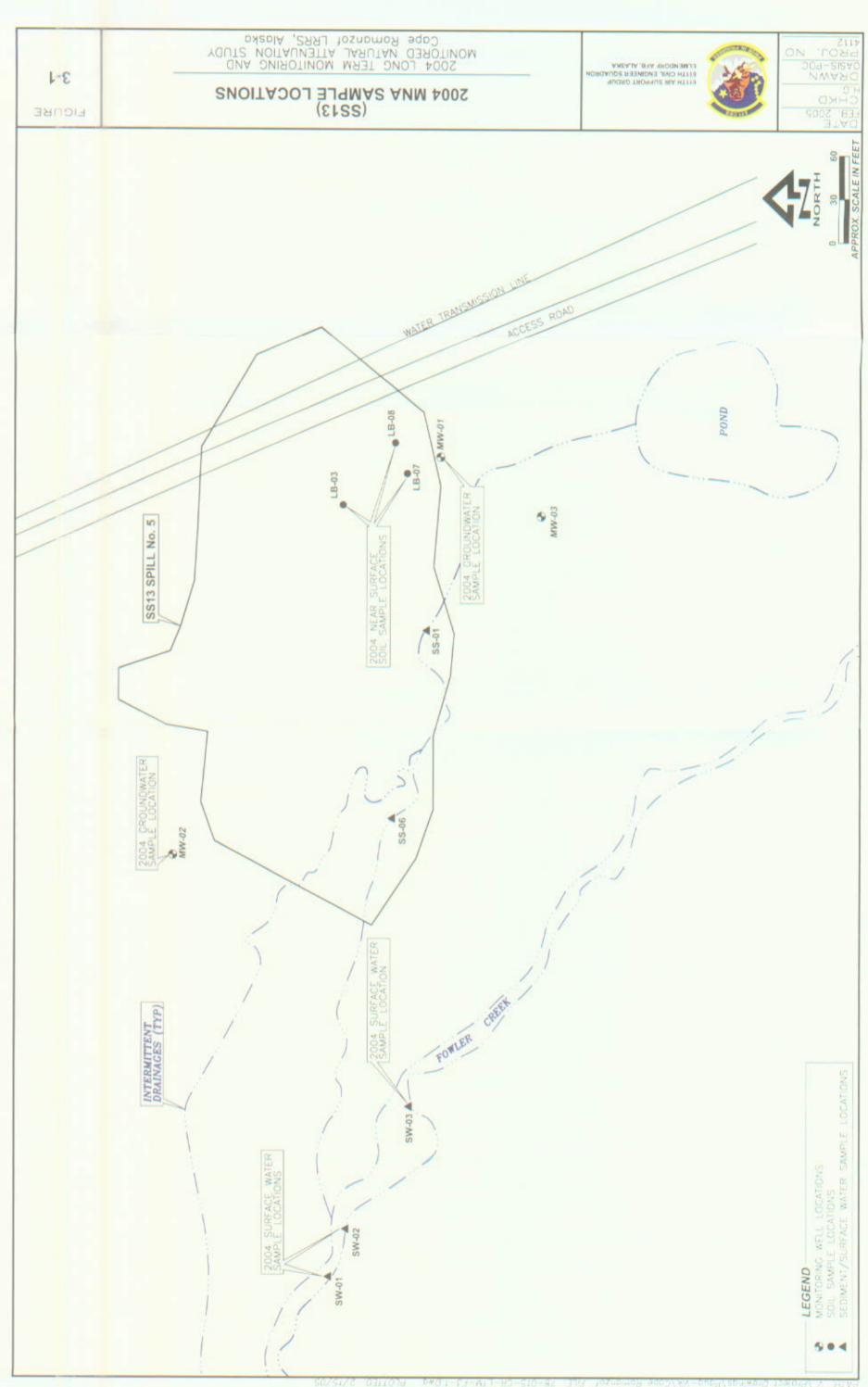
3-7

Table 3-7 LF03 Monitoring Well Information

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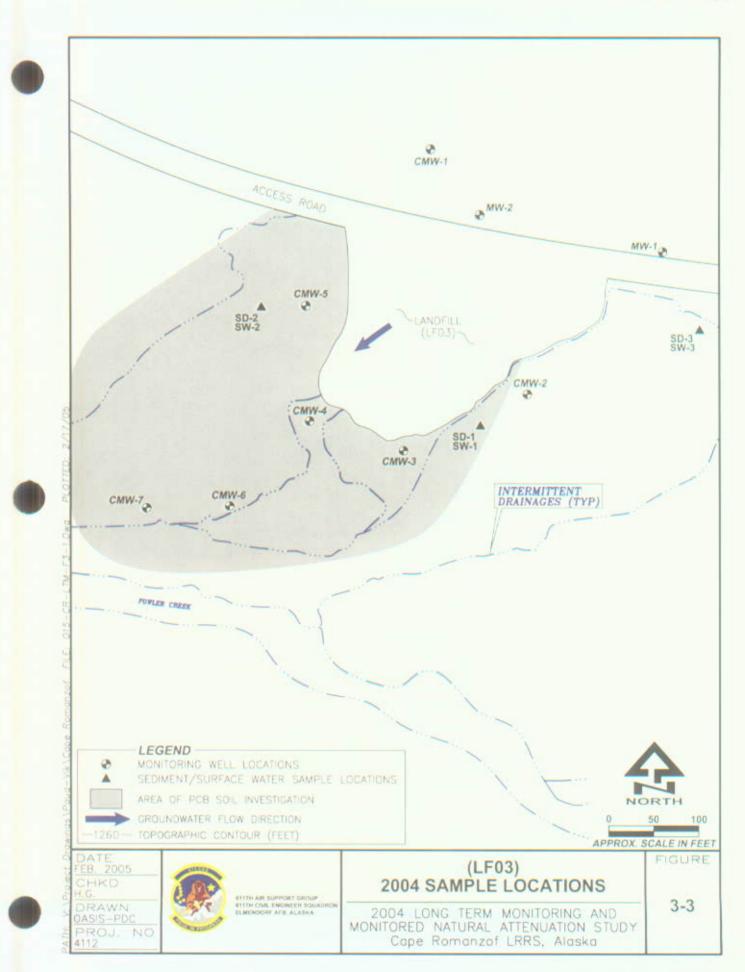






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PRELIMINARY REMEDIAL ACTION OBJECTIVES

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.

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Table 4-1 Groundwater Cleanup Levels for COCs and COPCs

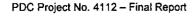
Contaminant of Concern	Cleanup Level (mg/L)	Regulatory Basis
- Mart		drocarbons
GRO	1.3	
DRO	1.5	
RRO	1.1	
	v	ocs
Benzene	0.005	
Toluene	1.0	
Ethylbenzene	0.7	- 18 AAC 75.345(b)(1)
Total Xylenes	10	
	P	AHs
Naphthalene	0.7	······································
Acenaphthene	2.2	
Anthracene	11.0	
Benzo(a)anthracene	0.001	
Benzo(a)pyrene	0.0002	
Benzo(b)fluoranthene	0.001	
Benzo(k)fluoranthene	0.01	18 AAC 75 345(b)(1)
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,l)perylene	1.1	
	P	CBs
PCBs	0.0005	18 AAC 75.345(b)(1)
Notes: 18 AAC 75.345(b)(1) = Alaska Departm Conservation Oil and Hazardous Subst Regulations, as amended through May (Table C) groundwater cleanup levels. Calculated cleanup level in accordance provided in ADEC Tech Memo 01-007, 2003	ances Pollution Control 26, 2004; Method Two with 18 AAC 75.340(g);	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

Contaminant of Concern	Criteria (mg/L)	Regulatory Basis		
	Bulk Hydro	ocarbons ¹		
ТАН	0.010			
ТАqН	0.015	18 AAC 70.020(b)		
DRO, GRO, RRO	No sheen			
	VO	Cs		
Benzene	0.005			
Ethylbenzene	0.7			
Toluene	1.0	18 AAC 70.020(b)		
Total Xylenes	10			
	PA	Hs		
Benzo(b)fluoranthene	0.3			
Benzo(g,h,l)perylene	0.3	NOAA SQuiRT Marine Criteria ²		
Naphthalene	0.62	NOAA SQuiRT Freshwater Criteria ²		
Pyrene	0.960	18 AAC 70.020 (b)		
	PC	Bs		
PCBs	0.000014	18 AAC 70.020 (b)		
 PCBs 0.000014 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).

Contaminant of Concern	Ingestion Pathway (mg/kg)	Inhalation Pathway (mg/kg)	Migration to Groundwater Pathway (mg/kg)	Regulatory Basis	
		Bulk Hydrocarb	oons*		
GRO	10,250	1,400	300		
DRO	10,000	12,500	250	18 AAC 75.341 (d)	
RRO	10,000	22,000	11,000		
		VOCs			
Benzene	20,300	9	0.02		
Toluene	10,000	180	5.4		
Ethylbenzene	203,000	89	5.5	18 AAC 75.341 (c)	
Xylenes (total)	203,000	81	78	1	
• • • … 1		PAHs and other S	SVOCs		
Chrysene	2,000	Not available	620	·······	
Napthalene	3,000	120	21	- 18 AAC 75.341 (c)	
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	1	
Phenanthrene	3000	Not available	4,300		
Benzo(g,h,l)perylene	2030	Not available	1500	ADEC Tech Memo 01-007	
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)	
use, a cleanup leve 18 AAC 75.341(c) and (d) Environmental Com Substances Pollutio through May 26, 20 precipitation) soil cl chemicals other tha	ntial use. For comm I of 10 mg/kg PCBs	g/kg PCBs is lercial/industrial is protective. nt of De izardous Di ns, as amended Gi der 40-inch mi i refers to P/ arbons (Table PC irocarbons Rf	olded cleanup level is the cleanup levels and is p and migration to groun afinitions: RO = diesel range organics RO = gasoline range organi g/L = milligrams per liter AHs = polynuclear aromatic CBs = polychlorinated biphe RO = residual range organic OCs = volatile organic comp	ics hydrocarbons enyls cs	

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

(Table B2) Calculated cleanup level in accordance with 18 AAC 75.340(g); provided in ADEC Tech Memo 01-007, dated November 24, 2003. 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.

Contaminants of Concern	Sediment Screening E (mg/kg) ¹	enchmark	Reference
	Bulk Hydro	carbone ²	
······	VOC		
Benzene	0.057		OWSER ET
Toluene	0.05		ORNL SQB
Ethylbenzene	0.089		ORNL SQB
Xylenes (total)	0.025		OSWER ET
	PAH	ls	C
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
	PCE	ls	
PCBs	0.0341		NOAA SQuiRT TEL
 Notes: Sediment screening was performed in accordance with Alaska Department of Environmental Conservation Technical Memorandum Sediment Quality Guidelines (2004). 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). 		Office of Ecotox Ridge M Benchr PAHs = polyn PCBs = polyc PEL = probab TEL = thresho UET = upper	Environmental Protection Agency (USEPA) of Solid Waste and Emergency Response Thresholds (USEPA, 1996)ORNL SQB = Oak National Laboratory Sediment Quality nark (Jones et al., 1997) uclear aromatic hydrocarbons hlorinated biphenyls ble effects level old effects level effects threshold ile organic compounds

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

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.

<u> </u>	

Table 4-5 Data Evaluation Procedures

Activity/Objective	Data Evaluation/Action		
Groundwater: Collect groundwater data from monitoring wells to assess the nature, degree,	 Compare data to ADEC groundwater cleanup levels in 18 AAC 75.345 Groundwater Cleanup Levels (Table C). 		
and extent of potential contaminant plumes.	 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	 Compare data to ADEC water quality standards in 18 AAC 70.020(b) 		
contaminants, or any adverse effects on water	Compare data to previous sample data.		
quality from surface water runoff.	 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	Compare data to ADEC Technical Memo "Sediment Quality Guidelines" (ADEC, March 2004)		
environmental impacts from identified contaminants.	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.



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. 					

Table 4-6	Summary of Evaluation Factors for Intrinsic Remediation
-----------	---

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.

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:

- 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.

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.	

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



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-03¹.
- 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-visisted 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.

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.

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 *	0.106*	ND	ND	ND	ND	ND
MW-03 ^b	0.142	ND	NA	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 (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. 					DRO = diesel rar GRO = gasoline- mg/L = milligrams NA = not analyze ND = below meth PAHs = polynuch PCBs = polychlo RAOs = remedia RRO = residual r SVOCs = semi-v	range organic s per liter d detection l ear aromatic h rinated biphen l Action Objec ange organics	limits hydrocarbons hyls tives (prelimir	nary)

Table 5-2 2004 Hydrocarbon Results for SS13 Groundwater Samples

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

Location	PAH Detected	Level Detected	Groundwater RAOs ¹
MW-01	MW-01 Naphthalene		0.7 mg/L
Conservation Oil and	ska Department of Environmental Hazardous Substances Pollution as amended through May 26,	Definitions: mg/L = milligrams per liter P hydrocarbons RAOs = Remedial Action Ol	

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).

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
1997 0.0091 2.47 0.020 0.0003 Note: 1					Definitions: DRO = diesel ran GRO = gasoline r mg/L = milligrams NA = not analyze ND = below meth RAOs = Remedia RRO = residual ra SVOCs = semivo	ange organic per liter d od detection I I Action Object ange organics	imits ctives (prelimi	inary)

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

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.)

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	
lotes:		Definitions:	······································	

mg/L = milligrams per liter

RAOs = Remedial Action Objectives (preliminary)

SVOCs = semivolatile organic compounds

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

Notes:

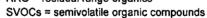
18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels.

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);

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

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
Department Oil and Haz Control Reg May 26, 200	5.345(b)(1) = A of Environme ardous Substa ulations, as ar)4; Method Tw r cleanup leve	ntal Conserva ances Pollutior mended throug vo (Table C)	tion GRO mg/L gh NA = RAOs RRO	= residual range	e organics r liter detection limits tion Objectives (prelin	ninary)		





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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	ND	ND	ND	ND	ND	ND	ND
SW-01D	ND	0.0678 a	ND	ND	ND	ND	Table 5- 5a	ND	ND
SW-02	0.0 <mark>653</mark>	0.139ª	ND	ND	ND	ND	Table 5- 5a	ND	ND
SW-03	0.0917 ª	0.363 *	ND	ND	ND	ND	Table 5- 5a	ND	ND
Conservat through Ju ² There are or GRO; 1 oils, and g surface of ^a = Value ind	ion Alaska V ine 26, 2003 no quantitat 8 AAC 70 re rease may r the water. icated is bel	Vater Quality (ADEC, 200 ive surface v equires that p not cause a v low the Prac	ent of Environn y Standards, as J3). water criteria fo petroleum hydr visible sheen u tical Quantitati Detection Limit	nental D s amended G or DRO, RRO, N ocarbons, N pon the P R on Limit for R	efinitions: RO = diesel ran RO = gasoline i g/L = milligrams A = not analyze D = below meth AHs = polynuck AOs = Remedia RO = Residual AH = Total aron	range organic s per liter d od detection ear aromatic al Action Obje range organi	limits hydrocarbons ectives (prelin cs	ninary)	

concentrations

concentrations

TAqH = Total aqueous hydrocarbons = sum of BTEX and PAH

Table 5-5 2004 Surface Water Hydrocarbon Results at SS13

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
70: therefore, ambient water q NOAA SQuiRT tables are use	k Reference Tables, updated 999). led for these analytes in 18 AAC juality criteria values found in the d as surface water screening SQuiRT values are not regulatory riteria. Practical Quantitation Limit for	mg/L = milligrams per liter PAHs = polynuclear aromatic RAOs = Remedial Action Obj	hydrocarbons ectives

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.

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	No sheen ²	No sheen	(0.005)	(0.7)	(1.0)	(10)	
2004	NA	0.06378	0.0969 *	ND	ND	ND	ND	NA
2003		Surfac	e water sam	ples were not	collected in 2003 (f	rozen conditio	ons)	
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:	<u>.</u>			De	finitions:			

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

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.

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

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		Surfa	ce water sam	ples were not	collected due to fr	ozen conditio	ons	
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
Conservati June 26, 2 ² There are r or GRO; 1 oils, and g surface of	.020 = Alaska I on Water Qual 003 (ADEC, 20 to quantitative : 8 AAC 70 requi rease may not the water.	ity Standards; 103). surface water of ires that petrole cause a visible	as amended th criteria for DRC cum hydrocarb sheen upon th	DRC mough GRC mg/l D, RRO, NA ons, ND he RAC RRC	nitions:) = diesel range orga) = gasoline range or _ = milligrams per lite = not analyzed = below method dete)s = Remedial Action) = residual range org Ccs = semivolatile org	ganics r ction limits Objectives (pr ganics	• *	

al Quantitation Limit for the analyte but above the Method Detection Limit.

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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	No sheen	No sheen 2	(0.005)	(0.7)	(1.0)	(10)	
2004	NA	0.0917ª	0.363 ª	ND	ND	ND	ND	NA
2003		Surfa	ce water sar	nples were n	ot collected in 2003 (f	rozen conditie	ons)	
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
Conserv through ² There are r or GRO; oils, and surface ³ 18 AAC 75 Conserv Control Method [*] Value indi	020 = Alaska ation Water Q June 26, 2003 to quantitative 18 AAC 70 re grease may r of the water. .345(b)(1) = Al ation Oil and I Regulations, a Two (Table C) cated is below yte but above	Auality Standar (ADEC, 2003) surface water equires that penot cause a vis laska Departm Hazardous Su is amended th groundwater the Practical	rds; as amend 3). r criteria for Di troleum hydro sible sheen up nent of Enviror bstances Poll rough May 26 cleanup level Quantitation L	al I ed C RO, RRO, I carbons, I on the I umental S ution , 2004; s umit for	Definitions: DRO = diesel range organic GRO = gasoline range or ng/L = milligrams per lite VA = not analyzed VD = below method dete RAOs = Remedial Action RRO = residual range org SVOCs = semivolatile org	rganics ction limits Objectives (pr ganics		

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

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 *	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
		erformed in acco nental Conservat	rdance with Alask tion Technical	a DRO = diesel ra mg/kg = milligra			

Table 5-9a 2004 Sediment PAH Results at SS13

Fluorene	0.0000	
	0.0323 mg/kg [*]	0.010 mg/kg ³
Fluorene	0.0306 mg/kg ^a	0.010 mg/kg ³
Phenanthrene	0.0118 mg/kg *	0.01419 mg/kg *
Chrysene	0.00372 mg/kg ^a	0.0571 mg/kg ⁴
Pyrene	0.00442 mg/kg *	0.053 mg/kg ⁴
Conservation Technical y <i>Guidelines</i> (2004). nic and Atmospheric k Reference Tables, updated 999)]. reshold Effects Level.	mg/kg = milligrams per kilog PAHs = polynuclear aromat	ic hydrocarbons
	Phenanthrene Chrysene Pyrene med in accordance with Alaska Conservation Technical y Guidelines (2004). nic and Atmospheric < Reference Tables, updated	Phenanthrene 0.0118 mg/kg a Chrysene 0.00372 mg/kg a Pyrene 0.00442 mg/kg a Values in Bold exceed preli Definitions: conservation Technical y Guidelines (2004). nic and Atmospheric k Reference Tables, updated 099)]. preshold Effects Level.

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.

Values in Bold exceed preliminary RAOs

SS13 Location SS01	GRO (mg/kg)	DRO (mg/kg)	RRÓ (mg/kg)	Benzene (mg/kg)	Ethyibenzene (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
Department Memorandur ² There are no	of Environmen n <i>Sediment Q</i> screening bei se alternate R 6.	ntal Conservat uality Guidelin nchmarks for I	ies (2004). bulk hydrocarb	Alaska DR mg NA bons in ND PA RA	finitions: O = diesel range or /kg = milligrams per = not analyzed = below method de Hs = polynuclear ar Os = Remedial Acti CO = residual range	kilogram tection limits omatic hydroc on Objectives	carbons (preliminary)	

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

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 E	Effects Threshold Effects Level.	Definitions: mg/kg = milligrams per kilograr RAOs = Remedial Action Obje SVOCs = semivolatile organic	ctives (preliminary)

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 SS	13 Comp	arison of	SS06 Hyd	Irocarbon Lev	els in Se	diments 1	997-2004
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
Departmen Mernorand ² There are sediment. ³ USEPA, 1 ⁴ Jones et a ^a Value indic		ental Consen Quality Guide benchmarks RAOs estable the Practical	vation Techni alines (SQG), for bulk hydro ished for soil Quantitation	cal (2004). carbons in Limit (PQL)	Definitions: DRO = diesel ran mg/kg = milligran NA = not analyze ND = below meth RAOs = Remedia RRO = residual r SVOC = semivola	ns per kilogram d ad detection al Action Obje ange organics	limits ctives (prelimi s	inary)

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

this instance, the PQL is above the RAO established for

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

benzene in this analyses.

Values in Bold exceed preliminary RAOs.

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
Department of Environr	s performed in accordance with Alaska nental Conservation Technical nt Quality Guidelines (SQG)," dated	mg/kg = milligrams per kile RAOs = Remedial Action SVOC = Semivolatile orga	Objectives (preliminary)

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.



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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
Environ Substar through precipit chemics and 34 ²	mental Consen nces Pollution C May 26, 2004; ation) soil clean als other than p 1(d) refers to pe	Method Two (u up levels; 341(o etroleum hydrod	azardous ons, as amended nder 40-inch	NA = not analy ND = below me PAHs = polynu , RAOs = Reme	ams per kilograr	limits lydrocarbons ctives (prelimina	ary)

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

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
through May 26, 2004; Met precipitation) soil cleanup le chemicals other than petrol	n Oil and Hazardous ol Regulations, as amended hod Two (under 40-inch evels; 341(c) refers to	Definitions mg/kg = milligrams per kilo PAHs = polynuclear aroma RAOs = Remedial Action C	tic hydrocarbons

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.

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
En Su thro pre che	C 75.341(c) and vironmental Co bstances Pollul ough May 26, 2 copitation) soil emicals other th), and 341(d) re	nservation Oil tion Control Re 2004; Method T cleanup levels nan petroleum	and Hazardou gulations, as a wo (under 40- ; 341(c) refers hydrocarbons	imended inch to (Table	Definitions: DRO = diesel range mg/kg = milligrams NA = not analyzed ND = below method PAHs = polynuclear RAOs = Remedial A RRO = residual rang	detection limit aromatic hydr action Objective	ocarbons)

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

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

Sediment Sample SVOC Detected Location (2000) Di-n-butylphthalate		Level Detected	Soil Cleanup Levels ¹
		0.042 mg/kg	1,700 mg/kg
through May 26, 2004; Mei precipitation) soil cleanup l chemicals other than petro	n Oil and Hazardous rol Regulations, as amended thod Two (under 40-inch	Definitions: mg/kg = milligrams per kilo PAHs = Polynuclear aroma RAOs = Remedial Action C	tic hydrocarbons



(Table B2)].

Values in Bold exceed oreliminary RAOs.

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.

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
Environm Pollution 2004; Me levels; 34 hydrocart hydrocart	Control Regula thod Two (und 1(c) refers to c	ation OI and H ations, as ame ler 40-inch pre- chemicals othe I), and 341(d) 2)].	lazardous Sub nded through I cipitation) soil (r than petroleu refers to petrol	stances C May 26, r cleanup N m N eum F	Definitions: DRO = diesel range or DRO = gasoline range ng/kg = milligrams per NA = not analyzed ND = below method de PAHs = polynuclear ar RAOs = Remedial Acti RRO = residual range	organics kilogram etection limits omatic hydroc ion Objectives	arbons (preliminary)	

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

Irface Soil Sample SVOC Results for L	.BV/
J	rface Soil Sample SVOC Results for L

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) [Ala Environmental Conservation O Pollution Control Regulations, 2004; Method Two (under 40-1 levels; 341(c) refers to chemic: hydrocarbons (Table B1), and hydrocarbons (Table B2)].	ska Department of mg/kg bil and Hazardous Substances RAOs as amended through May 26, SVOC nch precipitation) soil cleanup als other than petroleum	i tions: J = milligrams per kilogram S = Remedial Action Objective Cs = semivolatile organic com	es (preliminary) pounds	

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.

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	NĎ	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
Environm Pollution 2004; Me levels; 34 hydrocar hydrocar	5.341(c) and (nental Conserv Control Regul thod Two (und 41(c) refers to bons (Table B bons (Table B Bold exceed cu	vation Oil and H ations, as ame der 40-inch pre chemicals othe 1), and 341(d) 2)]	Hazardous Sul inded through icipitation) soil or than petrole refers to petro	DS DStances GI May 26, mi cleanup N/ um NI leum R/ RI	efinitions: RO = diesel range org RO = gasoline range org g/kg = milligrams per l A = not analyzed D = below method det AOs = Remedial Actio RO = Residual range of /OCs = semivolatile o	organics kilogram ection limits n Objectives (p organics	• •	

Table 5-15	SS13 Comparison of Hydro	ocarbon Levels in Soil at LB08 (1997-2004)
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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
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Soil Sample Location (2000)	SVOC Detected Level Detected		Soil Cleanup Levels		
LB08	Di-n-butylphthalate	0.12 mg/kg	620 mg/kg		
LB08	Bis (2-Ethylhexyl) phthalate	0.087 mg/kg	2,100 mg/kg		
¹ 18 AAC 75.341(c) and (d) [Ala Environmental Conservation C Pollution Control Regulations, 2004; Method Two (under 40- levels; 341(c) refers to chemic hydrocarbons (Table B1), and hydrocarbons (Table B2)].	Dil and Hazardous Substances RAC as amended through May 26, SVC inch precipitation) soil cleanup als other than petroleum	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.

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	1.03ª	67.3	600	ND	ND	ND	ND	Table 5- 16a
feet bgs 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 5-16
 2004 Results for Soil Boring Samples Collected at New Well MW-03

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			
Pollution Control Regulati 2004; Method Two (under levels: 341(c) refers to chi	on Oil and Hazardous Substances ons, as amended through May 26, 40-inch precipitation) soil cleanup emicals other than petroleum and 341(d) refers to petroleum	Definitions: mg/kg = milligrams per kilogram NA = not analyzed ND = below method detection lim RAOs = Remedial Action Objectiv SVOCs = semivolatile organic co	ves (preliminary)		

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.

SS15 Location	GRO (mg/L)	DRO (mg/L)	RRO (mg/L)	Benzene (mg/L)	Ethylbenzene (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 Tab								
WW-07	This well was dry and could not be sampled in 2004								
WW-08	0.0212ª	0.0212 ^a 0.315 ^a 0.223 ^a ND ND ND ND Tat							
Conservation Regulations (Table C) gi Value indica for the analy this instance preliminary	345(b)(1) = Ala on Oil and Haza o, as amended coundwater cle ated is below th yte but above t e, the PQL for RAO establish Id exceed preli	ardous Substa through May 2 anup levels. le Practical Qu he Method De the benzene a ed for benzen	nces Pollutio 16, 2004; Met nantitation Lin tection Limit (nalysis is abo e.	mental E n Control G hod Two n nit (PQL) F (MDL). In F	Definitions: PRO = diesel range of SRO = gasoline rang ng/L = milligrams pel ND = below method of PAHs = polynuclear a RRO = residual range /OCs = volatile organ	e organics r liter detection limits aromatic hydro e organics	carbons		

Table 5-17	2004 Groundwater Sample Hydrocarbon Results at SS15
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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
Conservation Oil - Regulations, as a (Table C) groundy ² Calculated cleans (g); provided in Al 24, 2003. ^a Value indicated is for the analyte bu)(1) = Alaska Department of Environmental and Hazardous Substances Pollution Contro- mended through May 26, 2004; Method Two water cleanup levels. up level in accordance with 18 AAC 75.340 DEC Tech Memo 01-007, dated November s below the Practical Quantitation Limit (PQL t above the Method Detection Limit (MDL). ceed current preliminary RAOs	SVOCs = semivolatile organ	

Table 5-17a 20	04 Groundwater	PAH Results	at SS15
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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).

SS15 WW-02	GRO (mg/L)	DRO (mg/L)	RRÓ (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

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

Note:

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

NA = not analyzed

ND = below method detection limits RRO = residual range organics

SVOCs = semivolatile organic compounds

Values in Bold exceed current preliminary RAOs.

Definitions:

DRO = diesel range organics GRO = gasoline range organics

mg/L = milligrams per liter

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Location (year)	SVOC Detected	Level Detected	Groundwater RAOs	
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)			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	
conservation Oil and Hazard Regulations, as amended thi Table C) groundwater clean Calculated cleanup levels in	ka Department of Environmental lous Substances Pollution Control rough May 26, 2004; Method Two up levels. accordance with 18 AAC 75.340 Memo 01-007, dated November 24,		AOs = Remedial Action Cs = semivolatile organic	

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

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			We	I was not sar	npled 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			
Conservati Regulation (Table C) g Values in Bo Definitions DRO = dies GRO = gaso	5.345(b)(1) = A on Oil and Ha s, as amende groundwater c old exceed pre t ange organ oline range org grams per liter	zardous Šubs d through May leanup levels eliminary RAC nics ganics	tances Pollut y 26, 2004; M	onmental ion Control ethod Two	NA = not analyzed ND = below method de PAHs = polynuclear ar RRO = residual range SVOCs = semivolatile	romatic hydroc organics					

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					
Conservation Oil and Ha	laska Department of Environmental zardous Substances Pollution Control d through May 26, 2004; Method Two eanup levels	mg/L = milligrams per liter RAOs = Remedial Action Obje SVOCs = semivolatile organic					

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.

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3)	(mg/L) (1.5)	(1.1)	(0.005)		1		
-		(1.1)	(0.005)	(0.7)	(1.0)	(10)	Table 5-20a
12 ^{°a} (0.315 ª	0.223 ª	ND	ND	ND	ND	NA
		ND	ND	0.00116	0.00131	0.002	ND
	0.16	0.23	ND	ND	ND	0.002	ND
		ND	ND	ND	ND	ND	NA
	0.165	0.275	ND	ND	ND	ND	Table 5-20a
	D D D D	D 0.16 D 0.363	D 0.16 0.23 D 0.363 ND	D 0.16 0.23 ND D 0.363 ND ND D 0.165 0.275 ND	D 0.123 ND ND D 0.16 0.23 ND ND D 0.363 ND ND ND D 0.165 0.275 ND ND	D 0.123 ND ND ND D 0.16 0.23 ND ND ND D 0.363 ND ND ND ND	D 0.129 ND ND ND 0.002 D 0.16 0.23 ND ND ND 0.002 D 0.363 ND ND ND ND ND D 0.165 0.275 ND ND ND ND GRO = gasoline range organics

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

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.

