United States Air Force
611th Air Support Group/
Civil Engineering Squadron

Elmendorf AFB, Alaska

Final

Risk Assessment

Barter Island Radar Installation, Alaska

08 JANUARY 1996

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Barter Island Radar Installation, Alaska

Prepared by:

ICF Technology Incorporated

08 JANUARY 1996

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PREFACE

This report presents the findings of Risk Assessments at sites located at the Barter Island radar installation in northern Alaska. The sites were characterized based on sampling and analyses conducted during Remedial Investigation activities performed during August and September 1993. This report was prepared by ICF Technology Incorporated.

This report was prepared between January 1995 and January 1996. Mr. Samer Karmi of the Air Force Center for Environmental Excellence was the Alaska Restoration Team Chief for this task. Dr. Jerome Madden and Mr. Richard Borsetti of the 611 CES/CEVR were the Remedial Project Managers for the project.

Approved:

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Thomas McKinney
Program Director
ICF Technology Incorporated

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NOTICE

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TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

APPENDICES

LIST OF TABLES

LIST OF TABLES (CONTINUED)

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

ADD	Average Daily Dose
Air Force	United States Air Force
ANWR	Alaska National Wildlife Refuge
API	Americal Petroleum Institute
ARAR	Applicable or Relevant and Appropriate Requirements
ATSDR	Agency for Toxic Substances and Disease Registry
BCF	Bioconcentration Factors
CDI	Chronic Daily Intake
COE	U.S. Army Corps of Engineers
COCs	Chemicals of Concern
DEW	Distant Early Warning
DRPH	Diesel Range Petroleum Hydrocarbons
ECAO	Environmental Criterion Assessment Office of EPA
EPA	U.S. Environmental Protection Agency
ERA	Ecological Risk Assessment
ha	Hectare
HQ	Hazard Quotient
HEAST	Health Effects Assessment Summary Tables
HSDB	Hazardous Substance Data Bank
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
IS	Onsite Dietary Intake
LADD	Lifetime Average Daily Dose
LOAEL	Lowest-Observed Adverse Effect Level
LRRS	Long Range Radar Station
MDEP	Massachusetts Department of Environmental Protection
MOGAS	Motor Vehicle Gasoline
MSL	Mean Sea Level
NOAEL	No Observed Adverse Effect Level
NOEL	No Observed Effect Level
NAS	National Academy of Science

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

PAHs	Polynuclear Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
RBSL	Risk-Based Screening Level
RfD	Reference Dose
RIs	Remedial Investigations
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
SIF	Scaling Factor
SF	Slope Factor
SVOC	Semi-Volatile Organic Compound
TPH	Total Petroleum Hydrocarbon
TRVs	Toxicity Reference Values
VOC	Volatile Organic Compound
UCL	Upper Confidence Limit
UF	Uncertainty factors
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey

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1.0 INTRODUCTION

This document contains the baseline human health risk assessment and the ecological risk assessment (ERA) for the Barter Island Distant Early Warning (DEW) Line radar installation. Fourteen sites at the Barter Island radar installation underwent remedial investigations (RIs) during the summer of 1993. The presence of chemical contamination in the soil, sediments, and surface water at the installation was evaluated and reported in the Barter Island Remedial Investigation/Feasibility Study (RI/FS) (U.S. Air Force 1996). The analytical data reported in the RI/FS form the basis for the human health and ecological risk assessments. The primary chemicals of concern (COCs) at the 14 sites are diesel and gasoline from past spills and/or leaks. The general location of the Barter Island radar installation is shown in Figure 1-1. The 14 sites investigated and the types of samples collected at each site are presented in Table 1-1.

The purpose of the risk assessment is to evaluate the human and ecological health risks that may be associated with chemicals released to the environment at the 14 sites investigated during the RIs. The risk assessment characterizes the probability that measured concentrations of hazardous chemical substances will cause adverse effects in humans or the environment in the absence of remediation. The risk assessment will be used to determine if remediation (site cleanup) is necessary and, if so, to rank sites for remedial action.

1.1 ORGANIZATION OF REPORT

Section 1.0 contains introductory information regarding the installation location and conditions, and a summary outline of the approach to the human health and ecological risk assessments. Section 2.0 is the Baseline Human Health Risk Assessment, and Section 3.0 is the Ecological Risk Assessment. References are presented in Section 4.0. Section 2.0, Baseline Human Health Risk Assessment, is composed of:

- **Selection of Site Contaminants**. Presents the COCs for human health and describes how they were selected for this risk assessment.

- **Exposure Assessment**. Identifies the pathways by which potential human exposures could occur, and estimates the magnitude, frequency, and duration of those exposures.

- **Toxicity Assessment**. Summarizes the toxicity of the selected COCs and the relationship between magnitude of exposure and the development of adverse health effects.

- **Risk Characterization**. Integrates the toxicity and exposure assessments to estimate the potential risks to human health from exposure to chemicals in environmental media.

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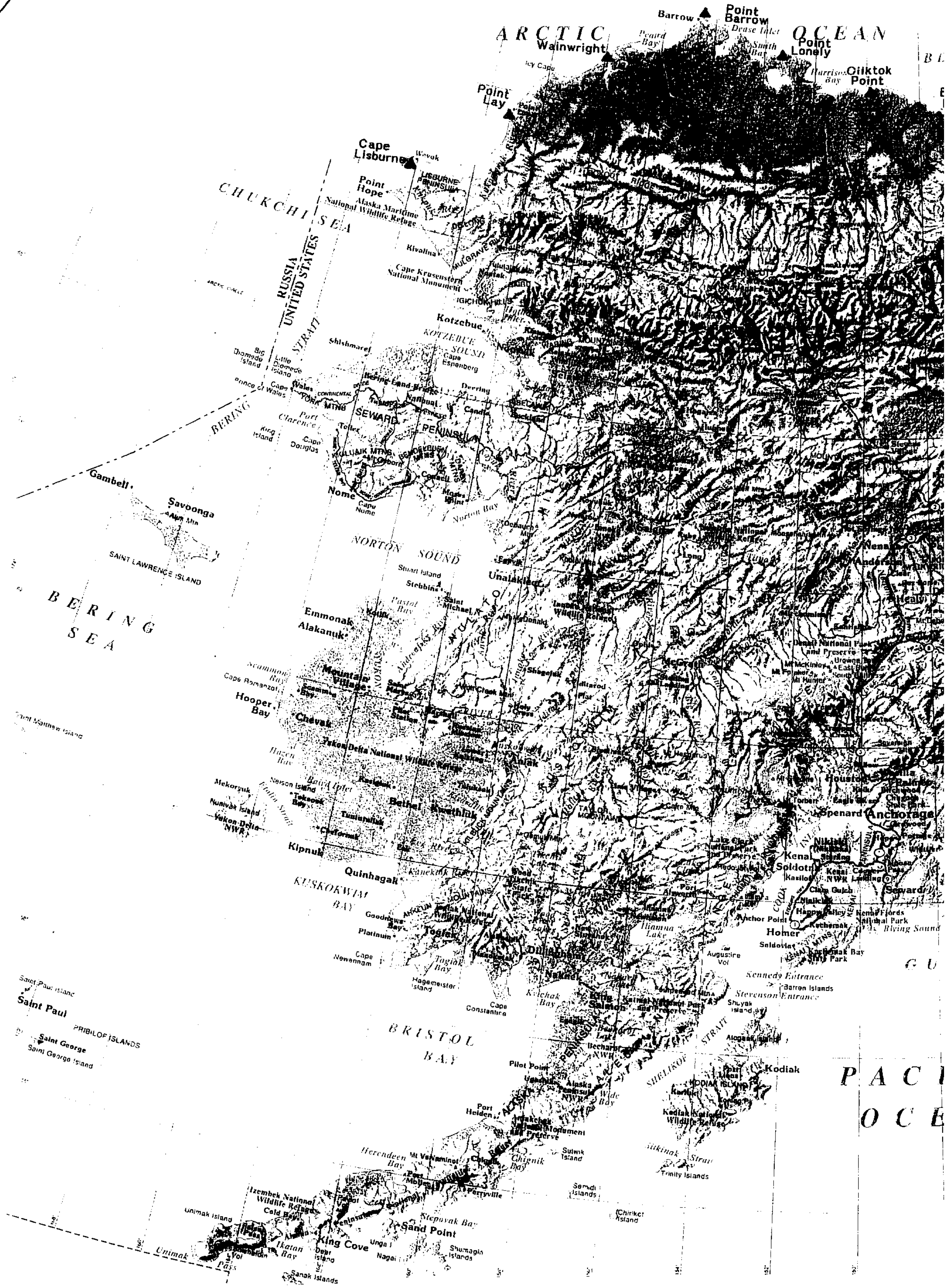
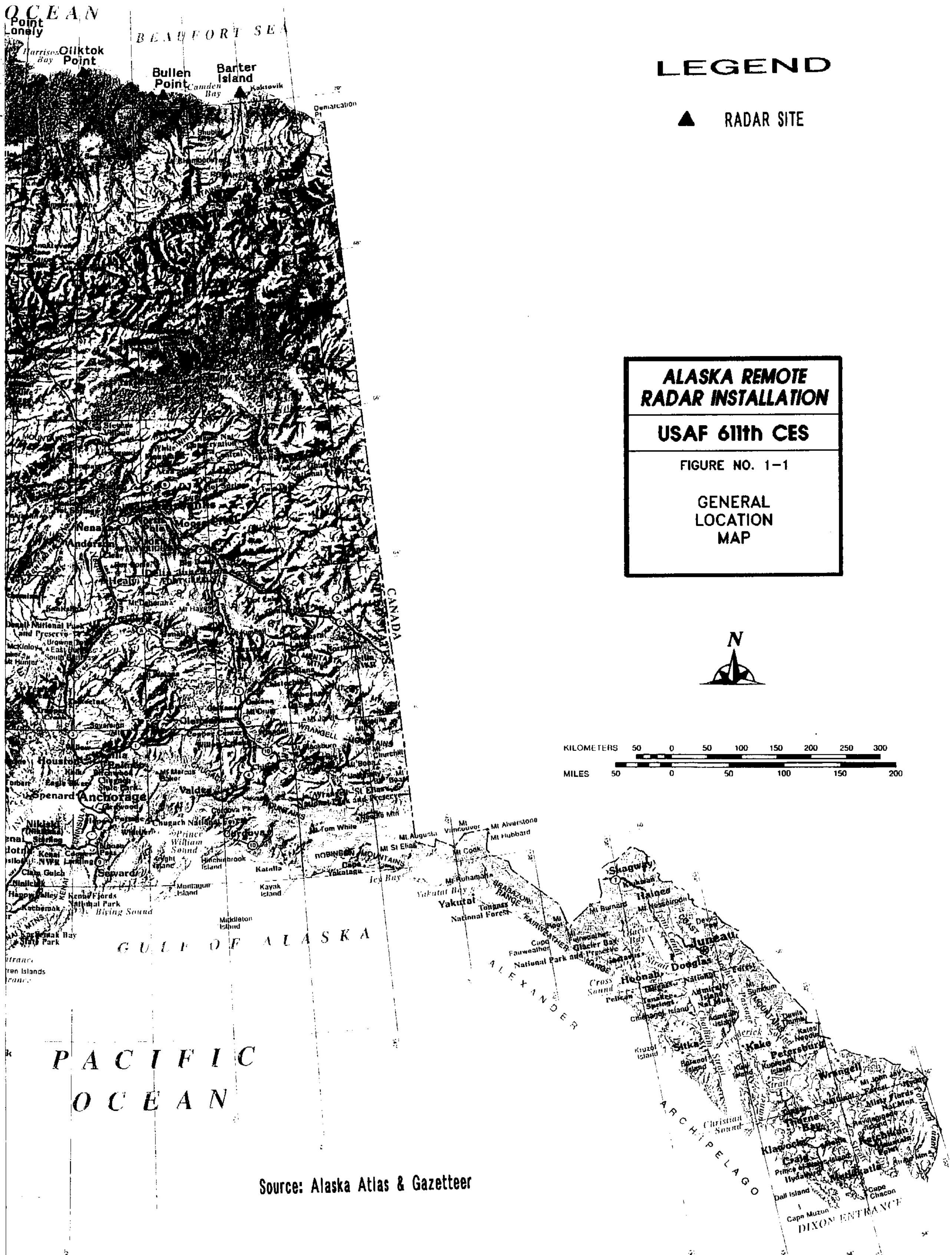

ARCTIC OCEAN
Barrow
Point Barrow
Wainwright
Point Lonely
Oliktok Point
Point Lay
Cape Lisburne
Point Hope
CHUKCHI SEA
RUSSIA
UNITED STATES
Kivalina
Kotzebue
KOTZEBUE SOUND
Shishmaref
Big Diomede Island
Little Diomede Island
Wales
SEWARD PENINSULA
BERING STRAIT
Gambell
Savoonga
SAINT LAWRENCE ISLAND
Nome
NORTON SOUND
Unalakleet
Stebbins
Emmonak
Alakanuk
BERING SEA
Hooper Bay
Chevak
Bethel
Kipnuk
Quinhagak
KUSKOKWIM BAY
Togiak
Dillingham
BRISTOL BAY
Saint Paul
PRIBILOF ISLANDS
Saint George
Pilot Point
Port Heiden
King Cove
Sand Point
Unimak Island
Kodiak
Kenai
Soldotna
Homer
Seward
Anchorage
Houston
PACIFIC OCEAN



ALASKA REMOTE RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 1–1

GENERAL LOCATION MAP

Source: Alaska Atlas & Gazetteer

TABLE 1-1. SITES EVALUATED AT BARTER ISLAND DEW LINE INSTALLATION

SITE NAME	SITE ID NUMBER	SOIL	SEDIMENTS	SURFACE WATER
Old Landfill	LF01	X	X	X
POL Catchment	LF03	X	X	X
Current Landfill	LF04	X	X	X
Contaminated Ditch	SD08	X	X	X
Old Runway Dump	LF12	X	NA	NA
Heated Storage	SS13	X	X	X
Garage	SS14	X	X	X
Weather Station Building	SS15	X	NA	NA
White Alice Facility	SS16	X	X	NA
POL Tanks	ST17	X	NA	NA
Fuel Tanks	ST18	X	X	NA
Old Dump Site	LF19	X	X	X
Bladder Diesel Spill	SS20	X	X	X
JP-4 Spill	SS21	X	NA	NA

X Chemical analyses were performed on these media.
NA No chemical analysis was performed.

- **Risk Characterization Uncertainty**. Describes the potential shortcomings in the data and the methods used to develop the risk assessment, and the uncertainties in the interpretation of the data and the risk characterization results.

- **Risk Assessment Summary and Conclusions**. Presents summaries and conclusions regarding the human health risks associated with exposure to contaminated media at the 14 sites at the Barter Island installation.

Section 3.0, the ERA, is composed of:

- **Selection of Site Contaminants**. Presents the COCs for ecological receptors and describes how they were selected for the ERA.

- **Ecological Exposure Assessment.** Identifies the potential receptors and representative species, habitat suitability, and exposure pathways.

- **Ecological Toxicity Assessment.** Describes the potential effects of site contaminants on the representative species.

- **Risk Characterization for Ecological Receptors.** Evaluates the likelihood of adverse effects on ecological receptors.

- **Ecological Uncertainty Analysis.** Describes the potential shortcomings in the data and the methods used to develop the ERA, and the uncertainties in the interpretation of the data and the ecological risk characterization results.

- **Summary of Ecological Risk.** Presents a summary of ecological risks associated with contaminated media at the 14 sites at the Barter Island installation.

Appendix A contains the human health risk assessment spreadsheets used to estimate chemical intake, noncancer hazard, and excess lifetime cancer risk. Appendix B consists of toxicology profiles. The exposure equations and calculations for ecological receptors are presented in Appendix C. Appendix D contains a summary of RI sampling and analyses, and RI analytical data for all sites from which the COCs were selected and upon which the human health and ecological risk assessments are based. Appendix E contains habitat maps for the potential ecological receptors at the Barter Island installation.

1.2 RISK ASSESSMENT GUIDANCE DOCUMENTS

The following guidance documents were used to develop the human health and ecological risk assessments:

- *Risk Assessment Guidance for Superfund: Volume 1, Human Health Evaluation Manual (Part A)* [U.S. Environmental Protection Agency (EPA) 1989a]

- Region 10 Supplemental Risk Assessment Guidance for Superfund (EPA 1991a)

- *Risk Assessment Guidance for Superfund: Volume 2, Environmental Evaluation Manual* (EPA 1989b)

- General Guidance for Ecological Risk Assessment at United States Air Force (Air Force) Bases (MITRE 1990)

- Handbook to Support the Installation Restoration Program (IRP) Statements of Work (U.S. Air Force 1991)

- Framework for Ecological Risk Assessment (EPA 1992a)

1.3 INSTALLATION DESCRIPTION AND ENVIRONMENTAL SETTING

The Barter Island DEW Line installation is located on a 4,353-acre island at 70°08'N, 143°35'W, approximately 75 miles west of the Canadian border on the Arctic Coastal Plain of Alaska, adjacent to the native village of Kaktovik. The area location of the Barter Island radar installation is shown on Figure 1-2, and a site plan is provided in Figure 1-3. The island consists of low-lying tundra on the northern border of the Alaska National Wildlife Refuge (ANWR). The maximum elevation on Barter Island is 55 feet above mean sea level (MSL), and drainage is radially away from the high points. The Barter Island radar installation is situated adjacent to the northern coast, on a relatively flat area below a gradual slope. Upgradient from the installation is a freshwater lake used as a drinking supply for the installation and Kaktovik village. Kaktovik, population approximately 225, is located east of the station, adjacent to Kaktovik Bay. The community of Kaktovik relocated in 1947, 1952, and 1964 to accommodate the establishment and expansion of the Barter Island radar installation. Land use prior to the construction of the radar installation was a mix of natural undisturbed tundra and areas where Kaktovik village was situated.

Barter Island radar installation, also known as BAR-M, was the prototype DEW Line station and has been in active use since 1952. The installation operates and maintains a radar and communication system for detection of potential enemy aircraft entering U.S. airspace. Approximately seven contract personnel currently are stationed at the installation. The radar installation has been upgraded over the years with modern electronic equipment and in recent years has been called a Long Range Radar Station (LRRS). The installation consists of two module trains, a power plant, garages, warehouses, a hangar, a weather building, and radar and communication structures.

Module train "A" houses the electronics equipment work areas and the radar tower, limited personnel quarters, administration offices, a mechanical room with emergency boiler and fuel storage, and a personnel support module with water storage, shower, and toilets. Adjacent to this structure, and connected by corridors, are the power plant and vehicle maintenance buildings.

Train "B" is the main living and personnel support area. The dining and recreation areas are located in the center of this module train. Mechanical rooms are distributed throughout the living quarters. The solid waste incinerator is connected by a corridor to module train "B".

The rotating radar is in the radome. The radome, platform, plenum, and stairwell/cable chase are supported by steel columns and trusses on the west end of module train "A". There are also two communications billboards (known as "White Alices") and a radio relay building located south of the module trains.

Aircraft facilities include a lighted gravel runway and hangar. The runway is 4,820 feet long with a 360-foot overrun on the east end and a 480-foot overrun on the west end. The total length of the runway, with overruns, is 5,660 feet.