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

Definitions:

DRO = diesel 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		
(g) Alaska Department	n accordance with 18 AAC 75.340 of Environmental Conservation Oil nees Pollution Control Regulations, ay 26, 2004	RAOs = Remedial Action Obje SVOCs = semivolatile organic	ctives (preliminary) compounds		

Site SS15 Soil Boring Hydrocarbon Data for WW09 5.2.2

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).

SS15 Soll 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
Conservation Regulations, (under 40-inc chemicals oth 341(d) refers	41(c) and (d) [A Oil and Hazard as amended th h precipitation) her than petrole to petroleum h l exceed prelim	lous Substan rough May 26 soil cleanup um hydrocart ydrocarbons (ces Pollution (; 2004; Metho evels; 341(c) pons (Table B1	onmental bgs Control DRC d Two GR refers to mg/ I), and ND RAC RRC	hitions: = belowground surfac > = diesel range organ O = gasoline range or (g = milligrams per kik = below method detec D = Remedial Action) = residual range org DCs = semivolatile org	iics ganics ogram tion limits Objectives (pr anics	•••	

Table 5-21	2004 Results for Soil Boring Samples Collected at New Well WW0
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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	Soll RAOs ¹
SB/WW-09	2-Methyinaphthalene	0.359 mg/kg	0.78 mg/kg ²
10 to 12 feet bgs	Bis(2-Ethylhexyl)phthalate	0.104 mg/kg	590 mg/kg
Pollution Control Regulation 2004; Method Two (under levels; 341(c) refers to che hydrocarbons (Table B1), hydrocarbons (Table B2)]. ² Calculated cleanup level in	on Oil and Hazardous Substances ons, as amended through May 26, 40-inch precipitation) soil cleanup emicals other than petroleum and 341(d) refers to petroleum	Definitions: bgs = belowground surface mg/kg = milligrams per kilogram RAOs = Remedial Action Objectiv SVOC = Semivolatile organic con	

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 report². 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).

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.

LF03 Location	DRO (mg/L)	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xyienes (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		Th	e well was dry in 2	004 and could	not be sample	d.	
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 *	ND	Table 5-22a
CMW-5	0.157	0.000195 ^a	ND	0.000543 ª	0.00056 *	ND	Table 5-22a
CMW-6	0.0853	0.00024 *	NĎ	0.000757 ª	0.00132 ª	ND	ND
CMW-6D	0.184	0.000532	ND	0.00139ª	0.0024 ^a	ND	Table 5-22a
CMW-7	ND	ND	ND	ND	ND	ND	Table 5-22a
Notes:		W	Det	finitions:	•		·

Table 5-22 2004 Groundwater Sample Hydrocarbon Results at LF03

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.

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 *	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
	ation Oil and Hazardous ontrol Regulations, as amended	Definitions: mg/L = milligrams per liter PAHs = polynuclear aromati RAOs = Remedial Action Ob	

groundwater cleanup levels.

* Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.



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.

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		0.0713ª	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
Conserv Regulati (Table C ^{a -} Value ind analyte	ation Oil an ons, as ame) groundwa icated is bel but above th	d Hazardous ended throug ter cleanup l low the Pract	h May 26, 2004 evels. ical Quantitatio etection Limit.	nvironmental D ollution Control G 4; Method Two m n Limit for the N R S S	efinitions: RO = diesel rar RO = gasoline g/L = milligram: A = not analyze D = below meth CBs = polychlor AOs = Remedia VOC = semivol OCs = Volatile	range organie s per liter ad nod detection rinated biphe al Action Obje atile organic	limits nyls ectives (prelir compounds	minary)	

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

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	<u>NA</u>
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	ND	NA	ND	ND
Notes: ¹ 18 AAC 75.3 Conservation	45(b)(1) = A Oil and Ha as amende oundwater cl ed is below	zardous Sub d through Ma eanup levels the Practical	Quantitation L	onmental D ion Control G ethod Two M Imit for the N R S	efinitions: RO = diesel ra RO = gasoline g/L = milligran A = not analyz D = below met CBs = polychl AOs = Remed VOC = semivo OCs = volatile	e range organ ns per liter ed thod detection prinated biphe ial Action Ob platile organic	ics n limits enyls jectives (prelir compounds	ninary)	

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

June 14, 2005

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.

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	0.226 a	ND	ND	ND	ND	ND	NA	NA
2003		•		Could not be sam	npled due to	lack of wat	er		
2000	ND	ND	ND	ND	ND	ND	ND	ND	ND
1996	ND	1.34	ND	ND	ND	ND	NA	ND	ND
Conserv Control F Method	ation Oil and Regulations, Two (Table (cated is belo	i Hazardou as amende C) groundw ow the Prac	Pepartment of 1 s Substances ed through Ma rater cleanup lo tical Quantitat od Detection L	Environmental D Pollution G y 26, 2004; m evels. N ion Limit for N imit. P S	efinitions: RO = diesel r. RO = gasolin g/L = milligrai A = not analy: ID = below me CBs = polych AOs = Remer VOC = semiv OCs = volatik	e range orga ms per liter zed lorinated bipl dial Action O olatile organi	nics on limits nenyls bjectives (pre c compounds		

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



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°	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
Conserval Regulation (Table C) ^a Value indica	tion Oil and I ns, as ameno groundwater	lazardous S ded through cleanup lev the Practical	Quantitation Li	nmental Di Ition Control Gi Method Two Mi Mit for the R/ Si	afinitions: RO = diesel ra RO = gasoline g/L = milligram D = below met A = not analyz AOs = Remed VOC = semivo DCs = Volatile	range organi as per liter hod detectior ed PCBs = p ial Action Obj latile organic	ics n limits olychlorinated ectives (prelin compounds	biphenyls ninary)	

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

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).

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
Conserv Control I Method Value ind	ation Oil an Regulations Two (Table icated is be	d Hazardoo , as amend C) groundy low the Pra	us Substances led through M water cleanup	ay 26, 2004; levels. ation Limit for the	GRO = ga mg/L = mi NA = not a ND = belo	esel range org soline range o lligrams per lit	organics er ection limits		

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

Values in Bold exceed preliminary RAOs

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	
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).

* 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

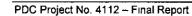


Table 5-27b	1996 Groundwater SVOC Results at CMW-4
-------------	--

Location	SVOC Detected	Level Detected	Groundwater RAOs		
CMW-4	Benzoic acid	0.0125 mg/L	146.0 mg/L		
Conservation Oil and Haz Control Regulations, as a Method Two (Table C) gro a [*] Value indicated is below th	e Practical Quantitation Limit above the Method Detection Limit	Definitions: mg/L = milligrams per liter RAOs = Remedial Action Obje VOCs = volatile organic comp	ectives (preliminary) ounds		

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.

LF03 CMW-5	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)		
2004	NA	0.157	0.000195	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. Conservation Regulations (Table C) gr ^a Value indica	n Oil and H , as amend oundwater ited is below	lazardous ed through cleanup le w the Pract	partment of En Substances Po May 26, 2004 vels ical Quantitatic Detection Limit.	Ilution Control ; Method Two on Limit for the	Definitions: DRO = diesel r GRO = gasolin mg/L = milligra NA = not analy ND = below me PCBs = polych RAOs = Reme SVOC = semiv VOCs = volatile	e range orga ms per liter zed ethod detectio lorinated bipt dial Action Ol rolatile organi	nics on limits nenyls bjectives (pre c compounds		

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

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 sample³ 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.

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 *	ND	0.000757 *	0.00132ª	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	NĎ
1996	ND	ND	ND	ND	ND	ND	NA	ND	ND
Conservatio Regulations (Table C) gr Value indicat	n Oil and Ha , as amende oundwater c ed is below t	zardous Sub d through Ma leanup levels	Quantitation Li	nmental on Control ethod Two mit for the	Definitions: DRO = diesel ra GRO = gasoline mg/L = milligram NA = not analyz ND = below met PCBs = polychic RAOs = Remed SVOC = semivo VOCs = volatile	range organic: ns per liter ed thod detection I prinated biphen ial Action Object latile organic co	imits yls ctives (prelimi ompounds	nary)	

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



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

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
Conservation Regulations, (Table C) gro Value indicat	Oil and Haz as amended undwater clo ed is below	zardous Sub through Ma eanup level the Practica	rtment of Enviro ostances Pollut ay 26, 2004; M s. Il Quantitation I ection Limit.	onmental E Ion Control G ethod Two n Imit for the N F S	befinitions: PRO = diesel r PRO = gasolin rg/L = milligra IA = not analy ID = below me CBs = polych AOs = Reme VOC = semiv VOCs = volatili	e range orga ms per liter zed ethod detectio lorinated bipt dial Action Ol olatile organi	nics on limits nenyls ojectives (prel c compounds		

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

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	ND⁵	ND ^b	ND
SW-1D (Seep 1)	0.0882 *	ND	ND	ND	ND	ND	ND	ND⁵	See Table 5-31a
SW-2 (Seep 2)	0.208 ª	0.000325ª	ND	0.00824 ^ª	0.00148ª	0.0797	0.010 ^b	0.010 b	ND
SW-3 (Seep 3)	0.117ª	ND	ND	ND	ND	ND	ND⁵	ND ^b	See Table 5-31a
Conserva quality sta (ADEC, 2 ² There are GRO; 18 grease m water. ³ 18 AAC 7 Conserva Regulatio (Table C) ⁸ Value indi analyte b ^b TAH and	tion Water Q andards table 003). no quantitati AAC 70 requ ay not cause 5.345(b)(1) = tion Oil and I ns, as amene groundwater cated is belo ut above the TAqH are cal	uality Standard: s, as amended ive surface wate ires that petrole a visible sheen Alaska Departi Hazardous Subs ded through Ma r cleanup levels w the Practical Method Detecti	Quantitation Limit f on Limit. based upon definit	eria; water 2003 RRO, or oils, and of the intal control d Two for the	DRO = dieset GRO = gasolii mg/L = milligr: ND = below m PAHs = polyn RAOs = Reme RRO = residu TAH = total ar TAqH = Total concentrations	ne range organ ams per liter hethod detection uclear aromati edial Action Ot al range organ romatic hydroc aqueous hydroc	nics on limits c hydrocart bjectives (pr ics arbons = sr	reliminary) um of BTEX	Concentrations EX and PAH

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.



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	
Conservation Water Qualit criteria; water quality stand through June 26, 2003 (AI ² There are no standards pr AAC 70; therefore, ambier found in the NOAA SQuiR water screening criteria values are not regulatory of ³ NOAA SQuiRT Freshwate	Jards tables, as amended DEC, 2003). ovided for these analytes in 18 it water quality criteria values T tables are used as surface Jote that the NOAA SQuiRT cleanup levels. r Criteria. he Practical Quantitation Limit	Definitions: mg/L = milligrams per liter PAHs = Polynuclear aromatic h RAOs = Remedial Action Object	ydrocarbons tives (preliminary)	

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

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 samples collected

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	NĎ	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
Conse criteria throug ² There ar RRO, hydroo sheen ³ 18 AAC Conse Contro	ervation Wate a; water qual bh June 26, 2 e no quantita or GRO; 18 carbons, oils upon the su 75.345(b)(1) ervation Oil a of Regulation	er Quality St ity standards 2003 (ADEC ative surface AAC 70 requ , and grease Inface of the = Alaska De and Hazardo is, as amend	water criteria uires that peti may not cau water. epartment of us Substance	er quality mended roleum use a visible Environmental es Pollution flay 26, 2004;		ine range orga ams per liter lyzed nethod detect nuclear aroma edial Action C	anics ion limits atic hydrocarbo Dbjectives (pre		

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

⁸ Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

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	NĎ	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
Conserv criteria; through ² = There au RRO, ou hydroca sheen u ^a = Value ind the anal	ration Wate water qualit June 26, 20 e no quant GRO; 18 / rbons, oils, pon the sur dicated is be yte but abo	r Quality Stan ty standards t 003 (ADEC, 2 itative surface VAC 70 requir and grease n face of the wa elow the Prac	water criteria es that petrole nay not cause ater. tical Quantitati d Detection Lir	Imental D Juality G Inded N for DRO, R Jum R a visible V on Limit for	RO = residua	te range org vzed ethod detect edial Action (al range orga volatile orgar	anics ion limits Dbjectives (prel nics nic 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.

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	(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
2004	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
1997	ND	ND	ND	ND	ND	ND	ND	ND	ND

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

Notes:

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

* 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	
lotes: 18 AAC 70.020 = Alaska De Conservation Water Quality	epartment of Environmental Standards; water quality criteria; es, as amended through June 26,	mg/L = milligrams per liter RAOs = Remedial Action Object VOC = volatile organic compou	ctives (preliminary) Inds	

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:

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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.

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 *	ND	ND
SD-2	154	ND	ND	ND	0.0389 *	153	Table 5-35a
SD-3	0.0296*	ND	ND	ND	0.0469 ^a	ND °	ND
Memorandu 2004. ² There are n sediment ³ USEPA, 19 ⁴ Jones et al. ⁵ NOAA SQu Value indica analyte b ^b Method detu above the ⁶ Method detu above the	Im Sediment Qu o screening ber 96. , 1997. iRT Lowest ARG ated is below the dit above the Me ection limit for the RAO for PCBs	C Threshold Effe e Practical Quant athod Detection L his analyte is 0.00 his analyte is 0.00 his analyte is 0.00 his analyte is 0.00	dated March hydrocarbons in cts Level. itation Limit for the	mg/kg = milligram ND = below metho PAH = polynuclea PCBs = polychlori RAOs = Remedial RRO = residual ra	od detection limi r aromatic hydro nated biphenyls Action Objectiv	ocarbons	

Table 5-35 2004 Sediment Hydrocarbon Results

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).



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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 *	0.053 mg/kg ⁴
Alaska Department of I Technical Memorandur dated March 2004. ² Values identified in NOA/ guidelines. ³ Identified in NOAA SquiR Threshold value. ⁴ Identified in NOAA SquiR * Value indicated is below f	T as Marine Apparent Effects	mg/kg = milligrams per kilogi PAH = polynuclear aromatic RAOs = Remedial Action Ob	hydrocarbons

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
2005	ND	21	ND	ND	ND	ND	0.045	ND	ND
1999	ND	98.3	ND	ND	ND	ND	ND	ND	ND
1995	ND	34.7	ND	ND	ND	ND	ND	ND	ND
Departme Memoran ² There an sediment ³ USEPA, ⁴ Jones et ⁵ NOAA S ^a Value ind analyte b ^b method above the	ent of Environ dum <i>Sedime</i> e no screenir 1996. al., 1997. quiRT Lowes dicated is belo ut above the detection limi e RAO for PC Bold exceed	Internetial Cons Int Quality Gu Ing benchmark At ARC Thres ow the Practi Method Detect t for this anal CBS in sedime	ervation Tec <i>idelines</i> , dat ks for bulk hy hold Effects cal Quantitat ection Limit. lyte is 0.118 j ents.	hnical r ed March 2004. 1 rdrocarbons in l	GRO = gasoli ng/kg = millig NA = not ana ND = below n PCBs = polyc RAOs = Rem SVOC = sem VOC = volatil	rams per kild lyzed nethod detec chlorinated bi edial Action (ivolatile orga	ogram tion limits phenyls Objectives (p nic compoun	reliminary) ds	

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.

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.

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
Depar Memo 2004.	tment of Envir randum <i>Sedir</i>	ronmental Co ment Quality	onservation T Guidelines, c	echnical N lated March N F drocarbons in F	ng/kg = millig IA = not analy ID = below m PCBs = polych RAOs = Reme SVOC = semin	vzed ethod detect nlorinated bip edial Action C	ion limits henyls)bjectives (pr	eliminary)	

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

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.

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Table 5-37a	2000 and 1997 SVOC Sediment Sample Results at SD-2
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Location (year)	SVOC Detected	Level Detected	Preliminary RAOs	
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	
Alaska Department of Technical Memorandu (SQG)," dated March ² = NOAA SQuIRT Upper freshwater sediment (ras performed in accordance with M FEnvironmental Conservation M um "Sediment Quality Guidelines F 2004. S Effects Threshold (UET) level for (Buckman, 1999) ent Effects Threshold (AET) for uckman, 1999).	ng/kg = milligrams per kilogr IA = not analyzed ID = below method detection RAOs = Remedial Action Ob SVOC = semivolatile organic	n limits jectives (preliminary)	

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.

LF03 SD-3	GRO (mg/kg)	DRÓ (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
2004	0.745	10.5	ND	ND	ND	ND	ND	ND	ND
2003	ND	18	ND	ND	ND	ND	ND	ND	See Table 5- 38a
1999	ND	109	ND	ND	ND	ND	ND	ND	ND
1995	ND	13.1	ND	ND	ND	ND	ND	ND	ND
Departme Sediment ² There are sedime ³ USEPA, 1 ⁴ Jones et a ⁵ NOAA S ⁸ Value ind analyte ^b Method of	nt of Environ Quality Guid no screening nt. 1996. al., 1997. QuiRT Lowes icated is bek icated is bek but above th detection limit the RAO for l	mental Cons lelines, dated g benchmark t ARC Thresh w the Practic the Method De	I March 2004. s for bulk hydr hold Effects Le cal Quantitatio stection Limit. yte is 0.0815 r	nical Memorandum rocarbons in	GRO = gaso mg/kg = mill NA = not an ND = below PCBs = poly RAOs = Rer SVOC = ser	el range orga bline range of igrams per ki alyzed method dete vchlorinated t medial Action nivolatile org tile organic co	ganics logram ction limits biphenyls i Objectives (anic compou	preliminary) nds	

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

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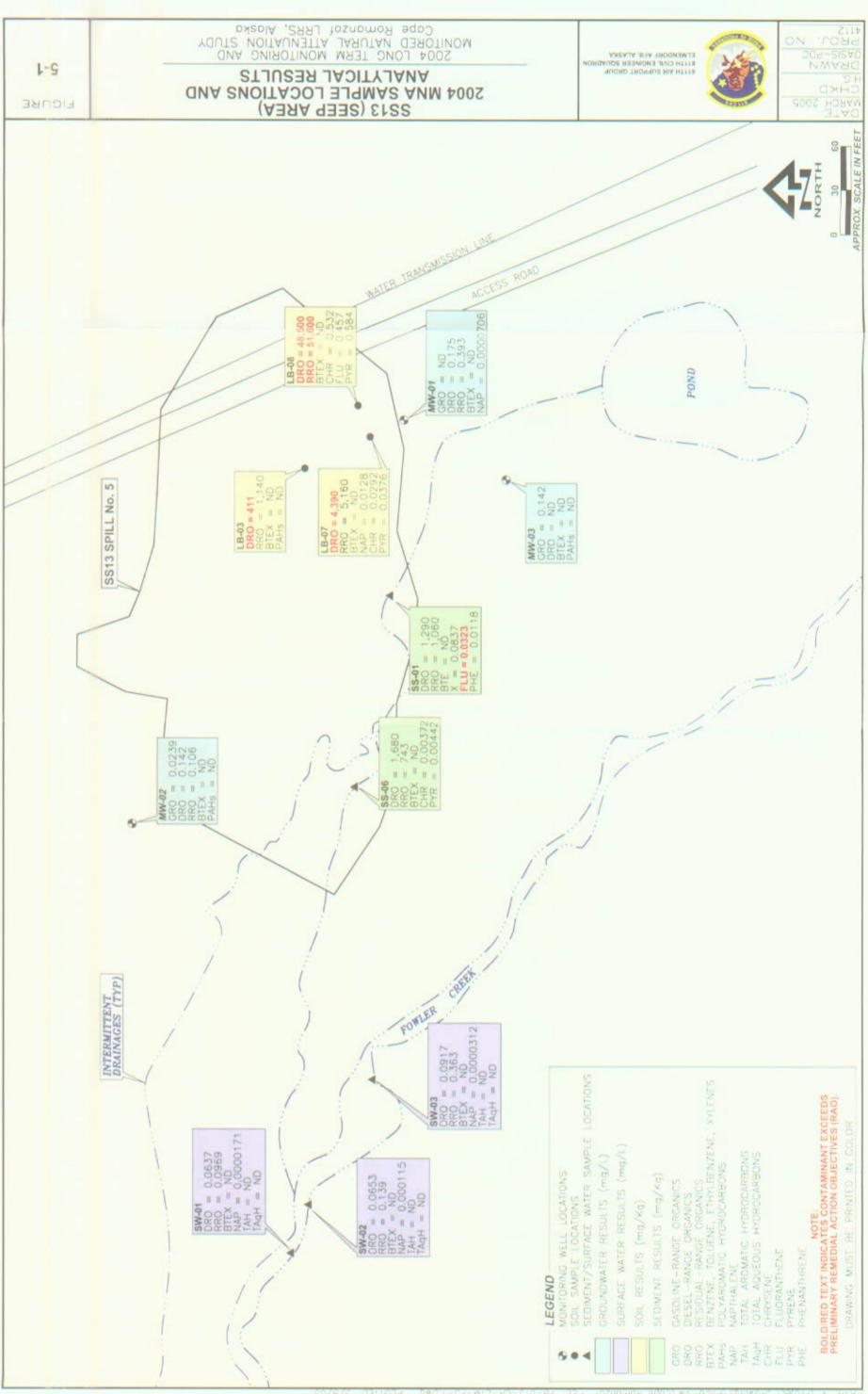
SVOC results are presented in Table 5-38a. Di-n-butylphthalate was detected above its preliminary RAO in 2000. Di-n-butylphthalate is a common laboratory contaminant, and the 2000 data exhibits a consistent pattern of anomalous detections of this nature and is suspect.

Table 5-38a	2000 Sediment Sample Results at Location SD-3
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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 kilog RAOs = Remedial Action OI SVOC = semivolatile organi	ojectives (preliminary)	







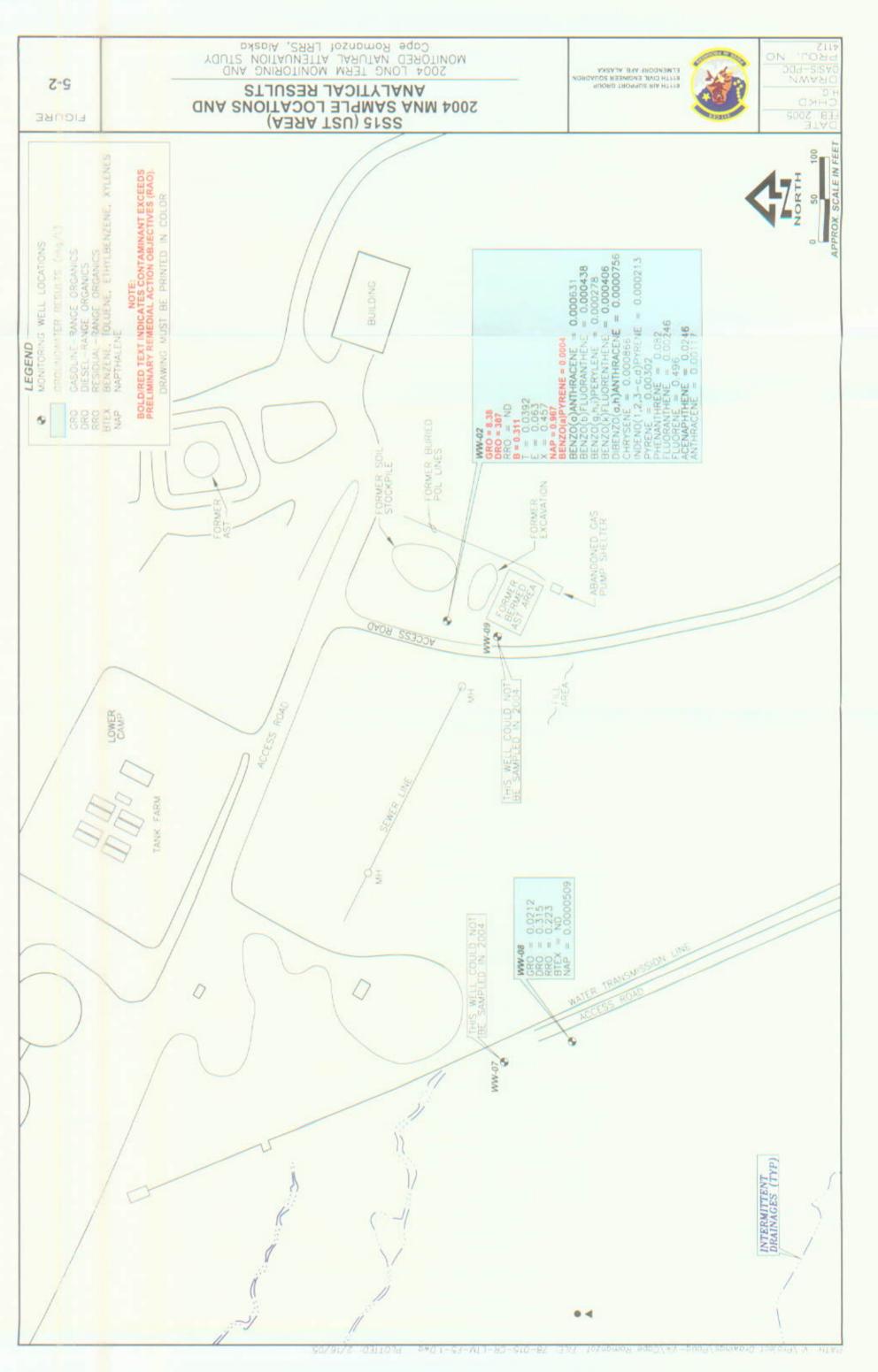
20/8/6 /03110/9 _pw0.t=23-ML1-90-610-87 -310 tosonon90.pu00//#V=pu05//springer_0120/9// HLA9







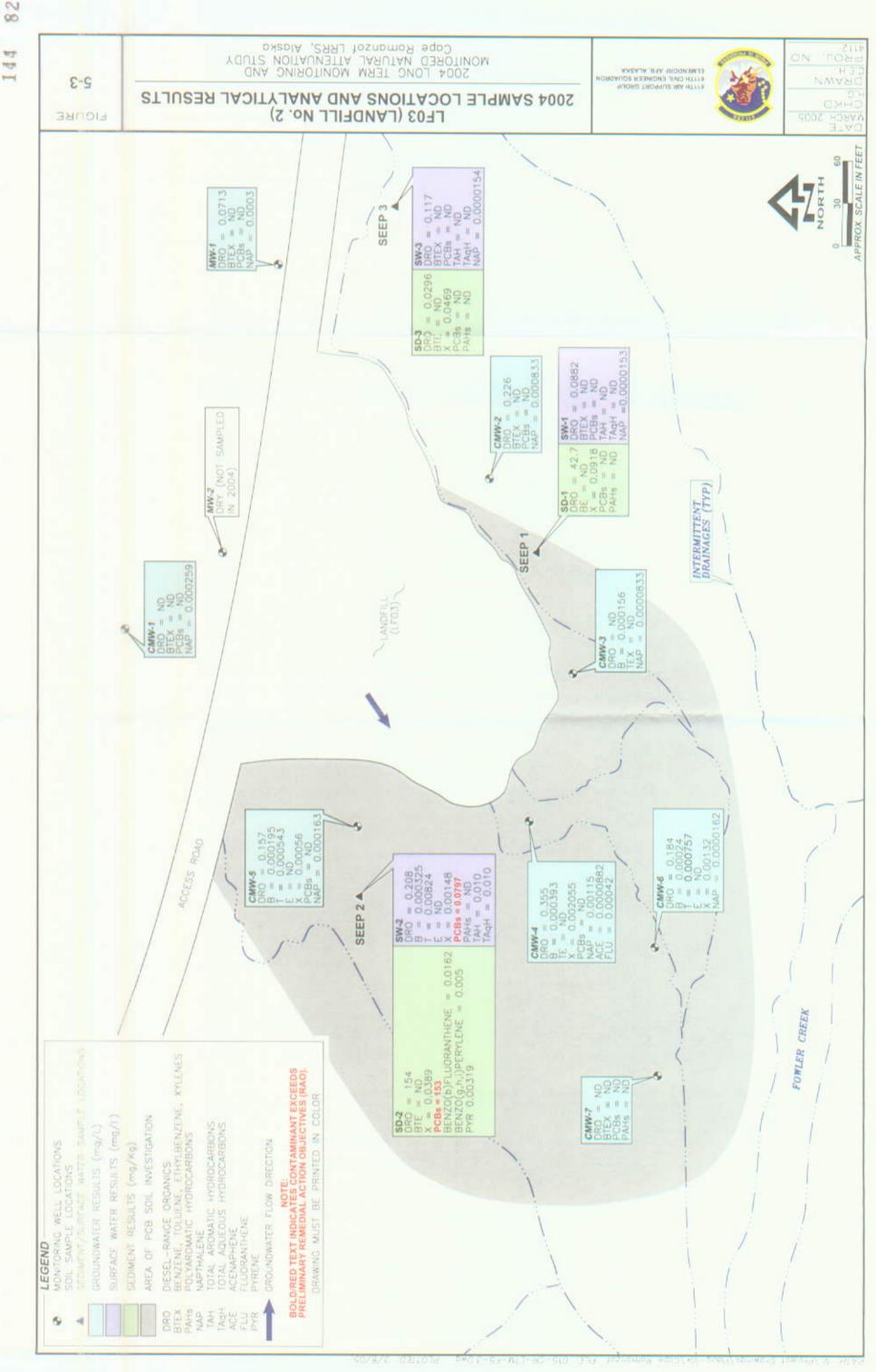












ASSESSMENT OF GROUNDWATER CONDITIONS THROUGH FIELD MEASUREMENTS AND INORGANIC DATA RESULTS

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.

Parameter/Analyte				MW-01 (SS1	3)	
Collection Date	Units	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
Aikalinity	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 ca mg/L = milligrams per L mV = millivolts		NTU = Nessler turbidity units ppm = parts per million Sm/cm ² = milliseimens per centimeter squared TDS = Total Dissolved Solids				uared

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



Parameter/Analyte		MW-02 (SS13) Sampling Results				
Collection Date	Units	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
РН		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	*** *****		ppm = Sm/ci	= Nessler turbic = parts per milli m ² = milliseimei = Total Dissolve	on ns per centimet	er squared

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

Table 6-3SS13 (MW-03) Groundwater Field Measurements and Inorganic Data June2004

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.

Parameter/Analyte	nalyte Units WW-02 (SS15) Sampling Results				ling 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 ca mg/L = milligrams per L mV = millivolts	Agrees Celsius NTU = Nessler turbidity units = below top of casing ppm = parts per million milligrams per Liter Sm/cm ² = milliseimens per centimeter set			r centimeter square	ed	

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

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

Parameter/Analyte	Units	its 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					



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BTOC = below top of casing	ppm = parts per million
mg/L = milligrams per Liter	Sm/cm ² = milliseimens per centimeter squared
mV = millivolts	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 wells⁴ 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.