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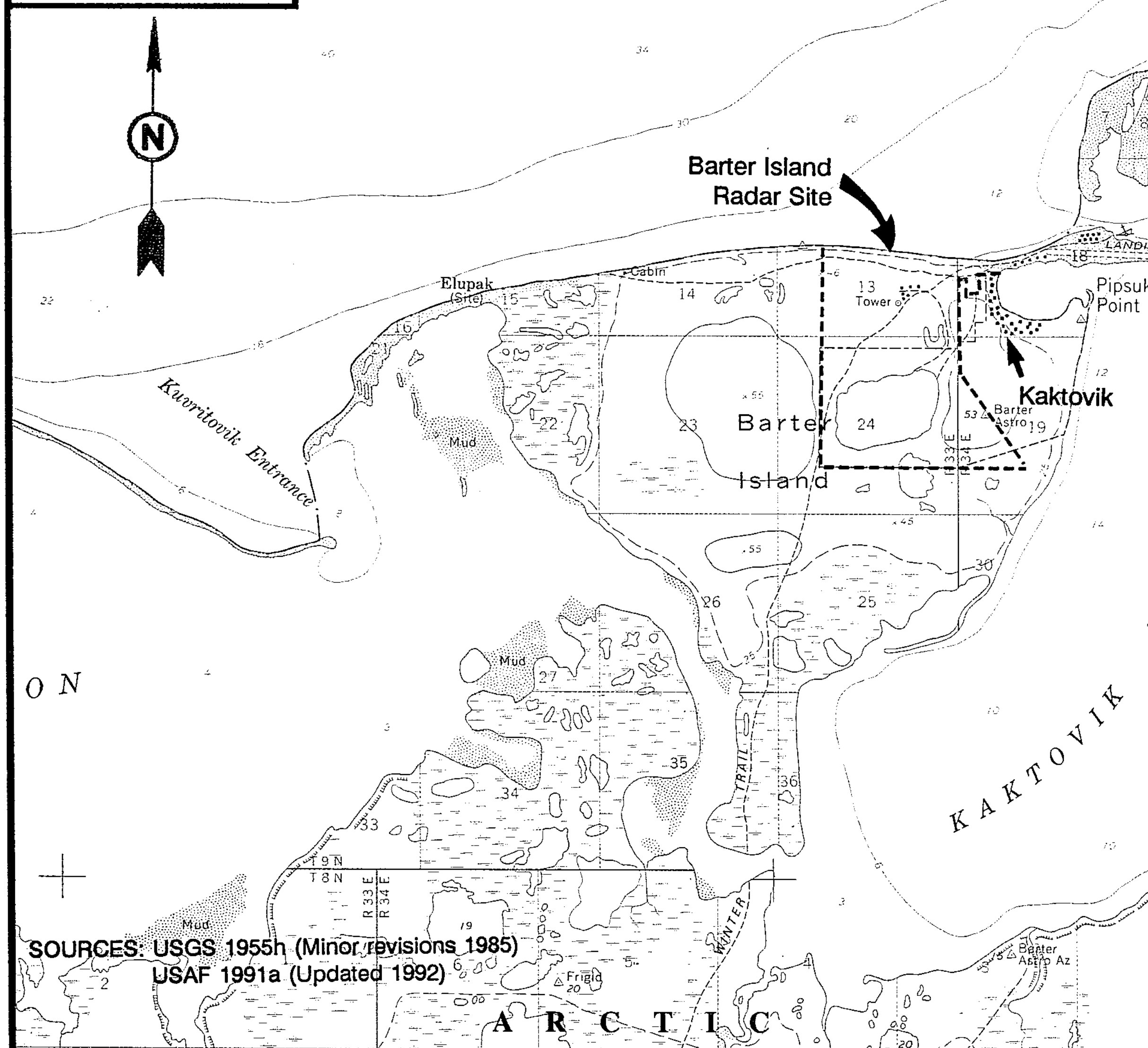
DRAWING No. BTR-AREA



BARTER ISLAND RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 1–2

AREA LOCATION MAP

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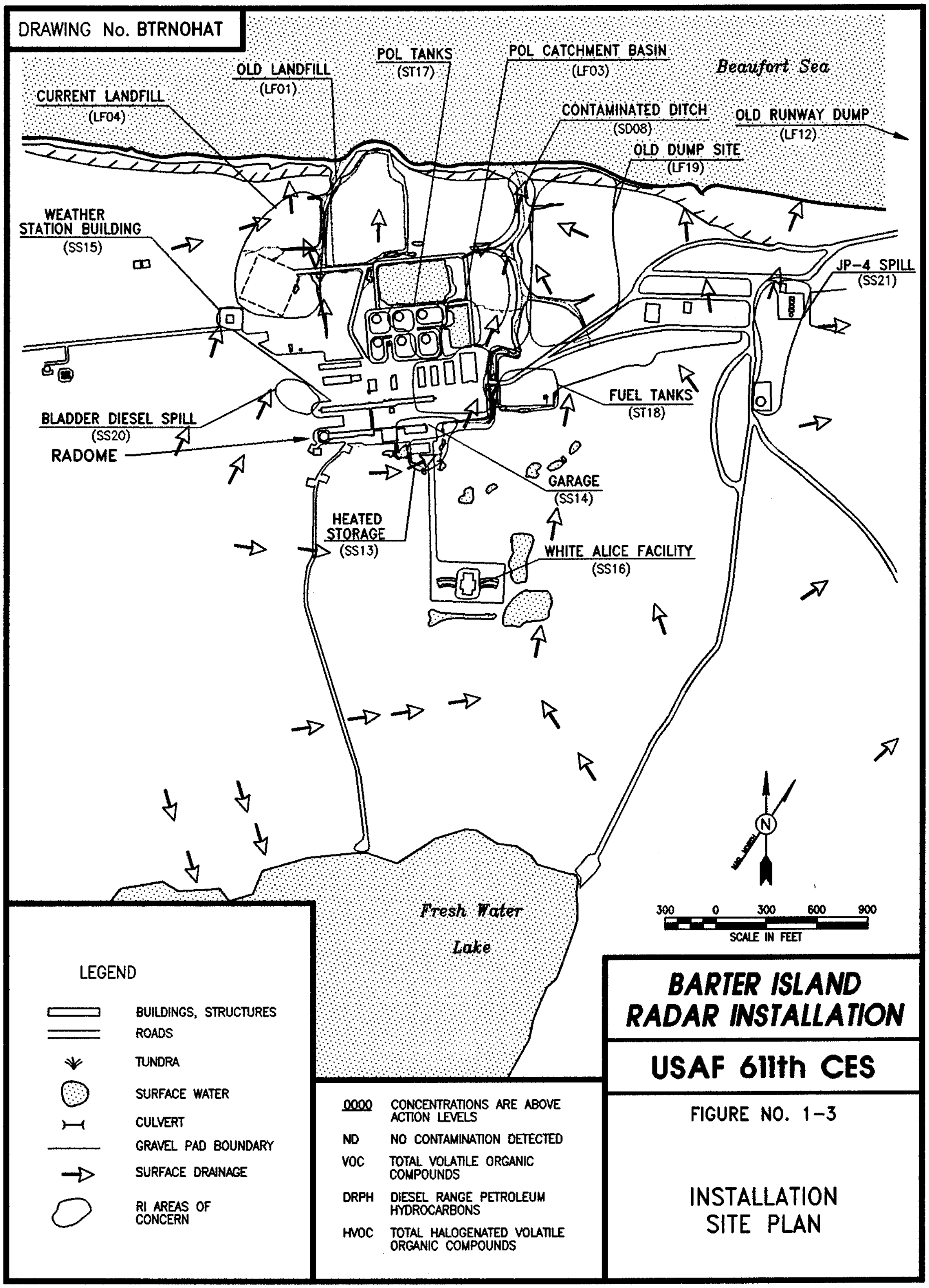
DRAWING No. BTRNOHAT
Beaufort Sea
OLD LANDFILL
(LF01)
POL TANKS
(ST17)
POL CATCHMENT BASIN
(LF03)
CURRENT LANDFILL
(LF04)
CONTAMINATED DITCH
(SD08)
OLD RUNWAY DUMP
(LF12)
OLD DUMP SITE
(LF19)
WEATHER
STATION BUILDING
(SS15)
JP-4 SPILL
(SS21)
FUEL TANKS
(ST18)
BLADDER DIESEL SPILL
(SS20)
RADOME
GARAGE
(SS14)
HEATED
STORAGE
(SS13)
WHITE ALICE FACILITY
(SS16)
Fresh Water
Lake
N
300 0 300 600 900
SCALE IN FEET
LEGEND
BUILDINGS, STRUCTURES
ROADS
TUNDRA
SURFACE WATER
CULVERT
GRAVEL PAD BOUNDARY
SURFACE DRAINAGE
RI AREAS OF CONCERN
0000 CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND NO CONTAMINATION DETECTED
VOC TOTAL VOLATILE ORGANIC COMPOUNDS
DRPH DIESEL RANGE PETROLEUM HYDROCARBONS
HVOC TOTAL HALOGENATED VOLATILE ORGANIC COMPOUNDS
BARTER ISLAND
RADAR INSTALLATION
USAF 611th CES
FIGURE NO. 1-3
INSTALLATION
SITE PLAN

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Precipitation at the Barter Island averages 7 inches per year, which includes 45 inches of snow. Average daily minimum and maximum temperatures in summer are 30°F and 46°F, respectively. In winter, these temperatures are -20°F and 6°F, respectively. Prevailing winds are easterly and average near 13 mph. The habitat on the island consist of arctic tundra with several large and small lakes and a few streams that flow to the ocean. The island is predominantly covered by a thin tundra mat, beneath which is a layer of sand and loess (wind blown silt) approximately two to three feet thick. Underlying these deposits are lenses and layers of marine and alluvial clay, silt, sand, and sandy gravel of the Meade River Unit of the Gubik Formation. Permafrost in the area is up to 1,300 feet thick. A detailed description of the geology, soil, hydrology, meteorology, and biology of Barter Island is presented in the Barter Island RI/FS report (U.S. Air Force 1996).

The Barter Island radar installation was investigated to evaluate possible contamination related to Air Force activities and historical waste disposal practices at the sites. Fourteen sites at the Barter Island radar installation were determined to be of potential concern based on previous IRP sampling activities, literature search, pre-survey and reconnaissance trips, interviews with station personnel, and information on disposal practices at DEW Line stations. The sites were investigated during RI/FS activities to confirm the presence or absence of chemical contamination; define the extent and magnitude of confirmed chemical releases; gather adequate data to determine the magnitude of potential risks to human health and the environment; and gather adequate data to identify and select the appropriate remedial actions for those sites where apparent risks exceed acceptable limits. The remainder of this Section describes the 14 sites at which sampling and analyses were conducted during RI activities.

1.3.1 Old Landfill (LF01)

The Old Landfill (LF01) site is located adjacent to the Beaufort Sea at the northernmost boundary of the Barter Island installation (Figure 1-3). The landfill was operational between 1956 and 1978 and occupies two to three acres. Historically, the landfill received all waste from the station and the nearby village of Kaktovik. It reportedly received household waste, human and animal waste, drums, and other maintenance wastes. Station personnel stated that compaction, grading, removal of drums, installation of a gravel cap, and a general cleanup of exposed waste was conducted in 1992. A seawall was constructed that currently prevents erosion of the landfill by coastal wave processes.

1.3.2 POL Catchment (LF03)

The POL Catchment site (LF03) is an almost rectangular, tundra area surrounded by a gravel berm. The site is located north of the module trains and directly east of the POL Tanks (Figure 1-3). The tundra area within the gravel berm is approximately 200 feet by 130 feet. The east portion of the bermed area consists of tundra and is dominated by a large pond. A small portion of the west side of the site consists of gravel, and there is a small stained area in the gravel at the base of the western berm. The POL Catchment serves as a secondary containment unit for petroleum hydrocarbons released from the POL Tanks (ST17) resulting from tank leaks and/or fuel spills. The POL Tanks area is a bulk fuel storage area for arctic grade diesel fuels.

1.3.3 Current Landfill (LF04)

The Current Landfill site (LF04) is located north of the module trains and southwest of the Old Landfill (LF01) (Figure 1-3). The Current Landfill covers approximately two acres and receives wastes generated by the installation. It received waste from the village of Kaktovik from 1978 to 1992 before the village constructed its own landfill; the use of the site by Kaktovik community residents was uncontrolled. It reportedly received household waste, human and animal waste, drums, and other maintenance waste. Currently the disposal of wastes at this site by station personnel is in accordance with appropriate regulations.

1.3.4 Contaminated Ditch (SD08)

The Contaminated Ditch site (SD08) is located approximately 100 yards northeast of the module trains (Figure 1-3). The Contaminated Ditch is a large, deep, naturally eroded gully running to the north and discharging to the Beaufort Sea. The village of Kaktovik was located west of the ditch from 1952 to 1964. The ditch was suspected of containing petroleum hydrocarbons from a ruptured fuel line near the warehouse area north of the module trains. Station personnel reported that a general cleanup was conducted at the ditch, and exposed metal debris was removed in 1992.

1.3.5 Old Runway Dump (LF12)

The Old Runway Dump (LF12) site is located on the northeast corner of Barter Island, east of the runway (Figure 1-3). It is a two-acre area suspected of receiving all wastes generated during the construction of the installation and for some short period thereafter. The site received construction debris, old vehicles, drums, and other waste generated during this period. The landfill has been closed since 1957 and was reportedly cleaned up between 1979 and 1980.

1.3.6 Heated Storage (SS13)

The Heated Storage site (SS13) is located southeast of the module trains and the power house (Figure 1-3). The Heated Storage building is approximately 80 feet by 40 feet and is used for vehicle maintenance and storage. The building is raised approximately three to four feet above the tundra and is bounded by a gravel pad on the north, south, and east sides. The floor drains within the building discharged directly to tundra area below and may have received waste oils and other waste automotive fluids. The floor drains were sealed in July 1993 by the Air Force to prevent future release of contaminants.

1.3.7 Garage (SS14)

The Garage (SS14) site is located east of the powerhouse and north of the Heated Storage building (Figure 1-3). The Garage is an approximately 90 feet by 30 feet building that is elevated approximately three feet above the tundra and surrounded by a gravel pad. The building is used for vehicle maintenance and storage and is connected to the module train by a corridor. The floor drains in this building discharged directly to the tundra beneath the structure and may have received vehicle maintenance wastes. The floor drains were sealed in July 1993 by the Air Force to prevent future release of contaminants.

1.3.8 Weather Station Building (SS15)

The Weather Station Building site (SS15) is located northwest of the module trains and southwest of the Current Landfill (LF04) (Figure 1-3). The Weather Station Building is approximately 30 feet by 30 feet and is elevated approximately five feet above the center of the gravel pad area. A 1,200-gallon above ground fuel storage tank is located at the northeast corner of the building. The diesel tank has leaked over the years, and a stained area was observed just below the tank fittings.

1.3.9 White Alice Facility (SS16)

The White Alice Facility (SS16) site is located 1,600 feet south of the module trains and (Figure 1-3) was a transmission and receiving unit for the station. The site consists of a radio relay building and two large White Alice "billboards" that look like outdoor movie screens. It was suspected that dielectric fluids containing polychlorinated biphenyls (PCBs) were discharged to the surface soils in small quantities during maintenance of the unit equipment.

1.3.10 POL Tanks (ST17)

The POL Tanks (ST17) site, an active bulk fuel storage area for arctic grade diesel fuels, is located north of the module trains and south of the active sewage lagoon (Figure 1-3). The site consists of six large, approximately 200,000 gallon, aboveground tanks and associated piping and pump house, each contained inside a currently lined berm. The POL Tanks were investigated as a possible source area of the POL Catchment (LF03).

1.3.11 Fuel Tanks (ST18)

The Fuel Tanks (ST18) site is an active tank farm located inside a lined berm approximately 300 feet east of module train B (Figure 1-3). The Fuel Tanks consist of six 10,000 gallon aboveground fuel tanks that contain vehicle fuel. Four tanks contain motor vehicle gasoline (MOGAS) and two tanks contain diesel. The tanks are used to fuel vehicles and heavy equipment used at the installation.

1.3.12 Old Dump Site (LF19)

The Old Dump Site (LF19) site consists of several acres of mostly tundra located northeast of the module trains and east of the Contaminated Ditch (Figure 1-3). The village of Kaktovik was located at this site from 1952 to 1964. There are no obvious areas of contamination at the site, and it is uncertain as to whether this area was ever used as a dump site. Previous contractors reported the site was used as a storage area for materials scheduled for retrograde by sealift.

1.3.13 Bladder Diesel Spill (SS20)

The Bladder Diesel Spill (SS20) site is a water-saturated tundra area with a thin gravel cover located west of module train B (Figure 1-3). The Bladder Diesel Spill area was historically a storage area for arctic grade diesel fuels. Site personnel indicated the possibility of a past fuel spill in this area, so, although the bladder diesel tank has been removed, the area adjacent to the tank site was suspected of containing petroleum hydrocarbons.

1.3.14 JP-4 Spill (SS21)

The JP-4 Spill site (SS21) is located approximately 1,300 feet east of the main facility (Figure 1-3). This reported fuel spill was from a cut in an approximately six-inch diameter JP-4 fuel line approximately 100 yards below the JP-4 fuel tank. The fuel line runs from the JP-4 tank to the hangar area. Site personnel indicated that a village diesel spill occurred upgradient of the JP-4 Spill area, and some of the product from the village spill may have migrated over this site.

1.4 APPROACH TO HUMAN HEALTH RISK ASSESSMENT

The Barter Island DEW Line installation presents a unique challenge in the development of a human health risk assessment. Many of the conventional assumptions applied in risk assessments do not apply to the North Slope of Alaska. Barter Island is remote and sparsely populated. Native residents, largely Inupiats, follow a lifestyle that includes a significant subsistence component; much of their food consists of mammals (whales, seals, moose, and caribou), aquatic life (arctic char), and birds (ptarmigan, ducks) that are abundant in this area of the arctic. The climate is generally harsh, and the soil and surface water are frozen for approximately nine months of the year.

The general approach to the human health risk assessment is to quantify the excess lifetime cancer risk or the noncancer hazard for the site contaminants detected at each of the 14 sites at the installation. The maximum concentration of each chemical detected is used instead of an arithmetic mean or 95th percentile upper confidence limit (UCL) because contamination was detected infrequently and found to be generally of low concentration. Incorporating nondetects into the calculation of an average or UCL when the frequency of positive detects is low tends to yield low and unreliable estimates of contamination. Use of the maximum concentration yields a conservative estimate of risk or hazard.

To the extent possible, site-specific information is incorporated into the development of the exposure assumptions. The harsh climate naturally serves to limit exposure to contaminated soil, sediment, and surface water.

Residential exposure assumptions were used to reflect the upper-bound potential future risk. Several North Slope communities have requested use of inactive buildings at DEW Line installations; therefore, an evaluation using potential residential scenarios at the installations and sites was conducted.

Excess lifetime cancer risk and noncancer hazard are calculated for the soil/sediment ingestion and water ingestion pathways. Other pathways were eliminated from consideration as described in Section 2.2, the Human Health Risk Exposure Assessment.

1.5 APPROACH TO ECOLOGICAL RISK ASSESSMENT

The objective of the ERA is to estimate potential impacts to aquatic and terrestrial plants and animals at the Barter Island radar installation. The MITRE guidance (1990) suggests that ERAs should "estimate the potential for occurrence of adverse effects that are manifested as changes in the diversity, health and behavior" of ecosystems. MITRE proposes that this can be accomplished by:

- Estimating the health risk to individual species;
- Evaluating the health of the community of exposed species; and
- Determining the potential adverse effects of contamination over several life cycles of the species under study.

Because this is a screening level assessment, the scope of this ERA is limited to the first task: estimating the health risk to individual species. If a potential health risk to individual species is identified, further work may be recommended to evaluate the community and life cycle effects. It is important to note that the health risk to an individual species is different from the health risk to an individual within a species. The former refers to population level biology, where the individual is not considered a relevant endpoint. The latter assesses the risks to an individual. In this ecological assessment, the individual is considered only in the case of threatened or endangered species.

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2.0 BASELINE HUMAN HEALTH RISK ASSESSMENT

The purpose of the baseline human health risk assessment for the Barter Island DEW Line installation is to provide a basis for developing a risk management plan, including remedial action alternatives based on data from the RI/FS. The RI at the Barter Island installation included investigation of 14 sites. The risk assessment develops numerical estimates of cancer risk and noncancer hazard for each site where sufficient information is available. Where information is not adequate to quantify noncancer hazard or cancer risk for a given COC, a qualitative discussion of the toxicity of that COC is provided in the Toxicity Profiles (Appendix B).

The risk assessment addresses issues unique to this location as described in the introduction. It follows the conventional approach; however, in that it is comprised of six sections:

- Identification of COCs - in which the chemicals detected in environmental samples are compared to risk-based screening levels (RBSLs) and concentrations considered to be applicable or relevant and appropriate requirements (ARARs);
- Exposure Assessment - in which the frequency, duration, and magnitude of potential exposures to the COCs are estimated;
- Toxicity Assessment - in which the toxicology of the COCs is assessed;
- Risk Characterization - in which the potential for adverse health effects in humans as a result of exposure to the COCs is quantified (as appropriate) and discussed;
- Uncertainty Assessment - in which the general sources of uncertainty in the assessment and the site-specific sources of uncertainty are discussed; and
- Risk Assessment Summary and Conclusions - in which the human health risks at each of the sites are summarized and conclusions based on these risks are presented.

2.1 IDENTIFICATION OF CONTAMINANTS OF CONCERN

Chemicals of potential concern to human health were selected for each site at the Barter Island facility based on comparison of chemical concentrations to RBSLs, naturally-occurring background concentrations, ARARs, and safe levels of essential human nutrients (e.g., calcium, magnesium, sodium, and potassium).

This section discusses the RI sampling strategy and an evaluation of data prior to screening (Section 2.1.1), describes and presents equations for calculating RBSLs (Section 2.1.2), identifies chemicals that are essential human nutrients (Section 2.1.3), describes the collection of background samples (Section 2.1.4), and discusses the selection of COCs (Section 2.1.5). The last segment (Section 2.1.6) identifies the COCs at each site.

2.1.1 Sampling Strategy and Evaluation of Analytical Data

The RI sampling strategy at the Barter Island sites was to characterize the nature and extent of potential contamination at each site. Suspected source areas were sampled to determine the concentrations of contaminants, if any, at the areas likely to have the highest concentrations. Migration pathways from the source areas were sampled to determine the extent, if any, that the contaminants had migrated from the sites. If no discernable pathways were evident, an attempt was made to sample around the source areas to determine the extent of site contaminants. Quick turn-around analyses were conducted on samples from the first sampling event, and a second round of sampling was conducted at those sites where further characterization of the nature and extent of contamination was needed.

Sample types included surface and subsurface soil/sediment samples and surface water samples. In almost all cases, samples were discrete grab samples from one sample location. Surface soil and sediment samples were collected in gravel and tundra areas at or near the ground surface (from ground surface to approximately six inches in depth). Subsurface soil samples were mainly collected in gravel pad areas where unsaturated conditions allowed vertical migration of contaminants. Sediment samples were collected below shallow ponds or streams, or in areas that visually appeared to have been previously covered with water. Surface water samples were collected from ponds, streams, springs, or leachate areas. Surface water samples included both total and dissolved metal analyses; however, the total metal analytical results were used in the risk assessment. A summary of the 1993 RI sampling and analyses conducted at the installation is presented in Appendix D.

Before screening for COCs, the results of the RI sampling program were sorted by medium (i.e., soil, sediment, and surface water) and reviewed for quality. The review included an evaluation of the analytical methods used, the sample quantitation limits, qualified data, and a comparison to background levels and blanks. Analytical data were reviewed for completeness, comparability, representativeness, precision, and accuracy. In addition, data validation qualifiers were considered in assessing the quality of the data. The review and validation of analytical data determined that a minimal amount of data was not usable. These data were qualified with an "R" and were not used in the risk assessment.

As outlined in the Risk Assessment Guidance for Superfund (EPA 1989a), site data were compared to available blank (laboratory, field, and trip) data. The data from blanks are presented in Appendix D. In accordance with EPA (1989a), if the detected concentration in a sample was less than 10 times the concentration from blanks for common laboratory contaminants (e.g., acetone, 2-butane, methylene chloride, toluene, and the phthalate esters) the chemical was not selected for evaluation in the risk assessment. For those organic or inorganic chemicals that are not considered by EPA to be common laboratory contaminants (all other compounds), if the detected concentration was less then five times the maximum concentration detected in the blanks, the chemical was not selected for evaluation in the risk assessment.

2.1.2 Risk-Based Screening Levels

An RBSL is a chemical concentration in a particular medium expected to yield a given risk or hazard quotient (HQ) (e.g., 10^{-7} risk; 0.1 HQ) under a given set of conditions. For Barter Island, the RBSLs were calculated for soil based on reasonable maximum exposure (RME) parameters (EPA 1991a). In developing the RBSLs, the most recent toxicity factors available from the Integrated Risk Information System (IRIS) and the Health Effects Assessment Summary Tables (HEAST) were used. IRIS and HEAST are databases of toxicity information for human health risk assessment maintained by the Environmental Criterion Assessment Office of the EPA. The information presented on IRIS represents the agency's consensus regarding the toxicity of chemicals released to the environment. Toxicity factors that EPA has withdrawn from IRIS and HEAST, or available from other sources were not used in this risk assessment.

2.1.2.1 Formulae for Calculating RBSLs. The RBSL concentrations were derived using EPA Region 10 guidance (1991a). The equations presented by EPA (1991a) are also presented in the Risk Assessment Guidance for Superfund Volume I, Part B (EPA 1991b). Exposure assessment and risk characterization algorithms for human health risk assessments use site-specific contaminant concentration data, factors describing exposure, and toxicity dose-response values [e.g., reference doses (RfDs) or carcinogen slope factors (SF)]. These risk assessment algorithms are solved for the concentration term to derive the RBSL for soil and ground or surface water. The algorithms are summarized as follows:

$$\text{Risk} = C \times \left(\frac{CR \times EFD}{BW \times AT}\right) \times SF \quad \text{or} \quad HQ = C \times \left(\frac{CR \times EFD}{BW \times AT}\right) / RfD \qquad \textbf{EQUATION 1, 2}$$

C	=	Concentration	AT	=	Averaging Time
CR	=	Contact Rate	SF	=	Slope Factor
EFD	=	Exposure Frequency and Duration	HQ	=	Hazard Quotient
BW	=	Body Weight	RfD	=	Reference Dose.

Risk-based screening levels are calculated using a specified target cancer risk or HQ with the toxicity and exposure factors. The EPA Region 10 guidance (1991a) recommends that a 1×10^{-7} target risk and a target noncancer HQ of 0.1 be used for soil and a 1×10^{-6} risk and 0.1 HQ be used for ground or surface water. The lower target cancer risk is used for screening soil because additional pathways, such as dermal contact and inhalation, are not accounted for by the calculations (EPA 1991a).

Equations (1) and (2) shown above are rearranged to solve for the concentration term (i.e., the RBSL):

$$C = \text{Risk} / \left(\left(\frac{CR \times EFD}{BW \times AT}\right) \times SF\right) \quad \text{or} \quad C = HQ / \left(\left(\frac{CR \times EFD}{BW \times AT}\right) / RfD\right) \qquad \textbf{EQUATION 3, 4}$$

Surface Water Ingestion Equations. Using standard default exposure factors (EPA 1989b) for water ingestion, the equation for cancer risk from drinking water ingestion becomes:

$$\text{Risk} = C\ (\mu g/L) \times 0.001\ mg/\mu g \times \left(\frac{2\ L/day \times 350\ day/year \times 30\ year}{70\ kg \times 70\ year \times 365\ day/year} \right) \times SF_o \qquad \textbf{EQUATION 5}$$

This can be rearranged to solve for an RBSL, for example with a target cancer risk of 10^{-6}:

$$C\ (\mu g/L) = 10^{-6} \times 1{,}000\ \mu g/mg \Big/ \left[\left(\frac{2\ L/day \times 350\ day/year \times 30\ year}{70\ kg \times 30\ year \times 365\ day/year} \right) \times SF_o \right] \qquad \textbf{EQUATION 6}$$

For non-carcinogens, the equation for HQ for drinking water ingestion is:

$$HQ = C\ (\mu g/L) \times 0.001\ mg/\mu g \times \left(\frac{2\ L/day \times 350\ day/year \times 30\ year}{70\ kg \times 30\ year \times 365\ day/year} \right) / RfD_o \qquad \textbf{EQUATION 7}$$

The equation for concentration representing HQ of 1 from ingestion is:

$$C\ (\mu g/L) = 1 \times 1{,}000\ \mu g/mg \Big/ \left[\left(\frac{2\ L/day \times 350\ day/year \times 30\ year}{70\ kg \times 30\ year \times 365\ day/year} \right) / RfD_o \right] \qquad \textbf{EQUATION 8}$$

Soil Ingestion Equations. The equation for calculating carcinogenic risk from soil ingestion, combining child and adult exposure, is as follows:

$$\text{Risk} = C\ (mg/kg) \times 0.000001\ kg/mg \times \qquad \textbf{EQUATION 9}$$

$$\left[\left(\left(\frac{200_c\ mg/day \times 350_c\ day/year \times 6\ year}{15_c\ kg \times 365\ day/year} \right) + \left(\frac{100_a\ mg/day \times 350_a\ day/year \times 24\ year}{70_a\ kg \times 365\ day/year} \right) \right) / 70\ year \right] \times SF_o$$

This can be rearranged to solve for concentration at a target cancer risk of 10^{-7}:

$$C\ (mg/kg) = 10^{-7} \times 1{,}000{,}000\ kg/mg/ \qquad \textbf{EQUATION 10}$$

$$\left[\left(\left(\frac{200_c\ mg/day \times 350_c\ day/year \times 6\ year}{15_c\ kg \times 365\ day/year} \right) + \left(\frac{100_a\ mg/day \times 350_a\ day/year \times 24\ year}{70_a\ kg \times 365\ day/year} \right) \right) / 70\ year \right] \times SF_o$$

For non-carcinogens in soil, HQ is calculated:

HQ = C (mg/kg) x 0.000001 kg/mg x **EQUATION 11**

$$\left[\left(\frac{200_c \text{ mg/day} \times 350_c \text{ day/year} \times 6 \text{ year}}{15_c \text{ kg} \times 365 \text{ day/year}}\right) + \left(\frac{100_a \text{ mg/day} \times 350_a \text{ day/year} \times 24 \text{ year}}{70_a \text{ kg} \times 365 \text{ day/year}}\right) / 30 \text{ year}\right] / RfD_o$$

For non-carcinogens, a concentration representing HQ of 0.1 is calculated by:

C (mg/kg) = 0.1 x 1,000,000 mg/kg / **EQUATION 12**

$$\left[\left(\left(\left(\frac{200_c \text{ mg/day} \times 350_x \text{ day/year} \times 6 \text{ year}}{15_c \text{ kg} \times 365 \text{ day/year}}\right) + \left(\frac{100_a \text{ mg/day} \times 350_a \text{ day/year} \times 24 \text{ year}}{70_a \text{ kg} \times 365 \text{ day/year}}\right)\right) / 30 \text{ year}\right) / RfD_o\right]$$

2.1.3 Screening of Chemicals by Comparing Maximum Detected Concentrations of Essential Human Nutrients

Based on EPA Region 10 guidance (1991a), calcium, magnesium, potassium, iron, and sodium are considered to be essential human nutrients and were eliminated from the human health risk assessment at the screening stage. These chemicals are often detected but are not toxic in humans except at extremely high doses. No quantitative toxicity information is available for these elements from EPA sources.

2.1.4 Concentrations of Organic and Inorganic Constituents in Background Samples

Eight samples were collected upgradient of the radar installation to determine the concentrations of naturally occurring organic and inorganic constituents in soil/sediment and surface water (Figure 2-1). Soil and sediment background samples were collected at a depth of zero to six inches. Although some naturally occurring compounds were detected in some of the soil/sediment background samples in the Diesel Range Petroleum Hydrocarbons (DRPH) analyses, the organic concentration in background samples is assumed to be non-detect. This conservative approach was used because it is not possible to determine what degree, if any, the DRPH detected in site samples were naturally occurring compounds.

In order to obtain a representative range of inorganic (metal) concentrations in soil/sediments and surface waters of the North Slope, 44 samples (29 soil/sediment and 15 water) from seven North Slope radar installations were collected to establish the naturally occurring background concentrations. The seven installation include Barter Island, Bullen Point, Oliktok Point, Point Lonely, Point Barrow, Point Lay, and Wainwright. Approximately four soil/sediment and two surface water background samples were collected and analyzed for metals at each of the seven radar installations to determine the background concentrations of inorganic (metal) analytes across similar coastal environments of the North Slope. Analytical results for background samples collected at Barter Island are presented in Appendix D.

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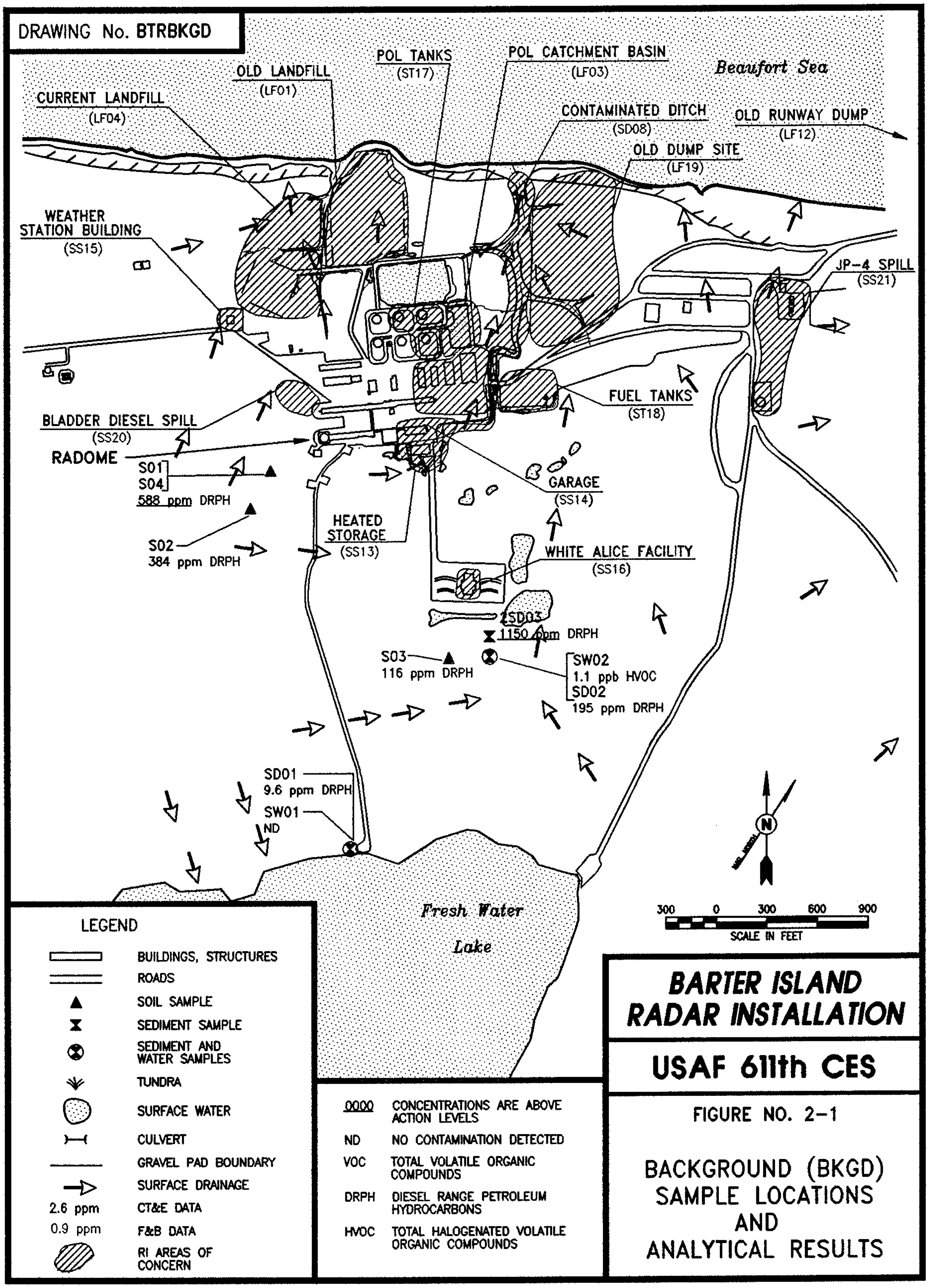

BARTER ISLAND RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 2-1

BACKGROUND (BKGD) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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2.1.5 Selection of Chemicals of Concern

Soil and Sediment. The maximum concentrations of the chemicals detected in soil or sediment samples at Barter Island and not considered to be essential human nutrients were compared, on a site-by-site basis, to the corresponding RBSLs, background concentrations, and where available, federal or state ARARs. Chemicals detected without an RBSL or ARAR were retained as COCs if concentrations exceeded background levels. A chemical with an RBSL or ARAR was selected as a COC for soil and sediment if the maximum concentration at which the chemical was measured exceeded the corresponding background concentration and the RBSL (based either on cancer risk or noncancer hazard) or ARAR (Table 2-1). Thus, for example, the maximum concentration of DRPH at the Contaminated Ditch (SD08), 2,260 mg/kg, exceeds the background range and the state ARAR of 500 mg/kg. Therefore, DRPH is selected as a COC for the soils at the Contaminated Ditch.

The COCs at each site were compared to background concentrations, RBSLs, and ARARs in Table 2-1. The chemicals retained as COCs exceed background concentrations, the RBSL, or an ARAR. A chemical was not retained if the level detected was less than the corresponding RBSL and ARAR, even though background levels were exceeded. The COCs selected that do not have an RBSL or an ARAR are discussed below. The COCs selected at each site that exceed an RBSL, ARAR, or both, are discussed in Sections 2.1.5.1 to 2.1.5.14.

Surface Water. The maximum concentrations of the chemicals detected in surface water samples at Barter Island were compared, on a site-by-site basis, to the corresponding RBSLs, background concentrations, and where available, federal or state ARARs. Chemicals detected without an RBSL or ARAR were retained as COCs if concentrations exceeded background levels. A chemical with an RBSL or ARAR was selected as a COC for surface water if the maximum concentration at which the chemical was measured exceeded the corresponding background concentration, and the RBSL (based either on cancer risk or noncancer hazard) or ARAR (Table 2-1). Thus, for example, the maximum concentration of benzene at the POL Catchment (LF03), 2.7 μg/L, exceeds the background concentration of <1 μg/L (not detected) and the RBSL based on cancer risk of 0.617 μg/L. Therefore, benzene was selected as a COC for the surface water at the POL Catchment. Total metal concentrations in water samples were used in the risk assessment.

The COCs at each site were compared to background concentrations, RBSLs, and ARARs in Table 2-1. The chemicals retained as COCs exceed background concentrations, the RBSL, or an ARAR. A chemical was not retained if the level detected was less than the corresponding RBSL and ARAR, even though background levels were exceeded. The COCs selected that exceed background levels, but do not have an RBSL or ARAR are discussed below. The COCs at each site that exceed an RBSL or ARAR, or both, are discussed in Sections 2.1.5 to 2.1.5.14.

Risk Characterization of Chemicals without RBSLs and ARARs. Several chemicals detected above background levels could not be thoroughly screened because an RBSL could not be calculated and no ARAR was available (Table 2-1). A list of these chemicals is presented in Table 2-2. The cancer risk and noncancer hazard for these chemicals cannot, therefore, be quantified. This section is a qualitative discussion of the potential for these chemicals to cause toxicity

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT BARTER ISLAND

SITE	MATRIX	CHEMICAL DETECTED[h]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL		ARAR	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Old Landfill (LF01)	Soil	RRPH	530	mg/kg	<480	--	--	2,000[a]	NO
		1,4-Dichlorobenzene	0.044	mg/kg	<0.020-<0.500	2.67	--	--	NO
		Naphthalene	0.105	mg/kg	<0.025-<3.50	--	1,100	--	NO
		1,2,4-Trichlorobenzene	0.046	mg/kg	<0.025-<0.500	--	270	--	NO
		1,2,4-Trimethylbenzene	0.041	mg/kg	<0.025-<0.500	--	--	--	**YES***
		Xylenes	0.033	mg/kg	<0.040-<1.000	--	54,000	--	NO
		Aluminum	3,600	mg/kg	1,500-25,000	--	--	--	NO
		Barium	76	mg/kg	27-390	--	1,890	--	NO
		Calcium	10,600	mg/kg	360-59,000	--	--	--	NO
		Chromium	6.6	mg/kg	<4.3-47	--	135	--	NO
		Copper	14	mg/kg	<2.7-45	--	999	--	NO
		Iron	12,000	mg/kg	5,400-35,000	--	--	--	NO
		Lead	29	mg/kg	<5.1-22	--	--	500[b]	NO
		Magnesium	2,700	mg/kg	360-7,400	--	--	--	NO
		Manganese	170	mg/kg	25-290	--	3,780	--	NO
		Nickel	8.6	mg/kg	4.2-46	--	540	--	NO
		Potassium	610	mg/kg	<300-2,200	--	--	--	NO
		Sodium	160	mg/kg	<160-680	--	--	--	NO
		Vanadium	11	mg/kg	6.3-59	--	189	--	NO
		Zinc	55	mg/kg	9.2-95	--	8,100	--	NO
	Surface Water	p-Isopropyltoluene	1.7	µg/L	<1	--	--	--	**YES***
		Toluene	56	µg/L	<1	--	96.5	1,000[c]	NO
		Aluminum	180	µg/L	<100-350	--	--	--	NO

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT BARTER ISLAND (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED[h]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL		ARAR	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Old Landfill	Surface	Barium	120	µg/L	<50-93	--	256	2,000[d]	NO
(LF01)	Water	Calcium	190,000	µg/L	4,100-88,000	--	--	--	NO
(Continued)	(Continued)	Iron	15,000	µg/L	<100-2,800	--	--	--	NO
		Magnesium	78,000	µg/L	<5,000-54,000	--	--	--	NO
		Manganese	1,500	µg/L	<50-510	--	18.3	--	**YES**
		Potassium	110,000	µg/L	<5,000	--	--	--	NO
		Sodium	440,000	µg/L	8,400-450,000	--	--	--	NO
POL Catchment	Soil	DRPH	28,600	mg/kg	9.55-1,150	--	--	500[a]	**YES**
(LF03)		GRPH	78.5	mg/kg	<0.400-<9	--	--	100[a]	NO
		RRPH	180	mg/kg	<480	--	--	2,000[a]	NO
		n-Butylbenzene	3.70	mg/kg	<0.025-<0.500	--	--	--	**YES***
		sec-Butylbenzene	1.62	mg/kg	<0.025-<0.500	--	--	--	**YES***
		Ethylbenzene	0.982	mg/kg	<0.020-<0.500	--	2,700	--	NO
		Isopropylbenzene	0.409	mg/kg	<0.025-<0.500	--	--	--	**YES***
		p-Isopropyltoluene	1.69	mg/kg	<0.025-<0.500	--	--	--	**YES***
		Methylene Chloride*	0.225	mg/kg	<.020-<0.500	8.53	1,620	--	NO
		2-Methylnaphthalene	3.44	mg/kg	<0.230-<3.50	--	--	--	**YES***
		n-Propylbenzene	0.920	mg/kg	<0.025-<0.500	--	--	--	**YES***
		Tetrachloroethane	5.42	mg/kg	<0.020-<0.500	1.23	270	--	**YES**
		Toluene*	0.116	mg/kg	<0.020-<0.500	--	5,400	--	NO
		1,2,4-Trimethylbenzene	0.638	mg/kg	<0.025-<0.500	--	--	--	**YES***
		1,3,5-Trimethylbenzene	0.536	mg/kg	<0.025-<0.500	--	--	--	**YES***
		Xylenes	5.30	mg/kg	<0.040-<1.000	--	54,000	--	NO