Parameter/Analyte	Units	,	MW-1 Sampling Res	sults	
		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				

Table 6-6	LF03 (MW-1) Groundwater Field Measurements 1997-2004
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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		sults				
		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 ca mg/L = milligrams per Li mV = millivolts		ppm = parts p Sm/cm² = milli	r turbidity units er million seimens per ce issolved Solids		ed		

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

Parameter/Analyte	Units	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 ca mg/L = milligrams per L mV = millivolts		NTU = Nessler turbidity units ppm = parts per million Sm/cm² = milliseimens per centimeter squared TDS = Total Dissolved Solids							



Parameter/Analyte	Units	s 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 ca mg/L = milligrams per Lr mV = millivolts	w top of casing Sm/cm ² = milliseimens per centimeter squared ams per Liter TDS = Total Dissolved Solids						d			

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

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

Parameter/Analyte	Units		s				
		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 ca mg/L = milligrams per Li mV = millivolts		NTU = Nessler turbidity units ppm = parts per million Sm/cm ² = milliseimens per centimeter squared TDS = Total Dissolved Solids					

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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		
РН		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 ca mg/L = milligrams per Li mV = millivolts		NTU = Nessler turbidity units ppm = parts per million Sm/cm² = milliseimens per centimeter squared TDS = Total Dissolved Solids							

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

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

Parameter/Analyte	Units	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 ca mg/L = milligrams per Li 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.



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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.

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).

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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 top 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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8

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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

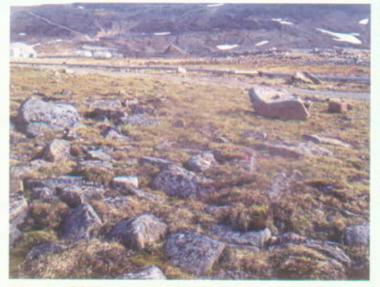
Appendix A

Field Site Photographs

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





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

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

	Selected Photographs – Sites SS13, SS15, and LF03 2004 Environmental Monitoring Report	Figure	Date March 2005	
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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 Ma A-2 Pro 41

Date March 2005 Project No. 4112.004

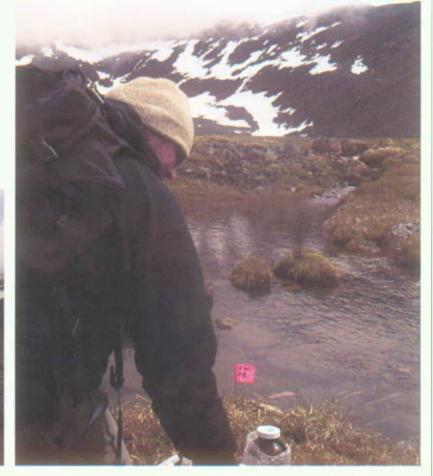


Left: SS13 sampling site SS-06. Photograph taken looking west.

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.



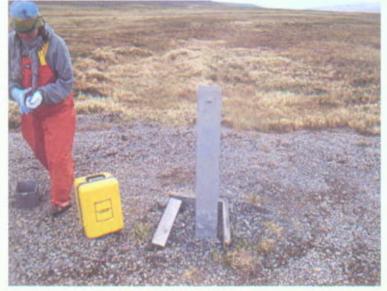


Selected Photographs – Sites SS13, SS15, and LF03 2004 Environmental Monitoring Report Cape Romanzof LRRS, AK

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 MVV-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

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Figure A-7
Daily Activity Summary
Project #: 4112 Date:
Location: <u>Cape Romanzof</u> Site: <u>5315/5513</u> (Mow)
Daily Activity Summary:
0500 - P 1030 Teresa Okaroll (TEO), Matt Carnahan (MJC),
(ANC) to Cape Romanzof (CR)
120 - 1295 BAT, MJC mob for water level measurements on ss13, ss15
to be dry. Only MWBD WW-02, WW-07
had water. All wells had 3/4" welt
Waterra tobingin them, WW-02 smelly,
but no product detected.
16°° - 1630 Set up computer / office space
19th - 1920 Recon DP-11 site visually from road
6 0/04 (m: 6/8/04
Field Team Leader Date Reviewer/Project Manager Date
PLANES IN: I CARAVAN (IGKYVAN + 1207) CARAVAN Ø I 207 (Shared w/ ATT) 207 A 60 cublers

Page 1_of

Figure A-7
Daily Activity Summary
Project #: 4112 Date: 6804 (TVES)
Location: <u>Cape Romanzof, AIC</u> Site: <u>SSI5</u> SSI3
Daily Activity Summary:
0800-1000 TEO, MTC, BAT hold HAS meeting, discuss
field work plans
1000-1200 BAT, MJC mob up for sampling SS13 SS15
1230-1100 MJC begins purging M- UNIOZ - bails dry.
BAT, TEO cannot locate MW-9, but find WW-08
instead. Group discovers that interior tubing
of wells is a waterra inertial pupp 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, MTC MOD to sample SW@ SSI3
1800-1830 Miscellaneous Work
1040 Sample WW-02 (043515WW02GW)
1900-2000 Scope out SN sampling locations -
not the as depicted in map.
Try to purge more the from WW-07. dry.
2100 Done for day.
68/04 (m c. H 8/8/09
Field Team Leader Date Reviewer/Project Manager Date
PLANES IN: PLANES OUT : COOLERS OUT :
· · · ·

Page _____of ____

Daily Activity Summary
Project #: 4112 Date: 619 04 (WED)
ocation: <u>Cape Romanzo</u> Site: <u>533</u>
Daily Activity Summary:
1800-1000 Back sat samples from \$513 (BT, MC) TEO @ Res. Dame deals and popenant
1000 - 1200 Take Soil / Sediment Sampho from SS13 dealing alpopenant
1029 Sample 09 SSI3LB0855 Note: TRIEd to
1030 Sample 09 5513 5501 50* (PUMP 11W-07)
1037 Sample 04 SS 13 LB 07 SS DRY!
1043 Sample 04551360355
1050 Sample 04 5513550650 (ms/ms) + duplicate 0455135510155
230 Pack soil samples for shipmet
330-1700 -Soit Sampliter. Surface Mater Sampling @ SSB (BTA
1500 Sample 0455/35W03SW
1530 Sample 0955135W028W
1545 Sample 0455135WOISN + dup 0455135WIOISW
1700-1900 Prep SW samples for shipment / papennol <a< td=""></a<>
1 6/9/04 (-: C - 6/7/04
Field Team Leader Date Reviewer/Project Manager Date
Planes Prophel Geor IN Planes Out Cooler Out
2 Drillers (mail run) Lynden HERC SS15 GW 3 forgot Lynden HERC Ssyvan SS13 Soil + Sed 3 to hame (Dolleg) 1 Box & 2 PIDS on Mail run

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Page _____ of ____

igure A-7 Daily Activity	y Summary
Project #: <u>4112</u>	Date: <u>6/11/2004</u>
Location: Cape Romanzof	Site: LFO3
FIELD TEAM 1(MJC, TEO) Daily Activity Summary:	
0720-1200 inspected la	ultill and cap att
	For screening samples
around SD2 and co	Mected screening samps
1200-0730 began sc	reenry samples collected
@ LFO3. Mechanical for	There of analyzer (RRA-1)
prevented acctual anal	4513 bot extractions
St First 21 sumples F	3 completed.
\$320.0500-1700-prepared	sample kits for
sedment and surface	l water samples to
be collected at 5509	and LPOS.
1730-1845 took wo	iter level measurements
at 6F03 (see field bor	sk)
	1
201	
6 15 09	(-10 - 6-14-04)
Field Team Leader Date Re	viewer/Project Manager Date
	the man chilor
M·\Projects\4112 - Cape Romanzof\Task 01 - WPs, pro	oject plans, site visit/Program Plans\Work Plan\Final Work Plan\Appendix A Attachments\A7 Daily Activity Form.doc

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Project #: <u>4112</u> Date: <u>6-13-2004</u> Location: <u>Cape Domanzof</u> Site: <u>LF03</u> team 2: MatrC. and TEO Daily Activity Summary: <u>C</u> <u>O63D-1100 Moved supplies to LF03 and FMBhed</u>	
team 2: Matric, and TEO Daily Activity Summary: <u>C</u> <u>0630-1100</u> Moved supplies to LFO3 and FMBhed	
team 2: Matric, and TEO Daily Activity Summary: C O630-1100 Moved supplies to LFO3 and FMBhed	
0630-1100 moved supplies to hFOB and FMBhed	
0630-1100 moved supplies to hFO3 and FMBhed	
paperwork.	
01130-2030 collect SW, sediment, and ground anter	
sumpos at LFO3	
2030+2200 prepare samples for shipment. The	
Following samples were idented for DRO, BTEX, PC	Us ₁ FAH
$p_{05} = 04LF03SW03SW$	
$\frac{1210}{1210} 09 \text{ LF03 50 03 50} $	
12:0 04 LFO3 MWOLATO F extra volume MS/MSD 12:30 04 LFO3 SWOLSTU & 04 LFO3 SW 101 SW	
1630 04LFO3CMWGGW 404LFO3CMW10664	\sim
1935 04 LFO3 SWO2 SW	
1945 04 LFO 3 5002 510	
2005 04 LPO3 CMW 56W	
2000 04 LICS CMW JISH	
6-14-04 C- Cl - 6-14-04	
Field Team Leader Date Reviewer/Project Manager Date	

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Page <u></u> of _	

Figure A-7	<u></u>		<u></u>
	Daily Activity	Summary	
Project #:		Date: 6/4/04	
Location: Cape Re	Manzoy_	Site: 1F0 2	2
Field Team 2: M	attC.		
Daily Activity Summary:		5-152	
0630 -> 1430	Pack Sample		<u>}</u>
1430-2 1930	· · · ·	eening Sample	<u>></u>
tor grea	2stublisted	AT NOS	
		· · · · · · · · · · · · · · · · · · ·	<u> </u>
		<u> </u>	
<u></u>			
		$-\eta$	
What The	6-14-04	Qu'. Qu	- 6-26 ct
Field Team Leader	Date Revi	ewer/Project Manager	Date
B	6/14/04		
100	•		
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	Figure A-7
ocation: <u>Cape Romanzof</u> Site: <u>DP11</u> (SS13 haily Activity Summary: <u>2700 - P 1700</u> CW, BT DESCEND T2 <u>DP11</u> , <u>TAKE SW-1 +0</u> SW-3 SAMPLES <u>3700 - D 2100</u> MJZ @ TDP-SAFETY <u>PACK SAMPLES</u> <u>1700 - D 2100</u> MJZ @ TDP-SAFETY <u>PACK SAMPLES</u> <u>SS12</u> (SJ5 - MW-1 HAD WATER (<u>PREVIOUSLY DRY</u>). <u>SAMPLED HELL</u> <u>AND PLACED LOTICS ON ALL WELLS</u> (<u>BT DOES PAPERWORF, ORGANIZES</u> <u>CEAR, PACKS SAMPLES</u>) <u>SAMPLES COLLECTED:</u> <u>SW-1</u> @ [080 <u>DP-11</u>] SW-2 @ (200 <u>SW-3</u> C 1130 <u>MW-1</u> (392) @ 2000	Daily Activity Summary
Paily Activity Summary: 2700 -P 1700 CW, BT DESCEND TO DP11, TAKE SW-1 -D SW-3 SAMPLES 300-D2100 MJZ @ TOP-SAFETY PACK SAMPLES NOO-D2100 QW, MJC DIP WELLS SS12, SS15 - MW-1 HAD WATER (PREVIOUSLY DRY). SAMPLED WELL AND PLACED LOTICS ON ALL WELLS (BT DOES PAPERWORK, ORCANIZES CEAR, PACKS SAMPLES) SAMPLES COLLECTED: 5 SW-1 @ 1030 DP-11 SW-2 @ 1200 MW-1 (392) @ 2000 MW-1 (392) @ 2000	Project #: 412 Date: 622/04
2700-PITRO CW, BT DESCEND TO DPII, TAKE SW-I-D SW-2 SAMPLES 700-D2100 MJZ @ TOP-SAFETY PACK SAMPLES 100-D2100 QW, MJC DIP WELLS SSI3 SSI5 - MW-I HAD WATER (PREVIOUSLY DRY), SAMPLED WELL AND PLACED LOGILS ON ALL WELLS (BT DOES PAPERWORF, ORCANIZES CEAR, PACKS SAMPLES) SAMPLES COLLECTED: CSW-I @ 1030 DP-11 SW-2 @ 1200 MW-1 (392) @ 2000 MW-1 (392) @ 2000	Location: Cape Romanzof Site: DP11 5513
2700-DITAD CWIRT DESCEND TO DPII, TAKE SW-I-D SW-2 SAMPLES 700-DZIOO MJZ @ TDP-SAFETY PACK SAMPLES 700-DZIOO OW, MTC DIP WELLS SSI3 SSI5 - MW-I HAD WATER (PREVIOUSLY DRY). SAMPLED WELL AND PLACED LOGICS ON ALL WELLS (BT DOCS PAPERWORK, ORCANIZES CEAR, PACKS SAMPLES) SAMPLES COLLECTED: CSW-I @ 1030 DP-11 SW-2 @ 1200 MW-1 (392) @ 2000 MW-1 (392) @ 2000	Daily Activity Summary:
DPII, TAKE SW-I-D SW-2 SAMPLES 700-D2100 MJZ- @ TDP-SAFETY PACK SAMPLES 700-D2100 OW, MJC DIP WELLS SSI2 SSI5 - MW-I HAD WATER (REVIOUSLY DRY). SAMPLED WELL AND PLACED LOCKS ON ALL WELLS (BT DOES PAPERWORK, ORCANIZES (BT DOES PAPERWORK, ORC	
700-D2100 MJZ @ TDP-SAFETY PACK SAMPLES 300-D2100 QW, MJC DIP WELLS SS13/SS15 - MW-1 HAD WATER (PREVIOUSLY DRY). SAMPLED WELL AND PLACED LOCKS ON ALL WELLS (BT DOES PAPERWORK, ORGANIZES (BT DOES PAPERWORK, ORGANIZES CEAR, PACKS SAMPLES) SAMPLES COLLECTED: 5 SW-1 @ 1030 DP-11 SW-2 @ 1200 SW-3 @ 1130 MW-1 (592) @ 2000 MW-1 (592) @ 2000	DPIL TAKE SWI-1-P SW-3 SAMPLES
PACK SAMPLES DOD-DZIOO OW, MJC DIP WELLS SSI3 SSI5 - MW-I HAD WATER (PREVIOUSLY DRY). SAMPLED WELL AND PLACED LOCILS ON ALL WELLS (BT DOES PAPERWORF, URCANIZES (BT DOES PAPERWORF, URCANIZES CEAR, PACKS SAMPLES) SAMPLES COLLECTED: (SW-I @ 1030 DP-11 (SN2) @ 2000 MW-1 (SN2) @ 2000 MW-1 (SN2) @ 2000	1-200-DZING MT- @ TOP-SAFETV
200 - DZIOO QW, MJC DIP WELLS SSI3 SSI5 - MW-1 HAD WATER (PREVIOUSLY DRY). SAMPLED WELL AND PLACED LOCKS ON ALL WELLS (BT DOES PAPERWORK, ORCANIZES CEAR, PACKS SAMPLES) SAMPLES COLLECTED: 5 SW-1 @ 1030 DP-11 (SN2) @ 2000 MW-1 (SN2) @ 2000 MW-1 (SN2) @ 2000	• 1
SSIZ SSIS - MW-1 HAD WATER (REVIOUSLY DRY). SAMPLED WELL AND PLACED LOCILS ON ALL WELLS (BT DOES PAPERWORF, ORGANIZES CEAR, PACES SAMPLES) SAMPLES COLLECTED: SW-1 @ 1030 DP-11 J SW-2 @ 1200 SW-3 @ 1130 MW-1 (392) @ 2000 MW-1 (392) @ 2000	
(PRÉVIOUSLY DRY). SAMPLED WELL AND PLACED LOCKS ON ALL WELLS (BT DOES PAPERWORK, ORGANIZES CEAR, PACKS SAMPLES) SAMPLES COLLECTED: 5 SW-1 @ [080 DP-11] SW-2 @ [200 SW-3 @ 1130 MW-1 (592) @ 2000 MW-1 (592) @ 2000	SSIZISCIE - ANNAL MATER
AND PLACED LOCILS ON ALL WELLS (BT DOES PAPERWORK-, URCANIZES CEAR, PACKS SAMPLES) SAMPLES COLLECTED: 5 SW-1 @ 1030 DP-11 / SW-2 @ 1200 SV-3 @ 1130 MW-1 (592) @ 2000 MW-1 (592) @ 2000	
(BT DOES PAPERWORF, ORGANIZES CEAR, PACES SAMPLES) SAMPLES COLLECTED: 5W-1 @ 1030 DF-11 J SW-2 @ 1200 SW-3 @ 1130 MW-1 (392) @ 2000 MW-1 (392) @ 2000	
<u>CEAR</u> , PACES SAMPLES) <u>SAMPLES COLLECTED:</u> <u>(SW-1) @ 1030</u> <u>DP-11 (SW-2) @ 1200</u> <u>MW-1 (S92) @ 2000</u> <u>MW-1 (S92) @ 2000</u> <u>MW-1 (S92) @ 2000</u>	
SAMPLES COLLECTED: (5W-1) @ 030 DP-11 5W-2 @ 1200 5W-3 @ 1130 MW-1 (592) @ 2000 MW-1 (592) @ 2000	
$\frac{5W-1}{DP-11} \begin{cases} 5W-1 \\ SW-2 \\ SW-2 \\ SW-3 \\ C1130 \\ MW-1 \\ (592) \\ C2000 \\ MW-1 \\ (592) \\ C2000 \\ MW-1 \\ SW-2 \\$	
$\frac{DP-11}{5W-2} \underbrace{C}_{1200} \\ \underbrace{SW-3}_{SW-3} \underbrace{C}_{1130} \\ \underbrace{MW-1}_{(592)} \underbrace{C}_{2000} \\ \underbrace{MW-1}_{S92} \underbrace{C}_{2000} \\ \underbrace{D}_{S92} \underbrace{D}_{S92} \underbrace{D}_{S92} \\ \underbrace{D}_{S92} \underbrace{D}_{S92} \underbrace{D}_{S92} \\ \underbrace{D}_{S92} \underbrace{D}_{S92} \underbrace{D}_{S92} \underbrace{D}_{S92} \\ \underbrace{D}_{S92} \underbrace{D}_{S9$	
$\frac{(57.3 C + 130)}{MW-1 (592) C 2000}$ $\frac{MW-1 (592) C 2000}{MW-1 (592) C 2000}$	
MW-1 (392) @ 2000	
10/2/09 Q-10-6-16-16	
	MW-1 (592) @ 2000
ield Team Leader Date Reviewer/Project Manager Date	10 - 10 22/04 (-: 0-6-16-
	Field Team Leader Date Reviewer/Project Manager Date

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Figure A-7 Daily Activity Summary	
Project #: <u>4112</u> Date: <u>6/23/04</u> Location: <u>Cape Romanzof</u> Site: <u>1703</u> , DP11	
Daily Activity Summary:	
0700 - P1400 Mob for DP-11 SW Sampling Send dollars stuft (ATV, Traiter Bentonite, out) out, 8 coolers	(Dieped LF03
HOO-p2300 Sample GW in 1st basin of DPII, prop samples for shipment	"dry" weite)
<u>Samples Paken:</u> <u>1500 55-7</u> 1530 55-5	
1600 SW-5, SD-5 1700 SW-6, SD-6	
$ \begin{array}{c cccccccccccccccccccccccccccccccccc$	
Q	
Field Team Leader Date Reviewer/Project Manager Date	
1 caravan 1 caravan (Dnikers ATV, trailer, Bent)	

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Figure A-7	Daily Act	tivity Summ	ary	
Project #: 4112		Date	6/23/04	
Location: <u>Cape</u>	Romanzof		DPIL, LFO	3
Daily Activity Sumr				
0700-0800 0800-0900	2 Mob fo	r DPILS	ampling	
0800-0900	2 load o	<u>pear for</u>	Carron F	light.
0900-1000	· supervise	110ad 1	plane - ou	<u></u>
	Inlers	AP ATV 3	trailer, be	antonite,
	Sample			
10-1200	Pip Lana	afill well	s (proviovis)	ndry) pac
1200- 1400		1	•••	
40-2200	DP-11 5	ampling,	packing o	+ samples
1230 BT N	upone for	dag. 2	300 UN DON	e for day
Sav	nples take			
	5W-40		(also =	<u>10-4)</u>
	<u>SW-50</u>		(also s	<u>5p-5)</u>
	5W-60	1700	(also .	52-6)
	55-A C	1930		
	·····	1530		
	<u>58-6 0,</u>	1845		
	SS-7 C	1500		
			<u> </u>	
			E.A.I	1 10-18-04
Field Team Leader	Date	Reviewer/Pro	ject Manager	Date
planes in	· planes	at	Cooler	sat
1 carowan		aven	<u> </u>	8
	[Dnillers ATV bento	(trailer)		-

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Figure A-7 **Daily Activity Summary** Project #: 4112 Date: _//24 Location: Jape Romanzo Site: LF03, DP1 **Daily Activity Summary:** F03 Amole marousin 2/000 - P 1200 shipment, demob Drco TA PS 1200 Famples @ DPI mole 12120 -V FOO Shipment SAM es -for 700 \$ 2300 us for demob. Dack Crool offic pack Samples taken: 1300 55-92 55-9 1330 45-10 140095-11 420 95-12 445 5-13 51 55-14 520 55-15 らよち 600 65-10 629/04 10-18-04 Date **Reviewer/Project Manager** Field Team Leader Date wolersat planes at planes in

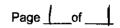


Figure A-7 Daily Activity Summary	
Project #: 4112 Date: 10/25/04 Location: Cape ROMANZOF Site: 12P-11, LFOS	
Daily Activity Summary: D700 Pack personal gear, re-ice sample to coolers, tape up st-molers, est 10 ³⁰ packers, leave stuff in cold st arange balls. 10 ²⁰ Travel to to 0600 Anchorage (CW, MC done for day 0700 BT done for day	<u>vr</u> açe
ATT 10/28/24 Jun Selfall 10.	
Field Team Leader Date Reviewer/Project Manager Date planes MAT (1 caravan 3 filks + geat 5	

Page _____ of _____

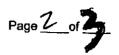
Figure A-7 **Daily Activity Summary** Date: 8 30 04 Project #: 4112 Site: 5109/5514/ 4F06/5313 SS15 Location: Cape Romanzof, At-**Daily Activity Summary:** BT (Brandre Theisen) 3 Mc (Matt Carnahan) both of Pava-vila 0430 Annue @ Annur! ANCHORAGE to Bethel 0600 to Cape formanco 0900 Bethe Case Romanzot, check in 1030 nVC wells that were dry in water levels in ~ c 1100 asure (no name) Well DTW: PRY βN/ji 9.36' (MW-3) DTW: TD: 23.02 BNCI Well masu DTW: 7.42' 171:12.03 WW-07 Inside w tubing WW-09 DTW: 10.10 TO: 2562 MW-02 UTW: 4.06' T0: 12.04114.5 Get 4-wheeler, cold storage ot Brak 1200 ant organizes, dols 1230 BT transport drums of 130í) ROAR to . with air strip empty supersaul 87 1530 ave paper Nor) BT, MC Met DM. Shattim 4 <u>8:30.69</u> 10-18-04 Date **Reviewer/Project Manager** Date Field Feam Leader planes 11: 1 207 W/ 2 people + genr

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Figure A-7	
Daily Activit	y Summary
Project #: 4112	Date: 8 30 04
	Site:
Daily Activity Summary: (continued)	
tor purge water, svil	_disposal
1530 Break	
1730 MC purges 10 Well vo	lumes (20 gal) from ENCi well
BIMis_ repeatedly, -	to remove inertial pump
tulang from inside of	- WW-OF, WITHOUT SUCCESS
1845 BT, Mt dump purge	later from MW-03 down shop dra:
1915 Pone for the day.	
0	
\rightarrow	
	1/.0///
830.04	(f-: (f-10-18-04)
Field Team Leader Date Rev	viewer/Project Manager Date

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Figure A-7 **Daily Activity Summary** Project #: 4112 8 Date: Location: Cape Romanzof, AK SS Site: **Daily Activity Summary:** calculates purge vol's, whi 0800 61 1/1/1 field probes 1 alibratis 0845 CG12/9519 200 sampling 0920 01100 13 MIM B 001 sampling 11/20 N 20 lM OV Cilicted ANL ~[130 N भ AW 1200 4(M URBID EXTREMELY **5**A Vem poor indition WU monument and rasi 8.3104 10-18-04 Field Team Leader Reviewer/Project Manager Date Date



igure A-7		_	
Daily Acti	vity Summar	ry	
Project #: 4/12	Date:	8 31 04	-
Location:2_	Site:		
Daily Activity Summary: <u>(パイiれい</u>	j		
cusing is loose		MINT DA	the MIRCE
15 also 10051. W	a sument	is wit a	ALL ALL ALL
into place. no soil	printe 1	IS not (<u>concentra</u>
Monument - inska	Dulde L		
a dippo of all	puole M	WIFU EXIST	$\frac{5}{10}$
a depth of ~1'	PRIVW YOU	mai groun	<u>a elevation</u>
white purging we	<u>u, a gwa</u>	1119 SOUNC	1 water
heard inside the	well -	15 THIS	indicative
of a break in	(using! +	water wa	5
extremely turbid	(~1070 Or	more se	diment)
VOAS WOULD ME	rt Seal pi	roperly du	e to
sediment in VIA	thraids	, , , , , , , , , , , , , , , , , , ,	
1210 Break for lunch	<u> </u>		
1300 Park coolers for	wells MM	V-2, MW-3	3.
Call TEO (tereso	a charoli)	ind discus	ς
progress. tell h	er mail t	plane is fi) II of
611th Arctec peo	ple. Call	Gra Dil	anis
BNCi, to report	progress,	touble one	ck qualus:
	1 / / /		
			<u> </u>
	0-5	All	10-18-04
Field Team Leader Date F	Reviewer/Projec	t Manager	Date

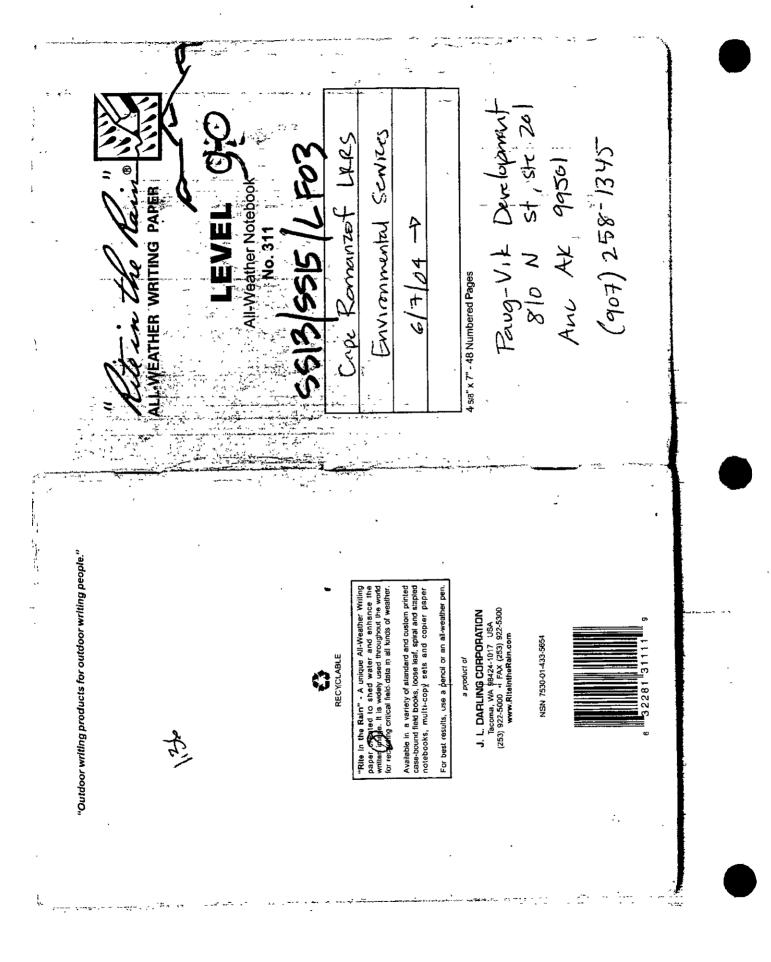
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Figure A-7
Daily Activity Summary
Project #: 4112 Date: 8/31/04
Location: CA Site:
Daily Activity Summary: Continued
1330 NC checks well CMW-2-
PTW: 8.71 TD: 9.51
1900 Mob to sample WW-07.
Well was by after priging al gal
Let recharge NIO min. Still 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
11000 Sample OFSSISMWOBGW
1730 Sample Equipment MSC (045SIJERGW)
(Rinse that to big after Decon provedure)
1800 MC samples 04LF03CMWZGW
1900 Prep for supping off site
1930 pone for day
R
8.31.04 10-18-04
Field Team Leader Date Reviewer/Project Manager Date

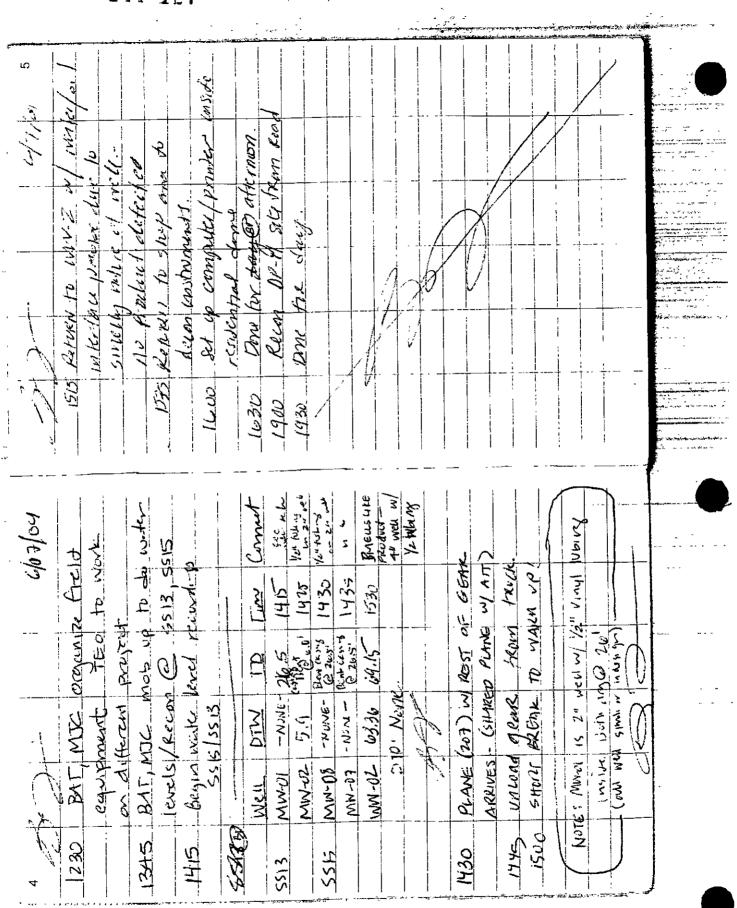
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Figure A-7 **Daily Activity Summary** Project #: 4112 Date: Location: <u>Cape Romanzo</u> Site: Daily Activity Summary: 0800 Pack coolers gear to demob 1080 (aravan lands load ANMS gear 1030 DENU nл nade to weather 100-1400 e any Ave れん 1400 ζ_{a} MON Sh KING eretts. VIA C 1930-1730 Tare clo d (200) D m 10-18-04 Field Team Leader Date **Reviewer/Project Manager** Date



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and a state of the second of	ـــــــــــــــــــــــــــــــــــــ	And the second		144.12
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Cosa Teres	5.4C	0 MB Condition		11 15 Cct 5
N				



4	kr				
i there we have	to find course to red	3° meto	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	SS 15 water - p tuber day.	d not Mwr. There
t is a	terra 2 bing 33 to	pump hubers" and water ante and up / source	e beth mtera w ver	t sist	mored theor of a new more than the more of a new more of the more
	الأحجا ا	<u>d</u> 2 2 2			
L'IN THE	345 Calle 245 Calle (360	u sud sube	400 Chre	only only suo Remov	verse a
· · · · · · · · · · · · · · · · · · ·	<u>23</u>		 		
u/ 3/04 11 muth g F75 plan		Proph &	12 22 22 22 22 22 22 22 22 22 22 22 22 2	MW-8 fourt	hon well.
1/1/1	Anter Carlo	- clart	Semples 1515	N La La	7 5
TEO BAT MJC MAN	s Harris			The the state of t	
	513/28215	Web up to		MW-9 nut f 10 locatim 15 shown debris (tubu weil Dade	MJC PULASS MJC PULASS MJA TES WILL PULASS MJ CHEVI
0300		00 01	0521 NOZ1		1300

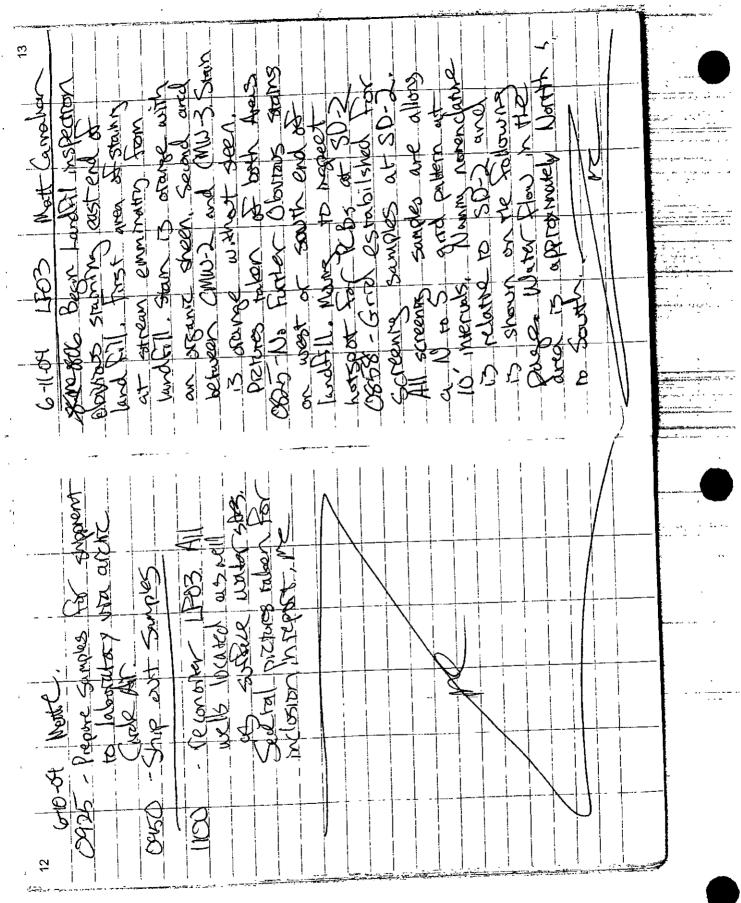
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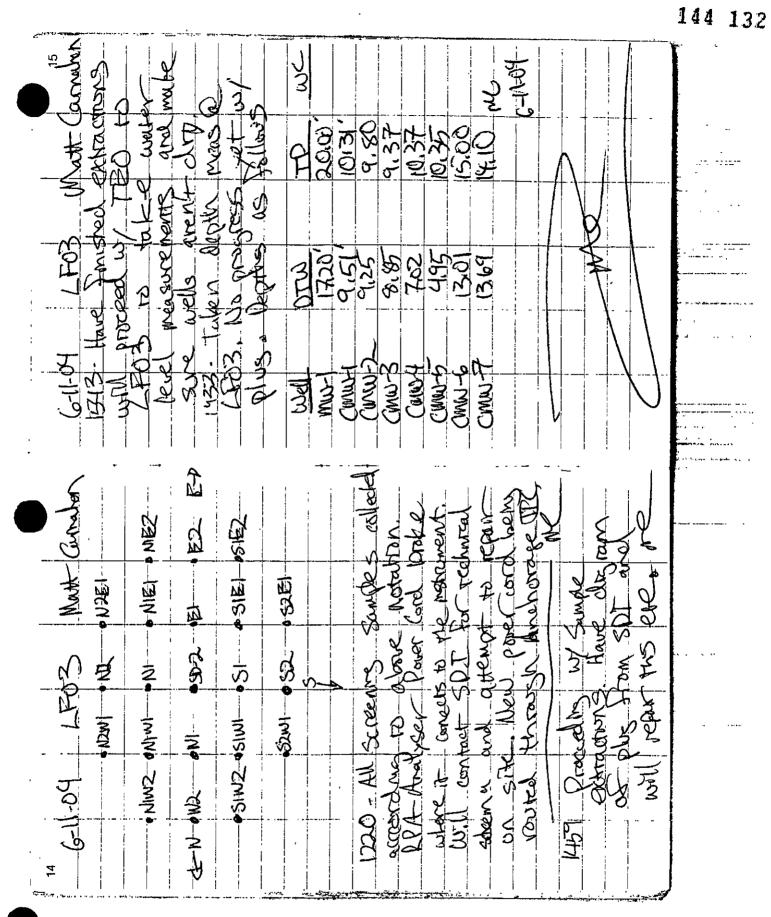
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9 4 40 /45) 4 4 6 4 7 10 7 10 7 10 7 10 7 10 7 10 7 10 7	(Surt so 2 10 03) -1 -1 (Sedmunt 55cy)	7 (Surt Surt Surt) 4 (Surt Surt) 3 urt Surt Surt) 7 (B 05)	an an an an an a
to cold h Ship cold h Ship cold to A Ship cold h Ship data attan Sare kemarked hits Pink fla		$ T = \langle T T \rangle$	
Privation of a content of a con	453131200955 (Swith 1944/BTEK 125004250-13 045513560190 (Sa	Sample for 1 brex + 7 + 15 0042-50-17 0455/32807755 (2455/32807755 (2455/32807755 (2455/32807755 (2455/3260355 (2477) 2042-50-17 2475/3260355 (2477)	
Pack / Pack / Jample Sc. Jample Sc.	Sample 04551318085 Sample 04551318085 Dep/Reo/PAH/BTEK Aroth of is 0042- Sumple 045513560 duplicate 045513550	14 8 0 1 1 8 0 1 1 K	
Brind Brind M. 6 Buche C. SSiz C. SSiz Scentle		Submit Se Meet Let Sample S Sample of Sample of Submit Sa De / Let	
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6/8/09 physicular) Rodan,	Sample Sample	- cennet arch mee watch mee is dry is dry feld as vits	
6/ 10 20 6/	N C N		
	N-0 N-0 Ret S		
Serie Stuck	Oal to say Oal to say Oal to say Oal to say Cod ssid wy Fod Bity/cee	Walk but to 5 occate exact intest does no from mw-oft from mw-oft and has not and has not and has not finish field w Finish field w	
	Out to solution of the solutio	Pecete sites d from m from m f	
8 [1000]	1810 1815 1814	2030	

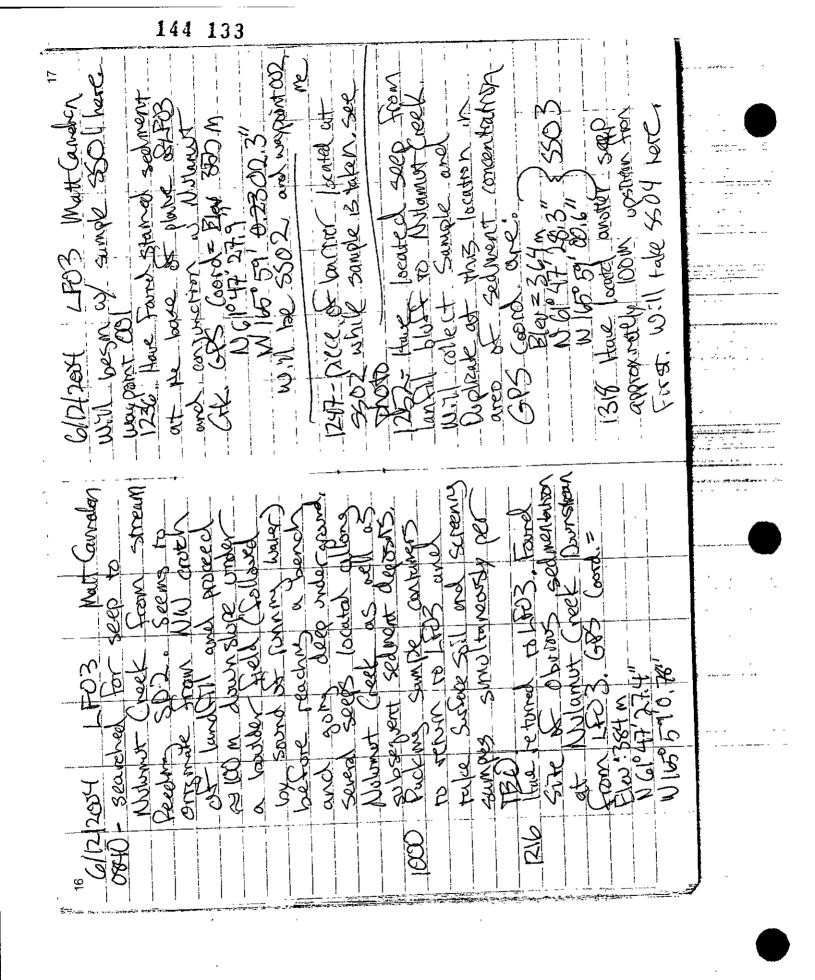
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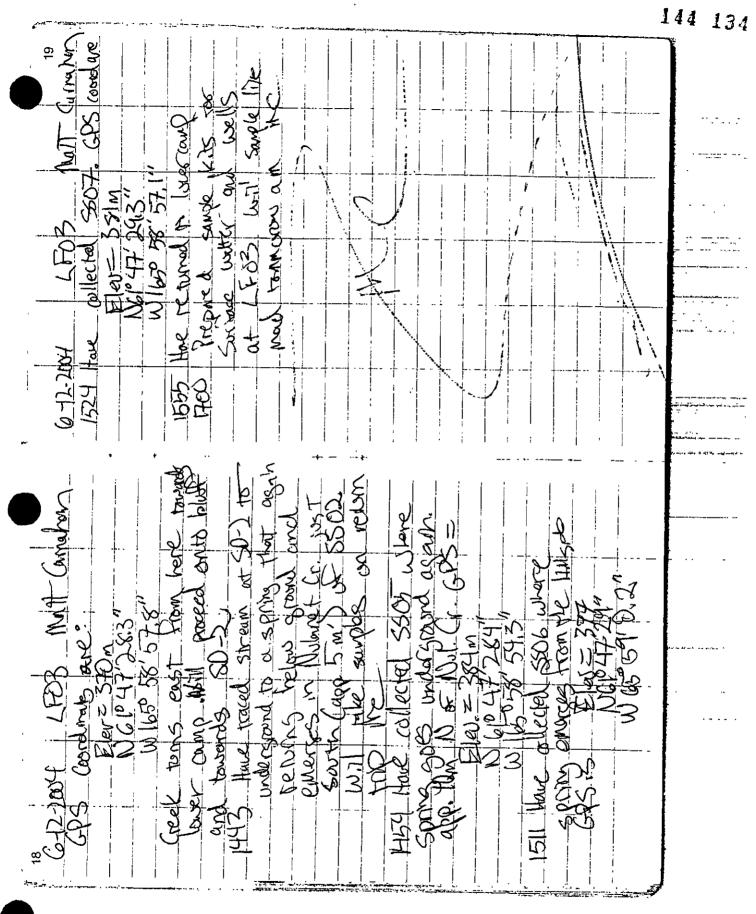
144 130 -6/4/04 cm and duplicity 0455135W1015W (1042) W210W26/22PO 1.1.2 (7744), PAH (TA-1 extra sumply the MS/MSO DR=/LLO Prep 5 とくて ţ Semple anoly si Funish Samp Oupener BIEK PA Simples shipines Sample done 1545 1615 1300 1915 2 % elalog cont. 55-26 of sui sumple Richard ame on sik this many. Sample of SABSENDERN (SW-02) ŚК fre BIEX + & (mt) Submit Samples for BTEX 14 (TAH), Dav/000 (SW-0\$) Paperner VOTE DRIVERS ; JOH an HERL also amond I gear BI, MJC mep to Sample 50 Ś p. Dru ara. Samply OfSSISSSOUSD Jample 04 551304 (8) MW-07. BIEX 14 4500421 Silbund - Sample ter W250m5813540 (TAA) ANC ON MEW (#26 - 37 #) -Ter Linch Rick up copled full AF SSC5 and PAH (That) Sumples DRolling/ PAH PRo/ KHO 3 PAH TKY IS PUMP Submit Sample inloaded (<u>unala</u>) NU CHI LIT Return, Buck Sample Suib A PULL 3, KJ 1050 1120 1135 1200 1530 1330 1230 158 9

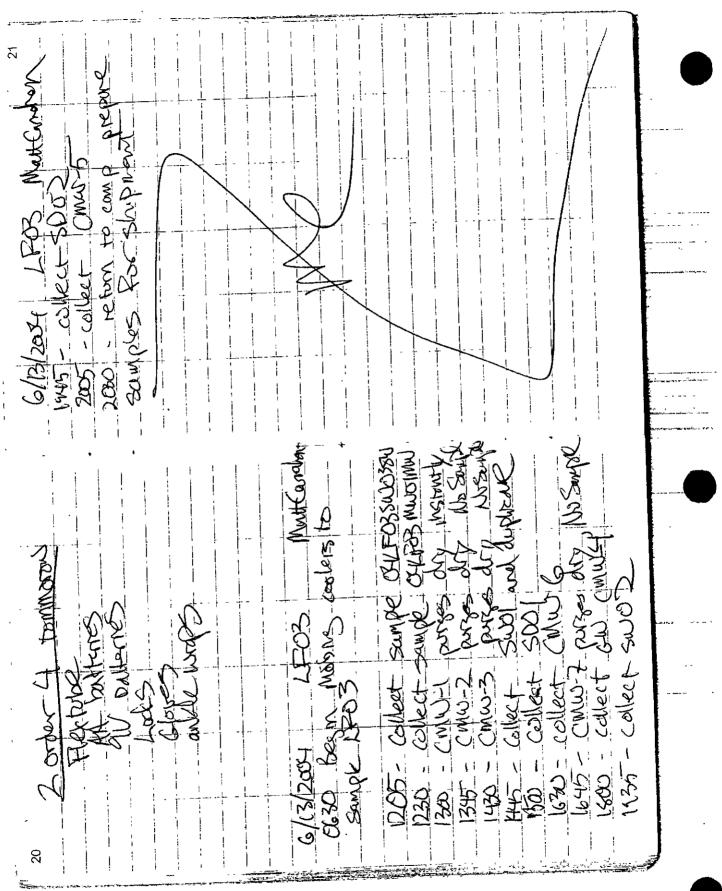
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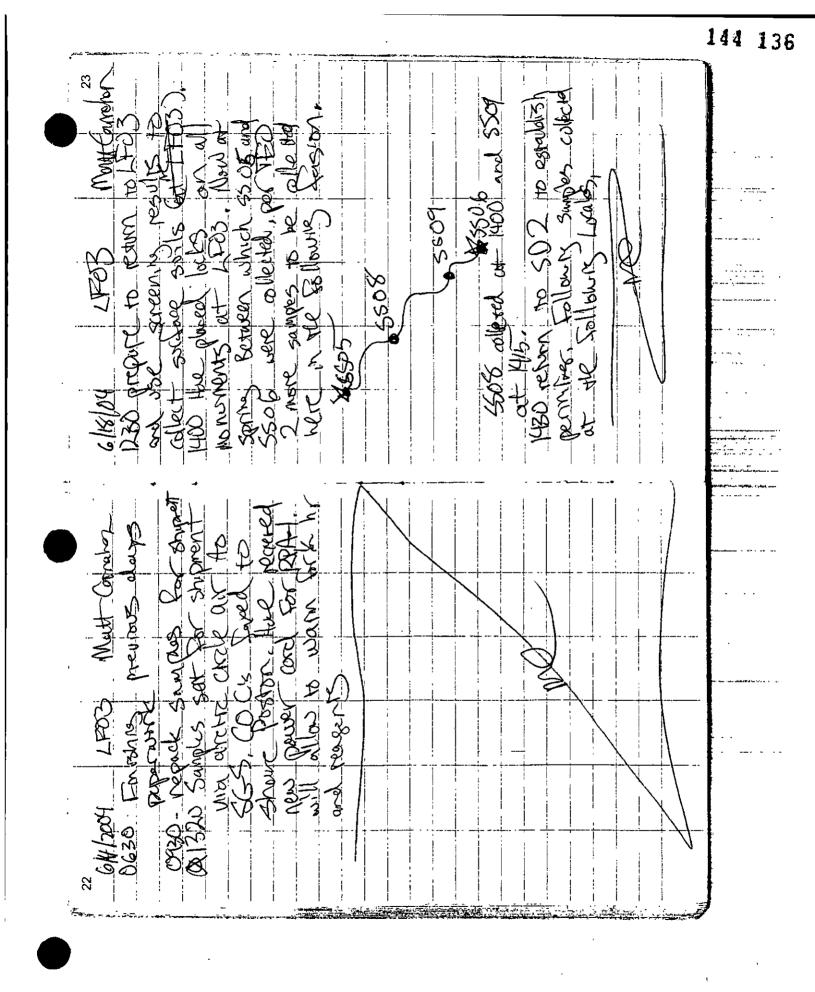


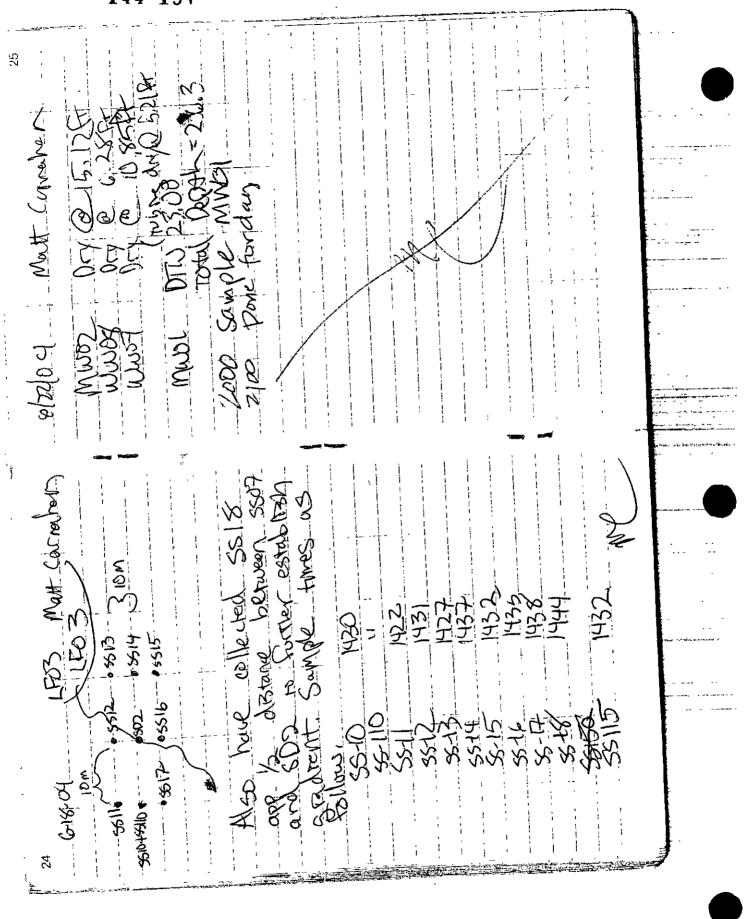












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144 138 27 hu wth he 1205* 12,04 25.62 19,0,1 Get GEAR, Why Arche Clears All 8420104 DHO MEASURE WATER LEUGLS IN -41-16 organize the AL AND CARGO TO OPEN ARRIVE CAPE ROMANZOF 32 10.10 936 4,06 Z 777 X INTIDE INCE THE TUBING 7-074 CHAT W DON RALPH 3 SET FCL ーちょ DEPART (FOR A)RPORT Cet & Wheder and Deets st TERRE TERRE BT does paperner thest for wich ALQUE BETHEY BRANDE THEFTER REPART TOR MW-02 WELLS BNCI WEU のとこうほう So-ww ACNALAN HO-MM - sleinj 145 230 0800 (030 0600 0000 202 00100 <u>8</u> ð \$ 23 5 C. Brenwish (P) MC ICW evers in 下でない。 1595 ß Water Leve CMW-7 CMW-3 CMW-7 200 1-1 MVV-2 J2714-0020 1000 121 26

a .

29 OBP BT Call ANL, Call'S prige WLS 1 - Car 18/20 OBYS NOD UP (N Sampling) SSIS 2/10/0 the cha very poor condition - casing a crack of the representative as surface Note: well monument/casing is 1 Sample NW-3 @ SSIS 10 - 30-MM allamos at Cul - 0011 bala gets shuch & rol the casive should not be imatered م ک Begin sampling MW-3 casine or the ca of ss 13mm036w mamore of the pame saterite. can infilme SAG N'CUS. 045513 MW026W Pu led puristra the Sample MW-2 Move to MW-2 nust be Full 01 When 0930 -1200-130 000 20 for (ML purges 10 well volumes (2047 trom BNLI well MW3 to the the new weither pump Hannie Jahren supersidents from angles 1, however Contra Led BIME and Startion Which parper wer NCNC WAR 5/30 Shup dauly water alow from with Minns to airport let Me Meet of Rudger to ret GNP-Jun P DV, MC ne fr Dere JANG K K کے بچ 14 いよう 361 130 <u>y</u> 20 Ę 9 28

144 140 9 qualities the well (not 62705m8) well was dry after phang P 1230 MC Checks water volume Ðİ 202 Will do equipment more hice Meb to sample WW-07 rechard Record Fubing - d. m. tion enoigh for the wells reprah 年のこのそうとう NW PUMA tobud SH minutes shi did that Sample ~1 op/101. Let remore inertial 045615 MW0 80M Man be resul (2) CMW-2. 70:9.51 wed. Thid W/0 SULLES. Stut Purging BT SAMPLES Note 12 (6) Sample BRAT 00 1730 1400 1230 300 lea 8 ALMAN 20 ž 10050 and manument is 10050 not comental unto place ... no aluoval 2-4011 2 1' below. hormal of no rd dever Sass Spill exists within 1'redus of renument - puddled menter to 2 S Ø water was extremely with Contes WC/15 that BNCI of casing break somewhe the wells ×006 not seal w/o bubbles and puellang Break for Inch all TED and in The new - may be Plane her other well had to charter On LOUS MUTER (~10% sediment). to Interin him a guarting sound 82700 MAD OF WHILE situation Tell Park cookers as mail nu Call Greg of celt (MIN-5, NW-3 he of 12-10 1300 8

33 -proph 2022 9:1:0 Pack bamples | field bear fu Amove in BET , late due to weather delargy ATV chipped via Everett 207 Caravan deput w GLAL DIAMES Shipped way and shore lands wheeler Dad Manor 2 282 Ž 3 Celers S- Carovan a a 200 **Anri**Vt Demol SMUND 207 130 800 00000 1000 220 1400 88 100 THROUGH HOSING ROL PURISTAUTIC XXXXX strettiges between uses themine (equipment that HOSING WAS RE-USED PUETO EQUIMENT RINGE IS RINGE WAS WASHED W/ HZB & ALL 8 31 64 Water row this supping the sufficiency RINSED IX W D. T. WATCH RANSED ZX W/ THP WAIT hosing after decon 24 LF03 CMW2 GV 6 NC Samples 045515EB01 ā Per tex Z g 1900 1000

Appendix C

Groundwater Sampling Log Sheets

Figure A-3

Project Number:	4112		GROUNDW	ATER SAMPLE		EET	A	1		
Project Name:		anzof 2003	<u> </u>	Sample Location	•		WNF	1	-	
Client:	Cape Romanzof 2003 AFCEE			_Sample ID (ie. 9		3):		02mw)	G IU	
Sampler: Matt		Tana	A	Date Sample Co		6-13-04				
		lenesa_		Time sampled:		30			_	
化加强性不同化合物			Casing	Well Information	i Sonta a la	和建筑和美国	是心理的	地行而已有	的間	
Groundwater:	<u>Jes</u>	Shallin	Diameter (in):	4"	<u> </u>	a) Well Depth	(ft):	20.0	3	
Other;						b) Water Depti	• •	_17-20	2	
			-			c) Water Colurd) Calc. Purge			$\frac{2}{1}$	
			<u></u>				vui. (gar).	- ty are	-4.6	
	ALLANGER:			ilating Purge Vol	ume 🕬		洋小技 名社			
Well Casing Diameter	Multiply c) by: 0.16	4				Sand Pack Diameter	Multiply c) by:		100 FE 10 11	
6	0.65]					0.71	4		
Example 1- purging only v						Note: assuming sand Example 2- purging v	pack has 29% po			
You have 2-inch casing and One Purge Volume= 0.16 X						You have 2-inch casin	u. 8-Inch sand par	ck, and 6-foot water coa (6) = 5.22 gallons wate	umn r	
Cast thinkows	ATTACK ST			DIMEASUREMEN	TSE STREET			ANDERSONAL	Sec. 2. 19. 201	
tivtime _	Volume (gallons)	}	Conductivity	·		Pom				
1º time		pH	(mS) 30	Temperature (F)		Turbidity	Redox	Dissolved O ₂	Other	
1024	16a	$\left(a, \mathcal{H} \right)$	40	3.6	dk br	10	17/	17.72		
145	25 gal	6.86	30	29	al sy	20	206	TETT		
1230	59.7	- 3.91	30	6.0	Ci	10	311	12.81		
					<u>_</u>					
Total Volume Purg Odor: Noลซ์	ed: .				Free Produc					
Purge Method (disp	oosable baile	r teflon balle	r, submersible	pump, etc.)	Sheen (y/n);	2	<u> </u>	········		
		‡ 	seristal.	tic pum	P					
Sample Method (di	sposable bai	ler, teflon bai	ler, submersible	e pump, etc.)	<u> </u>	<u> </u>				
		perista	altic phi	mp.						
Well Integrity (cond	ition of casin	g, flush moui	nt sealing prope	erly, cement seal i	ntact, etc.)			· · · · · · · · · · · · · · · · · · ·		
Poor,	brok	en use	11 casino	i, bent	protec	tive casi	14.11	ussing	cai	
		- conditional	003014200113).	collect	nd pel	ca voluti		Me los	<u> </u>	
Slew	well	recover.	i.	Dent	2762		~~ ~ ~	op ins	いン	
Duplicate Sample			0		21201	PCBS PA	172		<u></u>	
Split Sample ID:	-									
Signadi	1 hr						1.17	501		
Signed: -	KI	Ļ	<i>αγ</i>		- 1	Date:	<u>6-13-(</u> 6-14-	<u> </u>		
Signed/reviewer:		(1 un	<u>5. 00</u>	anall	Date:	6-14-0	261		
•										
Arrive G	ilacu	a in	02			•				
	, , , ,		00	1 L	í J					
purged Arrive be	dry af	bter	2 gallon	is , allew	to recha	rge				
Arrive be	ch Q	well	11:40			U				
	C		ı				A3 GI	N Sample Data Si	heet	