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT BARTER ISLAND (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED[h]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL CANCER	RBSL NON-CANCER	ARAR	CHEMICAL OF CONCERN
POL Catchment	Surface	DRPH	1770	µg/L	<200	--	292	--	**YES**
(LF03)	Water	GRPH	367	µg/L	<20	50	730	--	**YES**
(Continued)		Benzene	2.7	µg/L	<1	0.617	--	5[e]	**YES**
		n-Butylbenzene	2.4	µg/L	<1	--	--	--	**YES***
		sec-Butylbenzene	1.0	µg/L	<1	--	--	--	**YES***
		Ethylbenzene	19	µg/L	<1	--	158	700[c]	NO
		Isopropylbenzene	2.9	µg/L	<1	--	--	--	**YES***
		p-Isopropyltoluene	2.1	µg/L	<1	--	--	--	**YES***
		Naphthalene	35	µg/L	<1	--	150	--	NO
		n-Propylbenzene	3.6	µg/L	<1	--	--	--	**YES***
		1,2,4-Trimethylbenzene	19	µg/L	<1	--	--	--	**YES***
		1,3,5-Trimethylbenzene	13	µg/L	<1	--	--	--	**YES***
		Xylenes	38.4	µg/L	<2	--	7,300	10,000[c]	NO
Current Landfill	Soil	DRPH	60	mg/kg	9.55-1,150	--	--	500[a]	NO
(LF04)		GRPH	8	mg/kg	<0.400-<9	--	--	100[a]	NO
		Toluene*	0.026	mg/kg	<0.020-<0.500	--	5,400	--	NO
		Xylenes	0.2	mg/kg	<0.040-<1.000	--	54,000	--	NO
		Aluminum	7,500	mg/kg	1,500-25,000	--	--	--	NO
		Barium	120	mg/kg	27-390	--	1,890	--	NO
		Calcium	10,000	mg/kg	360-59,000	--	--	--	NO
		Chromium	3.4	mg/kg	<4.3-47	--	135	--	NO
		Copper	18	mg/kg	<2.7-45	--	999	--	NO
		Iron	17,000	mg/kg	5,400-35,000	--	--	--	NO

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT BARTER ISLAND (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED[h]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL		ARAR	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Current Landfill	Soil	Lead	6.1	mg/kg	<5.1-22	--	--	500[b]	NO
(LF04)	(Continued)	Magnesium	3,800	mg/kg	360-7,400	--	--	--	NO
(Continued)		Manganese	380	mg/kg	25-290	--	3,780	--	NO
		Nickel	16	mg/kg	4.2-46	--	540	--	NO
		Sodium	870	mg/kg	<160-680	--	--	--	NO
		Vanadium	21	mg/kg	6.3-59	--	189	--	NO
		Zinc	65	mg/kg	9.2-95	--	8,100	--	NO
	Surface	Dichlorofluoromethane	3.7	µg/L	<1	--	--	--	**YES***
	Water	p-Isopropyltoluene	1.1	µg/L	<1	--	--	--	**YES***
		Trichloroethene	36	µg/L	<1	7.75	--	5[e]	**YES**
		Barium	150	µg/L	<50-93	--	256	2,000[d]	NO
		Calcium	120,000	µg/L	4,100-88,000	--	--	--	NO
		Iron	21,000	µg/L	<100-28,000	--	--	--	NO
		Magnesium	41,000	µg/L	<5,000-54,000	--	--	--	NO
		Manganese	1,800	µg/L	<50-510	--	18.3	--	**YES**
		Potassium	12,000	µg/L	<5,000	--	--	--	NO
		Sodium	100,000	µg/L	8,200-450,000	--	--	--	NO
Contaminated Ditch	Soil	DRPH	2,260	mg/kg	9.55-1,150	--	--	500[a]	**YES**
(SD08)		GRPH	171	mg/kg	<0.400-<9	--	--	100[a]	**YES**
		Ethylbenzene	3.01	mg/kg	<0.020-<0.500	--	2,700	--	NO
		Xylenes	12.53	mg/kg	<0.040-<1.000	--	54,000	--	NO
		Aluminum	2,500	mg/kg	1,500-25,000	--	--	--	NO
		Barium	44	mg/kg	27-390	--	1,890	--	NO

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT BARTER ISLAND (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED[h]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL		ARAR	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Contaminated Ditch	Soil	Beryllium	3.2	mg/kg	<2.6-64	0.0149	135	--	NO
(SD08)	(Continued)	Cadmium	2.8	mg/kg	<3.0-<36	--	27	--	NO
(Continued)		Calcium	12,300	mg/kg	360-59,000	--	--	--	NO
		Chromium	5.3	mg/kg	<4.3-47	--	135	--	NO
		Cobalt	5.7	mg/kg	<5.1-12	--	--	--	NO
		Copper	5.8	mg/kg	<2.7-45	--	999	--	NO
		Iron	12,000	mg/kg	5,400-35,000	--	--	--	NO
		Magnesium	2,600	mg/kg	360-7,400	--	--	--	NO
		Manganese	250	mg/kg	25-290	--	3,780	--	NO
		Nickel	7.6	mg/kg	4.2-46	--	540	--	NO
		Potassium	440	mg/kg	<300-2,200	--	--	--	NO
		Selenium	57	mg/kg	<7.8-<170	--	135	--	NO
		Sodium	80	mg/kg	<160-680	--	--	--	NO
		Vanadium	8.4	mg/kg	6.3-59	--	189	--	NO
		Zinc	27	mg/kg	9.2-95	--	8,100	--	NO
	Surface Water	cis-1,2-Dichloroethene	1.5	µg/L	<1	--	36.5	70[c]	NO
		Aluminum	1,900	µg/L	<100-350	--	--	--	NO
		Barium	110	µg/L	<50-93	--	256	2,000[d]	NO
		Calcium	71,000	µg/L	4,100-88,000	--	--	--	NO
		Iron	4,200	µg/L	<100-2,800	--	--	--	NO
		Magnesium	31,000	µg/L	<5,000-54,000	--	--	--	NO
		Manganese	170	µg/L	<50-510	--	18.3	--	NO
		Sodium	120,000	µg/L	8,200-450,000	--	--	--	NO

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT BARTER ISLAND (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED[h]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL		ARAR	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Old Runway Dump (LF12)	Soil	Aluminum	1,700	mg/kg	1,500-25,000	--	--	--	NO
		Barium	16	mg/kg	27-390	--	1,890	--	NO
		Calcium	2,200	mg/kg	360-59,000	--	--	--	NO
		Chromium	4.5	mg/kg	<4.3-47	--	135	--	NO
		Copper	7.3	mg/kg	<2.7-45	--	999	--	NO
		Iron	7,500	mg/kg	5,400-35,000	--	--	--	NO
		Magnesium	1,100	mg/kg	360-7,400	--	--	--	NO
		Manganese	67	mg/kg	25-290	--	3,780	--	NO
		Nickel	5.3	mg/kg	4.2-46	--	540	--	NO
		Sodium	410	mg/kg	<160-680	--	--	--	NO
		Vanadium	5.1	mg/kg	6.3-59	--	189	--	NO
		Zinc	16	mg/kg	9.2-95	--	8,100	--	NO
Heated Storage (SS13)	Soil	DRPH	3,580	mg/kg	9.55-1,150	--	--	500[a]	**YES**
		GRPH	423	mg/kg	<0.400-<9	--	--	100[a]	**YES**
		RRPH	2,400	mg/kg	<480	--	--	2,000[a]	**YES**
		Ethylbenzene	0.283	mg/kg	<0.020-<0.500	--	2,700	--	NO
		Toluene	0.632	mg/kg	<0.020-<0.500	--	5,400	--	NO
		1,3,5-Trimethylbenzene	7.68	mg/kg	<0.025-<0.500	--	--	--	**YES***
		Xylenes	2.53	mg/kg	<0.040-<1.000	--	54,000	--	NO
		Aroclor 1254	2.72	mg/kg	<0.020-<0.100	--	0.54	10[f]	**YES**
		Aluminum	3,000	mg/kg	1,500-25,000	--	--	--	NO
		Barium	43	mg/kg	27-390	--	1,890	--	NO
		Cadmium	2.7	mg/kg	<3.0-<36	--	27	--	NO

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT BARTER ISLAND (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED[h]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL		ARAR	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Heated Storage	Soil	Calcium	14,000	mg/kg	360-59,000	--	--	--	NO
(SS13)	(Continued)	Chromium	17	mg/kg	<4.3-47	--	135	--	NO
(Continued)		Copper	12	mg/kg	<2.7-45	--	999	--	NO
		Iron	9,600	mg/kg	5,400-35,000	--	--	--	NO
		Lead	33	mg/kg	<5.1-22	--	--	500[b]	NO
		Magnesium	4,900	mg/kg	360-7,400	--	--	--	NO
		Manganese	96	mg/kg	25-290	--	3,780	--	NO
		Nickel	7.9	mg/kg	4.2-46	--	540	--	NO
		Potassium	580	mg/kg	<300-2,200	--	--	--	NO
		Sodium	60	mg/kg	<160-680	--	--	--	NO
		Vanadium	14	mg/kg	6.03-59	--	189	--	NO
		Zinc	500	mg/kg	9.2-95	--	8,100	--	NO
	Surface	DRPH	5,760	µg/L	<200	--	292	--	**YES**
	Water	GRPH	6.9	µg/L	<20	50	730	--	NO
		Benzene	6.9	µg/L	<1	0.617	--	5[e]	**YES**
		Chloromethane	4.2	µg/L	<1	6.54	--	--	NO
		1,2-Dichloroethane*	9.1	µg/L	1.3B-3.2B	0.934	--	5[e]	NO[g]
		Ethylbenzene	3.2	µg/L	<1	--	158	700[c]	NO
		Naphthalene	1.6	µg/L	<1	--	150	--	NO
		Tetrachloroethane	12	µg/L	<1	1.63	36.5	5[c]	**YES**
		1,2,4-Trimethylbenzene	1.4	µg/L	<1	--	--	--	**YES***
		1,3,5-Trimethylbenzene	1.3	µg/L	<1	--	--	--	**YES***
		Xylenes	12.8	µg/L	<2	--	7,300	10,000[c]	NO

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT BARTER ISLAND (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED[h]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL CANCER	RBSL NON-CANCER	ARAR	CHEMICAL OF CONCERN
Heated Storage	Surface	Aluminum	210	µg/L	<100-350	--	--	--	NO
(SS13)	Water	Barium	82	µg/L	<50-93	--	256	2,000[d]	NO
(Continued)	(Continued)	Calcium	130,000	µg/L	4,100-88,000	--	--	--	NO
		Iron	12,000	µg/L	<100-2,800	--	--	--	NO
		Magnesium	46,000	µg/L	<5,000-54,000	--	--	--	NO
--		Manganese	540	µg/L	<50-510	--	18.3	--	**YES**
		Potassium	17,000	µg/L	<5,000	--	--	--	NO
		Sodium	110,000	µg/L	8,200-450,000	--	--	--	NO
Garage	Soil	DRPH	12,400	mg/kg	9.55-1,150	--	--	500[a]	**YES**
(SS14)		GRPH	700	mg/kg	<0.400-<9	--	--	100[a]	**YES**
		RRPH	27,000	mg/kg	<480	--	--	2,000[a]	**YES**
		Benzene	1.4	mg/kg	<0.020-<0.500	2.2	--	0.5[a]	**YES**
		n-Butylbenzene	4.22	mg/kg	<0.025-<0.500	--	--	--	**YES***
		sec-Butylbenzene	1.28	mg/kg	<0.025-<0.500	--	--	--	**YES***
		tert-Butylbenzene	0.256	mg/kg	<0.025-<0.500	--	--	--	**YES***
		cis-1,2-Dichloroethene	0.069	mg/kg	<0.025-<0.500	--	270	--	NO
		Ethylbenzene	11	mg/kg	<0.020-<0.500	--	2,700	--	NO
		Isopropylbenzene	0.681	mg/kg	<0.025-<0.500	--	--	--	**YES***
		p-Isopropyltoluene	2.47	mg/kg	<0.025-<0.500	--	--	--	**YES***
		Naphthalene	46	mg/kg	<0.025-<3.50	--	1,100	--	NO
		n-Propylbenzene	1.17	mg/kg	<0.025-<0.500	--	--	--	NO

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT BARTER ISLAND (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED[h]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL CANCER	RBSL NON-CANCER	ARAR	CHEMICAL OF CONCERN
Garage	Soil	Tetrachloroethane	0.023	mg/kg	<0.020-<0.500	1.23	270	--	NO
(SS14)	(Continued)	Toluene	2.3	mg/kg	<0.020-<0.500	--	5,400	--	NO
(Continued)		1,2,4-Trimethylbenzene	14.7	mg/kg	<0.025-<0.500	--	--	--	**YES***
		1,3,5-Trimethylbenzene	9.32	mg/kg	<0.025-<0.500	--	--	--	**YES***
		Xylenes	47	mg/kg	<0.040-<1.000	--	54,000	--	NO
		Isophrone	1.49	mg/kg	<0.230-<3.50	67.4	5,400	--	NO
		2-Methylnaphthalene	14.5	mg/kg	<0.230-<3.50	--	--	--	**YES***
		Phenanthrene	4.79	mg/kg	<0.230-<3.50	--	--	--	**YES***
		Fluoranthene	2.28	mg/kg	<0.230-<3.50	--	1,080	--	NO
		bis(2-Ethylhexyl)Phthalate	4.6	mg/kg	<0.230-<3.50	4.57	540	--	**YES**
		Aluminum	2,100	mg/kg	1,500-25,000	--	--	--	NO
		Barium	29	mg/kg	27-390	--	1,890	--	NO
		Calcium	9,300	mg/kg	360-59,000	--	--	--	NO
		Chromium	53	mg/kg	<4.3-47	--	135	--	NO
		Copper	16	mg/kg	<2.7-45	--	999	--	NO
		Iron	6,500	mg/kg	5,400-35,000	--	--	--	NO
		Lead	231	mg/kg	<5.1-22	--	--	500[b]	NO
		Magnesium	4,500	mg/kg	360-7,400	--	--	--	NO
		Manganese	63	mg/kg	25-290	--	3,780	--	NO
		Nickel	5.6	mg/kg	4.2-46	--	540	--	NO

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT BARTER ISLAND (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED[h]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL CANCER	RBSL NON-CANCER	ARAR	CHEMICAL OF CONCERN
Garage (SS14) (Continued)	Soil (Continued)	Potassium	310	mg/kg	<300-2,200	--	--	--	NO
		Sodium	110	mg/kg	<160-680	--	--	--	NO
		Vanadium	7.5	mg/kg	6.3-59	--	189	--	NO
		Zinc	200	mg/kg	9.2-95	--	8,100	--	NO
	Surface Water	Xylenes	8	µg/L	<2	--	7,300	10,000[c]	NO
		Barium	74	µg/L	<50-93	--	256	2,000[d]	NO
		Calcium	110,000	µg/L	4,100-88,000	--	--	--	NO
		Iron	6,000	µg/L	<100-2,800	--	--	--	NO
		Magnesium	34,000	µg/L	<5,000-54,000	--	--	--	NO
		Manganese	490	µg/L	<50-510	--	18.3	--	NO
		Potassium	9,100	µg/L	<5,000	--	--	--	NO
		Sodium	140,000	µg/L	8,200-450,000	--	--	--	NO
Weather Station Building (SS15)	Soil	DRPH	8,420	mg/kg	9.55-1,150	--	--	500[a]	**YES**
		GRPH	1,020	mg/kg	<0.400-<9	--	--	100[a]	**YES**
		Ethylbenzene	1.09	mg/kg	<0.020-<0.500	--	2,700	--	NO
		Naphthalene	0.083	mg/kg	<0.025-<3.50	--	1,100	--	NO
		Toluene	0.137	mg/kg	<0.020-<0.500	--	5,400	--	NO
		1,3,5-Trimethylbenzene	0.084	mg/kg	<0.025-<0.500	--	--	--	**YES***
		Xylenes	2.34	mg/kg	<0.040-<1.000	--	54,000	--	NO
White Alice Facility (SS16)	Soil	Aroclor 1254	52	mg/kg	<0.020-<0.100	--	0.54	10[f]	**YES**

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT BARTER ISLAND (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED[h]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL		ARAR	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
POL Tanks (ST17)	Soil	DRPH	1,670	mg/kg	9.55-1,150	--	--	500[a]	YES
		GRPH	295	mg/kg	<0.400-<9	--	--	100[a]	YES
		Ethylbenzene	0.4	mg/kg	<0.020-<0.500	--	2,700	--	NO
		Toluene*	1.0	mg/kg	<0.020-<0.500	--	5,400	--	NO
		1,2,4-Trimethylbenzene	0.511	mg/kg	<0.025-<0.500	--	--	--	YES
		Xylenes	0.6	mg/kg	<0.040-<1.000	--	54,000	--	NO
Fuel Tanks (ST18)	Soil	DRPH	490	mg/kg	9.55-1,150	--	--	500[a]	NO
		GRPH	6	mg/kg	<0.400-<9	--	--	100[a]	NO
		RRPH	190	mg/kg	<480	--	--	2,000[a]	NO
		Benzene	0.1	mg/kg	<0.020-<0.500	2.2	--	0.5	NO
		Ethylbenzene	0.2	mg/kg	<0.020-<0.500	--	2,700	--	NO
		Toluene*	0.1	mg/kg	<0.020-<0.500	--	5,400	--	NO
		1,2,4-Trimethylbenzene	0.128	mg/kg	<0.025-<0.500	--	--	--	NO
		1,3,5-Trimethylbenzene	0.048	mg/kg	<0.025-<0.500	--	--	--	NO
		Xylenes	0.4	mg/kg	<0.040-<1.000	--	54,000	--	NO
Old Dump Site (LF19)	Soil	DRPH	580	mg/kg	9.55-1,150	--	--	500[a]	YES
		GRPH	22	mg/kg	<0.400-<9	--	--	100[a]	NO
		RRPH	5,800	mg/kg	<480	--	--	2,000[a]	YES
		Aluminum	3,500	mg/kg	1,500-25,000	--	--	--	NO
		Barium	31	mg/kg	27-390	--	1,890	--	NO
		Calcium	12,000	mg/kg	360-59,000	--	--	--	NO
		Chromium	7.4	mg/kg	<4.3-47	--	135	--	NO
		Copper	7.9	mg/kg	<2.7-45	--	999	--	NO

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT BARTER ISLAND (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED[h]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL CANCER	RBSL NON-CANCER	ARAR	CHEMICAL OF CONCERN
Old Dump Site	Soil	Iron	8,800	mg/kg	5,400-35,000	--	--	--	NO
(LF19)	(Continued)	Magnesium	1,900	mg/kg	360-7,400	--	--	--	NO
(Continued)		Manganese	160	mg/kg	25-290	--	3,780	--	NO
		Nickel	7.8	mg/kg	4.2-46	--	540	--	NO
		Potassium	410	mg/kg	<300-2,200	--	--	--	NO
		Sodium	70	mg/kg	<160-680	--	--	--	NO
		Vanadium	9.3	mg/kg	6.3-59	--	189	--	NO
		Zinc	21	mg/kg	9.2-95	--	8,100	--	NO
	Surface	Aluminum	160	µg/L	<100-350	--	--	--	NO
	Water	Barium	140	µg/L	<50-93	--	256	2,000[a]	NO
		Calcium	170,000	µg/L	4,100-88,000	--	--	--	NO
		Iron	18,000	µg/L	<100-2,800	--	--	--	NO
		Magnesium	75,000	µg/L	<5,000-54,000	--	--	--	NO
		Manganese	70	µg/L	<50-510	--	18.3	--	NO
		Potassium	8,700	µg/L	<5,000	--	--	--	NO
		Sodium	320,000	µg/L	8,200-450,000	--	--	--	NO
Bladder Diesel Spill	Soil	Naphthalene	0.280	mg/kg	<0.025-<3.50	--	1,100	--	NO
(SS20)		Toluene	0.097	mg/kg	<0.020-<0.500	--	5,400	--	NO
		Phenanthrene	1.96	mg/kg	<0.230-<3.50	--	--	--	**YES***
		Fluoranthene	1.70	mg/kg	<0.230-<3.50	--	1,080	--	NO

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT BARTER ISLAND (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED[h]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL		ARAR	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Bladder Diesel Spill	Soil	Pyrene	1.26	mg/kg	<0.230-<3.50	--	810	--	NO
(SS20)	(Continued)	Aluminum	2,100	mg/kg	1,500-25,000	--	--	--	NO
(Continued)		Barium	20	mg/kg	27-390	--	1,890	--	NO
		Calcium	33,000	mg/kg	360-59,000	--	--	--	NO
		Chromium	9.3	mg/kg	<4.3-47	--	135	--	NO
		Copper	6.6	mg/kg	<2.7-45	--	999	--	NO
		Iron	6,200	mg/kg	5,400-35,000	--	--	--	NO
		Lead	11	mg/kg	<5.1-22	--	--	500[b]	NO
		Magnesium	17,000	mg/kg	360-7,400	--	--	--	NO
		Manganese	77	mg/kg	25-290	--	3,780	--	NO
		Nickel	7.7	mg/kg	4.2-46	--	540	--	NO
		Sodium	80	mg/kg	<160-680	--	--	--	NO
		Vanadium	6.7	mg/kg	6.3-59	--	189	--	NO
		Zinc	30	mg/kg	9.2-95	--	8,100	--	NO
	Surface Water	Naphthalene	2.7	µg/L	<1-<10	--	150	--	NO
JP-4 Spill	Soil	DRPH	1,300	mg/kg	9.55-1,150	--	--	500[a]	**YES**
(SS21)		GRPH	300	mg/kg	<0.400-<9	--	--	100[a]	**YES**
		Benzene	3.9	mg/kg	<0.020-<0.500	2.2	--	0.5[a]	**YES**
		n-Butylbenzene	4.20	mg/kg	<0.025-<0.500	--	--	--	**YES***
		sec-Butylbenzene	1.94	mg/kg	<0.025-<0.500	--	--	--	**YES***
		tert-Butylbenzene	0.345	mg/kg	<0.025-<0.500	--	--	--	**YES***
		Ethylbenzene	11.8	mg/kg	<0.020-<0.500	--	2,700	--	NO
		Isopropylbenzene	2.25	mg/kg	<0.025-<0.500	--	--	--	NO

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT BARTER ISLAND (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED[h]	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL		ARAR	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
JP-4 Spill	Soil	p-Isopropyltoluene	2.56	mg/kg	<0.025-<0.500	--	--	--	**YES***
(SS21)	(Continued)	Naphthalene	5.54	mg/kg	<0.025-<3.50	--	1,100	--	NO
		n-Propylbenzene	3.26	mg/kg	<0.025-<0.500	--	--	--	**YES***
		Toluene	24.0	mg/kg	<0.020-<0.500	--	5,400	--	NO
		1,2,4-Trimethylbenzene	18.1	mg/kg	<0.025-<0.500	--	--	--	**YES***
		1,3,5-Trimethylbenzene	9.16	mg/kg	<0.025-<0.500	--	--	--	**YES***
		Xylenes	69.0	mg/kg	<0.040-<1.000	--	54,000	--	NO
		2-Methylnaphthalene	1.42	mg/kg	<0.230-<3.50	--	--	--	**YES***

* Chemicals without an RBSL or ARAR are considered chemicals of potential concern and are discussed in Section 2.1.5.
a Target cleanup levels for DRPH, GRPH, and RRPH in soil are based on ADEC Non UST guidance and do not necessarily correspond to final site specific cleanup goals.
b EPA 1991c.
c MCL, 56 FR 3526 (30 January 1991).
d MCL, 56 FR 30266 (01 July 1991).
e MCL, 52 FR 25690 (08 July 1987).
f TSCA Cleanup Level.
g 1,2-Dichloroethane was detected in the majority of blank and background samples and site concentration did not exceed five times the maximum detected concentration in blank samples, therefore was not selected as a COC.
h The concentrations reported for metals detected in surface water are results from total metals analyses.

TABLE 2-2. CHEMICALS WITHOUT RBSLS AND ARARS OBSERVED IN THE SOIL, SEDIMENT, OR SURFACE WATER AT THE BARTER ISLAND INSTALLATION

SUBSTITUTED BENZENES
1,2,4-Trimethylbenzene
1,3,5-Trimethylbenzene
n-Propylbenzene
Isopropylbenzene
n-Butylbenzene
sec-Butylbenzene
tert-Butylbenzene
p-Isopropyltoluene
ESSENTIAL HUMAN NUTRIENTS
Calcium
Iron
Magnesium
Potassium
Sodium
POLYCYCLIC AROMATIC HYDROCARBONS
2-Methylnaphthalene
Phenanthrene
OTHER
Dichlorofluoromethane
Aluminum
Cobalt

among the receptor groups identified at the Barter Island installation. The essential human nutrients were discussed in Section 2.1.3 and will not be discussed further here. Essential nutrients are not considered COCs in this assessment.

The American Petroleum Institute (API) recently published an evaluation of the environmental fate, transport, and toxicity of twelve organic chemicals found frequently in petroleum products. The twelve were selected from a large list of "candidates" based on:

- abundance in crude and refined petroleum products, including residual and used oils;
- chemical/physical properties that represent a range of mobilities in soil and solubilities in aqueous environments; and
- and toxicity in mammals and aquatic organisms (API 1994).

Two of the chemicals detected at Barter Island , 1,2,4-trimethylbenzene, and naphthalene, were selected from the list of twelve chemicals (API 1994) and are used in this risk assessment as surrogates for the chemicals without RBSLs and ARARs. These chemicals have similar chemical structures and, therefore, will represent the substituted benzenes and the polycyclic aromatic hydrocarbons that do not have toxicity criteria (Table 2-2).

1,2,4-Trimethylbenzene has a low order of toxicity in mammals (API 1994). No effect was observed on the kidneys of rats that received 0.5 or 2.0 g/kg orally five days per week for four weeks. Inhalation of high concentrations of 1,2,4-trimethylbenzene produces central nervous system depression in humans and rats. Lung toxicity, including bronchitis, pneumonitis, and edema was also observed in humans. 1,2,4-Trimethylbenzene has not been observed to be carcinogenic or mutagenic in laboratory studies of rats and cultured mammalian cells. Potential exposure of receptors to 1,2,4-trimethylbenzene at the Barter Island installation would probably be limited to oral ingestion of soil and at the maximum concentration measured (18.1 mg/kg soil) would be expected to be nontoxic.[1] For the purposes of this risk assessment, 1,2,4-trimethylbenzene is considered to be a reasonable surrogate for the substituted benzenes observed at the Barter Island installation.

Because of the lack of toxicology information available for 2-methylnaphthalene and phenanthrene, naphthalene will be used as a surrogate in this discussion of chemicals without RBSLs and ARARs. Naphthalene has a low order of toxicity in mammals (API 1994). The toxicology of this chemical has been well characterized in several species, including humans, rats, rabbits, and mice. The toxicity in humans is known from cases of accidental or intentional (suicide) ingestion of contaminated food or mothballs, and the most common effect is liver damage (jaundice) and destruction of red blood cells resulting in anemia. These effects occur

[1] Based on the following calculation: assume average daily soil ingestion rate of 200 mg of soil per day and 18.1 mg of 1,2,4-trimethylbenzene per kg of soil (maximum concentration measured at Barter Island installation). This yields a dose of 0.00006 mg of 1,2,4-trimethylbenzene per kg body weight per day. The oral dose of 1,2,4-trimethylbenzene received by rats that showed no kidney effects was equivalent to 2000 mg of 1,2,4-trimethylbenzene per kg body weight, which is more than 33,000,000 times greater than the estimated dose for potential receptors at the Barter Island installation.

at exposure levels that far exceed the levels to which the receptor groups at the Barter Island installation could be exposed. Dose-response information is available from studies in rats, mice, and rabbits. High doses of naphthalene administered over several days to one month resulted in cataract formation and other less serious ocular effects. High doses administered over several days to three months produced mild toxic effects on the liver, lung, kidney, and immunological system. The no effect level of oral exposure in these species occurs in the range of 100 to 300 mg naphthalene per kg body weight per day (100 to 300 mg/kg/day). The oral exposure levels to 2-methylnaphthalene and phenanthrene that may occur through soil ingestion at the Barter Island installation are in the range of 0.00001 to 0.00004 mg/kg/day. Furthermore, the RBSL for naphthalene exceeds the maximum concentrations of 2-methylnaphthalene and phenanthrene. Therefore, any exposure to 2-methylnaphthalene and phenanthrene in the soil or surface water at the Barter Island installation is expected to be nontoxic.[2]

The chemicals without RBSLs and ARARs which are listed in the "Other" category of Table 2-2 are not expected to pose a significant hazard to the receptor groups identified at the Barter Island installation. Dichlorofluoromethane was observed in only one surface water sample at 3.7 µg/L. A structurally similar chemical, dichlorodifluoromethane, has an RBSL of 500 µg/L, which is more than 100 times greater than the concentration of dichlorofluoromethane measured at Barter Island. Cobalt was observed in only one soil sample at a concentration of 5.7 mg/kg. The common range of cobalt concentrations in the lithosphere is 1 to 40 mg/kg (Lindsay 1979); therefore, it is not likely that any level of toxicity would result from the cobalt detected at Barter Island. It is not considered a COC in this assessment. Aluminum is the most abundant metal in the earth's crust (Lindsay 1979), and the concentrations measured (maximum concentration 7,500 mg/kg) were below the range generally expected in the lithosphere (10,000 to 300,000 mg/kg).

In conclusion, the organic chemicals discussed above have been marked in Table 2-1 as COCs to indicate that there is some uncertainty in screening out these chemicals. Without toxicity criteria the potential risks of these chemical cannot be quantified. However, based on the information in this section, and the concentrations measured at the sites, these chemicals are not expected to pose a heath risk.

Exposures to Lead. Exposures to lead may cause adverse noncarcinogenic health effects; however, EPA has not developed an RfD for this chemical. Lead concentrations in soil were compared to EPA's final action level for lead in soil of 500 to 1,000 mg/kg. It is estimated that exposure to soil containing 500 mg of lead per kilogram soil would yield blood lead levels below 10 µg/L (a blood lead level of concern) in roughly 99 percent of young children who are not also exposed to excessive lead paint hazards or heavily contaminated soils (EPA 1991d). Lead concentrations did not exceed 500 mg/kg at any sampling location at the Barter Island facility.

Chemicals with RBSLs and/or ARARs. Following are discussions of the COCs at each site that exceeded background levels and an RBSL, ARAR, or both.

---

[2] Based on the following assumptions: soil ingestion rate, 200 mg/day; drinking water ingestion rate, 2 L/day; 70 kg body weight for typical receptor; maximum soil concentration of 2-methylnaphthalene, 14.5 mg/kg; maximum soil concentration of phenanthrene, 4.79 mg/kg.

2.1.5.1 Old Landfill (LF01). No COCs were identified for the soil matrix at the Old Landfill (Figure 2-2) based on a comparison of the maximum concentrations of the detected chemicals to background levels, and the RBSL and/or ARAR concentrations (Table 2-1). Manganese was the only chemical identified as a COC for surface water (Table 2-1).

2.1.5.2 POL Catchment (LF03). DRPH and tetrachloroethane were identified as COCs for the soil matrix at the POL Catchment site (Figure 2-3). The maximum concentration of DRPH exceeded the ARAR for diesel contamination of soil (Table 2-1) (ADEC 1991). The maximum concentration of tetrachloroethane exceeded the carcinogen RBSL (Table 2-1).

DRPH, GRPH, and benzene were identified as COCs for the surface water at the POL Catchment (Figure 2-3). The maximum concentration of DRPH exceeded the noncarcinogen RBSL for diesel contamination of surface water (Table 2-1). The maximum concentrations of GRPH and benzene exceeded their carcinogen RBSLs (Table 2-1).

2.1.5.3 Current Landfill (LF04). No COCs were identified for the soil matrix at the Current Landfill (Figure 2-4) based on a comparison of the maximum concentrations of the detected chemicals to background levels, and the RBSL and/or ARAR concentrations (Table 2-1).

Trichloroethene and manganese were identified as COCs for the surface water at the Current Landfill (Figure 2-4). The maximum concentration of trichloroethene exceeded the drinking water MCL (Table 2-1). The maximum concentration of manganese exceeded the noncarcinogen RBSL (Table 2-1).

2.1.5.4 Contaminated Ditch (SD08). DRPH, GRPH, and beryllium were identified as COCs for the soil matrix at the Contaminated Ditch (Figures 2-5 and 2-6). The maximum concentrations of DRPH and GRPH exceeded the ARARs for diesel and gasoline contamination of soil (Table 2-1) (ADEC 1991). The maximum concentration of beryllium exceeded the carcinogen RBSL (Table 2-1).

No COCs were identified for surface water at the Contaminated Ditch (Figure 2-5) based on a comparison of the maximum concentrations of the detected chemicals to background levels, and the RBSL and/or ARAR concentrations (Table 2-1).

2.1.5.5 Old Runway Dump (LF12). No COCs were identified for the soil matrix at the Old Runway Dump (Figure 2-7) based on a comparison of the maximum concentrations of the detected chemicals to background levels, and the RBSL and/or ARAR concentrations (Table 2-1).

No surface water bodies were identified at the Old Runway Dump.

2.1.5.6 Heated Storage (SS13). DRPH, GRPH, RRPH, and Aroclor 1254 were identified as COCs for the soil matrix at the Heated Storage site (Figures 2-8 and 2-9). The maximum concentrations of DRPH, GRPH, and RRPH exceeded the ARARs for petroleum hydrocarbon contamination of soil (Table 2-1) (ADEC 1991). The maximum concentration of Aroclor 1254 exceeded the noncarcinogen RBSL (Table 2-1).

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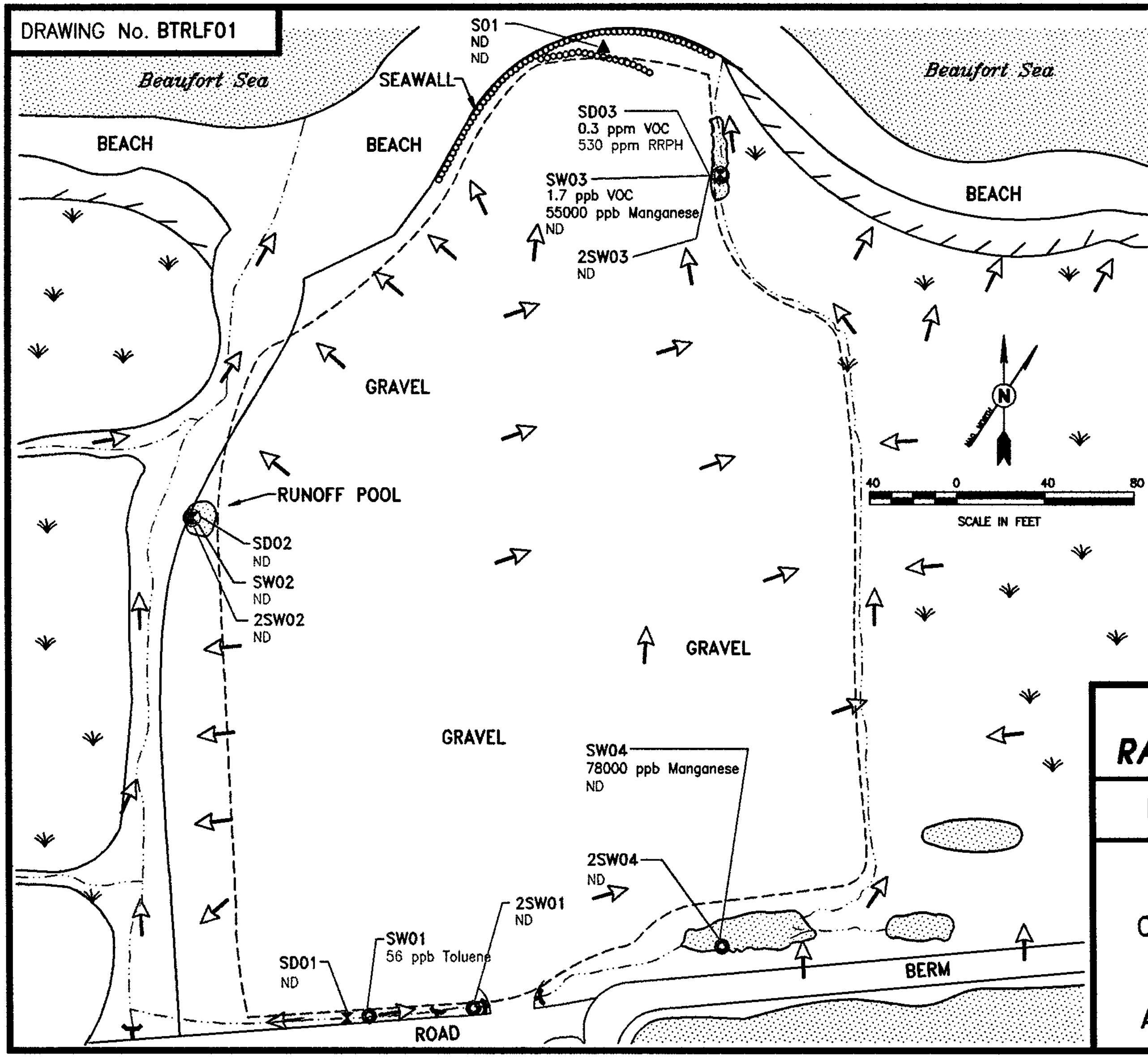
DRAWING No. BTRLF01



LEGEND

(symbol)	ROADS
▲	SOIL SAMPLE
(symbol)	SEDIMENT SAMPLE
(symbol)	SURFACE WATER SAMPLE
(symbol)	SEDIMENT AND WATER SAMPLES
(symbol)	TUNDRA
(symbol)	SURFACE WATER
(symbol)	CULVERT
(symbol)	BLUFF
(symbol)	GRAVEL PAD BOUNDARY
(symbol)	LANDFILL BOUNDARY
(symbol)	SURFACE DRAINAGE
2.6 ppm	CT&E DATA
0.9 ppm	F&B DATA

0000	CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND	NO CONTAMINATION DETECTED
VOC	TOTAL VOLATILE ORGANIC COMPOUNDS
RRPH	RESIDUAL RANGE PETROLEUM

BARTER ISLAND RADAR INSTALLATION

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FIGURE NO. 2-2

OLD LANDFILL (LF01) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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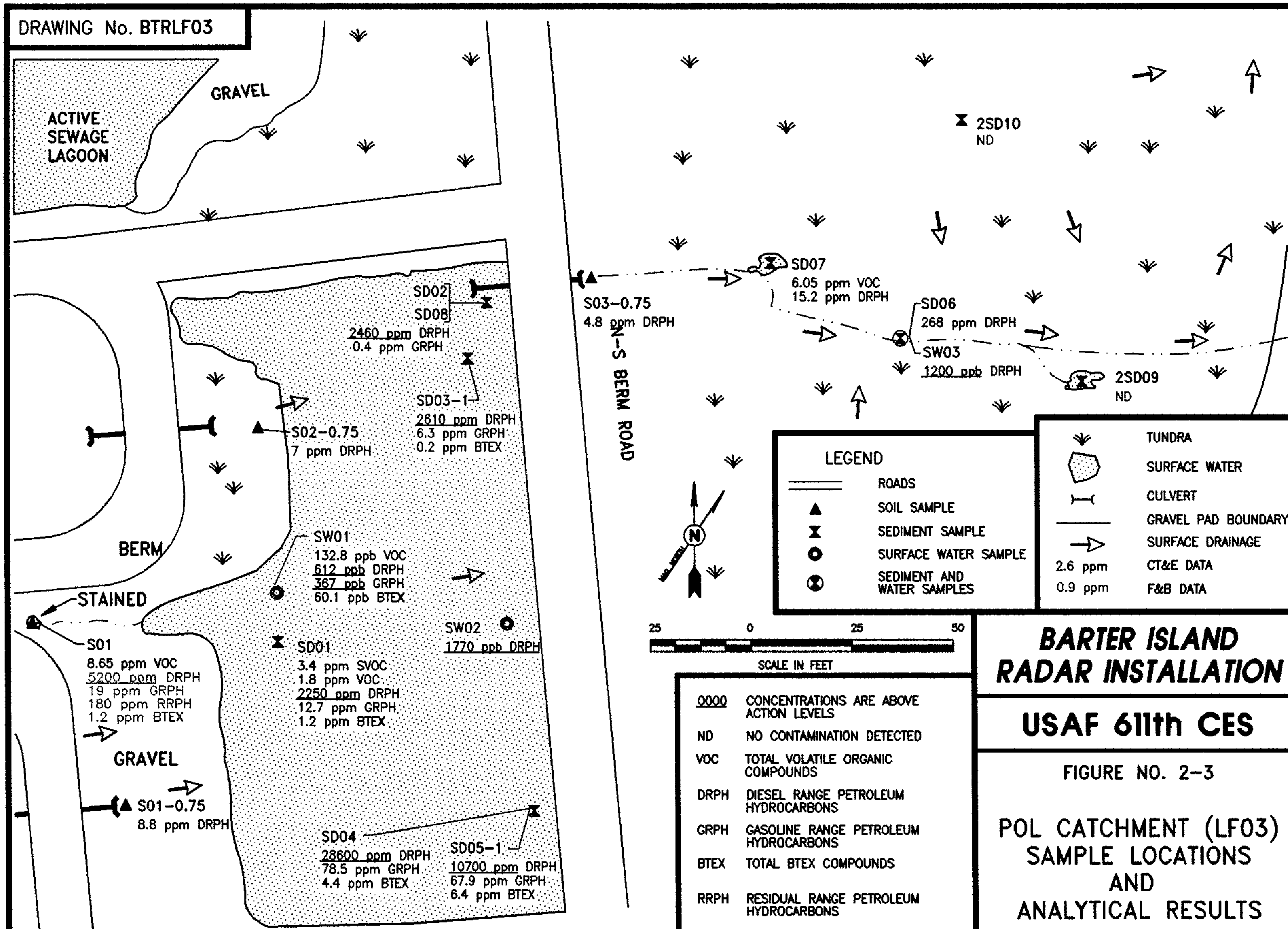