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Figure A-3

		(GROUNDWA	TER SAMPLE D	ATA SHE	ET		,	
Project Number:	4112			Sample Location (-	CMW		
Project Name:	Cape Roman	zof 2003		Sample ID (ie. 95	BIA WG003	i):	044F	03-NOS	ample
Client:	AFCEE			Date Sample Colle		-	6/12/0	24	
Sampler:	r(, +	Teresa_	0	Time sampled:	No 2	Sample			
			W. C. L.	ell information	所有的社	時世代出来的		帶風電影響	and the second
	<u> </u>		Casing Diameter (in):	2		a) Well Depth (i	t):	10.31	
Groundwater:	_ res,	millow	Diameter (m)			b) Water Depth		10,31-9	.51
Other:						c) Water Colum		Or8	-LWC
•						d) Calc. Purge	voi. (gai):	On Or	
		les serves bas		ating Purge Volu			NSISSIME?	BRAIL	24
and the second			() 新 · 新 · 新 · S · S · S · S · S · S · S ·	ating Purge you	III CAN SERVICE	Sand Pack Diameter	Multiply C) by:		
Well Casing Diameter	Multiply c) by: 0.16 0.65					10	0.71 1 1.28		
6	1,47					12 Note: assuming sand	pack has 29% po	 rosity	
Example 1- purging only You have 2-inch casing an	well casing volume	9 YU				Example 2- purging v You have 2-inch casin	n 8-inch sand part	and pack volume ck, and 6-toot water colu (6) = 5.22 gallons wate	1700. T
One Purge Volume= 0 16	X 6 = 0.96 gallons w	ster		· · · · · · · · · · · · · · · · · · ·				TRACT AUXILIA	
		2.24日前日	家谷然有些	MEASUREMEN	ITSI: M		1 1		
Time	Volume (gallons)	pH	Conductivity (mS)	Temperature (P)	Color	PPM Turbidity	Redox	Dissolved O ₂	Other
j320	(3	6.64	30	7.1	dkgray	10	189	13.75	
							<u> </u>	+	
	_ <u></u>						<u> </u>		<u> </u>
Total Volume Pu	roed:				Free Prod				- .
0.4am 13.0					Sheen (y/	<u>n </u>	<u></u> , .		<u> </u>
Purge Method (d	isposable bail	er, tetion ball		pump, etc.)					
			PUMP	le pump, etc.)					
Sample Method	(disposable ba	aller, tenon ba	mer, submersie	ae pump, etc.y					
N/4	-dilian of oppi	ing fluch mo	int sealing pror	perly, cement seal	intact, etc.)			
		ny, insir not	ant accord pro-						
Remarks (well re	Guod	ual conditions	(observations)						
			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,						
	$s \omega$								
Duplicate Sam Split Sample II			·		_				
opin cumpio n					<u> </u>			2 9(1	
Signed:	AL	X	a >		- ,	Date:	6-1-	3.04	<u> </u>
	-hac	1	72	5. O'C	arrol	Date:	6-1	MOU	
Signed/review			1/ Jula						
arrie	(we		1315				-		
purged d									
6 9 A	0,0,	N	Л			_			1
No Sai	mple / 1	Viz We	U.	•		•	A	3 GW Sample Dat	a Sheet
	, •	\sim						-	

Figure A-3

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			GROUNDWA	TER SAMPLE	DATA SH	EET	<u>ي بي بين تن وروب</u>		<u>من ب</u> المحمد بالباط
Project Number:	4112			Sample Location			CMU	V-)	
Project Name:	Cape Roma	nzof 2003		Sample ID (ie. 9)		3):	No	<u>V-2</u> Sampia M4	-
Client:	AFCEE			Date Sample Co		,	6-13-	04	•
Sampler:				Time sampled:	No	Sampl		<u> </u>	
			同時的設計	Vell Information				A STATE AND	
Groundwater:	Shallow		Casing	<u> </u>	a an				1. S. M. M. M.
Stounowater:	514 100		Diameter (in):			a) Well Depth (b) Water Depth		1.80	
Other:		<u> </u>	_			c) Water Colum		0.5	
			,			d) Calc. Purge	Vol. (gal):	O O	- QK
		11/2 CHEC N. 1 1993	alle a Triat and the Triat		12.12 a Clark Million av	+ 24 (32) (32) (33) (34)	Lawy of sold used "	<u> </u>	
Vel Casing Diameter	Mutterly c) by:		Calcu	lating Curge Vol	Umater				
<u></u>	0.16					Sand Pack Diameter	Multiply c) by:	-	
6	1.47					12 Note: assuming sand	1.28		
example 1- purging only ou have 2-inch casing an						Example 2- purging v	well casing and s		m n
)ne Purge Volume= D 16	X 6 = 0.96 gallons w	ater						(6) = 5.22 gallons wate	
	推到時期的	11-25-54		DMEASUREMEN	its a tea		的复数		
Time	Volume (gallons)	Hq	Conductivity (mS)	C Temperature (F)	Color	Turbidity	Redox	Dissolved O ₂	Other
1346	0.01	F***	`		Clear	· · · · · ·	TREBUX		Other
	<u> </u>	·				<u> </u>	_		
				<u> </u>	<u> </u>	1	<u> </u>		
Fotal Volume Pure		0.1	galion		Free Prody	ct (v/m):)			
Odor:	Ne		0		Sheen (vin)				
Purge Method (dis			er, submersible faltic						
Sample Method (o		`							
	N								
Vell Integrity (con	dition of casir	g, flush mou	int sealing prop	erly, cement seal	intact, etc.)				
	Good								
			_						
Remarks (well rec	overy, unusua	al conditions	/observations):						
Remarks (well rec			/observations):			· <u>·</u>			
Remarks (well rec	Ory i		/observations):						
	Dry_ i		/observations):						
Duplicate Samp	Dry_ i		/observations):						
Duplicate Samp	Dry_ i		/observations):			Date: ,		3-04 4-00	

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Figure A-3

			GROUNDWA	TER SAMPLE D	ATA SHE	ET			
Project Number:	4112			Sample Location (ie. MW1):	_	CMW-	-3	
Project Name:	Cape Romar	nzof 2003		Sample ID (ie. 951	BIA WG003)	:	CMW- No Sau	npil	
Client:	AFCEE			Date Sample Colle		1	<u>2-13-0</u>	<u>9 </u>	· ·
Sampler: Matt		resa D		Time sampled:	N²	Sample	,		
			a state	Vell Information				相位法律学	
	a. ()		Casing	2		a) Well Depth (fi	ŋ.	937	
Groundwater:	_ Shall	<u>ow</u>	Diameter (in):			b) Water Depth	-	8.35	
Other:						c) Water Colum		0.52	
						d) Calc. Purge \	/ol. (gal):	0	45
			ernelini "Zuertu – 200 "Vie					10 10 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
			Calcu	lating Purge Volu			Multiply c) by:	NUT WHEN LEAD BLOOM	11.15 TE THE COMPLEX
Well Casing Plameter	Multiply c) by: 0.16						0.71]	
6	0.65					12 Note: assuming sand p	1.28 lack has 29% por	osity	
Example 1- purging only	well casing volum		,			Example 2- purging w You have 2-inch casing	 8-inch sand pace 	k, and 6-fool water con	ımı
You have 2-inch casing an One Purge Volume= 0.16.	d 6-toot water colum X 6 = 0.96 gallons w	nn. /ater				One Purge Volume= (0	.16 X 6) + (0.71 >	(6) = 5.22 gailons wate	
		2011545		DMEASUREMEN	ITS A FIE	的結果是		國科学的教育的	品和基金
and the second	Volume		Conductivity (mS)	C Temperature (🗹)	Color	م¢م Turbidity	Redox	Dissolved O2.	Other
Time	(gallons) D.(рн 6.89	60	6.3	It. gray	20	56	5.11	
1405		6101						<u> </u>	
·		•						╄╼───	
		ļ	<u> </u>	<u> </u>		<u> </u>			
·			<u> </u>	<u></u>	E				
Total Volume Pur		0.1	<u>sellon</u>		Free Produ Sheen (y/n)				-
Odor: <u>Na</u> Purge Method (di	sposable bail	er, teflon bail	er, submersible	e pump, etc.)					
	Parv	stallia	= pumt	P					
Sample Method (disposable ba	ailer, teflon ba	ailer, submersit	ble pump, etc.)					
		уA							
Well Integrity (co	ndition of casi	ing, fluşh mo	unt sealing pro	perly, cement seal	intact, etc.)				
		ood							
Remarks (well re			s/observations)	:					**
	Well	-			nple				
Duelleste Cam			<u>8 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1</u>		<u> </u>				
Duplicate Sam Split Sample IE		<u></u>			-				
		<u> </u>		<u> </u>		•••••••	(1)		
Signed:	NAQ-	-		<u> </u>	- 1	Date:	6-12	<u></u>	-
Signed/review		FI	THUR E	O'Cane	-ll	Date:	<u>(-1</u> 2 6-14	-00	
	0								
A	b wel	(\bigcirc)	1400						
HNUN	e wa	x @	11						

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Figure A-3

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			GROUNDWA	TER SAMPLE	DATA SHE	EET			
Project Number:	4112		· · · · · · · · ·	Sample Location	(ie. MW1):	•	<u>CMU</u>		_
Project Name:	Cape Roma	nzof 2003		Sample ID (ie. 9	5 <mark>BIA WG</mark> 003	04LFO3CMW6GW			
Client:	AFCEE			Date Sample Collected:			6-13-04		
Sampler: Mat	(C +)	lensa (7	Time sampled:	16			-	
RUNDER BURNER	和重要的	· · ·		Vell information		発展である			的理论
Groundwater:			Casing Diameter (in):	2		_a) Weil Depth (ft):	00,61	
-						b) Water Depth	• •	13.01	
Other:	· · · · ·					c) Water Colun	• •	1,99	1-7-5
						d) Caic. Purge	voi. (gai):	22451	· 1.72
	1.266分支		Calcu	lating Purge Vol			E STATISTICS	如公司出版的建	
Well Casing Diameter	Multiply c) by:					Sand Page Stameter	Multiply c) by		46 38 C 12 C 14
2	0.16					10	0.71]	
6	1,47	1				12 Note: assuming aand	1.28 pack has 29% po	_] rosity	
Example 1- purging only You have 2-inch casing an						Example 2- purging v	vell casing and s		
One Purge Volume= 0.16								(8) = 5.22 gallons wate	
調整に変換する	和日期也可	神秘 。如	發展機能自己	MEASUREME	vis. Weier	作其影响的资		的關係認識	
Time	Volume (gailons)		Conductivity (mS)	Temperature (+)	Color	PP#	Dedau	Disastered O	
1550	D	рН 7,52	60	3.4	Color CK br.	Turbidity 30	Redox 333	Dissolved O ₂	Other
1555	1,75	2.62	40	2.0	H, br	RO	336	11.72	
1605	1.75	7.27	40	2.5	CLEAN	20	348	1.79	1
1625	1.75	7,07	40	2.2	Clear	20	349	12,50	
	Í				L	<u> </u>			
Total Volume Pure	ged:		5.25 941	llons	Free Produ	ct (wh)			-
Odor: N Ø	popphia halls	r toflag he ^{ll}	y submoralitie	numn ofe l	Sheen (ym)	<u> </u>			
Purge Method (dis	Jari sta	i, teiion balle (上さと	PKMP	pump, etc.)					
Sample Method (c					P	· · · · · · · · · · · · · · · · · · ·			
	pori	shaltic	: pur	пp	·				
Well Integrity (con	dition of casir	ng, flush mou	nt sealing prop	erly, cement seal	intact, etc.)				
	Good	•							
Remarks (well rec	overy, unusu	al conditions/	observations):				-036-		
Good. 1	Prover			collector		P OYLE		\cdots $[\cup G G$	Ś
,	. 0	1		DRO,	BTEX	PCBS,	PAHs		·
Duplicate Samp Split Sample ID:		-hn			-	· ·			
opin oampie ID.					-				
		V		· · · · · · · · · · · · · · · · · · ·			1 JR	.Υ (
Signad									
Signed:	-lan		# Y	<u>}</u>	-	Date:	6-13-	<u>09</u>	-

Figure A-3

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	(ET	(AA . A	-7	1
4112						<u> </u>	- 1	
Cape Roman	nzof 2003	·	Sample ID (ie. 95	BIA WG003)	:	<u>No 1</u>	Sampre .	
AFCEE			Date Sample Coll	ected:	-	615-	2007	
It C +	Teresu	0	Time sampled: 🗼	Jo Sur	pl			
			ell Information		期利息性检查	獲得考虑	的保留的同时们	和何時心
المرمال			2		a) Well Depth (i	i):	14.10	
Shan	<u> </u>	Diameter (my.	~		• • •	-	13,69	
					•		0.41	
					d) Calc. Purge	Vol. (gal):	0.58	
			and the matter state strength and a	IN STATISTICS			and the second shall be	法国外部的法律 网
计编辑机器		Calcu	ating Purge Volu	ume 🦂 👯			Car Vice and the	ų Pžer (Palikanin Vindia).
0.16					8	1		
1,47					12 Note: assuming sand] osity	
well casing volume	•				Example 2- purging v You have 2-inch casin	vell casing and s g, 6-inch sand pac	and pack volume k, and 6-foot water col	umn
X 6 = 0.96 gallons w	ater				One Purge Volume= ().16 X 6) + (0 71)	(6) = 5.22 gallons wat	er
2.5500530.960		NO REL	MEASUREMEN	ITS SHOL			书解和名称名	部で書き
Volume	[Conductivity			}	Redox	Dissolved O ₂	Other
				br/ser		250	13,29	
0.5				21319				
					<u> </u>			·
	· · · · · · · · · · · · · · · · · · ·	<u> </u>		<u></u>				
						······		
rged:								_
isposable baile	er, tefion bail	er, submersible	pump, etc.)					
1								
(disposable ba	iler, teflon ba	ailer, submersib	le pump, etc.)					
-								
ndition of casi	ing, flush mot	unt sealing prop	erly, cement seal	intact, etc.)				
covery, unusu	ual conditions	s/observations):						
0.	\cap	_	4.	S.				
	V arm	<u> </u>	a gain					<u>.</u>
				_				
VILLE	X	1/	<u></u>		Date:			
-740-	10				Date:	6-1	4-09	
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Figure A-3

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				TER SAMPLE			A	. / i	
Project Number:	4112			Sample Location			CMU	<u></u>	- .
Project Name:	Cape Roman	12of 2003		Sample Location (ie. MW1): CNW-7 Sample ID (ie. 95BIA WG003): 04LF03CMW4 Date Sample Collected: 6-13-04					N.
Client:	AFCEE			Date Sample Collected:			6-13-1	04	-
Sampler: Mat	£ He	vesa D)	Time sampled:		00			-
業業を見て	對研究的情	A MP R	WEIKING BOOK	Vell-Information	認為時期	語が中国教師	東岸自制	湖门常常的	
Groundwater:	Shallow	1	Casing Diameter (in):	2		a) Well Depth (ft)·	10.37	
						b) Water Depth	-	7.02	
Other:						c) Water Colum	ın (ft):	3.35	
		•		,		d) Calc. Purge	Vol. (gai):	- Dative	34
	STATE STATE AND CONTRACT	ane lan rest W	ter state to set the set	lating Purge Volu	-to-astat fills	うたいなど主体的なな		i with the second	i
しては、 Well Casing Diameter	Mulliply c) by:	opper are h	Calcu	isting.Purge you	IIII 9 YALLIA	Sand Pack_Diameter	Multiply c) by		G MAL
4 0.85 10 1 6 1.27 1.28 Note: assuming sand pack has 29% porceity									
Example 1- purging only						Example 2- purging v	veli casing and s	and pack volume	
You have 2-Inch casing an One Purge Volume= 0.16 :								k, and 6-foot water col. (6) = 5.22 galions wate	
E RESERVEN		操作者研究		MEASUREMEN	市东水桥等		通信には語	计判定的现象	
	Volume		Conductivity	G		PpM Turbidity			1
Time 1420	(gallons)	рН 6-86	(mS) 140	Temperature (F)	Color H br	70	Redox IOI	Dissolved O2	Othe
1420	1.6	7,07	120	5-1	11 br	70	148	6:15	-
1515	1.25	7.12	120	6,2	CLEAT	50	147	5.68	
······									
	<u> </u>	l <u></u>	<u> </u>	I		<u> </u>	L	<u> </u>	<u> </u>
Total Volume Pur		31	85 211100	.5	Free Produc				-
Odor: Non Purge Method (dis	TEG-13-	<u>44 51</u>	icht hy	dro caibon	Sheen (yh)	/			
Hurge Method (di	sposable baile		er, suomersible	pump, etc.)					
	1		tic pum						
Sample Method (
	1	ersstalt	· · ·	1	,		i		
Well Integrity (cor		1	unt sealing prop	erly, cement seal	intact, etc.)				
	Goo	d							
Remarks (well red	covery, unusu	al conditions	/observations):	····-					
Mod	lecate 1	well r	erou may		0.2	TEX, P	R. C	SDIJC	
Duplicate Samp			0		~ 10	· CALLE	<u>, 60 1</u>	<u>, (, ,)</u>	
Split Sample ID									
			$\overline{\mathcal{A}}$		-	<u> </u>			
Signed:	the	X				Date:	6-12	5-04	
-	-¥-¥-		2VV		•		6-14		
Signed/reviewe	r:(Date:	017		
	<u> </u>								
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\sim	well 6) 141	5		<u> </u>		f 1		
Irriro Q pursod diy	well () 41	5 11 on 5 o	migrol dry	Ptu	1.25	gallons		

A3 GW Sample Data Sheet

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Figure A-3

Project Number: 4112 Sample Location (ie. MW1): CM ($U-5$) Project Name: Cape Romanzof 2003 Sample ID (ie. 95BIA WG003): 04 ($LCO3 c$ ($MU5 GW$) Clent: AFCEE Date Sample Collected: $D-13-20^{-4}$ Sampler: Mattr C and TBD Time sampled: 2,005 Bits History Sample Sample Collected: $D-13-20^{-4}$ Iffer Sample Collected: $D-13-20^{-4}$ Groundwater: $Ohall OW$ Casing a) Well pepth (R): $(10, 3-5)^{-5}$ Other: O) Casing a) Well pepth (R): $(10, 3-5)^{-1}$ $(10, 3-5)^{-1}$ Other: O) Casing (a) Casing a) Well pepth (R): $(10, 3-5)^{-1}$ Other: O) Casing Collected: (b) Water Column (R): $(10, 3-5)^{-1}$ Other: (a) Casing Collected: (b) Water Column (R): $(10, 3-5)^{-1}$ Other: (b) Casing Collected: (b) Water Column (R): $(10, 3-5)^{-1}$ Other: (b) Casing Collected: (b) Water Column (R): $(10, 3-5)^{-1}$ Other: (b) Casing Collected: (b) Casing Collected: $(10, 3-5)^{-1}$ Other: (b) Casing Collected: (b) Ca	GROUNDWATER SAMPLE DATA SHEET	
Project Name: Cape Romancof 2003 Sample ID (ie. 95BIA W6003): $0.4 \pm 0.5 \pm 0.1 \pm 0.5 \pm 0.1 $	Sample Location (ie. MW1):	
Client: ACCEE Date Sample Collected: $b-13-20^{14}$ Sampler: Matt 1 and 152 Time sampled: 2005 Groundwater: Shallow Diameter (in): a) Weil Depth (i): $b \cdot 3-5$ Other:	zof 2003 Sample ID (ie. 95BIA WG003): 04 LF03 c MW 5 GW	
Sampler: Matter C And FEQ Time sampled: 2005 Bigsteider Heiner Status Casing a) Weil Depth (fil: (D. 3/2) Groundwater: Shallow Diameter (in): 2 a) Weil Depth (fil: (D. 3/2) Other:		
Advance State of the second seco	TEA Time sampled: 2005	
And the product of		海科
Global water	Casing	
Other: c) Water Column (ft): $514D$ d) Calc. Purge Vol. (gal): $41,7D$ Ministry (gal): $41,7D$ Minis		
Childing c) Calc. Purge Vol. (gal): 4, 70 Control c) Calc. Purge Vol. (gal): 4, 70 Control c) Calc. Purge Vol. (gal): 4, 70 Control c) Calc. Purge Vol. (gal): c) Calc. Purge Vol. (gal): 4, 70 Control c) Calc. Purge Vol. (gal): Control c) Calc. Purge Vol. (gal): c) Calc. Calc. (gal): c) Calc. Calc. (gal):		
Stand Party City: The case of color water colume. To a party colume column. To a party column.		
Stand Party City: The case of color water colume. To a party colume column. To a party column.		
We carry Gunder Matter 101 $\frac{1}{2}$ $\frac{1}{$	Calculating Purge Volume	
Image: transmit is purple and purple will call by the set of the se	Sand Pack Diameter Multiply c) by:	
Example 1- purpling only well casing volume Note::::::::::::::::::::::::::::::::::::	- 10 1	
Example 1- purging only well calling volume You have 2-bit calling. Buch and puck, and 6-bit wells: You have 2-bit calling. Buch and puck, and 6-bit wells: You have 2-bit calling. Buch and puck, and 6-bit wells: You have 2-bit calling. Buch and puck and 6-bit wells: You have 2-bit calling. Buch and puck and 6-bit wells: You have 2-bit calling. Buch and puck and 6-bit wells: You have 2-bit calling. Buch and puck and 6-bit wells: You have 2-bit calling. Buch and puck and 6-bit wells: You have 2-bit calling. Buch and puck and 6-bit wells: You have 2-bit calling. Buch and puck and 6-bit wells: You have 2-bit calling. Buch and puck and 6-bit wells: You have 2-bit calling. Buch and puck and 6-bit wells: You have 2-bit calling. Buch and puck and 6-bit wells: You have 2-bit calling. Buch and puck and 6-bit wells: You have 2-bit calling. Buch and puck and 6-bit wells: You have 2-bit calling. Buch and puck and 6-bit wells: You have 2-bit calling. Buch and puck and 6-bit wells: You have 2-bit calling. Buch and puck and buch and puck and buch and puck and 6-bit wells: You have 2-bit calling. Buch and puck and buch and puck and 8-bit wells: You have 2-bit calling: You have 2-bit calling. Buch and puck and buch and puck and puck and 9-bit wells: You have 2-bit calling. Buch and puck and pu	Example 2- purging well casing and sand pack volume	
Image: Second Strike Strite Strike Strike Strite Strike Strike Strike Strike Strike Strik	You have 2-inch casing, 8-inch sand pack, and 6-foot water column.	
Time (respective) (ms) Temperature (F) Color Turbidity Redox Dissolved O2 Other 1425 0 $(.37)$ 50 5.5 $(.47)$ 7.5 2.66 $4(.51)$ 1455 5 $(.147)$ 40 3.12 $Clear$ 40 3.60 45.33 1420 4.5 6.147 40 3.12 $Clear$ 40 3.60 45.33 1420 4.5 6.147 40 3.12 $Clear$ 40 3.60 45.33 1420 4.5 6.147 40 3.12 $Clear$ 2.0 2.10 9.44 1420 4.5 6.15 40 3.2 2.0 2.10 9.44 1.63 1.66 1.6		
Time (gallons) pH (mS) Temperature (F) Color Turbidity Redox Dissolved 02 Other 1425 Q (.35) 50 5.5 L+B 20 216 4151 1475 5 (.47 40 312 Cleas 40 360 15.33 1470 4.5 (.47 40 3.2 Cleas 40 360 15.33 1470 4.5 (.47 40 3.2 Cleas 40 360 15.33 1470 4.5 (.47 40 3.2 Cleas 40 360 15.33 1470 4.5 (.47 40 3.2 Cleas 40 360 15.33 1470 4.5 (.47 40 3.2 Cleas 40 3.60 15.33 16.36 1470 4.5 (.47 40 3.3 Cleas 40 16.46 Odor 9.5 5.44 Sheen (y/g) Sheen (y/g) Sheen (y/g) 16.36 16.36 16.36 16.36		1145-53
1325 0 $(.37)$ 50 5.5 $(.47)$ 70 216 4.56 1475 5 $(.47)$ 40 3.2 0.64 40 360 5.33 1470 4.5 6.15 40 3.2 0.64 40 360 5.33 1470 4.5 6.15 40 3.3 0.64 20 210 9.44 1470 4.5 6.15 40 3.3 0.64 20 210 9.44 1470 4.5 6.15 40 3.3 0.64 20 9.44 1470 4.5 6.15 40 3.3 0.64 20 9.44 Odor: 9.56 9.56 5.66 5.66 5.66 5.66 5.366 6.44 6.44 6.44 6.44 6.66 6.66 6.66 6.66 6.66 6.66 6.66 6.66 6.66 6.66 6.66 6.66 6.66 6.66 6.66 6.66	L (C) Townshing (E) Color Turbidity Bodoy Dissolved O. (Othe	ier
1420 4.5 0.75 40 $3, 3$ $0.4ert$ 20 210 9.44 1420 4.5 0.75 40 $3, 3$ $0.4ert$ 20 210 9.44 Total Volume Purged: 9.5 9.5 9.5 9.6 9.6 9.6 Odor: Sheen (yrd) Sheen (yrd) 9.5 9.6 9.6 9.6 Purge Method (disposable baller, teflon baller, submersible pump, etc.) 9.6 9.6 9.6 9.6 Perf3ral frz Pump 9.6 9.6 9.6 9.6 9.6 Well Integrity (condition of casing, flush mount sealing property, cement seal intact, etc.) 0.6 0.6 0.7		
1920 4,5 6,7 40 3,3 11 12		
Otor: Sheen (y/p) Purge Method (disposable bailer, teflon bailer, submersible pump, etc.) $PerFStaltx PumP$ Sample Method (disposable bailer, teflon bailer, submersible pump, etc.) $perFStaltx PumP$ Sample Method (disposable bailer, teflon bailer, submersible pump, etc.) $perFStaltx PumP$ Well Integrity (condition of casing, flush mount sealing property, cement seal intact, etc.) $Gacd$ Remarks (well recovery, unusual conditions/observations): $DR0$, $BTEX$, $PC(Bs, FAHs)$ Duplicate Sample ID: $Signed$: Signed: $MMMM$	6,75 40 3,3 CHEN 20 210 7.97	
Otor: Sheen (y/p) Purge Method (disposable bailer, teflon bailer, submersible pump, etc.) $PerFStaltx PumP$ Sample Method (disposable bailer, teflon bailer, submersible pump, etc.) $perFStaltx PumP$ Sample Method (disposable bailer, teflon bailer, submersible pump, etc.) $perFStaltx PumP$ Well Integrity (condition of casing, flush mount sealing property, cement seal intact, etc.) $Gacd$ Remarks (well recovery, unusual conditions/observations): $DR0$, $BTEX$, $PC(Bs, FAHs)$ Duplicate Sample ID: $Signed$: Signed: $MMMM$		
Otor: Sheen (y/p) Purge Method (disposable bailer, teflon bailer, submersible pump, etc.) $PerFStaltx PumP$ Sample Method (disposable bailer, teflon bailer, submersible pump, etc.) $perFStaltx PumP$ Sample Method (disposable bailer, teflon bailer, submersible pump, etc.) $perFStaltx PumP$ Well Integrity (condition of casing, flush mount sealing property, cement seal intact, etc.) $Gacd$ Remarks (well recovery, unusual conditions/observations): $DR0$, $BTEX$, $PC(Bs, FAHs)$ Duplicate Sample ID: $Signed$: Signed: $MMMM$		
Purge Method (disposable bailer, tefton bailer, submersible pump, etc.) PerBtaltz Pump Sample Method (disposable bailer, tefton bailer, submersible pump, etc.) PerBtaltz Pump Well Integrity (condition of casing, flush mount sealing property, cement seal intact, etc.) Good Remarks (well recovery, unusual conditions/observations): DR0, BTEX, PCBs, PAHS Duplicate Sample ID: Split Sample ID: Signed: Date: 6-13-04		
Sample Method (disposable bailer, teflon bailer, submersible pump, etc.) PETSTUTTE POMP Well Integrity (condition of casing, flush mount sealing property, cement seal intact, etc.) Good Remarks (well recovery, unusual conditions/observations): DR0, BTEX, PCBs, PAHS PORced DD, BEC Z well VolumeS = 9.5 gallers Duplicate Sample ID: Split Sample ID: Signed: Date: 6-13-04		
Sample Method (disposable bailer, teflon bailer, submersible pump, etc.) PETSTUTTE POMP Well Integrity (condition of casing, flush mount sealing property, cement seal intact, etc.) Good Remarks (well recovery, unusual conditions/observations): DR0, BTEX, PCBs, PAHS PORced DD, BEC Z well VolumeS = 9.5 gallers Duplicate Sample ID: Split Sample ID: Signed: Date: 6-13-04	Imp	
Well Integrity (condition of casing, flush mount sealing property, cement seal intact, etc.) Good Remarks (well recovery, unusual conditions/observations): DR0, BTEX, PC(B>, PAHS Porced Diagonal (Conditions) Duplicate Sample ID: Diagonal (Conditions) Split Sample ID: Date: 6-13-04	ler, tefton baller, submersible pump, etc.)	
Well Integrity (condition of casing, flush mount sealing property, cement seal intact, etc.) Good Remarks (well recovery, unusual conditions/observations): DR0, BTEX, PC(B>, PAHS Porced Diagonal (Conditions) Duplicate Sample ID: Diagonal (Conditions) Split Sample ID: Date: 6-13-04	Pomp	
GOOG Remarks (well recovery, unusual conditions/observations): DRO, BTEX, PC(3), PAHS Publicate Sample ID: Duplicate Sample ID: Split Sample ID: Date: 6-13-04	g, flush mount sealing properly, cement seal intact, etc.)	
Remarks (well recovery, unusual conditions/observations): DRO, BTEX, PCB3, PAHS P_{U} peod P_{U} peod P_{U} peod Duplicate Sample ID:		
Porsed Porsed <td>al conditions/observations): DRO, BTEX, PCB, PAHS</td> <td></td>	al conditions/observations): DRO, BTEX, PCB, PAHS	
Duplicate Sample ID:	S. C. D. all Holmons = 9,5 sallers	
Split Sample ID: Date: 6-13-04	, after 2 will volowes to start	
Signed: Date: 6-13-04		
	Date: 6-13-04	
Date: 6-14-14	Date: 6-14-04	
Signed/reviewer: Date.	Line Contraction Date.	

A3 GW Sample Data Sheet

Figure A-3

Contraction and the second		The Target All And The Party of the		Production and a second se					
			GROUNDWA	ATER SAMPLE	DATA SH	EET			
Project Number	4112			Sample Location	(ie. MW1)		CM	W - 7	
Project Name	Cape Roma	nzo(2003		Sample ID (ie. 9	5BIA WG00	3):	MIF	oz Mul	AGN
Cliant:	AFCEE			- Date Samp ia Col	llected.		10	124/14	5 1000
Sampler:				- Time sampled.	0730				
				Nell Information			······	······································	
		مجيجية مسرعها ورحافا الألال فتلقفه	Casino					<u>س</u> ر ، سر میذا میرو . در می نانشوی کا هر بر ۲۰۰۰ م	
Groundwater			Dismeter (m).	<u>_2"</u>		_a) Well Depth		13.8	35
Other						b) Water Dept	-	U.y	<u>ę5 </u>
Other:	-		-			 c) Water Colur d) Calc. Purge 			25
						di Osidi i dige	(gai)		
			Calcu	lating Purge Vol	uine	· · · · · · · · · · · · · · · · · · ·	·····	ور ر جنوع و سرد و معر به معر به است و ا منطقه معد محر دا معی ه هه بوسه چی معد و آف مساله ب	
Well Casing Diamoter	houinaly c) by					South Pack Diameter	Multiply c) by:		
2	0.10					e 10	0.54		
ę 1	3.47]		•		Note: assuming same	1 29 I nack has 29% pr	- Intraily	
Example 1- purping only You have 2-hon casing a						Example 2- purging	wall casing and s		lutions.
One Purps Volume= D 16			•					7 5) = 5 22 gellons wat	
			FIEL	D MEASUREMEN	(TS				
	Volume		Conductivity						1
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	10.8	1-5-		2	BPN	20	412	10.17	······
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			L			ļ	1 - 1 - 1-		
	1	l	ĺ	1	L		<u> </u>	{	·
Total Volume Pur	ged.	-41	.5		Free Produ	xet (y/n):	<u>N</u>	·····	~
Odor Purge Method (di	Tooshia kojir	Than huil	n oubmoraible		Shesn (y/r	<u>);</u>	لا		
i uite Meinoù (u			a, suomersuie	pump, eu.,					
	\langle								
Sample Method	disposable Ba	lier, tellon ba	llier, suomersio	e pump, etc.)					
					<u></u>				·····
Well Integrity (cor			int sealing prop	erly, cement seal	intact, etc.)				
l		GOOD		·					
Remarks (well re-	covery, unusu								
		NFI	n cocle	2				•	
Ouplicate Samp									
Split Sample ID	:				-				
		2)				. 1	7	
Signed:	JE J	·····			_	Date:	6/24	04	_
Signed/reviews						Dote:	1	I	
	·								



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A3 GW Sample Dats Sheet

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Figure A-3

			GROUNDWA	TER SAMPLE D	DATA SHE	ET	<i>.</i>	. 7	
Project Number:	4112		!	Sample Location ((ie. MW1):	-	CMV	<u>v-2</u>	
Project Name:	Cape Roman	zof 2003		Sample ID (ie. 95i	BIA WG003)	n 6	ALFO	3CMWD	SGW
Client:	AFCEE			Date Sample Coll	ected:	-	_ 10/2	4/04-	
Sampler:	<u></u>			Time sampled:			0715	2	
		a s ta (j. 1747)		ell Information				NAME AND	
	AND DAMENS	and the second	Casing					9.12	
Groundwater:			_Diameter (in):	2"		a) Well Depth (f b) Water Depth		7.60	2
						c) Water Colum		1.52	2
Other:			-			d) Calc. Purge	Vol. (gal):	0.2	4
					<u></u>				
	to a late of the		Calcu	ating Purge Vol	ime	自然走近到我	建筑经济 和1		
Well Casing Diameter	Multiply c) by:					Sand Pack Diameter	Multiply c) by: 0.71		
2 4	0.16					10 12	1.28		
6	1.47					Note: assuming sand Example 2- purging v	elt casing and Sa	nd pack volume	
Example 1- purging only You have 2-inch casing a	and 6-foot water coluit	ជា.				You have 2-inch casing One Purge Volume= (0	 S-inch sand pack 	K. 2nd 6-rool water con	ປກະກຳ. ສຳ
One Purge Volume= 0.16	5 X 6 = 0.96 gallons w	rater							The transmission of the
	E MARKEN S	THE REAL PROPERTY	S. C. W. FIEL	MEASUREMEN	vts读 》清	建設的建設			n near star T
	Volume		Conductivity	Temperature (E)		Turbidity	Redox	Dissolved O ₂	Other
Time	(gallons)	pH	(/46)	Temperature (C)	BAN		300	9.7	
	0.15	7.4	+ 40-	6.	(1	10	300	859	
	0.50	6.5	40	5.	4	10	335	8.07	
	<u> 0·15</u>	6.2	190-					ļ	
		<u> </u> -			<u> </u>		<u> </u>	<u> </u>	
		-77	gal		Free Produ	uct (y/n):	$-\mathcal{N}$		_
Total Volume Pu	irged:	<u> </u>	-		Sheen (y/r		$-\rho$		
Odor: Purge Method (fisposable bail	er, teflon ba	iller, submersible	pump, etc.)					
		Ξ́							
Sample Method	(disposable bi	ner, teflon l	bailer, submersit	ble pump, etc.)		<u></u>			
Sample Wealou	(dispedicie 1								
		funts en	ount sealing pro	perly, cement sea	l intact, etc.)	· · · · · · · · · · · · · · · · · · ·			
Well Integrity (C	ondition of cas	~							
			1000			,			<u> </u>
Remarks (well r	ecovery, unus	ual conditio	ns/observations)						
		1	New Loc	Je-					
Duplicate San	nole ID:		·						
Split Sample	ip: ID:			······	_				
								. / .	
		5	7	_		Date:	6/20	<u>+/04</u>	
Signed:	1					Doto:	1	•	
Signed/reviev						Date:			

A3 GW Sample Data Sheet

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Figure A-3

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			GROUNDWA	TER SAMPLE	DATA SHE	ET	^	N/ 1	
Project Number:	4112			Sample Location	(ie. MW1):		CMI	<u>N-1</u>	-
Project Name:	Cape Romar	nzof 2003		Sample ID (ie. 95	044FO3MWDIGW				
Client:	AFCEE			Date Sample Collected:			6/24/04		
Sampler:	BT.C	2NIN	2	Time sampled:			0700		
二三十十二十二十二十二十二十二十二十二十二十二十二十二十二十二十二十二十二十二				Vell Information	派书 梁尔	建设设是 这种	的形动的		
	X	196 WA 19 1	O					10 05	1.1001.4
Groundwater:			_ Diameter (in):			a) Well Depth (b) Water Depth	•	5.00	<u>ァ</u> ろ
Other:						c) Water Colum		A.9	2 7
			-			d) Calc. Purge		0,7	9
				· · · ·					
		NE TRAIN	Calcu	lating Purge Volu	inie 注意法	校派和 自由的	別制計論	的行至是自己	ЯЩ.
Well Casing Diameter	Multiply c) by: 0.16					Sand Pack Diameter 8	Multiply c) by: 0.71		
4	0.65					10	1.28	-	
	-*	1				Note: assuming sand	pack has 29% po		
Example 1- purging only You have 2-inch casing a	nd 6-foot water colum	N T.					g, 8-inch sand pa	and pack volume =, and 6-foot water col < 6) = 5.22 gallons wate	
One Purge Volume≃ 0.16 				·····				· · · ·	
等建設書寫		带和型管		DMEASUREMEN	TS			and in the set	
Time	Volume (galions)	pH	Conductivity (c)(S)	Temperature (Color	Turbidity	Redox	Dissolved O ₂	Othe
	0.9	6.08	10	2.6	BRN	20	1.88	9.4%	
	1.6	6.13	20	2.0	BRN	10	330	9.44	
	7.4	6.15	30	1.8	Ben	10	363	9.55	<u> </u>
			-						\vdash
· · · · · · · · · · · · · · · · · · ·			<u></u>	<u></u>	· · · · · ·	<u> </u>			<u>.</u>
Total Volume Pur	ged:	<u>3</u>	Ogn-	•	Free Produ				-
Odor: Purge Method (d	sposable baile	> er, teflon bal	ller, submersible	pump, etc.)	Sheen (y/n	<u>, `</u>			
		\leq							
Sample Method (distosable ba	iler_teflon h	ailer, submersib	le pump, etc.)		····-		<u> </u>	
	200000000000000000000000000000000000000	ingi pronon o							
E	ndition of casis	na flush ma	unt sealing proc	eriv cement seal	intact etc.)	<u></u>	<u> </u>		
Mell Integrity (co	nonuon or cash	ng, nuarrino	<u>^</u>						
Well Integrity (co			(200X				<u></u>		
		al a a - 201	alahaan Mara - N						
Well Integrity (co Remarks (well re	covery, unusu	al condition							
	covery, unusu	al condition		V Lock					
Remarks (well re Duplicate Sam	ple ID:	al condition							
Remarks (well re	ple ID:								
Remarks (well re Duplicate Sam	ple ID:								
Remarks (well re Duplicate Sam	ple ID:					Date:	4/24	104	

A3 GW Sample Data Sheet

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Figure A-3

			GROUNDWA	TER SAMPLE	DATA SHE	ET			
Project Number:	4112			Sample Location ((ie. MW1):		CMM	-2	
Project Name:	Cape Romar	zof 2003		Sample ID (ie. 95	BIA WG003)	k (j	AG		
Client:	AFCEE			Date Sample Coll	ected:		2440	3CMW2	GW
Sampler:				Time sampled:		8	3104	- 1800	
	er alegaren alaren eralen er		NET SALE	Vell Information		والمتعادية المجرمة المتعادية		ية من	ب سر محمد میں براہ میں میں
	2.2.7.6605.0000 vs. vs		Casing		and and the second s	<u> </u>			
Groundwater.			_Diameter (in):			a) Well Depth (b) Water Depth	•		
•						c) Water Colum			
Other:			-			d) Calc. Purge		······································	
	is in the	المراجع والم		lating Purge Volu					المجرجة بما المسابق وتسلع ما
Well Casing Diameter	Nutiply c) by		and a contract of the second			Sand Pack Diameter	WULTERY C) DY:		
2 4	0.16					<u>8</u> 10	0.71	1	
	1,47					12 Note: assuming sand	1.28 pack has 29% por	 rosity	
Example 1- purging only	well casing volume					Example 2- purping v	eli casing and sa		
You have 2-inch casing a One Purge Volume= 0.16	nd 6-foot water colum	n.				One Purge Volume# (), 16 X 6) + (0.71 X	(fi) = 5.22 gallons wat	H .
					بالمرجوعة المرجوعة المستحد		8-12-14 A. 1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-		
			Conductivity	DMEASUREMEN		and the second second of the	1. 1997 (1997-1972) 1. 1997 (1997-1972)	and the other is	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1
Time	(gallons)	рНа	(mS)	Temperature (F)	Color	Turbidity	Redox	Dissolved O ₂	Other
l Ime	(ganons)	<u>pri</u>							<u> </u>
			1						
						1	l		
				· · · · · · · · · · · · · · · · · · ·					
								<u> </u>	
Total Volume Plu	med				Free Produ	ct (y/n):			-
Total Volume Pur Odor:					Free Produ Sheen (y/n)	-			-
Total Volume Pur Odor: Purge Method (d		er, teflon ba	iler, submersible	pump, etc.)	-	-			-
Odor		er, teflon ba	,	pump, etc.) V (G.L	-	-			-
Odor: Purge Method (d	isposable baile	Did	not p	wige	-	-			-
Odor	isposable baile	Did	not p	wige	-	-			-
Odor: Purge Method (d Sample Method	isposable baile disposable ba	D1J iller, totion b	hot <u>P</u> Bailer, submersib	v rg l lie pump, etc.)	Sheen (y/n)	-			-
Odor: Purge Method (d Sample Method	isposable baile disposable ba	D1J iller, totion b	hot <u>P</u> Bailer, submersib	wige	Sheen (y/n)	-			
Odor: Purge Method (d Sample Method Well Integrity (co	isposable baile disposable ba	D1J iller, tofion b	hot P pailer, submersib punt sealing prop	vgl lie pump, etc.) perty, cement seal	Sheen (y/n)	-			
Odor: Purge Method (d Sample Method	isposable baile disposable ba	D1J iller, tofion b	hot P pailer, submersib punt sealing prop	vgl lie pump, etc.) perty, cement seal	Sheen (y/n)	-			-
Odor: Purge Method (d Sample Method Well Integrity (co	isposable baile disposable ba	D1J iller, tofion b	hot P pailer, submersib punt sealing prop	vgl lie pump, etc.) perty, cement seal	Sheen (y/n)	-			
Odor: Purge Method (d Sample Method Well Integrity (co Remarks (well re	isposable baile disposable ba ndition of casi covery, unusu	D1J iler, tefion b ng, flush mo	hof P pailer, submersib punt sealing prop s/observations):	vgl lie pump, etc.) perty, cement seal	Sheen (y/n)	-			
Odor: Purge Method (d Sample Method Well Integrity (co Remarks (well re Duplicate Sam	isposable baile disposable ba ndition of casi covery, unusu ple ID:	D1J iler, tefion b ng, flush mo	hot P pailer, submersib punt sealing prop	vgl lie pump, etc.) perty, cement seal	Sheen (y/n)	-			
Odor: Purge Method (d Sample Method Well Integrity (co Remarks (well re	isposable baile disposable ba ndition of casi covery, unusu ple ID:	D1J iler, tefion b ng, flush mo	hof P pailer, submersib punt sealing prop s/observations):	vgl lie pump, etc.) perty, cement seal	Sheen (y/n)	-			
Odor: Purge Method (d Sample Method Well Integrity (co Remarks (well re Duplicate Sam	isposable baile disposable ba ndition of casi covery, unusu ple ID:	D1J iler, tefion b ng, flush mo	hof P pailer, submersib punt sealing prop s/observations):	vgl lie pump, etc.) perty, cement seal	Sheen (y/n)	<u></u>			
Odor: Purge Method (d Sample Method Well Integrity (co Remarks (well re Duplicate Sam	isposable baile disposable ba ndition of casi covery, unusu ple ID:	D1J iler, tefion b ng, flush mo	hof P pailer, submersib punt sealing prop s/observations):	vgl lie pump, etc.) perty, cement seal	Sheen (y/n)	-	<u>q/1/c</u>		

Figure A-5 Sediment Sample Sheet

Sample ID 04LF03SD01SD Site LF03 Location SD01	Date <u>6-13-04</u> Time <u>1500</u> Sampler <u>MC</u> QA/QC Sample No TEO 6-13-04 Associated QA/QC Sample Split Duplicate
🗋 Brackish 💦 🗍 River (RV)	Sample Depth <u>4''</u> Total Depth <u>4'''</u> Seep/Spring (SE) Dother
Sand	Color <u>greenish grau</u> , brown stathing Odor <u>Nont</u> Sheen <u>Nont</u> Debris <u>rust</u> Other
Location Diagram/Notes X3D01 LF03 Dwg	DRO, BTEK, PCBS, PAHS Bulder Field - G/14/04

A5 Sediment Sample Sheet

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Figure A-5 **Sediment** Sample Sheet

Sample ID 04LF03SD02SP Date 6-3-04 Time 1945 Site LF03 Sampler MC Location 5D2 QA/QC Sample Associated QA/QC Sample Split Duplicate Brackish River (RV) Sample Depth 177 Freshwater Stream/Creek (SP) Seep/Spring (SE) Other
□ Freshwater □ Stream/Creek (SP) Seep/Spring (SE) □ Other
Clay Color
Location Diagram/Notes BTEX DRO, PAH, PCBS
Bouldor Freld XSDOD
TA LFO3
100 6/14/04

A5 Sediment Sample Sheet

Figure A-5 Sediment Sample Sheet

Sample ID 04LF03SD03SD	Date 6-13-04 Time 1210
Site LF03	Sampler <u>TEO/MC</u>
Location <u>SW315D3</u>	QA/QC Sample
	Associated QA/QC Sample Split Duplicate
□ Marine □ Lake/Pond (LK) □ Brackish □ River (RV) □ Freshwater □ Stream/Creek (SP) □	Sample Depth <u>6''</u> Total Depth <u>6''</u> Seep/Spring (SE) D Other
Gravel	Color <u>greenish gray</u> Odor <u>No</u> Sheen <u>No</u> Debris <u>No</u> Other
Location Diagram/Notes BTEX TORO, PO	Bauldor Field
R Se LIUS	d
Atat	En 6/14/04

A5 Sediment Sample Sheet

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Figure A-4 Surface Water Sample Sheet

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Sample ID 04 LF03 SW02 SW	Date 6-13-04 Time 1935
Site LF03	Sampler MC
Location SW 2/5D2	QA/QC Sample
	Associated QA/QC Sample Split Duplicate
□ Marine □ Lake/Pond (LK) □ Brackish □ River (RV) □ Freshwater □ Stream/Creek (SP) ☑ Seep/Spring (SE) □ Other □ Emergent Vegetation □	Total Depth
pH [Conductance (mS) [Color <u>clear</u> Odor <u>none</u> Sheen <u>none</u> Debris <u>none</u> Turbidity <u>none</u>
Location Diagram/Notes BTEX DRO	, PAH, PCBS
	Budder Field X Swo2
LF03	
A4 Surface Water Sample Sheet	Jan 6/14/04

Figure A-4 Surface Water Sample Sheet

Sample ID <u>04LF03SW0ISW</u> SiteLF03 Location <u>SW0</u> Marine Lake/Pond (LK) Brackish River (RV) Freshwater X Stream/Creek (SP)	Date (
Seep/Spring (SE) Other Emergent Vegetation	Flow Direction
pH Conductance (mS)	□ Color <u>Cley</u> □ Odor <u>None</u> □ Sheen <u>None</u> □ Debris <u>(JSt</u> □ Turbidity <u>(OM</u>)
Location Diagram/Notes	BTEX, DRO, PCBS, PAHS
ASurface Water Sample Sheet	Baubler Freh

Figure A-4 Surface Water Sample Sheet

Sample ID 04LF036W036W Site $_$ LF03 Location $_$ SW3/503	
	Associated QA/QC Sample Split Duplicate
□ Marine □ Lake/Pond (LK) □ Brackish □ River (RV) □ Freshwater □ Stream/Creek (S ☑ Seep/Spring (SE) □ Other □ Emergent Vegetation □	Sample Depth Total Depth P) Velocity (ft./Sec.) Flow Direction
Temperature °C 8.8 pH 7.80 Conductance (mS) 30 Dissolved O2 15.55	$\begin{array}{ c c c c c c c c c c c c c c c c c c c$
Location Diagram/Notes Sampled For	BTEX, DRO, PCBS, PAHS -Boylder
XS003 LFO3 NOAQ A4 Surface Water Sample Sheet	Mw 6/14/09

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QUALITY ASSURANCE SAMPLES		Sample Type/ Notes Concentration	Soil samply Dup of OfSS145B125B 121 Culturyo	" Dup of cotostassisses 151	soil-borine MS/MSD extran volume collect	" DUP of OtST23252751331	Crandwate MS/MSD extra valume collecto	surve MS/MSD extra volume cullected
QUALITY ASSI		Matrix	t not	¥	11	n	wake G	=
Farranzet	e ader	Date Made/Sent	6/12/04		6/14/04	۲۲ ۲	6/21/05	copoloy 6/20/04
280	f the Investigition:	Lab Sent to	545	565	595	<i>StaS</i>	<i>S</i> 65	=
Project:	Quality Assurance Objective of the Investigation:	Sample Numbers	045545631258 13	0455H5B1155B15	18 45727624242424	243503561273231	MOSOWM 601540	MEDDWG416540

A8 Quality assurance samples

Figure A-8

Project: 4112 Samolino Leader / Team:	Cape Romanzet		QUALITY ASS Theisen	QUALITY ASSURANCE SAMPLES Date: 000000000000000000000000000000000000	
Quality Assurance Objective of the Investigation	the Investigtion:	llè	0		
Sample Numbers	Lab Sent to	Date Made/Sent	Matrix	Sample Type/ Concentration	Notes
045 SISTBOW	Ses	tolog elglot	water	trip blant	The Blank for cealer AK 66742684
0455B35ebsD	Ses	6/104	s ei l	sediment	ms/msd - extra volume
0965135510150	366	6/9/04	soil	sedime.t	the bland of Duplicate of CYSSISSDISD BTEX (DRO (PRO / PAH
04551371655	565	6904	lias	trip black	the black for cooker Ak 63003301
04551332MASM	SS	6907 6101-	welter.	water	mejmsd -extra velume duplicate taken (an 095913522181542) Tah (Ded/Eeo /Tan H
04-5513-TBSW	595	chilot chilot	water	trip blank	Trip Blant for cooler lecals

A8 Quality assurance sar

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QUALITY ASSURANCE SAMPLES	Sample Type/ Notes Concentration	soil from Duplicate of 045709MW075851 51 51	soil fram extra velume collected for sse Ms/MSD	soil from Duplicate of O455145BV58 151 cuthings	" DUPLICAT OF OF SIESE N	Soil from Extra volume provided for MS/MSD	Soil freum u n n soil Soil freum u n n n n n n n n n n n n n n n n n n
QUALITY AS	Matrix	Ji05	Soil	-	וו	11	=
Comenze heisen	Date Made/Sent	10/11/09 10/14/04	6/12/04 6/19/04	6/12/09	-	=	E
12 Lape 1 Brandre 1 of the Investigtion:	Lab Sent to	s' ses	365	365	1 Sec	565	595
Project: <u>4112</u> La.pc. Sampling Leader / Team: <u>Providite</u> Quality Assurance Objective of the Investigtion:	Sample Numbers	C4 5109 MN 10758	0456 458 02583	045514581258	C4551456115815	04 91095 62358 5	0455145E025B 31

A8 Quality assurance samples

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les Loy	5 × 5		Notes	1 Duplicate of OYLFU35503 55											
QUALITY ASSURANCE SAMPLES 승준 Date: CIIQI 이	Carnehan	2	Sample Type/ Concentration	Sur Face soil	Giab							<u>.</u>			
OUALITY AS	H= W	Q 4 7 P	Matrix		201							4		 	
N S	2 mas	566	Date Made/Sent	40/21/9	4/14/04			 			-		1	 	
4117 600	the Investintion.		Lab Sent to	ر د د	5 5 F										
Droiact:	g Leader / Team:		Sample Numbers	04LF035510355											

A8 Quality assurance san

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	DOY Nan Jeresa O'Carmell	Notes extra volumos collected for MSIMSD DRO, BTEX, PCBS, PAHS	Duplicate of OYLFO3CMW6GW DEO, BTEX, PCB, PAHS		
	QUALITY ASSURANCE SAMPLES	Matrix Sample Type/ Concentration () (S-(J) (MSD)	W Dup		
	Pomanz Comanz See 2	Date Ma Made/Sent Ma 6 113 104 W			
	<i>イ</i> //2 (bers Lab Sent to Juol Gw S&S	4)0664U 5&5		
Figure A-8	Project: Sampling Leader / Team: Quality Assurance Object	Sampie Numbers of LFO3 MW0[GW	odlFcs:cmm10664		

A8 Quality assurance samples



0	QUALITY ASSURANCE SAMPLES	
Project: 4/12 Corpe Fornanzot De Sampling Leader / Team: 737	te: 6 20	1 40
Quality Assurance Objective of the Investigtion:		
Sample Numbers Lab Sent Date Matrix to Made/Sent	Sample Type/ Concentration	Notes
6/20/04	Heo sufacen	Dup of 0455145WD35W
3	Grand	My of afsted Mugger

144 166

A8 Quality assurance samples

Figure A-3

		•	GROUNDW/	ATER SAMPLE	DATA SHE	ET					
Project Number:	4112			Sample Location	(ie. MW1):		10F 1/	VW-08			
Project Name:	Cape Roma	inzof 2003		Sample ID (ie. 95BIA WG003):							
Client:	AFCEE		<u>_</u>	Date Sample Co							
Sampler: B	TIME		······	Time sampled:				00	-		
									_		
			Casing	Vell Information	<u> </u>		· · · · · · · · · · · · · · · · · · ·	×1			
Groundwater:	[D.	Ø	Diameter (in):	24		a) Well Depth	(ft):	2562			
Other						b) Water Dept	• •	10.10			
Other:						c) Water Colur		15.62			
						d) Calc. Purge	Vol. (gal);	25			
					4.4	-					
Well Casing Diameter	Multiply c) by:	T.	Calcu	lating Purge Vol	ume	Rend Deats Of-		<u>, ·</u>			
2	0,18	1				Sand Pack Diameter 8 10	Multiply c) by 0.71				
8	1.47	1				12	1.28	_			
Example 1- purging only						Note: essuming sand Example 2- purging 1	well casing and (sand pack volume			
You have 2-inch casing a One Purge Volume# 0.16						You have 2-inch casin	g, 8-inch send pe	ck, and 6-foot water co X 6) = 5.22 gallons well	kuma. er		
					······································						
	Volume	r	Conductivity	MEASUREMEN		<u> </u>			<u>.</u>		
Time	(gallons)	рН	1087, (Temperature (F)	Color	Turbidity	Redox	Dissolved Q ₂	Other		
1540	2,5	5.8	40	3.9	dour	none	421	4 19/1			
1669	150	9.6	79	3.7.	yellow	NUM	108	4.5			
610	17.	5.2	8 0 80	3.6	dir	Ho re	429	4.4~9)	4_ <u></u>		
<u>y</u> ~		- 2 •		<u> </u>	alex	none	939	<u> </u>	<u> </u>		
Total Volume Pu	mod:				Enter Deside		44.4				
	.gou.		NO	<u> </u>	Free Produc Sheen (y/n):		NO	····	-		
Odor:		a Andlan balls	submersible	pump, etc.)					•		
Odor: Purge Method (d	isposable baile	r, tenori dallei	, 44.0110101010								
	Isposable baile		•	umi							
	P	enstal	tic p	ump	·						
Purge Method (d	D disposable bai	enstal	tic p	e pump, etc.)					·····		
Purge Method (d Sample Method (Di disposable bail P	enstal iler, teflon bait Wi Sta	hc p er, submersibt	ump, etc.)	intact atc.)						
Purge Method (d Sample Method (Well Integrity (co	Di disposable bail P ndition of casin	enstal ler, teflon balt W Sta ng, flush mour	t sealing prop	UM (e pump, etc.)) UM (erly, cement seal		~ 1	Ó45				
Purge Method (d Sample Method (Well Integrity (co CAS (v	(disposable bail p ndition of casin h_{3} q p p	enstal iler, teflon bail Wista ng, flush mour rears f	tic p er, submersibl tisealing prop be	ump, etc.)		6'6+0		baller t go furt			
Purge Method (d Sample Method (Well Integrity (co CAS1 v Remarks (well re	(disposable bail p ndition of casin 1.6 4 p p covery, unusua	enstal lier, tefton bail w Sta ng, flush mour ea (s f al conditions/c	t sealing prop	UM (e pump, etc.)) UM (erly, cement seal bro (um	@~		C hu Pas	t go furt this p	ner		
Purge Method (d Sample Method (Well Integrity (co CASI v Remarks (well re WULNIV	(disposable bail ndition of casin Again app covery, unusua gain ar	enstal lier, tefton bail w Sta ng, flush mour ea (s f al conditions/c	t sealing prop	UM (e pump, etc.)) UM (erly, cement seal	@~		C ho Pas an	t go furt this po d was co	ner oint		
Purge Method (d Sample Method (Well Integrity (co CASI v Remarks (well re WULAW NATIV M Duplicate Samp	(disposable bail ndition of casin Agay por covery, unusus good cov ple ID:	enstal lier, tefton bail w Sta ng, flush mour ea (s f al conditions/c	t sealing prop	UM (e pump, etc.)) UM (erly, cement seal bro (um	@~		C ho Pas and In	t go furt this p d was cu bento hi	ner oint vere ite wh		
Purge Method (d Sample Method (Well Integrity (co. CASI v Remarks (well re WULIN	(disposable bail ndition of casin Agay por covery, unusus good cov ple ID:	enstal lier, tefton bail w Sta ng, flush mour ea (s f al conditions/c	t sealing prop	UM (e pump, etc.)) UM (erly, cement seal bro (um	@~		C ho Pas and In	t go furt this po d was co	ner oint vere ite wh		
Purge Method (d Sample Method (Well Integrity (co CASI v Remarks (well re WULAW NATIV M Duplicate Samp	(disposable bail ndition of casin Agay por covery, unusus good cov ple ID:	enstal lier, tefton bail w Sta ng, flush mour ea (s f al conditions/c	t sealing prop	UM (e pump, etc.)) UM (erly, cement seal bro (um	@~		C ho Pas and In	t go furt this p d was cu bento hi	ner oint vere ite wh		
Purge Method (d Sample Method (Well Integrity (co CASI v Remarks (well re WULAW NATIV M Duplicate Samp	(disposable bail ndition of casin Agay por covery, unusus good cov ple ID:	enstal lier, tefton bail w Sta ng, flush mour ea (s f al conditions/c	t sealing prop	UM (e pump, etc.)) UM (erly, cement seal bro (um	@~		C ho Pas and In	t go furt this p d was cu bento hi	ner oint vere ite wh		

Figure A-3

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			GROUNDWA	TER SAMPLE	DATA SHE	ET		_	
Project Number.	4112			Sample Location ((ie. MW1);	-	WW-	-07_	_
Project Name:	Cape Roman	zof 2003		Sample ID (ie. 951	BIA WG003)	: _	CASSIC	<u>5WN07</u>	GW
Client:	AFCEE			Date Sample Colk	ected:	-	83	104	
Sampler:	BT/M	C		Time sampled:			42	30 H	
				ell information			<u> </u>		<u> </u>
····		*	Casing	211				12 02	
Groundwater:	1.42	<	Diameter (in):	2"		a) Well Depth (i b) Water Depth		7 47	
						c) Water Colum	• -	4.0	
Other:			•	, .	<i>.</i>	d) Calc. Purge	Vol. (gal):	2,25	
	* San	npled w	ater in 1	nner tube	<u> </u>				
				ating Purge Volu					
Vell Casing Diameter	Multiply c) by.					Sand Pack Diameter 8	Multiply c) by: 0.71	}	
4	0 16					10	1.28	1	
8	1.47					Note: assuming sand	pack has 29% por	osity 	
Example 1- purging only	y well casing volume					Example 2- purging v You have 2-inch casin	a 8-inch sand pac	k, and 5-tool water col.	
/ou have 2-inch casing a One Purge Volume= 0.10	ind 6-tool water colum 3 X 8 = 0,98 gallons w	ni. Ater	<u>.</u> .			One Purge Volume= (0.16 X 6) + (0.71 ×	(6) = 5.22 gallons wate	r
			FIEL		rrs				
	Volume	[Conductivity			محاله الطير وال	Redox	Dissolved O ₂	Other
Time	(galions)	pН	(mS)	Temperature (F)	Color	Turbidity			
	175		<u> </u>		<u> </u>	<u> </u>			
	1 12								Ļ
	- hike 2	<u> </u>					 	┣───	┞───
							<u> </u>	<u> </u>	<u> </u>
Total Volume Pu	uraed'				Free Produ	ct (y/n):	4		-
Mor	-	N			Sheen (y/n)		<u>N</u>		<u></u>
Purge Method (o	lisposable baik	er, teflon bai	iler, submersible	pump, etc.)					
			ithe Pu						
Sample Method	(disposable ba	ailer, teflon b	ailer, submersib	le pump, etc.)					
	F	zenst	altic f	mp					
Well Integrity /o	1			arty comont sea	l intact, etc.)				
	1 hag	merti.	al ouma	v tvbing	Insite	COUI	1 not	- remov	1C
Remarks (well r	1 1/47	11107 110	s/observations)		<u> </u>				
Remarks (well f	oonaerà, minsi				AINA	SMA	21 -		
1				PIP	Nor	SAMA	UL.		
Duplicate San	nple ID:				-				
Split Sample I	D:				-		=		
	· · · · ·	7		0		Deter	84	04	
Signed:			2	/	=1, 1	Date:			_
	1.00		///	~ / / /	1 1	1	10-11	8-04	
Signed/reviev	<i>F. E</i>	•	1 1/11	un 4.0	Cull	Date:	10-1	0 0	_