0000	CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND	NO CONTAMINATION DETECTED
VOC	TOTAL VOLATILE ORGANIC COMPOUNDS
DRPH	DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH	GASOLINE RANGE PETROLEUM HYDROCARBONS
BTEX	TOTAL BTEX COMPOUNDS
RRPH	RESIDUAL RANGE PETROLEUM HYDROCARBONS

BARTER ISLAND RADAR INSTALLATION

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FIGURE NO. 2-3

POL CATCHMENT (LF03) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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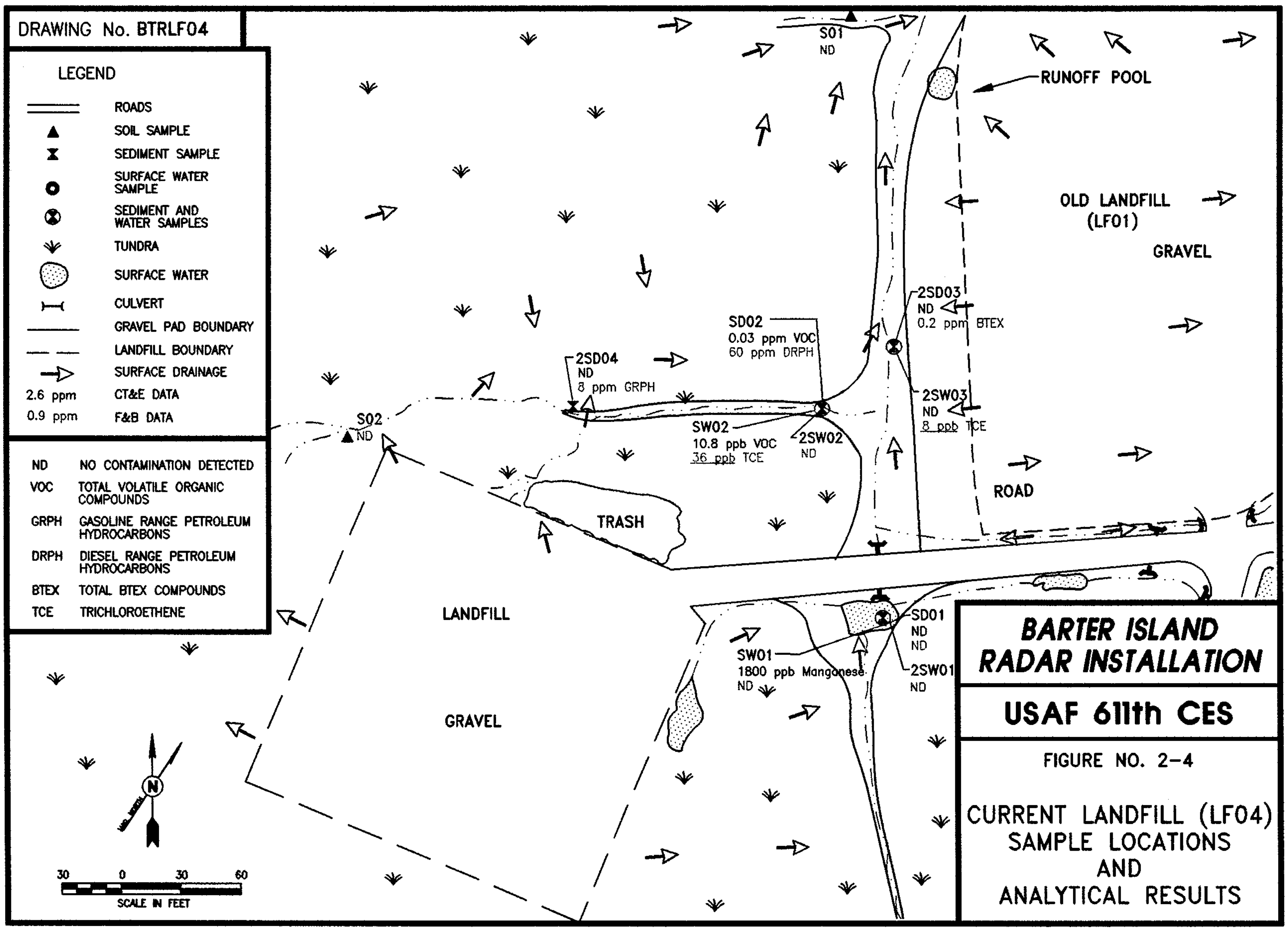
DRAWING No. BTRLF04
LEGEND
ROADS
SOIL SAMPLE
SEDIMENT SAMPLE
SURFACE WATER SAMPLE
SEDIMENT AND WATER SAMPLES
TUNDRA
SURFACE WATER
CULVERT
GRAVEL PAD BOUNDARY
LANDFILL BOUNDARY
SURFACE DRAINAGE
2.6 ppm CT&E DATA
0.9 ppm F&B DATA
ND NO CONTAMINATION DETECTED
VOC TOTAL VOLATILE ORGANIC COMPOUNDS
GRPH GASOLINE RANGE PETROLEUM HYDROCARBONS
DRPH DIESEL RANGE PETROLEUM HYDROCARBONS
BTEX TOTAL BTEX COMPOUNDS
TCE TRICHLOROETHENE
S01 ND
RUNOFF POOL
OLD LANDFILL (LF01)
GRAVEL
2SD03 ND 0.2 ppm BTEX
2SW03 ND 8 ppb TCE
SD02 0.03 ppm VOC 60 ppm DRPH
2SD04 ND 8 ppm GRPH
S02 ND
SW02 10.8 ppb VOC 36 ppb TCE
2SW02 ND
ROAD
TRASH
LANDFILL
GRAVEL
SD01 ND ND
SW01 1800 ppb Manganese ND
2SW01 ND
N
30 0 30 60
SCALE IN FEET
BARTER ISLAND RADAR INSTALLATION
USAF 611th CES
FIGURE NO. 2-4
CURRENT LANDFILL (LF04) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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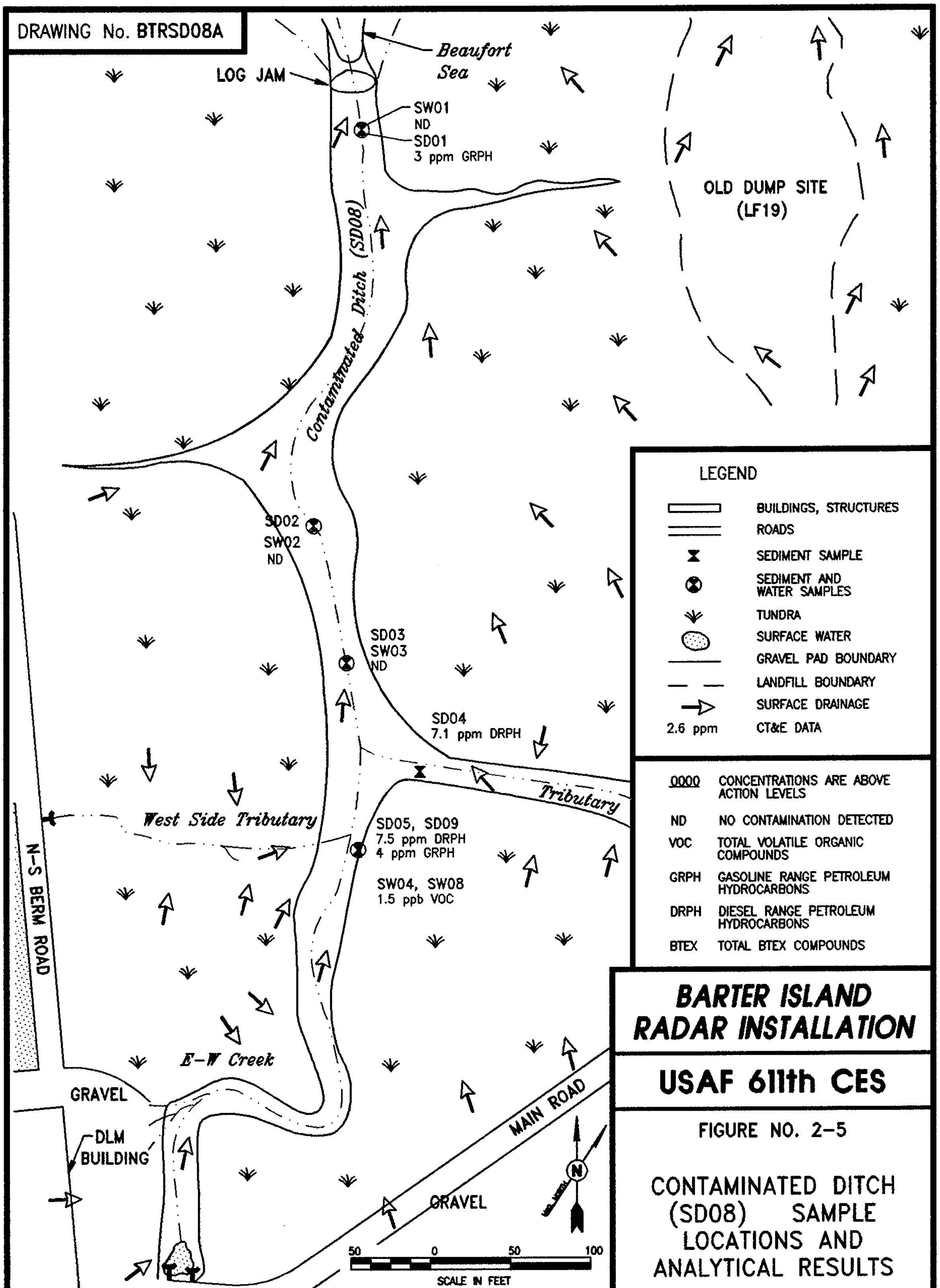

BARTER ISLAND RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 2–5

CONTAMINATED DITCH (SD08) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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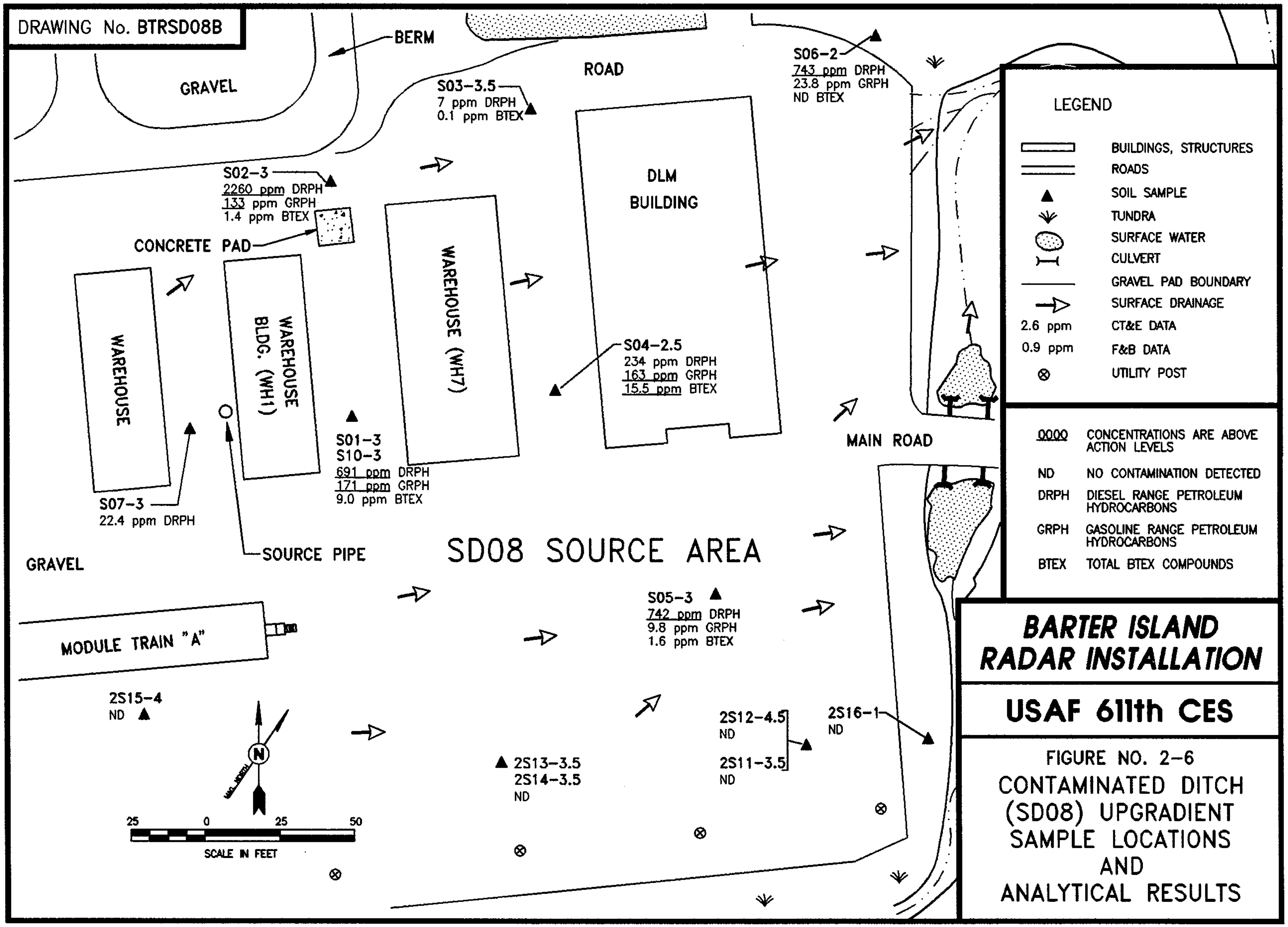

FIGURE NO. 2-6
CONTAMINATED DITCH (SD08) UPGRADIENT SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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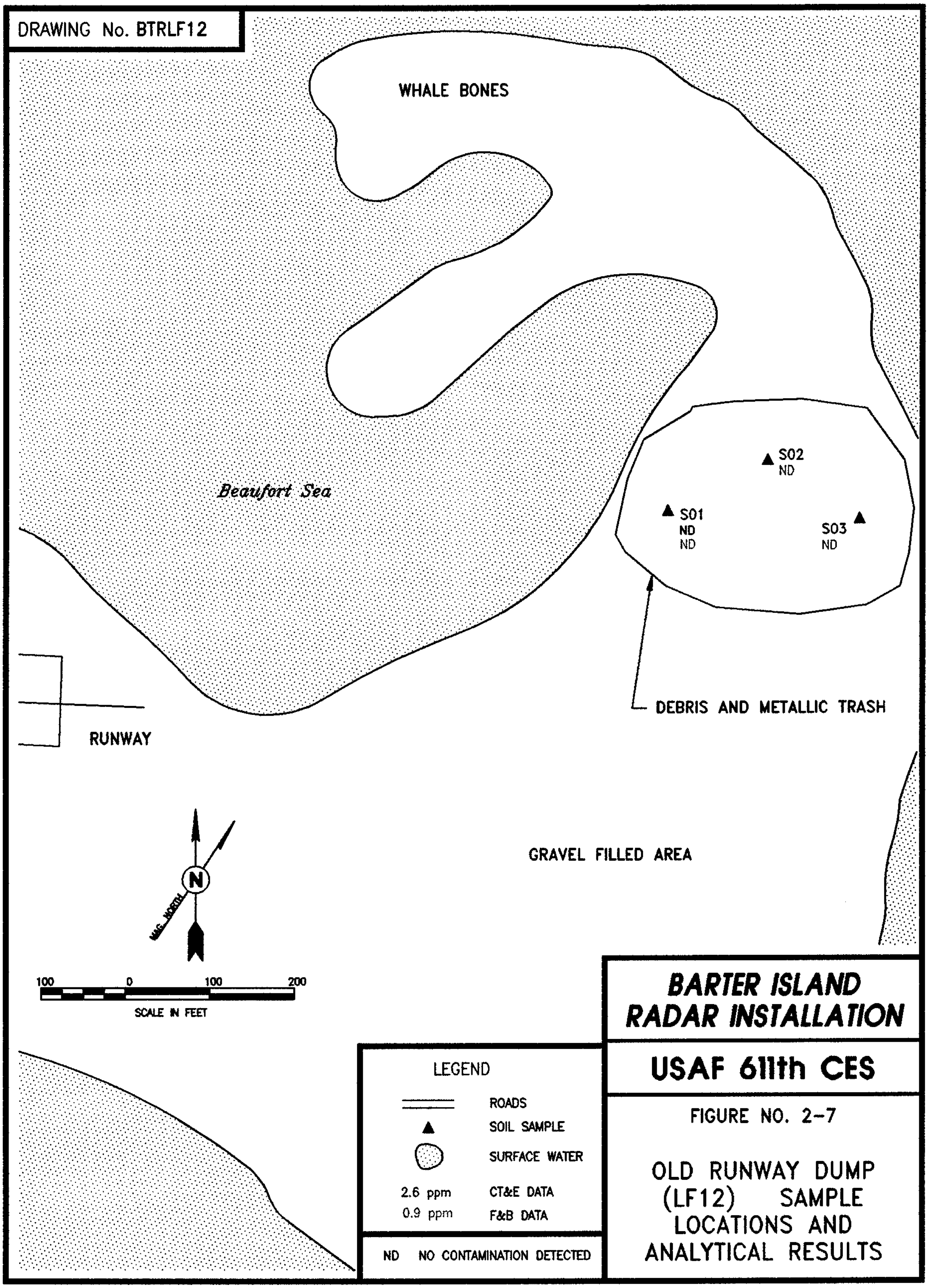

BARTER ISLAND RADAR INSTALLATION

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FIGURE NO. 2-7

OLD RUNWAY DUMP (LF12) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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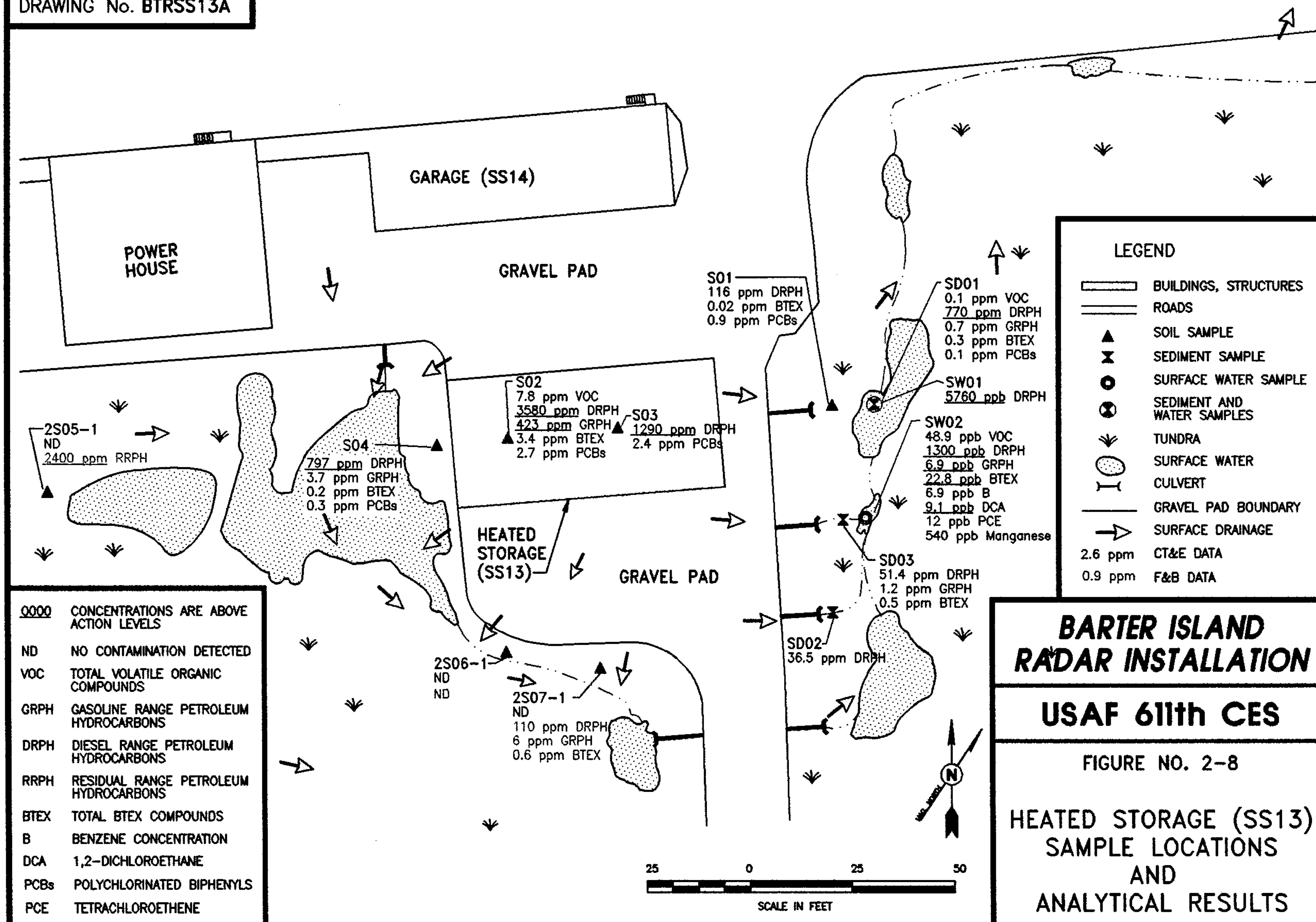