A3 GW Sample Data Sheet

Figure A-3

Drojact Number	4110						KA1A/-	02 1	<-12
Project Number:	4112			Sample Location	•		- V V V	02,5	
Project Name:		Cape Romanzof 2003Sample ID (ie. 95BIA WG003):045513 MWo Z GWAFCEEDate Sample Collected:8 3104							
Client:	AFCEE			Date Sample Coll	ected:				_
Sampler:	BT,N			Time sampled:	<u> </u>		12	00	
-				Vell Information					-
Groundwater:	4.0	Ь	Casing Diameter (in):	24		a) Well Depth (it):	12.04	
			-			b) Water Depth	-	4,06	
Other:	. <u></u>		-			c) Water Colum	• •	7,98	
						d) Calc. Purge '	Vol. (gal):	3.8	
	-11		Calcul	isting Purge Volu					
Well Casing Diameter	Multiply c) by: 0.18					Sand Pack Diameter	Multiply c) by		
4	0.85					10	0.71	3	
6	147					12 Note: assuming send	1 28 back has 29% p	Jicaity	
Example 1- purging only You have 2-inch casing an		n				Example 2- purging w	ell casing and s		
One Purge Volume= 0.15								X 6) = 5.22 galons wat	
	· · · · ·		FIELD	MEASUREMEN	T8				
tante .	Volume		Conductivity						T
Time	(gallons)	pH	1	Temperature (F)	Color	Turbidity	Redox	Dissolved O ₂	Other
42357 370	1.5	4.7	50 40	5.B 5.3	BRN	Met to Hi	393	3.5	+
the.	45	4.8	40	5.2	BIN	#:	<u>405</u> 411	3.5	
							<u> </u>		
								ĺ	
Total Volume Pur	ged:	N (1		Free Produc	t (y/n):	NO		
Odor:					Sheen (y/n):		No		_
Purge Method (di	sposable baile	r, lefion bail	er, submersible	pump, etc.)					
Sample Method (disposable bai	ler, teflon ba	ailer, submersible	e pump, etc.)					
Well Integrity (cor									
Stanks ou NT	15 20056		INDING N	ATER ~1	3ª Deep	Next T	* Moi	NUMENT	
Remarks (well rec		•				AS EXT			BIP_
BAILS DRY				WEL				NO SE	ĸ
			ngesc		MILER	- Pel	HAPS	CASING	NOT
Duplicate Samp		\ .	INF.			EHY CON			
Split Sample ID	:	<u></u> N	ONE					•	
	······································	1/20	Yr	<u> </u>		<u> </u>	8.31	04	
Signed:		M	KL	Tu		Date:	8.5		
		11/1		0	/			3-04	-

Figure A-3

	<u></u>		GROUNDWA	TER SAMPLE C	DATA SHE	ET			_			
Project Number:	4112			Sample Location (-	(MW)	-2				
Project Name:	Cape Roman	zof 2003		Sample ID (ie. 951	BIA WG003)		AG		\sim			
Client:	AFCEE	<u></u>		Date Sample Colk	ected:	ر بر	0440	3CMW2	θN			
Sampler:	BTI	<u>ης</u>		Time sampled:		83104 800						
			N	ell information								
	<u>.</u>		Casing			a) Well Depth (f	+)-					
Groundwater:			Diameter (in)			b) Water Depth						
Other:						c) Water Colum						
2016).		<u> </u>				d) Calc. Purge \	/ol. (gal):					
			Calcu	lating Purge Volu	ime	Sand Pack Diameter	Muttiply c) by:	1				
Vell Casing Diameter	Multiply c) by 0.18					8 10	0.71					
4	0.65					12 Note: essuming sand	1.28) natily				
	unit casing volume					Example 2- purging w You have 2-inch casing	ell casing and \$4	nd pack volume				
Example 1- purging only You have 2-inch casing 8 One Purge Volume= 0.16	nd 6-foot water colum	1 171				You have 2-inch casing One Purge Volume= (4), 16 X 6) + (0 71)	(d) = 5.22 gations wate	n			
		, <u> </u>		D MEASUREMEN								
	Volume	T	Conductivity	DINEABORENE					Other			
Time	(gallons)	рН	(mS)	Temperature (F)	Color	Turbidity	Redox	Dissolved O2	Other			
······································		ļ	ļ	 	┨────							
		<u> </u>	<u> </u>		<u> </u>							
								ļ				
	-								<u> </u>			
Total Volume Pu					Free Produ	ict (y/n):			_			
Oder					Sheen (y/n):						
Purge Method (c	lisposable bail	ier, teflon bai	ler, submersible	epump, etc.)								
		Did		Nrgl								
Sample Method	(disposable ba	ailer, toton b	ailer, submersit	ble pump, etc.)								
Well Integrity (c	ondition of cas	ing, flush mo	ount sealing pro	perty, cement sea	l intact, etc.)							
Remarks (well r	ecovery, unus	ual condition	s/observations)	:								
Duplicate San	nole ID [.]	A .	ONC									
Split Sample	D:	N										
							alit	A.				
Signed:	1	15	2 - 1	7	411	Date:	<u>9/1/3</u>	21				
	-00			un 4.C.1	M	Date:	10-1	8-04				
Signed/review	ver:											
olgriourierier			T									

A3 GW Sample Data Sheet

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Figure A-6 Surface Soil Sample Sheet

Sample ID <u>\$3</u> 0495131B0355 Site <u>5513</u> Location <u>Cape Roman zuf</u>	Date <u>69</u> <u>4</u> Time <u>1043</u> Sampler <u>MJC</u> QA/QC Sample Associated QA/QC Sample Split Duplicate
Sample Depth Total Depth	surface 2ª
Image: Clay	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$
ation Diagram/Notes	1.B-03 5 juis J.p. mw-01
DRU/ERO/PAH/BIEX	stram

Figure A-6 Surface Soil Sample Sheet

Sample ID- <u>F5 04 SS13LBU 755</u> Site <u>SS13</u> Location <u>Cape Romana</u> t	Date 6/1/67 Time /037 Sampler <u>MJC</u> QA/QC Sample Associated QA/QC Sample Split Duplicate
Sample Depth Total Depth	suctau 2ª
Image: Clay	Color <u>Dave Brown</u> Odor <u>No</u> Sheen <u>No</u> Debris <u>Organico</u> Other
Location Diagram/Notes	4807 (D-MW-0)
	poro

A6 Surface Soil Sample Sheet

Figure A-6 Surface Soil Sample Sheet

Sample ID <u>045513 LB 08 55</u> Site <u>5513 - LB 08</u> Location <u>Cupe Romanzed</u>	Sampler <u>MTC</u> QA/QC Sample Associated QA/QC Sample Split Duplicate
Sample Dep Total Depth	th <u>Surface</u>
_	· AND I" below surtacy · LB-05 J 201 AMW-01
	Pori

A5 Surface Soll Sample Sheet

Figure A-5 **Sediment** Sample Sheet

	Sample ID <u>5513 04551355</u> Site <u>55 (3 550)</u> ocation <u>Cape Roma</u>	·	Date(e) 9 e4 Til Sampler QA/QC Sample LATE Associated QA/C Split Duplicate	
	□ Marine □ L □ Brackish □ F □ Freshwater X Stream	.ake/Pond (LK) River (RV) m/Creek (SP) □	Total Depth	<u>~6" unde</u> r weft <u>~gu</u> □ Other
XNDDX	Clay Silt Sand Gravel Organic <u>~ 3.7,</u>		-	
	n Diagram/Notes			- Anni-ol
TN	-		55:01 2	oi Pond

A5 Sediment Sample Sheet

Figure A-5 Sediment Sample Sheet

Date 6 9 04 Time 1050 Site <u>5513</u> 55-06 Sampler BT Location Cape Romanzot DE QA/QC Sample MS/MSD LXNA Sample volume printed □ Associated QA/QC Sample Split Duplicate Marine Lake/Pond (LK) Sample Depth ~ 1" under wat Total Depth _____ total D Brackish River (RV) K Stream/Creek (SP) D Seep/Spring (SE) Freshwater Other D Color Dark to Light Brown 🕅 Clay _____ Odor No Silt Sheen <u>Na</u> Sand Debris _____ Gravel 🕺 Organic 2011. Other Location Diagram/Notes ĺλ \$ MW-01 55-06 160' Pono

A5 Sediment Sample Sheet

Figure A-4 Surface Water Sample Sheet

Sample ID <u>045513500 SW</u> Site <u>5513, 5W01</u> Location <u>Cape Romanzof</u>	Date <u>6/9/04</u> Time <u>1545</u> Sampler <u>BT/MC</u> Add H mal Sample provided Add H mal Sample provided X Associated QA/QC Sample Split Duplicate <u>0455/35W1015</u> W
□ Marine □ Lake/Pond (LK) □ Brackish □ River (RV) ☑ Freshwater ☑ Stream/Creek (SP) □ Seep/Spring (SE) □ Other □ Emergent Vegetation □	Sample Depth Total Depth Velocity (ft./Sec.) Flow Direction
Temperature °C 107.7 pH 7.5 Conductance (mS) 10.0 mS Dissolved O_2 11.09	Color <u>Clast</u> Odor <u>No</u> Sheen <u>No</u> Debris <u>No</u> Turbidity <u>Clast</u>
Location Diagram/Notes	<i>.</i>
See. figure	. SW-03

A4 Surface Water Sample Sheet

Figure A-4 Surface Water Sample Sheet

Sample ID <u>8455135W025W</u> Site <u>55/3 SW 82</u> Location <u>Roman zof</u>	Date <u>6 1 64</u> Time <u>530</u> Sampler <u>BT/MC</u> QA/QC Sample Associated QA/QC Sample Split Duplicate
Image: Marine Image: Lake/Pond (LK) Image: Brackish Image: River (RV) Image: Freshwater Image: Stream/Creek (SP) Image: Seep/Spring (SE) Image: Other Image: Emergent Vegetation Image: Stream (Stream (Stream (SP))	Total Depth
Temperature °C 1.9 pH 1.07 Conductance (mS) [0 Dissolved O2 [1.35]	X Color Clear Odor NON Sheen NONC Debris Nonc Turbidity Clear
ocation Diagram/Notes	
see hour	5W)-03

A4 Surface Water Sample Sheet

Figure A-4 Surface Water Sample Sheet

Sample ID 0465136W035W	Date 6 9 09 Time 1500
Site5513SW-03	Sampler61
Location Romanzof	QA/QC Sample
	Associated QA/QC Sample Split Duplicate
	Sample Depth
□ Marine □ Lake/Pond (LK)	
□ Brackish □ River (RV)	
Freshwater X Stream/Creek (SP)	
Seep/Spring (SE) Other	Flow Direction
Emergent Vegetation	
Temperature °C K. 6.8.	Color CLAR
pH1.97	Odor <u>No</u>
Conductance (mS)	🗆 Sheen <u>Nø</u>
	Debris Nonk
Dissolved O2 11.31 mg/L	Turbidity VCRY Little.
2	
ik i	
Location Diagram/Notes	h
	€MW-02
Appropri	BIE PORd
	SW-03 ph 1 The second s

A4 Surface Water Sample Sheet

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Figure A-3

	`		GROUNDWA	TER SAMPLE	DATA SHE	ET				
Project Number:	4112	<u>_</u>		Sample Location	(ie. MW1):		MW-	01	-	
Project Name:	Cape Romanzof 2003			Sample ID (ie. 9	5BIA WG003					
Client:	AFCEE			Date Sample Collected:		6/22/04				
Sampler: C.W	lang, M. Camahan			- Time sampled:		2000				
	修法建造物	的建筑和		Vell Information	R EAR		ang dise that	的学校校委	- 朝鮮病	
Groundwater:		1	Casing	2"			a	01.1	2 2	
Giounuwater.	X	·~	Diameter (in):			a) Well Depth (b) Water Depth		2.	<u>-</u>	
Other:						c) Water Column (ft):		3.3		
		· · ·			•	•	Calc. Purge Vol. (gal);		0.5	
								=.		
			Calcu	lating Furge Vol	ume	1			We and	
Well Casing Diameter 2	Multiply c) by: 0.18					Sand Pack Diameter 8	Multiply c) by 0.71	ł		
4	0.65					10	1.28	· ·		
Example 1- purging only	well casing volum			•		Note: assuming send Example 2- purging v	•	•	×	
You have 2-inch casing an One Purge Volume= 0.18	nd 6-foot water colum	м.				You have 2-inch casin	g, 8-Inch sand pac	ind pack volume k, and 6-foot water coh (6) = 5.22 gallons wate		
	× 0 = 0.00 galoris in	· · · · · · · · · · · · · · · · · · ·				One Fulge volume= ((0) = 5.22 galoris wall		
				DIMEASUREMEN	TSHAR		和新聞祭			
Time	Volume (gallons)	рH	Conductivity (mS)	Temperature (F)	-' Color	Turbidity	Redox	Dissolved O ₂	Other	
1945	0.5	5.8	60	2.8	rust	NONE	356	3.56	40	
1950	0,5	5.70	60	2.6	rust	NONE	405	4.0	30	
1955	1.5	5.52	60	2.9	nist	NONE	405	4.0	30	
					l	<u> </u>		<u> </u>		
Total Volume Pur					Free Produ	ct (y/n):	N		-	
Odor: FUEL		toflog holi			Sheen (y/n)	: VER	Y 1-171	LE		
Purge Method (di		a, tenon oatt	si, submersiole	pump, etc.)						
Sample Method (disposable bai	iler, teflon ba	iler, submersib	le pump, etc.)	•					
Well Integrity (cor	dition of casir	ig, flush mou	int sealing prop	erly, cement seal	intact, etc.)	· · · · · ·	* ••			
GODE	, MONU	MENT	GGNIF	KANTLY.	High	THANK	AL_C	ARING		
Remarks (well red										
	-		- ,					1		
ADDED A	-		•					<u>`</u> 0		
Duplicate Samp					-					
Split Sample ID	:				-					
Signed:		mt;				Date:	4/22	104		
O /		; 0			-	D (1	<u>_</u>	1	-	
Signed/reviewe	r: \	<i>.</i>				Date:				

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Figure A-3

	<u></u>	(GROUNDWA	TER SAMPLE	DATA SHE	ET			
Project Number:	4112			Sample Location	(ie. MW1):			WW-0	
Project Name:	Cape Roman	zof 2003		Sample ID (ie. 95	BIA WG003)	:	DASSI	5WW020	3W
Client:	AFCEE			Date Sample Col	lected:		6/8	1/09	
Sampler:	BAT, C	172		Time sampled:	-		184	0	
		14 A. A. B.		ell'information-					
Groundwater:	63.3	36	Casing Diameter (in):			a) Well Depth b) Water Dept	• •	69.15	
Other:	<u>smells</u>			ſ		c) Water Colu d) Calc. Purge		5.79 3.76	/well co
	USC Pro	duct/wo	iter inki	face - No 1	<u>o vavat</u>	defected		~IL GAL	porqu.
		感過這個	Calci	ating Rurge Vol	Unio assist		Multiply c) by:		
Well Casing Diameter	Multiply c) by:					Sand Pack Diamete	0.71	4	
	0.65		,			12 Note: assuming sar	1.28	j psitv	
Example 1- purging only You have 2-inch casing a One Purge Volume= 0.16	nd 6-foot water colum	n				Example 2- purging You have 2-inch case	y well casing and s ing, 8-inch sand par	and pack volume k, and 6-foot water colu (6) = 5.22 gallons wate	ımın. r
				MEASUREME					
	Volume		Conductivity	1	1			Disasturd	IPS
Time	(gallons)	рН	(mS)	Temperature (F)		Turbidity	Redox	Dissolved O2	Cure of
1300	7.2	Ba	led Dry	- 1-tad 5	hear so Brown	$d_n d_n \pi$	A take	Teb mec	80
1531		+2-	- ATU	(12 QU	TROPIN	Viikh			
<u></u> <u>_</u> _								<u> </u>	<u> </u> d
				<u> </u>	<u> </u>	<u> </u>			
Total Volume Pu	rged:	e,	2.5 gallo	n5	Free Produc		No		-
Odor: Mills	5	- Ann hait	<u>3.0</u>	oump etc.)	Sheen (y/n)	<u>: yes</u>			
Purge Method d		ar, tenon ball	er, submersible	, houth' ere'					
		The ballon by	iles submorsib	la nump atc.)					
Sample Method	(disposable ba		aller, submersic	ie ponip, ew.)					
			- to	adu comont con	(intact etc.)				
Well Integrity (co	Indition of Casil	ng, tiush moi	unt sealing prop	eny, cement sea					
MI	ISSING 1	OCK				<u> </u>		<u> </u>	
Remarks (well re	covery, unusu	ial conditions	s/observations):	a wker	n of v	Nell	۱۸.		
well ourse	ad dry	\$3	Ret-SHIN	present. p	unneter	5 fm	al N	e	
Duplicate Sam	ipie ID:		neen	1	_		- ·		
Split Sample II):	<u> </u>		, 	-				
· · · · · · · · · · · · · · · · · · ·		~				Deter	68/0	sch	
	L	2.0	$ \rightarrow $	<u> </u>		Date:			-
Signed:		19	$\langle \cdot, \cdot \rangle$	<u> </u>		Date:	6/8/	04	
-	er: /								
Signed: Signed/review	er:	1							
-		1 not	mias	ire Dn	Ø.	this in	rell		
-	Día	d not	Masi	ire DO	e	this w	reU	unt.	
-	Día	d not 15 sh beha	reen ce	ire DO	e esferc	this w w/ w	reU Istrumi	int	

A3 GW Sample Data Sheet

Figure A-3

			GROUNDWA	TER SAMPLE	DATA SHE	ET		_	
Project Number:	4112			Sample Location	(ie. MW1):		MW-	-02,5	5-13
Project Name:	Cape Roman	1zof 2003		Sample ID (ie. 95	BIA WG003)	:	0455	13 MWOZ	Gw
Client	AFCEE			Date Sample Coll	ected:		83	1104	_
Sampler:	BTIN	1C		Time sampled:			12	00	-
	at the state		6. († 19. j	ell Information	ملق من التو مقاولين		12:00-0-1	at Block Star	- Contra Sur
<u>**</u> **	4.0		Casing	2 ⁴					
Groundwater:	<u> </u>		Diameter (in):	· · ·		a) Well Depth (b) Water Depth	•	12.04	
Other:						c) Water Deput	• •	7,98	
	- 		•			d) Calc. Purge		3.8	
	<u>. </u>	<u></u> -							
時間のない			Calcul	ating Purge Volt	ine -	的目的目的		(马黎省世生)	
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A3 GW Sample Data Sheet

Figure A-3

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						 b) Water Depth c) Water Column 		- <u>+.42</u>	
Other:			-			d) Calc. Purge		2.25	
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Figure A-3

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A3 GW Sample Data Sheet

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





Appendix D – Quality Assurance Review 2004 Monitored Natural Attenuation

Cape Romanzof LRRS

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 spike 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



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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 reanalysis 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:

% completeness = <u>number of valid (i.e., non-R flagged) results</u> 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.

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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.
В	The analyte was found in an associated blank, as well as in the sample.
М	A matrix effect was present.
S	To be applied to all field screening data.
Т	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

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(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 (C19H32) 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.

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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.



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• 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.

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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.



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- 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.

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- 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.



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• 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.

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• 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 (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 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 (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.

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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.



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- 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

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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.

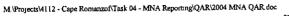
- Method blanks were analyzed at the appropriate frequency to assess for potential PAH contamination. The PAH compound naphthalene was detected in the method blank at a concentration greater than the method detection limit, but less than the reporting limit. As a result sample concentrations within five 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.



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- 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





		Location	MW-01		CMW-01		CMW-02		CMW-03		CMW-04	
		Sample Type	z		z		z		z		z	
		Client Sample ID (Matrix	04LF03MW01GW WG	04LF	04LF03CMW1GW WG	04LF0:	04LF03CMW02GW WG	0411	04LF03CMW3GW WG	04LFC	04LF03CMW04GW WG	
		Laboratory Report #	1043358		1043725		1045677		1043725		1043353	
Analyte	Method	Units										
Diesel Range Organics	AK102	MG/L	0 0713 1	0 0713 F VI,VM	Q	MV [E 0]	0 226	0 226 F VM,VJ	ND C	MV [525.0 UN	0.355 V	0.355 VB,VI,VM
Benzene	SW8021B	NGA	Ð	[0 5]	Ð	[0.5]	Ð	[0.5]	0 156	íL.	0 393	ί τ. ,
Ethylbenzene	SW8021B	NGA	QN	[2]	Ð	[2]	Ð	[2]	QN	[2]	QN	[2]
Toluene	SW8021B	NGA	QN	[2]	Q	[2]	QN	[2]	QN	[2]	Ð	[2]
m.p-Xylene (Sum of Isomers)	() SW8021B	UG/L	QN	[2]	QN	[2]	QN	[2]	DN	[2]	0 935	F VB
o-Xylene	SW8021B	NGL	QN	[2]	Q	[2]	QN	[2]	QN	[2]	1.12	ц
PCB-1016 (Arodor 1016)	SW8082	NGA	QN	[0 102]	QN	[1 0]	QN	[0.111]	Ð	[0 108]	QN	[0.102]
PCB-1221 (Arodor 1221)	SW8082	NGA	Ð	[0 102]	QN	[0.1]	QN	[0.111]	QN	[0.108]	QN	[0 102]
PCB-1232 (Arodor 1232)	SW8082	NG/L	QN	[0 102]	Ð	[0.1]	QN	[0.111]	QN	[0.108]	QN	[0 102]
PCB-1242 (Arocior 1242)	SW8082	UGA	Ð	[0 102]	Ð	[0.1]	QN	[111.0]	QN	[0.108]	Ð	[0 1 02]
PCB-1248 (Arodor 1248)	SW8082	NGL	Q	[0 102]	Ð	[0.1]	QN	[0.111]	Q	[0.108]	Q	[0 102]
PCB-1254 (Aradiar 1254)	SW8082	NGA	Ð	[0 102]	Q	[0.1]	QN	[111 0]	QN	[0.108]	QN	[0 102]
PCB-1260 (Arocior 1260)	SW8082	NGA	QN	[0.102]	QN	[0.1]	QN	[111 0]	QN	[0.108]	QN	[0 102]
Acenaphthene	BNASIM	UGA	QN	[0 05]	Q	[0 051]	QN	[0.2]	QN	[0 0526]	0.0882	
Acenaphthylene	BNASIM	NG/L	Q	[0.05]	QN	[0 051]	Ð	[0 2]	Ð	[0.0526]	QN	[0 05]
Anthracene	BNASIM	NGA	QN	[0.05]	Ð	[0.051]	QN	[0.2]	Q	[0.0526]	QN	[0 05]
Benzo(a)anthracene	BNASIM	NGA	QN	[0.05]	Ð	[0 051]	QN	[0 2]	QN	[0.0526]	Ð	[0 05]
Benzo(a)pyrene	BNASIM	NGA	QN	[0.05]	ŊŊ	[0 051]	QN	[0 2]	Ð	[0 0526]	QN	[0 05]
Benzo(b)fluoranthene	BNASIM	NG/L	QN	[0.05]	Q	[0 051]	QN	[0 2]	QN	[0.0526]	QN	[0.05]
Benzo(g,h,i)perylene	BNASIM	NGA	QN	[o 02]	Q	[0 051]	QN	[0.2]	Q	[0 0526]	Q	[0 05]
Benzo(k)fluoranthene	BNASIM	NGA	QN	[0.05]	Q	[0.051]	QN	[0 2]	QN	[0 0526]	Q	[0 05]
Chrysene	BNASIM	NGAL	QN	[0 05]	Q	[0 051]	QN	[0.2]	QN	[0.0526]	Q	[0:05]
Dibenzo(a,h)anthracene	BNASIM	NGA	QN	[0 05]	Q	[0 051]	UN	[0.2]	QN	[0 0526]	Q	[0.05]
Fluoranthene	BNASIM	ner	Q	[0.1]	QZ	[0 102]	QN	[0.4]	QN	[0.105]	QN	[0]]
Fluorene	BNASIM	NG/L	Ð	[0.05]	QN	[0 051]	QN	[0.2]	QN	[0.0526]	0.42	
Indeno(1,2,3-cd)pyrene	BNASIM	UG/L	QN	[0.05]	Q	[0 051]	QN	[0 2]	QN	[0 0526]	QN	[o o2]
Naphthalene	BNASIM	NG/L	0 03	FVB	0 259		0 0864	F VM	0,0833	VB	1.15	
Phenanthrene	BNASIM	NGA	QN	[1 0]	QN	[0.102]	QN	[0 4]	QN	[0 105]	QN	[0.1]
Pyrene	BNASIM	UGA	QN	[0.05]	Q	[1 50 0]	QN	[0 2]	QN	[0 0526]	QN	[0.05]

Cape Romanzof LF03 Ground Water

		Sample Type	N	041 100	N N		FD PALED3CMANA6CM	UALE		70	TB 041 E03TRSW	12240	TB DASS13TR01GW	
	Le	Cilent Sample to U4LFU3CMYVU3GVV Matrix WG Laboratory Report # 1043353			043353		WG 1043353		WG 1043725	6	WQ 1043358		WQ 1045677	
	Mathod				}									
Anaryue Diesel Range Organics	AK102	MG/L	0.157 VB,VJ,VM	MV,UM	0.0853 VJ,VB,VM	VB.VM	0 184 VJ	0 184 VJ.VB,VM	ND	ND 0.319] VM	•	•	1	
Renzenê	SW8021B	NG/L	0 195	ы	0 24	لئم	0.532		QN	[0 5]	<u>UN</u>	[0.5]	Q	[o 5]
Ethulhenzene	SW8021B	nG/L	QX	[2]	QN	[2]	QN	[2]	QN	[2]	QN	[2]	QN	2
Toluene	SW8021B	ngr	0.543	<u>г</u> н	0 757		1 39	Ŀ	QN	[2]	Ð	[2]	DN	
m.p-Xvlene (Sum of Isomers)		UG/L	0 56	F VB	0 669	F VB	1 47	F VB	QN		0 826	<u>ب</u>	QN	[2]
o-Xylene	SW8021B	NG/L	QN	[2]	0 651	н	0 93	<u>ت</u>	QN	[2]	QN	[2]	Q	-
PCB-1016 (Arocior 1016)	SW8082	NGA	DN	[0.1]	DN	[0.101]	QN	[1 0]	DN	[111 0]	•	•	•	
PCB-1221 (Aroclor 1221)	SW8082	NG/L	QN	[0 1]	<u>UN</u>	[0 101]	QN	[0.1]	QN		•	•	1	
PCB-1232 (Aroclor 1232)	SW8082	NG/L	QN	[0 1]	QN	[0 101]	Ð	[0 1]	QN		•	•	•	
PCB-1242 (Aradiar 1242)	SW8082	NG/L	QN	[1 0]	QN	[0 101]	QN	[1 0]	UN			•	1	
	SW8082	NG/L	QN	[I 0]	QN	[101 0]	QN	[0.1]	QN		•	•	F	
	SW8082	NG/L	QN	[0 1]	QN	[101 0]	QN	[1 0]	QN		ı	•	I	
PCB-1260 (Aroclor 1260)	SW8082	NG/L	QN	[0.1]	QN	[101 0]	ΩN	[1 0]	QN	[0 111]	•	•	'	
Acenaphthene	BNASIM	UG/L	QN	[0 05]	QN	[0 05]	DN	[0 05]	QN		•	•		
Acenaphthylene	BNASIM	UG/L	QN	[0.05]	Q	[0 05]	QN	[so o]	QN	_	•	•	•	
Anthracene	BNASIM	NG/L	UN	[0 05]	QN	[0.05]	QN	[0 05]	DN	_	ſ	•	'	
Benzo(a)anthracene	BNASIM	NG/L	DN	[0 05]	ND	[0 05]	DN	[0 05]	Q	_	•	•	'	
Benzo(a)pyrene	BNASIM	UG/L	QN	[0 05]	QN	[0 05]	DN	[0 05]	QN	-	•	•	•	
Benzo(b)fluoranthene	BNASIM	NG/L	Q	[0.05]	QN	[0 05]	QN	[0 05]	QN	_	,		'	
Benzo(g,h,i)perylene	BNASIM	NG/L	QN	[0 05]	ΩN	[0 05]	QN	[0 05]	Q	_	,	•	•	
Benzo(k)fluoranthene	BNASIM	NG/L	QN	[0 05]	QN	[0 05]	Q	[0 02]	QN			•	1	
Chrysene	BNASIM	NG/L	QN	[0.05]	QN	[0 02]	QN	[0 05]	QN		•	•		
Dibenzo(a,h)anthracene	BNASIM	NG/L	QN	[0.05]	Ð	[0:05]	QN	[0 05]	DN	_	'	•	•	
Fluoranthene	BNASIM	NG/L	QN	[1 0]	QN	[0 1]	QN	[1 0]	QN		'	•	1	
Fluorene	BNASIM	NG/L	QN	[so o]	QN	[0.05]	QN	[0.05]	QN	_	•	,	•	
Indeno(1,2,3-cd)pyrene	BNASIM	UG/L	QN	[o 05]	QN	[0.05]	QN	[o o5]	DN	0.0	•	,	•	
Naphthalene	BNASIM	ng/L	0 0163	F VB	Q	[0 05]	0 0162	F VB	0 101		•	•	•	
Phenanthrene	BNASIM	NG/L	QN	[1 0]	QN	[1 0]	Q	[1 0]	QN	[6010]	۱	•	•	

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Cape Romanzof LF03 Surface Water