0000	CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND	NO CONTAMINATION DETECTED
VOC	TOTAL VOLATILE ORGANIC COMPOUNDS
GRPH	GASOLINE RANGE PETROLEUM HYDROCARBONS
DRPH	DIESEL RANGE PETROLEUM HYDROCARBONS
RRPH	RESIDUAL RANGE PETROLEUM HYDROCARBONS
BTEX	TOTAL BTEX COMPOUNDS
B	BENZENE CONCENTRATION
DCA	1,2-DICHLOROETHANE
PCBs	POLYCHLORINATED BIPHENYLS
PCE	TETRACHLOROETHENE

LEGEND

- BUILDINGS, STRUCTURES
- ROADS
- SOIL SAMPLE
- SEDIMENT SAMPLE
- SURFACE WATER SAMPLE
- SEDIMENT AND WATER SAMPLES
- TUNDRA
- SURFACE WATER
- CULVERT
- GRAVEL PAD BOUNDARY
- SURFACE DRAINAGE
- 2.6 ppm CT&E DATA
- 0.9 ppm F&B DATA

BARTER ISLAND RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 2-8

HEATED STORAGE (SS13) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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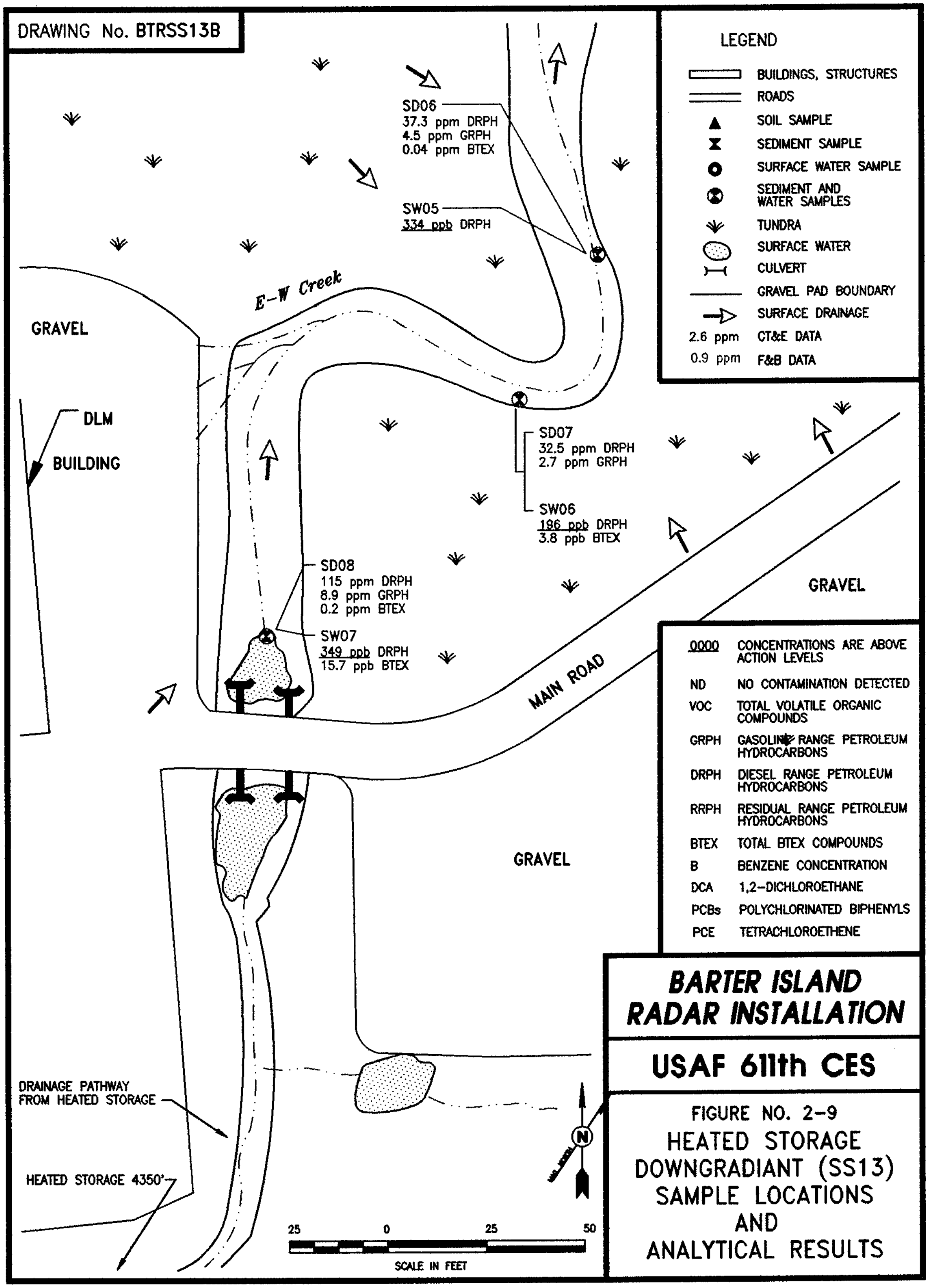

FIGURE NO. 2-9
HEATED STORAGE DOWNGRADIANT (SS13) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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DRPH, benzene, tetrachloroethane, and manganese were identified as COCs for the surface water at the Heated Storage site (Figures 2-8 and 2-9). The maximum concentration of DRPH exceeded the noncarcinogen RBSL for diesel contamination of surface water (Table 2-1). The maximum concentrations of benzene and tetrachloroethane exceeded their carcinogen RBSLs (Table 2-1). The maximum concentration of manganese exceeded the noncarcinogen RBSL (Table 2-1). 1,2-Dichloroethane was detected at this site; however, 1,2-dichloroethane was also detected in the associated blank and background samples at similar concentrations. Therefore it was not included as a COC.

2.1.5.7 Garage (SS14). DRPH, GRPH, RRPH, benzene, and bis(2-ethylhexyl)phthalate were identified as COCs for the soil matrix at the Garage (Figure 2-10). The maximum concentrations of DRPH, GRPH, and RRPH exceeded their ARARs for petroleum hydrocarbon contamination of soil (Table 2-1). The maximum concentration of benzene exceeded the ARAR for benzene in soil (Table 2-1) (ADEC 1991). The maximum concentration of bis(2-ethylhexyl)phthalate exceeded the carcinogen RBSL (Table 2-1).

No COCs were identified for surface water at the Garage (Figure 2-10) based on a comparison of the maximum concentrations of the detected chemicals to background levels, and the RBSL and/or ARAR concentrations (Table 2-1).

2.1.5.8 Weather Station Building (SS15). DRPH and GRPH were identified as COCs for the soil matrix at the Weather Station Building (Figure 2-11). The maximum concentrations of DRPH and GRPH exceeded the ARARs for petroleum hydrocarbon contamination of soil (Table 2-1) (ADEC 1991).

No surface water bodies were identified at the Weather Station Building.

2.1.5.9 White Alice Facility (SS16). Aroclor 1254 was identified as a COC for the soil matrix at the White Alice Facility (Figure 2-12). The maximum concentration of Aroclor 1254 exceeded the noncarcinogen RBSL (Table 2-1). No other COCs were identified for the site.

No surface water bodies were identified at the White Alice Facility.

2.1.5.10 POL Tanks (ST17). DRPH and GRPH were identified as COCs for the soil matrix at the POL Tanks (Figure 2-13). The maximum concentrations of DRPH and GRPH exceeded the ARARs for petroleum hydrocarbon contamination of soil (Table 2-1).

No surface water bodies were identified at the POL Tanks site.

2.1.5.11 Fuel Tanks (ST18). No COCs were identified for the soil matrix at the Fuel Tanks site (Figure 2-14) based on a comparison of the maximum concentrations of the detected chemicals to their RBSL and/or ARAR concentrations (Table 2-1).

No COCs were identified for surface water at the Fuel Tanks site (Figure 2-14) because no contaminants were detected at concentrations greater than the analytical detection limits (Appendix D).

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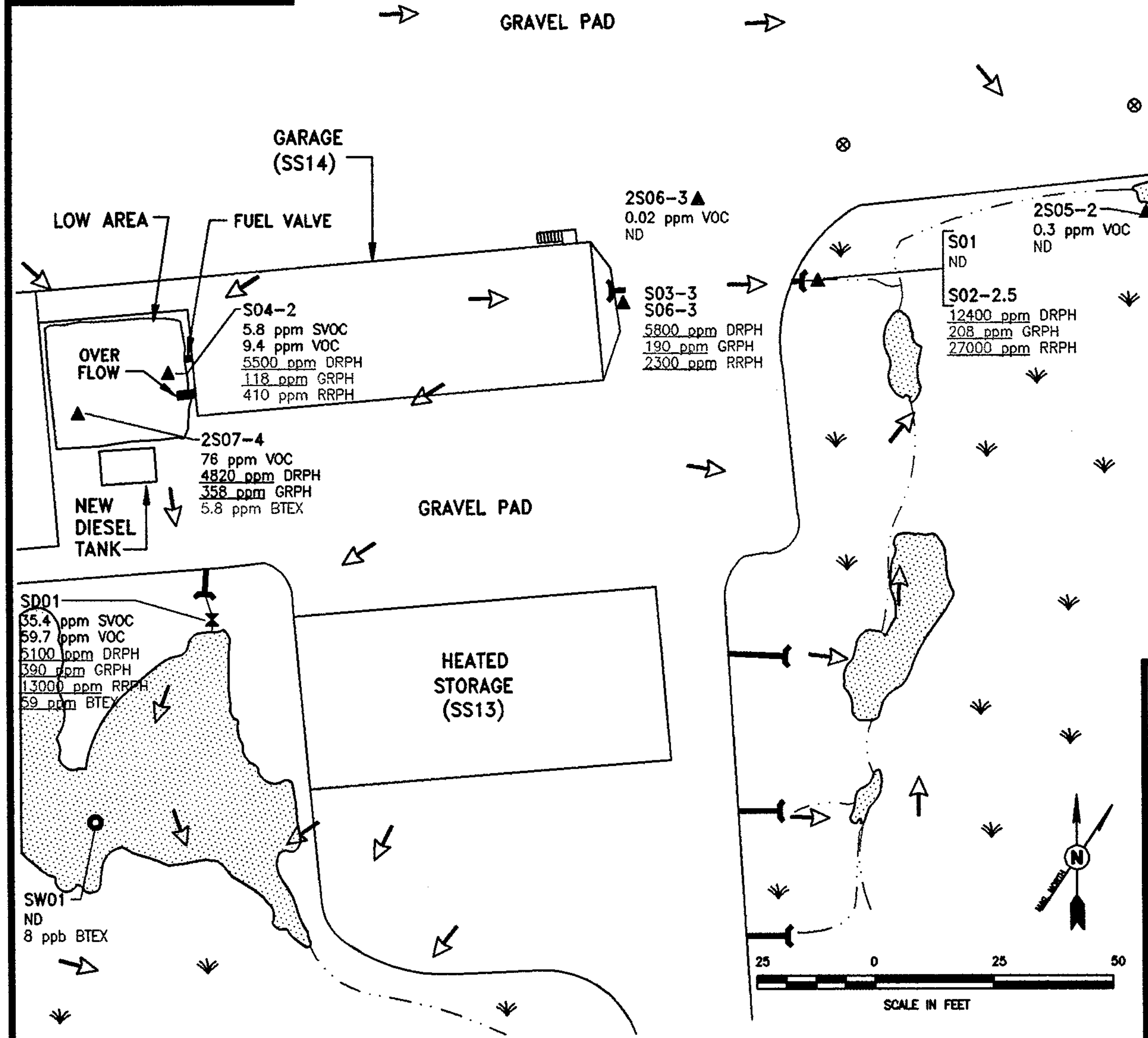
DRAWING No. BTRSS14



LEGEND

	BUILDINGS, STRUCTURES
	ROADS
▲	SOIL SAMPLE
	SEDIMENT SAMPLE
	SURFACE WATER SAMPLE
	TUNDRA
	SURFACE WATER
	CULVERT
	GRAVEL PAD BOUNDARY
	SURFACE DRAINAGE
2.6 ppm	CT&E DATA
0.9 ppm	F&B DATA
⊗	UTILITY POST

0000	CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND	NO CONTAMINATION DETECTED
SVOC	TOTAL SEMI-VOLATILE ORGANIC COMPOUNDS
VOC	TOTAL VOLATILE ORGANIC COMPOUNDS
DRPH	DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH	GASOLINE RANGE PETROLEUM HYDROCARBONS
RRPH	RESIDUAL RANGE PETROLEUM HYDROCARBONS
BTEX	TOTAL BTEX COMPOUNDS

BARTER ISLAND RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 2-10

GARAGE (SS14)
SAMPLE LOCATIONS
AND
ANALYTICAL RESULTS

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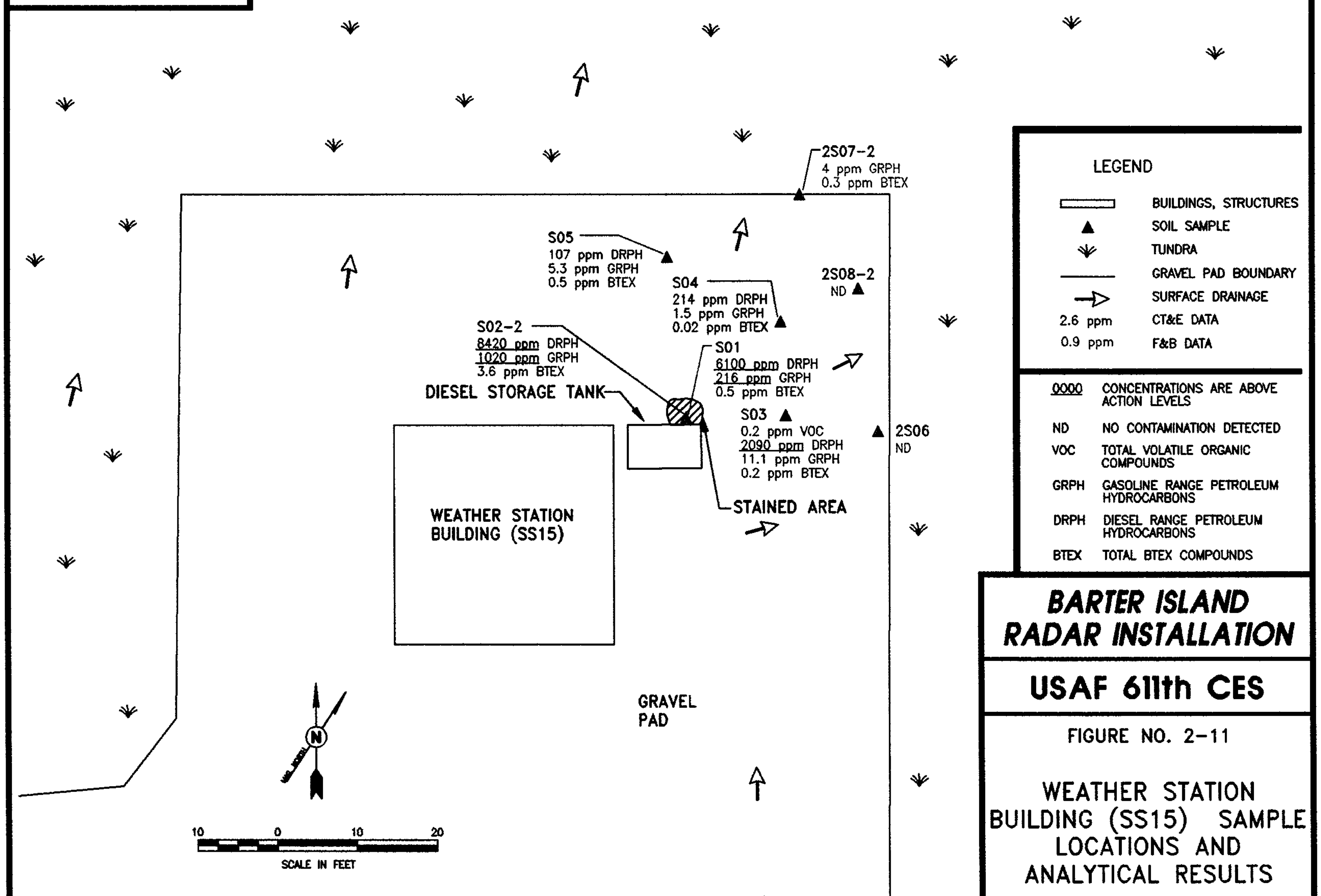

BARTER ISLAND RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 2-11

WEATHER STATION BUILDING (SS15) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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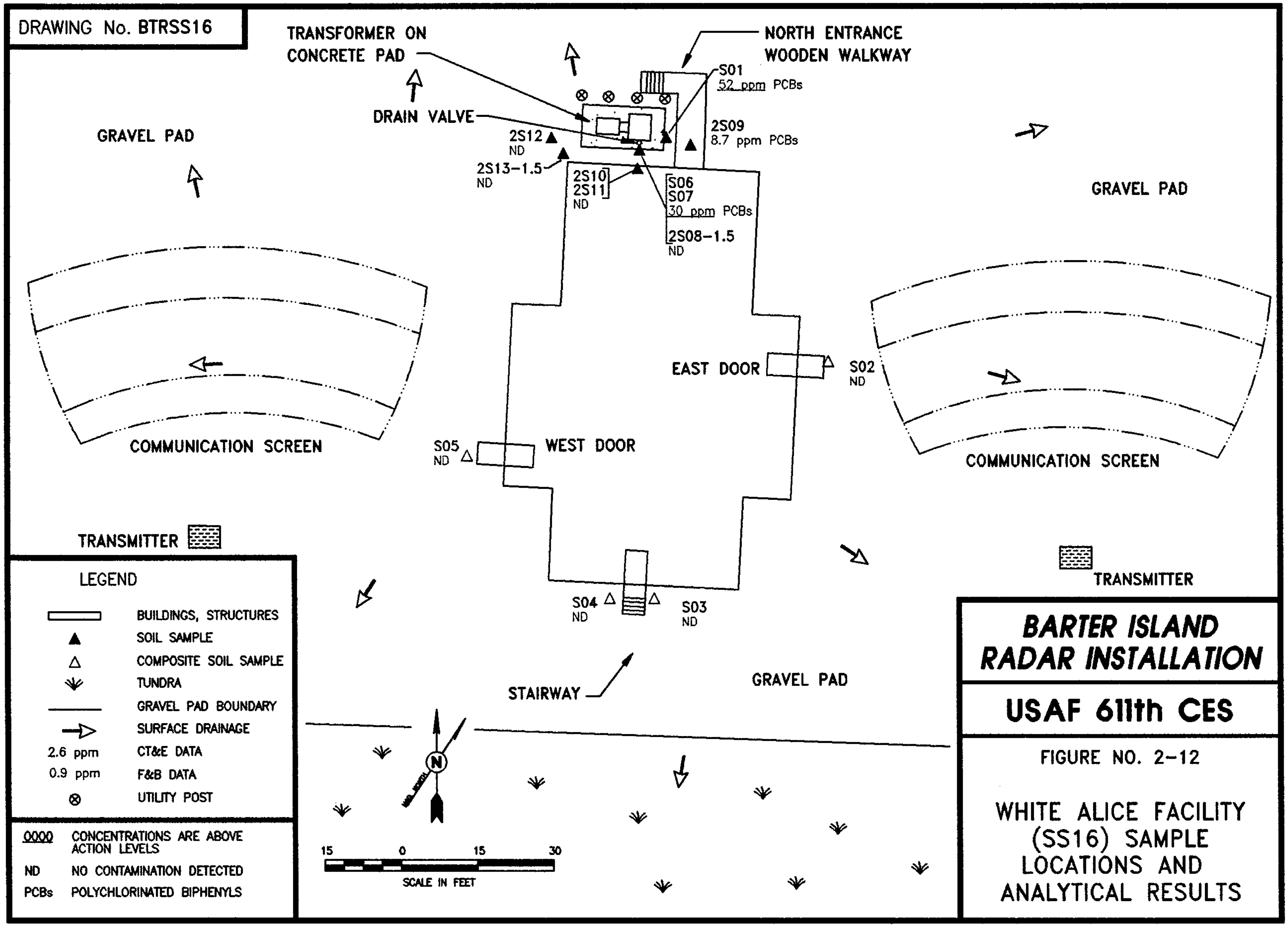