Annuelisher			Location	10-WS		SW-01D		SW-02		SW-03		FIELDQC		FIELDQC	
Matrix Visc Wo 1043333 Visc Wo 1044334 Visc Mode Method Units 0.03383 1 V1/3 0.03383 1 V1/3 1 043334 1 04344 1 04344 1 0444		Sam Client Si	ple Type ample ID 04L9	N 1035W015W	04LF0	PD 13SW101SW	04LFC	N 03SW02SW	04LF0	N N	94	TB F03TBSW	04SS13	TB TB01GW	
Method Units Constrained Distrained Constrained Constraine Constrained Constr		Laboratory	Matrix Report #	WS 1043358		WS 1043358	i	WS 1043353		WS 1043358		WQ 1043358		WQ 1045677	
Swapzile Ucl. ND [03] ND ND ND ND ND ND ND ND ND ND <th></th> <th>Method AK102</th> <th>Units MG/L</th> <th></th> <th>F VJ,VB</th> <th>0.0882</th> <th>F VJ,VB</th> <th></th> <th>F VJ,VB</th> <th>0 117</th> <th>F VJ,VB</th> <th>•</th> <th>,</th> <th>,</th> <th></th>		Method AK102	Units MG/L		F VJ,VB	0.0882	F VJ,VB		F VJ,VB	0 117	F VJ,VB	•	,	,	
Swazzib Ucd. No 23 No No 23		SW8021B		QN	[0 5]	Ð	[0.5]	0 325	ц	£	[0,5]	Q	[0 5]	QN	[0.5]
Sweezis Lot ND Z ND Z <thz< th=""> ND Z ND <thz< th=""></thz<></thz<>		SW8021B	UG/L	DN	[2]	£	[2]	QN	[2]	Ð	5	Q	[2]	Ð	[2]
SW0021B UCI ND [2] 0.891 F ND [2] 0.835 F ND [2] ND ND [2] ND		SW8021B		Ð	[2]	Ð	[2]	0 824	Ľ.	QN	[2]	Ð	[2]	Ð	[3]
SW00213 LGL ND [2] ND ND [2]	(suemo	SW8021B		<u>CN</u>	[2]	Ð	[2]	0 891	Ĺ	Q	[2]	0.826	ц	QN	[2]
SW8082 UGL ND [0.1]	•			QN	[2]	QN	[2]	0.59	íz.,	Q	[2]	QN	[2]	Q	[2]
SW8082 UGL ND [0.1] ND ND <t< td=""><td>16<u>)</u></td><td>SW8082</td><td>NG/L</td><td>QN</td><td>[0.1]</td><td>Ð</td><td>[0,1]</td><td>Q</td><td>[0.103]</td><td>Q</td><td>[11 0]</td><td>I</td><td>ŗ</td><td>•</td><td>·</td></t<>	16 <u>)</u>	SW8082	NG/L	QN	[0.1]	Ð	[0,1]	Q	[0.103]	Q	[11 0]	I	ŗ	•	·
SW8082 UG(L ND [01] ND [013] ND ND [013] ND ND [013] ND [013] ND [013] ND [013] ND [013] ND [013] ND ND [013] ND [013] ND [013] ND ND [013] ND ND <th< td=""><td><u>, </u></td><td>SW8082</td><td>UG/L</td><td>QN</td><td>[1 0]</td><td>Q</td><td>[0.1]</td><td>QN</td><td>[0.103]</td><td>Ð</td><td>[0.11]</td><td>I</td><td>,</td><td>1</td><td>ı</td></th<>	<u>, </u>	SW8082	UG/L	QN	[1 0]	Q	[0.1]	QN	[0.103]	Ð	[0.11]	I	,	1	ı
SW8082 UG(ND [0.1] ND	2	SW8082	UG/L	Ð	[10]	Q	[1 0]	CIN	[0.103]	QN	[110]	ı	,	•	ı
SW8082 UG/L ND [0.1] ND [0.1] ND [0.13] ND [0.13] ND [103] ND ND ND ND ND [103] ND ND [103] ND ND [103] ND	2	SW8082	UG/L	QN	[0.1]	QN	[1 0]	Ð	[0.103]	Q	[1110]	•	•	•	•
SW0082 UGL ND [0.1] ND [0.1] ND [0.103] ND ND [0.103] ND ND [0.103] ND ND [0.103] ND <	8	SW8082	NG/L	Q	[0.1]	QN	[0.1]	QN	[0.103]	Ð	[11.0]		,	•	ı
(b) SW8082 UG/L ND [0.1] 797 ND BNASIM UG/L ND [0.0] ND [0.1] 797 ND BNASIM UG/L ND [0.03] ND [0.03] ND [0.05] ND BNASIM UG/L ND [0.03] ND [0.05] ND [0.05] ND BNASIM UG/L ND [0.03] ND [0.03] ND [0.03] ND BNASIM UG/L ND [0.03] ND [0.03] ND [0.03] ND BNASIM UG/L ND [0.03] ND [0.03] ND [0.03] ND BNASIM UG/L ND [0.03] ND [0.03] ND [0.03] ND BNASIM UG/L ND [0.03] ND [0.03] ND [0.03] ND BNASIM UG/L ND [0.03] ND [0.03] ND	4	SW8082	UG/L	QN	[0.1]	QN	[0.1]	QN	[0.103]	Ð	[0.11]	,	,	•	ı
BNASIM UGL ND [005] ND ND [005] ND ND [005] ND	ío	SW8082	NG/L	QN	[1 0]	Ð	[0.1]	7 9 7		Q	[11 0]	ı	ı	•	•
BNASIM UG/L ND [0.05] ND [005] ND ND ND [005] ND ND		BNASIM	UG/L	Ð	[0 05]	Ð	[0 05]	QN	[c0 0]	Q	[0.05]	ı	•		,
BNASIM UG/L ND [0.05] ND ND [0.05] ND ND [0.05] ND [0.05] ND ND [0.05] ND [0.05] ND [0.05] ND [0.05] ND ND [0.05] ND [0.05] ND ND [0.05] ND ND <td></td> <td>BNASIM</td> <td>UG/L</td> <td>Ð</td> <td>[0.05]</td> <td>Ð</td> <td>[so o]</td> <td>Q</td> <td>[0 02]</td> <td>QZ</td> <td>[0.05]</td> <td>ı</td> <td></td> <td>•</td> <td>ı</td>		BNASIM	UG/L	Ð	[0.05]	Ð	[so o]	Q	[0 02]	QZ	[0.05]	ı		•	ı
UG/L ND [0.05] ND [005] ND ND [005] ND ND [005] ND [005] ND IND [005] ND IND [005] ND IND [005] ND IND IND <t< td=""><td></td><td>BNASIM</td><td>NG/L</td><td>Ð</td><td>[0:05]</td><td>£</td><td>[0.05]</td><td>Q</td><td>[0 05]</td><td>Q</td><td>[0 05]</td><td>,</td><td>ı</td><td>•</td><td>•</td></t<>		BNASIM	NG/L	Ð	[0:05]	£	[0.05]	Q	[0 05]	Q	[0 05]	,	ı	•	•
BNASIM UG/L ND [0.05] ND [005] ND [005] <t< td=""><td></td><td>BNASIM</td><td>UG/L</td><td>£</td><td>[0.05]</td><td>Ð</td><td>[50 0]</td><td>Q</td><td>[0 05]</td><td>QN</td><td>[0 05]</td><td>ł</td><td></td><td>•</td><td>ı</td></t<>		BNASIM	UG/L	£	[0.05]	Ð	[50 0]	Q	[0 05]	QN	[0 05]	ł		•	ı
BNASIM UG/L ND [005] ND [005] <th< td=""><td></td><td>BNASIM</td><td>NG/L</td><td>Ð</td><td>[0.05]</td><td>Ð</td><td>[so o]</td><td>QN</td><td>[0 05]</td><td>Ð</td><td>[0.05]</td><td>,</td><td></td><td>•</td><td>ı</td></th<>		BNASIM	NG/L	Ð	[0.05]	Ð	[so o]	QN	[0 05]	Ð	[0.05]	,		•	ı
BNASIM UG/L ND [0.05] ND [0.01] ND [0.01] ND [0.01] ND [0.01] ND [0.05] ND [0.01] ND [0.05] <		BNASIM	NG/L	£	[co o2]	Q	[0:05]	QN	[0 05]	Ð	[0 05]	,	•	•	
BNASIM UG/L ND [0.05] <		BNASIM	UG/L	QN	[0.05]	Ð	[0:05]	Ð	[0 05]	QN	[0 05]	•	•	•	•
BNASIM UG/L ND [005] ND [005] <th< td=""><td></td><td>BNASIM</td><td>NG/L</td><td>GN</td><td>[0.05]</td><td>Q</td><td>[0:05]</td><td>QN</td><td>[0 05]</td><td>Ð</td><td>[0 05]</td><td>•</td><td>•</td><td>,</td><td>•</td></th<>		BNASIM	NG/L	GN	[0.05]	Q	[0:05]	QN	[0 05]	Ð	[0 05]	•	•	,	•
BNASIM UG/L ND [005] ND [001] ND [003] ND [003] <th< td=""><td></td><td>BNASIM</td><td>UG/L</td><td>DN</td><td>[so o]</td><td>£</td><td>[0 05]</td><td>QN</td><td>[0 05]</td><td>QN</td><td>[0 05]</td><td>1</td><td>,</td><td>,</td><td></td></th<>		BNASIM	UG/L	DN	[so o]	£	[0 05]	QN	[0 05]	QN	[0 05]	1	,	,	
UG/L ND [0.1] ND [0.1] ND [0.1] ND UG/L ND [0.05] ND [005] ND [005] ND UG/L ND [005] ND [005] ND [005] ND UG/L ND [005] ND [005] ND [005] ND UG/L ND [005] 0.0153 F VB ND [005] 0.0154 UG/L ND [001] ND [001] ND [005] ND UG/L ND [005] ND [005] ND [005] ND		BNASIM	UG/L	Ð	[0 05]	Ð	[0 05]	Q	[0 05]	Q	[0 05]	,	,	,	ı
UG/L ND [005] ND [100] ND [10		BNASIM	NG/L	UN	[0.1]	Ð	[[0]	Ð	[0.1]	QN	[0.1]	ı	•	•	ı
UG/L ND [005] ND [005] ND [005] ND [100] ND ND [100] ND<		BNASIM	UG/L	Ð	[0 05]	Q	[0 05]	QN	[0 05]	QN N	[0:05]	ı		•	•
BNASIM UG/L ND [0 05] 0.0153 F VB ND [0 05] 0.0154 1 BNASIM UG/L ND [0 01] ND [0 01] ND [0 05] 0.0154 1 ND [0 05] 0.0154 1 ND [0 1] ND [0 1] ND BMASIM UG/L ND [0 05] ND [0 05] ND ND [0 05] ND		BNASIM	UG/L	<u>ON</u>	[0 05]	Q	[0.05]	Ð	[0 05]	Ð	[0 05]	•	•	•	
UG/L ND [0.1] ND [0.1		BNASIM	UG/L	QN	[0 05]	0.0153	F VB	QN	[o os]	0.0154	F VB	ı		•	ı
UG/L ND [0.05] ND [0.05] ND [0.05] ND		BNASIM	NG/L	QN	[1 0]	Ð	[0.1]	QN	[1 0]	QN	[[0]	,		•	ŀ
		BNASIM	UG/L	Q	[0 05]	Q	[0 05]	QN	[0 05]	Q	[0 05]	·		•	•

		Location	SD-01		SD-02		SD-03		FIELDOC	
	Sar	Sample Type	N		N N				TB DAI E03TE01SD	
	Client	Client Sample ID Matrix	04LF03SD01SD SE	-	U4LFU3SUU2SU SE		U4LFU33DU33D			
	Laborator	tory Report #	1043361		1043361		1043361		1043361	
Anaivte	Method	Units								
Diesel Range Organics	AK102	MG/KG	42.7	<u>ل</u> تا	154		29 6	ц		ı
Benzene	SW8021B	NG/KG	QN	[33 7]	<u>AN</u>	[12 6]	Q	[24]	QN	[12 1]
Ethvlbenzene	SW8021B		Ð	[135]	QN	[50 4]	Q	[1 96]	Ð	[484]
Toluene	SW8021B	UG/KG	QN	[135]	Q	[504]	Ð	[96.1]	QN	[484]
lsomers)	SW8021B	NG/KG	Ð	[135]	QN	[504]	QN	[196]	22 4	ч
o-Xylené	SW8021B	NG/KG	918	ĽL,	38 9	ц	46 9	Ŧ	QN	[484]
PCB-1016 (Arocior 1016)	SW8082	MG/KG	QN	[0.118]	UN	[0 067]	QN	[0 0815]	,	ı
	SW8082	MG/KG	Ð	[0 118]	QN	[0 067]	Q	[0 0815]	1	•
	SW8082	MG/KG	Q	[0 118]	QN	[0 067]	QN	[0 0815]	I	•
	SW8082	MG/KG	QN	[0.118]	QN	[0 067]	Ð	[0 0815]	•	•
	SW8082	MG/KG	DN	[0 118]	QN	[0.067]	Ð	[0 0815]	•	•
	SW8082	MG/KG	QN	[0 118]	Ð	[0 067]	Q	[0 0815]	•	•
	SW8082	MG/KG	QN	[0 118]	153		QN	[0 0815]	•	•
Acenaphthene	BNASIM	NG/KG	QN	[11 8]	QN	[9 76]	QN	[8 14]	•	·
Acenaphthylens	BNASIM	NG/KG	Q	[11 8]	QN	[6 76]	Q	[8.14]		•
Anthracene	BNASIM	NG/KG	QN	[11.8]	QN	[6.76]	QN	[8 14]	ı	,
Benzo(a)anthracene	BNASIM	NG/KG	QN	[11.8]	Q	[6 76]	Q	[8 14]	1	•
Benzo(a)pyrent	BNASIM	UG/KG	QN	[11 8]	Q	[676]	Q	[8 14]	•	•
Benzo(b)fluoranthen.	BNASIM	UG/KG	DN	[11.8]	162		Ð	[8 14]	•	•
Benzo(g,h,i)perylen(BNASIM	NG/KG	DN	[11.8]	Ŷ	μ.,	Ð	[8,14]	•	•
Benzo(k)fluoranthen:	BNASIM	UG/KG	Ð	[11.8]	QN	[6 76]	Q	[8 14]	•	
Chrysene	BNASIM	UG/KG		[11.8] VM		ND [6 76] VM	Ð	ND [8 14] VM	•	•
Dibenzo(a,h)anthracen	BNASIM	UG/KG	QN	[11 8]	QN	[6 76]	Q	[8 14]	•	
Fluoranthene	BNASIM	UG/KG	QN	[11.8]	QN	[6 76]	Q	[8 14]	•	•
Fluorene	BNASIM	NG/KG	Ð	[11 8]	QN	[6 76]	Ð	[8 14]	L	•
Indeno(1,2,3-cd)pyrent	BNASIM	UG/KG	QN	[811]	QN	[6.76]	Ð	[8,14]	•	•
Naphthalene	BNASIM	UG/KG	QN	[11.8]	QN	[6,76]	Q	[8,14]	•	•
Phenanthrene	BNASIM	UG/KG	QN	[11 8]	QN	[6 76]	Ð	[8 14]	•	ı
Pyrene	BNASIM	NG/KG	CN	[11.8]	3 19	Ľч,	Ð	[8 14]		ı

Cape Romanzof SS13 and SS15 Groundwater

		Client Samule ID 04SS1	04SS13MW01GW	045	04SS13MW02GW	04SS	04SS15WW02GW	045	04SS15WW08GW		04SS15EBGW
		Location	MW-01	•	MW02	1	WW-02		WW08		EB
		Sample Type	z		z		z		z		z
		Matrix	MG		MG		MG		MG		MG
		Laboratory Report #	1043659		1045677		1043252		1045677		1045677
	Method	Units									
Gasoline Range Organice	AK101	NGA		ı	23.9	F VB	8380		21.2	F VB	102
Diesel Range Organicc	AK102	MG/L	0.175	ц	0.142	F VB	387	٢٧	0.315	F VB	0 187
Residual Range Organice	AK103	MG/L	0.393	ц	0.106	<u>ن</u> ي	Ð	[26.3]	0 223	íL,	0 0771
	SW8021B	NG/L	Ð	[0 5]	Ð	[0 5]	311		Ð	[0.5]	7 42
	SW8021B	NGA	QN	[2]	QN	[2]	39.2		QN N	[2]	272
Ethylbenzene	SW8021B	NGA	QN	[2]	QN	[2]	63		QN	[2]	1 96
m,p-Xylene (Sum of Isomers	SW8021B		Q	[2]	QN	[2]	406		QN	[2]	7 12
	SW8021B	NGAL	QN	[2]	QN	[2]	51.1		QN	[2]	2 55
Alkalinity, Tota	A2320	MG/L	30		40		141		22		
	E300	MG/L	1 49		2 91	ŝ	34.1		4 04	٢٧	,
Nitrogen, Nitrate-Nitrite	E300	MG/L	QN	Ξ	QN	Ξ	QN	[1 0]	60	ц	ı
	SW6010B	MG/L	QN	[0 2]	,	ı	7 61		'	ı	,
	SW6020	NG/L	•	•	CN N	[0001]	•	•	QN	[1000]	I
Acenaphthene	BNASIM	NG/L	Q	[0 02]	Ð	[0 02]	24 6		QN	[0 0562]	Q
Acenaphthylene	BNASIM	NG/L	QN	[0.05]	QN	[0 05]	Ð	[2]	Q	[0 0562]	QN
	BNASIM	NGA	QN	[30 0]	Q	[0 05]	117		QN	[0 0562]	Q
Benzo(a)anthracent	BNASIM	NGA	Ð	[0 05]	QN	[0 05]	0 631		QN	[0 0562]	Q
Benzo(a)pyrent	BNASIM	NGA	QN	[0 05]	QN	[0 05]	0 434		Q	[0 0562]	Q
Benzo(b)fluoranthens	BNASIM	NGL	UN	[0.05]	Q	[0 05]	0 438		CN N	[0 0562]	Q
Benzo(g,h,i)perylen:	BNASIM	NG/L	UN	[0.05]	Q	[0:05]	0 278		QN	[0 0562]	QN
Benzo(k)fluoranthen.	BNASIM	NGL	<u>ON</u>	[0 05]	Q	[0:05]	0 406		Q	[0.0562]	Ð
	BNASIM	NG/L	<u>GN</u>	[0 05]	Ð	[20:05]	0 866		Q.	[0 0562]	Ð
Dibenzo(a,h)anthracent	BNASIM	NGL	QN	[0 02]	QN	[0 05]	0.0756		QN	[0 0562]	Q
Fluoranthene	BNASIM	NG/L	DN	[0.1]	QN	[0.1]	2 46		QN	[0 112]	QN
	BNASIM	NG/L	QN	[0.05]	QN	[0.05]	49 6		Ð	[0 0562]	Ð
Indeno(1,2,3-cd)pyren	BNASIM	NG/L	QN	[0:05]	QN	[0.05]	0 213		QN	[0.0562]	Ð
Naphthalene	BNASIM	NG/L	0 0706		QN	[0.05]	967		0.0509	ц	0384
Phenanthrene	BNASIM	NG/L	QN	[0.1]	QN	[0.1]	18 2		Q	[0 112]	Ð
	BNASIM	NG/L	Q	[0.05]	Ð	- [0.05]	3.02		QN	[0 0562]	Ð

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Cape Romanzof SS13 and SS15 Groundwater

		Client sample IU	40	0400101001000	2	M901010040			
		Location		FIELDQC		FIELDQC		FIELDOC	
		Sample Type Matrix		AD WQ		at v		at av	
	Le	Laboratory Report #		1045677		1043659		1043252	
Analyte	Method	Units							
Gasoline Range Organics	AK101	NGAL		QN	[06]	,		13.9	ц
Diesel Range Organics	AK102	MG/L	F VB			ı	•	ł	•
Residual Range Organics	AK103	MG/L	Γ	•	•	ı	•	ı	1
Benzené	SW8021B	UG/L		QN	[0 5]	QN	[0.5]	Ð	[0 5]
Toluene	SW8021B	NG/L		QN	[2]	QN	[2]	QN	[2]
Ethylbenzene	SW8021B	NG/L	í.	QN	[2]	QN	[2]	QN	[2]
m.p-Xylene (Sum of Isomers	SW8021B	UG/L		QN	[2]	QN	[2]	QN	[2]
o-Xylen¢	SW8021B	NG/L		QN	[2]	QN	[2]	Ð	[2]
Alkalinity. Tota	A2320	MG/L	ı	1	ı	ı	ł	ı	•
Sulfate	E300	MG/L	•		•	•	ı		•
Nitrogen, Nitrate-Nitrite	E300	MG/L	•	I	ı	•	·	I	•
Iron	SW6010B	MG/I	r	ı	,		,		
Iron	SW6020	NG/L	ı	ı	·		ı	1	-
Acenaphthene	BNASIM	UG/L	[0 0568]	I		•	ı		
Acenaphthylen	BNASIM	NGA	[0 0568]		,		•		-
Anthracene	BNASIM	NG/L	[0.0568]	٩	ı	I			
Benzo(a)anthracene	BNASIM	NG/L	[0 0568]	·	•	ı	•	•	·
Benzo(a)pyren.	BNASIM	NG/L	[0 0568]	•		•	ł	•	
Benzo(b)fluoranthen€	BNASIM	NG/L	[0 0568]	•	•	•	•	•	
Benzo(g,h,i)perylen(BNASIM	NG/L	[0 0568]	•	•	•	I	•	·
Benzo(k)fluoranthen.	BNASIM	NG/L	[0.0568]	•	,	ı	ı	•	•
Chrysene	BNASIM	NG/L	[0.0568]	,	,	•	•	•	•
Dibenzo(a,h)anthracen	BNASIM	NG/L	[0 0568]		,	1	•	•	•
Fluoranthene	BNASIM	NG/L	[0 114]		•	I	•	•	•
Fluorene	BNASIM	NG/L	[0 0568]	•	ı	•	,	L	,
Indeno(1,2,3-cd)pyrent	BNASIM	NG/L	[0.0568]	•	ı	•	•	•	-
Naphthalene	BNASIM	NG/L		ı	r	I	ı	ı	•
Phenanthren€	BNASIM	NG/L	[0.114]	•	•	ı	1		

Cape Romanzof SS13 and SS15 Surface Soil and Sediment

	Client	Client Sample ID	04SS13LB03SS	04551	04SS13LB07SS	04S	04SS13LB08SS	OFS	04SS13SS01SD	04	04SS13SS06SD	04S	04SS13SS101SD	ð	04SS13TBSS	
	Sai	Sample Type	z		z		z		z		z		Ð		TB	
	Laborator	Laboratory Report #	1043258		1043258		1043258		1043258		1043258		1043258		1043258	
		Matrix	SO		S		S		3		ŝ		SE		ß	
Analyte	Method	Units														
Diesel Range Organics	AK102	MG/KG	411		4390	[7	48500	Ŋ	866	٢٧	1680		1290		'	•
Residual Range Organics	AK103	MG/KG	1140		5160	٢J	51600	[V	1060	VJ,VM	743		834	-	•	•
Benzene	œ	UGKG	QN	[57.4]	QN	[37 1]	Ð	[45.7]	Q	[16 5]	QN	_	Q		QN	[12.5]
Toluene	8	NGKG	QN	[230]	QN	[149]	QN	[183]	QN	[63.9]	QN	_	QN N		Q	[50.2]
Ethylbenzene	80	UG/KG	QN	[230]	Q	[149]	£	[183]	Ð	[62.9]	QN	_	<u>a</u>	[77.8]	Ð	[50 2]
o-Xylene	80	NG/KG	QN	[230]	Ð	[149]	Ð	[183]	21.4	щ	QN	[54.5]	83.7		Ð	[50 2]
Isomers)	8	NG/KG	Q	[230]	Q	[149]	QN	[183]	35.5	F VB	QN	_	615		Ð	[20 Z]
Acenaphthene	BNASIM	UG/KG	QN	[56 7]	Q	[38 6]	QN	[434]	QN	[35.9]	QN	_	Ð	[37 2]	ı	•
Acenaphthylene	BNASIM	NG/KG	Ð	[56 7]	Ð	[38 6]	Ð	[434]	QN	[35.9]	QN	_	UN		•	•
Anthracene	BNASIM	NGKG	QN	[56 7]	£	[38 6]	Ð	[434]	Q	[35 9]	<u>UN</u>	-	QN		ł	ı
Benzo(a)anthracene	BNASIM	NG/KG	CIN	[567]	QN	[38 6]	149	<u>с</u> .	Ð	[95 9]	<u>a</u> n		Q		1	ı
Benzo(a)pyrene	BNASIM	NG/KG	QN	[56 7]	QN	[38.6]	Ð	[434]	Ð	[35 9]	<u>a</u> N		QN		•	٠
Benzo(b)fluoranthene	BNASIM	NG/KG	QN	[56.7]	Q	[38.6]	Q	[434]	Q	[35 9]	QN	_	QN		1	ı
Benzo(g,h,i)perylene	BNASIM	NG/KG	Q	[56.7]	Q	[38 6]	an	[434]	Q	[35.9]	đ	_	QN		'	•
Benzo(k)fluoranthene	BNASIM	NG/KG	QN	[56 7]	QN	[38 6]	QN	[434]	QN	[35 9]	QN	_	QN		•	•
Chrysene	BNASIM	D3//ON	Ð	[56 7]	292	5	532		Q	[35 9]	3 72		Q		•	ı
Dibenzo(a,h)anthracene	BNASIM	NG/KG	Q	[56 7]	Ð	[38 6]	Ð	[434]	Q	[35.9]	Q	_	QN		•	•
Fluoranthene	BNASIM	NG/KG	<u>G</u> N	[56 7]	Q	[38.6]	457		Q	[35.9]	Q	_	UN		•	ı
Fluorene	BNASIM	NG/KG	QN	[56 7]	QN	[38 6]	Ð	[434]	32.3	ъ	QN	_	30.6		'	,
Indeno(1,2,3-cd)pyrene	BNASIM	NG/KG	QN	[56.7]	QN	[38.6]	Q	[434]	Q	[35.9]	QN	_	ΩŊ		ı	•
Naphthalene	BNASIM	NG/KG	QN	[56 7]	12 8	ц	Ð	[434]	Q	[35.9]	QN	_	D N		•	ŀ
Phenanthrene	BNASIM	NG/KG	QN	[56 7]	QN	[38 6]	£	[434]	QN	[35.9]	Q.		118		1	•
Pyrene	BNASIM	NGKG	QN	[26 7]	37.6	<u>ن</u> ي	584		QN	[35.9]	4 42		DN		•	•

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Cape Romanzof SS13 and SS15 Surface Water												
	Client	Client Sample ID 04SS13SW01SW	S13SW01SW	045	04SS13SW02SW	04SS1	04SS13SW03SW	04SS	04SS13SW101SW		04SS13TBSW TB	
	l ahorator	Sample Type	N 1043273		1043273		1043273		1043273		1043273	
	randiaro	Matrix	SW .		MS		WS		SW		WQ	
		Location	SW-01		SW-02		SW-03		SW-01D		FIELDQC	l
Analyte	Method	Units										
Diesel Range Organics	AK102	MG/L	0.0637 F	F VB,VM	ц	B,VM	0 0917	0 0917 F VB,VM	0 ON	ND 0 326] VM	١	•
Residual Range Organics	AK103	MG/L	0 0969	F VM		F VM	0 363	F VM	0.0678	F VM	• !	• :
Benzene	E624	NG/L	QN	[04]	QN	[0 4]	Ð	[0.4]	Q	[0 4]	Q !	[0,4]
Toluene	E624	NG/L	Q	Ξ	QN	[1]	QN	[1]	Ê	[1]		Ξ
Ethylbenzene	E624	NG/L	QN	Ξ	QN	[1]	Q	Ξ	8	Ξ	Ð Í	Ξ
o-Xylene	E624	NG/L	Q	[1]	Ð	Ξ	QN	Ξ		Ξ	Q (Ξ
m,p-Xylene (Sum of Isomers	E624	NG/L	QN	[2]	Ð	[2]	Ð	[2]	Q I	5	9 9	[2]
1,2-Dichlorobenzent	E624	NG/L	QN	[1]	QN	Ξ	QN	Ξ	Q I	Ξ	CN !	Ξ
1,3-Dichlorobenzent	E624	UG/L	QN	[1]	QN	Ξ	Q	Ξ	Q I	Ξ	ON S	Ξ
1,4-Dichlorobenzent	E624	NG/L	QN	[0 5]	QN	[0 5]	a	[0.5]	QN	[0 5]	Q !	[c n]
Chlorobenzen	E624	UG/L	Ð	[0.5]	QN	[0 5]	QN	[0 5]	Q	[0 5]	QN	0.5]
Acenaphthene	BNASIM	UG/L	£	[0 05]	Q	[0 05]	Q	[0 0549]	ON !	[0 0556]	•	•
Acenaphthylent	BNASIM	UG/L	Q	[0.05]	Q	[0.05]	Q	[0 0549]	QN .	[0.0556]	•	ı
Anthracene	BNASIM	NG/L	Ð	[0 05]	QN	[0.05]	QN	[0.0549]	QN	[0 0556]	1	ı
Benzo(a)anthracent	BNASIM	NG/L	Ð	[0.05]	QN	[0 05]	Q	[0 0549]	QN :	[0 0556]		ı
Benzo(a)pyrent	BNASIM	UG/L	QN	[0.05]	DN	[0 05]	Q !	[0 0549]	(IN)	[0 0556] [8 2220]	,	ı
Benzo(b)fluoranthene	BNASIM	UG/L	QN	[0 05]	QN	[0 05]	QN 1	[0 0549]	UN 2	[0cc0 0]	•	,
Benzo(g,h,i)perylen:	BNASIM	NG/L	QN	[0.05]		[0 05]	Q 9	[0 0549] [0 0540]		נסככט טן נסככט טן	•	• •
Benzo(k)fluoranthen	BNASIM	UG/L	Ð	[0.05]	Q ;	[cn n]		[0.0540]		forco al		•
Chrysene	BNASIM	UG/L	Q	[0.05]	DN ;	[cn n]	B E	[8400 0]			. 1	
Dibenzo(a,h)anthracent	BNASIM	UG/L	CIN :	[cnːn]	U Å	[cn'n]	Ð Á					ı
Fluoranthene	BNASIM	NG/L	ON	[1 0]	ND	[1.1]	Đ ļ		ð č			
Fluorene	BNASIM	NG/L	Q	[0 05]	Q	[0 05]	a ;		D ([0000.0]	•	
Indeno(1,2,3-cd)pyrene	BNASIM	NG/L	QN	[0.05]	Q	[0 05]		[0 0549]		[ocen n]	1	•
Naphthalene	BNASIM	NG/L	QN	[0.05]	0 115		0 0312		1/10'0	-		•
Phenanthren€	BNASIM	NG/L	Ð	[0.1]	QN	[0 1]	QN		ON !		I	•
Pyrene	BNASIM	UG/L	QN	[0 05]	QN	[0 05]	Ð	[0 0549]	Q	[0 0556]	• !	•
TAH	AN	NG/L	QN		QN		Q		Q		CIN	
TAqH	AN	NG/L	QN		0 115		QN		QN			

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Appendix F

Complete Analytical Data Package

(Electronic Copy Only)