FIGURE NO. 2-12

WHITE ALICE FACILITY (SS16) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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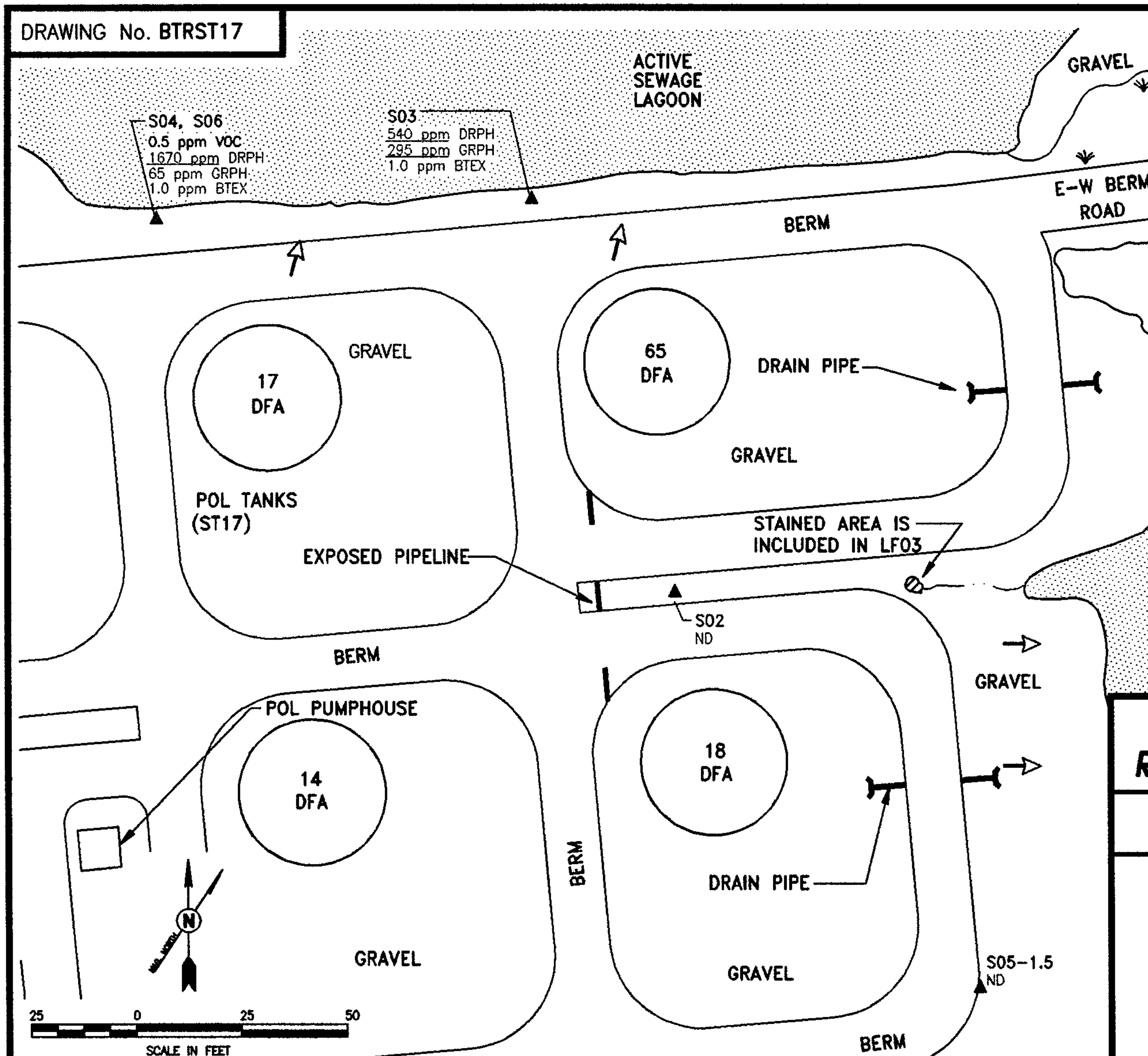

LEGEND

- BUILDINGS, STRUCTURES
- ROADS
- SOIL SAMPLE
- SURFACE WATER
- CULVERT
- GRAVEL PAD BOUNDARY
- SURFACE DRAINAGE
- 2.6 ppm — CT&E DATA
- 0.9 ppm — F&B DATA

0000	CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND	NO CONTAMINATION DETECTED
SVOC	TOTAL SEMI-VOLATILE ORGANIC COMPOUNDS
VOC	TOTAL VOLATILE ORGANIC COMPOUNDS
DRPH	DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH	GASOLINE RANGE PETROLEUM HYDROCARBONS
RRPH	RESIDUAL RANGE PETROLEUM HYDROCARBONS
BTEX	TOTAL BTEX COMPOUNDS

BARTER ISLAND RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 2-13

POL TANKS (ST17) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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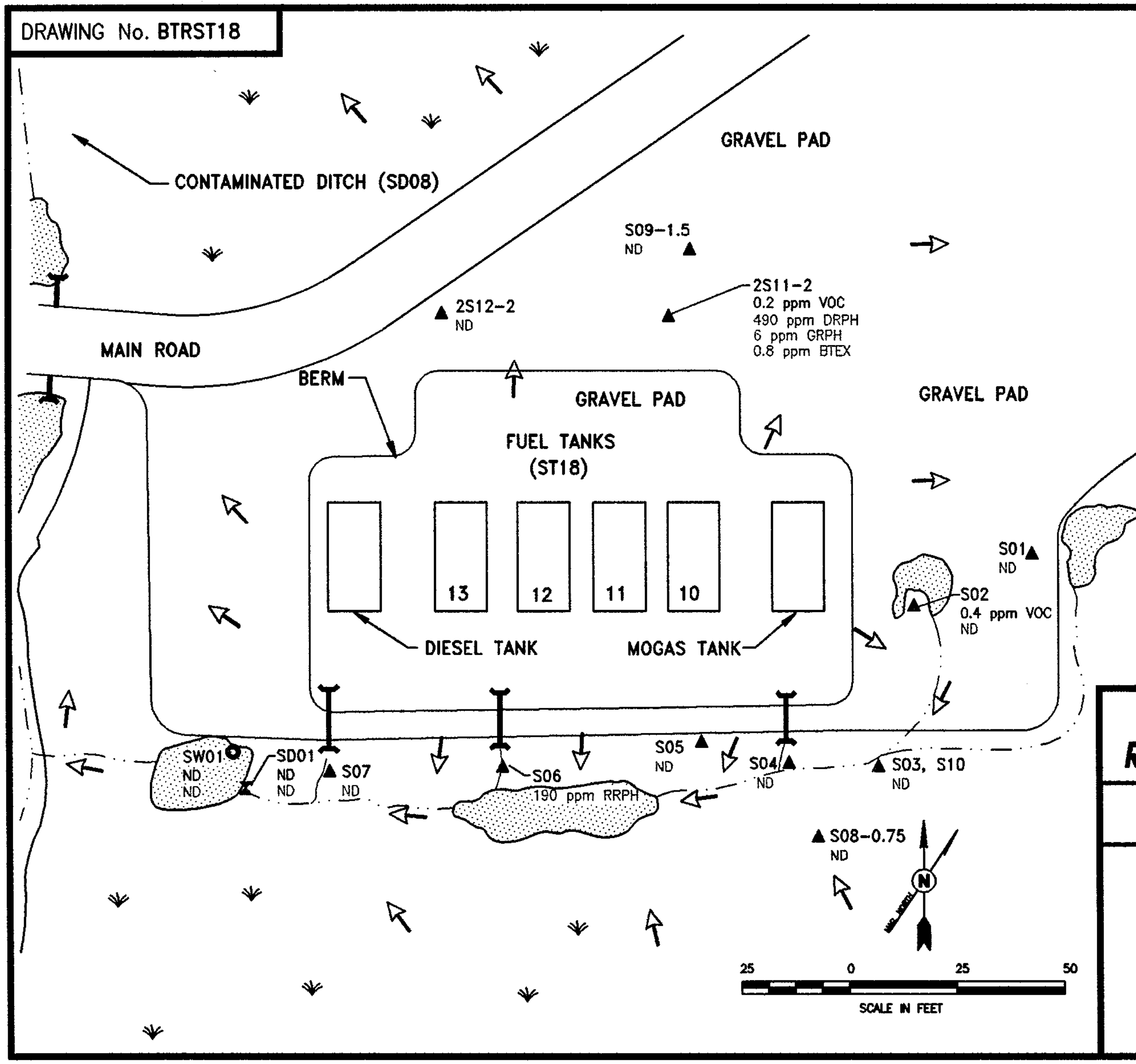

BARTER ISLAND RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 2-14

FUEL TANKS (ST18)
SAMPLE LOCATIONS
AND
ANALYTICAL RESULTS

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2.1.5.12 Old Dump Site (LF19). DRPH and RRPH were identified as COCs for the soil matrix at the Old Dump Site (Figure 2-15). The maximum concentrations of DRPH and RRPH exceeded the ARARs for petroleum hydrocarbon contamination of soil (Table 2-1).

No COCs were identified for surface water at the Old Dump Site (Figure 2-15) based on a comparison of the maximum concentrations of the detected chemicals to background levels, and the RBSL and/or ARAR concentrations (Table 2-1).

2.1.5.13 Bladder Diesel Spill (SS20). No COCs were identified for the soil or surface water at the Bladder Diesel Spill site (Figure 2-16) based on a comparison of the maximum concentrations of the detected chemicals to background levels and the RBSL and/or ARAR concentrations (Table 2-1).

2.1.5.14 JP-4 Spill (SS21). DRPH, GRPH, and benzene were identified as COCs for the soil matrix at the JP-4 Spill site (Figure 2-17). The maximum concentrations of DRPH and GRPH exceeded the ARARs for petroleum hydrocarbon contamination of soil (Table 2-1). The maximum concentration of benzene exceeded the carcinogen RBSL (Table 2-1).

No surface water bodies were identified at the JP-4 Spill site.

A summary of the COCs at Barter Island sites is presented in Table 2-3.

2.2 EXPOSURE ASSESSMENT

The exposure assessment section of a baseline human health risk assessment identifies and describes potential receptors and the exposure pathways by which exposure may occur, and estimates the magnitude of those exposures. This section includes an analysis of which pathways are complete (Section 2.2.1), migration and fate of COCs (Section 2.2.2), an estimation of the total intake of the chemicals (Section 2.2.3), and a summary of how the average daily dose (ADD) was calculated (Section 2.2.4).

2.2.1 Pathway Analysis

Pathway analysis involves the evaluation of the components of potential exposure pathways and a determination of whether each pathway is complete. An exposure pathway describes the course a chemical will take from a source to an exposure point where a receptor can come into contact with the chemical. A complete exposure pathway has five components:

- source of contamination;
- release mechanism;
- transport mechanism;
- exposure point; and
- receptor.

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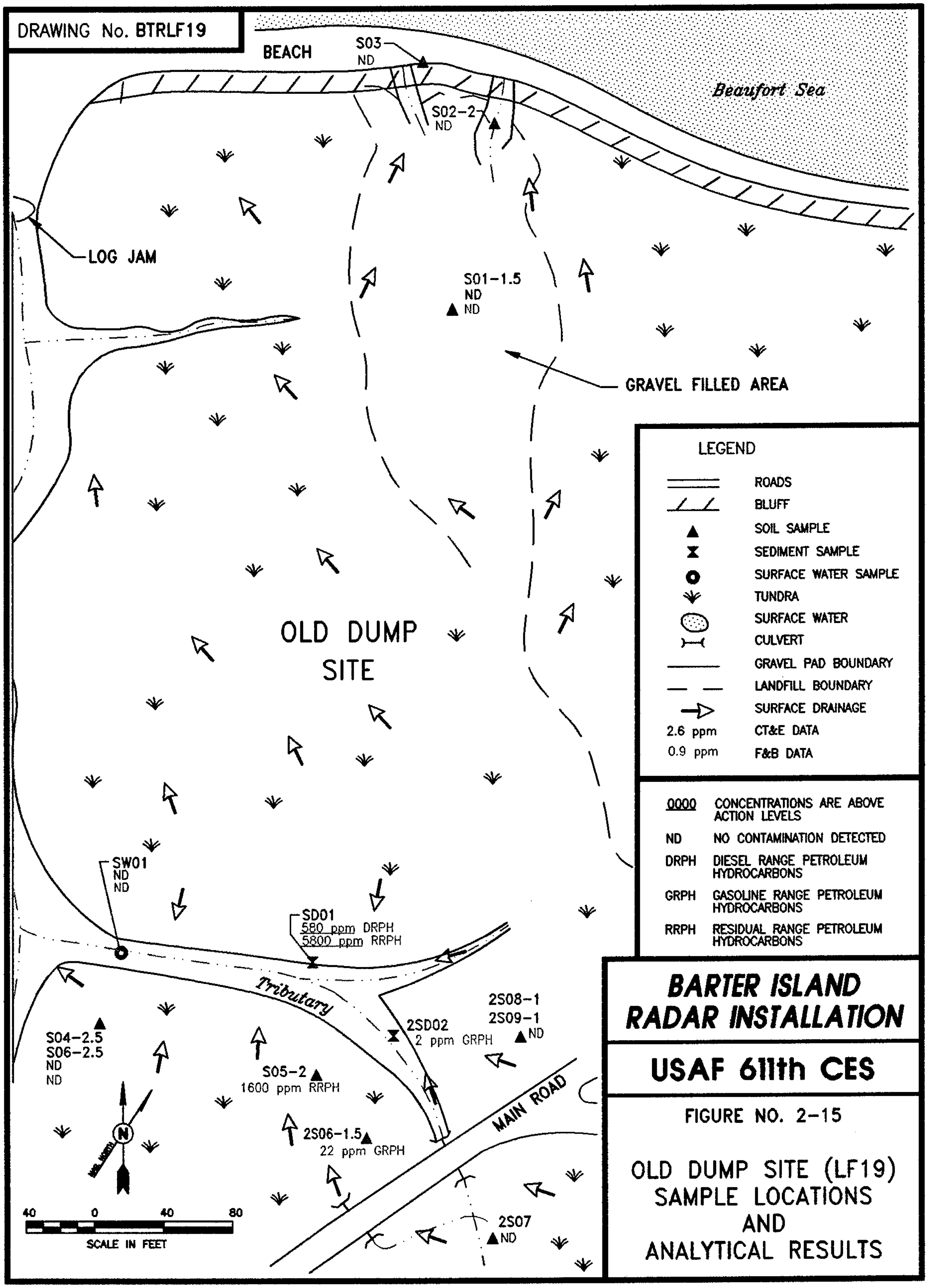
DRAWING No. BTRLF19
BEACH
Beaufort Sea
S03 ND
S02-2 ND
LOG JAM
S01-1.5 ND ND
GRAVEL FILLED AREA
OLD DUMP SITE
SW01 ND ND
SD01 580 ppm DRPH 5800 ppm RRPH
Tributary
2SD02 2 ppm GRPH
2S08-1 2S09-1 ND
S04-2.5 S06-2.5 ND ND
S05-2 1600 ppm RRPH
2S06-1.5 22 ppm GRPH
MAIN ROAD
2S07 ND
N
40 0 40 80
SCALE IN FEET
LEGEND
ROADS
BLUFF
SOIL SAMPLE
SEDIMENT SAMPLE
SURFACE WATER SAMPLE
TUNDRA
SURFACE WATER
CULVERT
GRAVEL PAD BOUNDARY
LANDFILL BOUNDARY
SURFACE DRAINAGE
2.6 ppm CT&E DATA
0.9 ppm F&B DATA
0000 CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND NO CONTAMINATION DETECTED
DRPH DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH GASOLINE RANGE PETROLEUM HYDROCARBONS
RRPH RESIDUAL RANGE PETROLEUM HYDROCARBONS
BARTER ISLAND RADAR INSTALLATION
USAF 611th CES
FIGURE NO. 2-15
OLD DUMP SITE (LF19) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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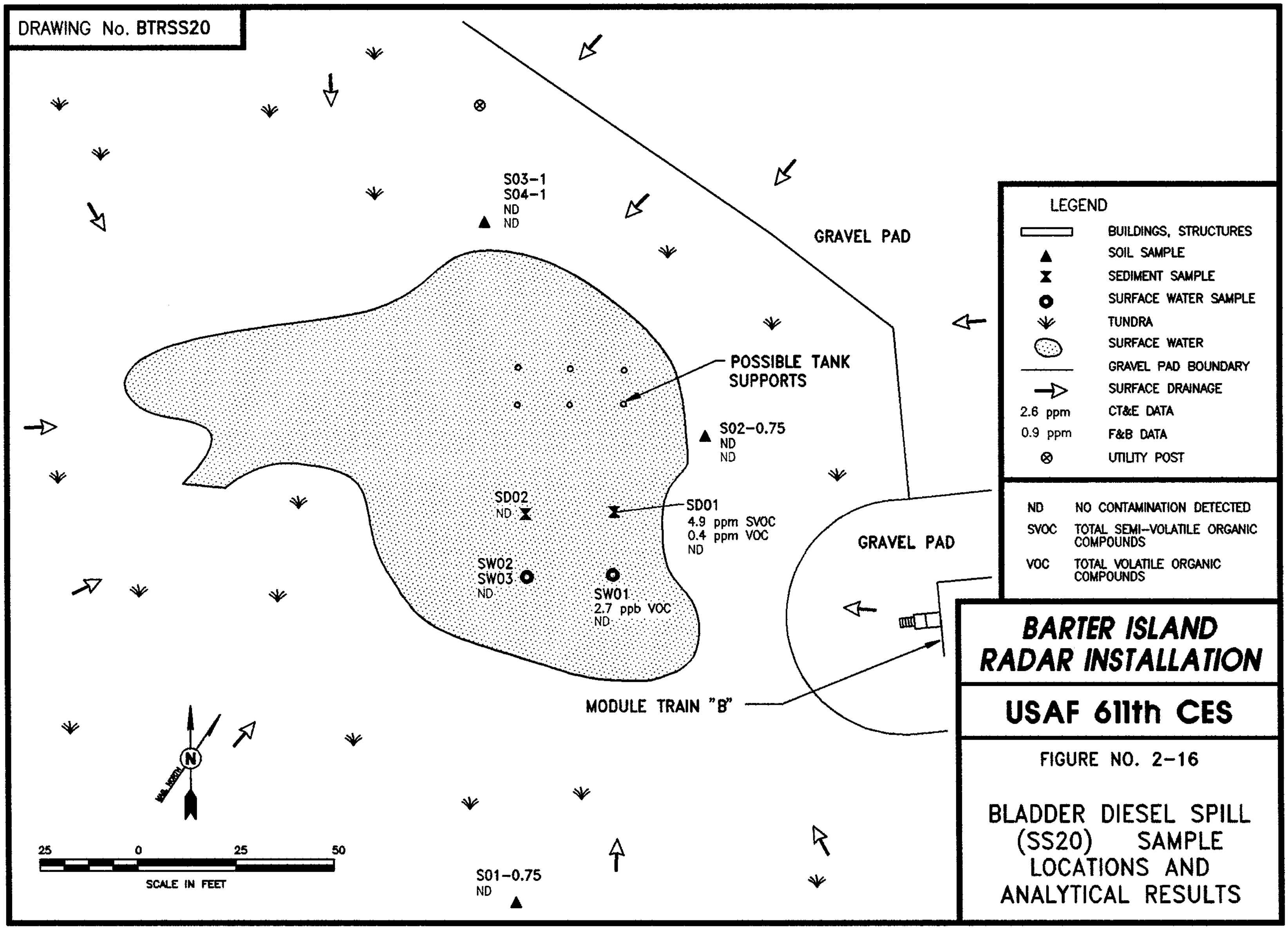
DRAWING No. BTRSS20
GRAVEL PAD
GRAVEL PAD
POSSIBLE TANK SUPPORTS
S03-1
S04-1
ND
ND
S02-0.75
ND
ND
SD02
ND
SD01
4.9 ppm SVOC
0.4 ppm VOC
ND
SW02
SW03
ND
SW01
2.7 ppb VOC
ND
MODULE TRAIN "B"
S01-0.75
ND
N
25 0 25 50
SCALE IN FEET
LEGEND
BUILDINGS, STRUCTURES
SOIL SAMPLE
SEDIMENT SAMPLE
SURFACE WATER SAMPLE
TUNDRA
SURFACE WATER
GRAVEL PAD BOUNDARY
SURFACE DRAINAGE
2.6 ppm CT&E DATA
0.9 ppm F&B DATA
UTILITY POST
ND NO CONTAMINATION DETECTED
SVOC TOTAL SEMI-VOLATILE ORGANIC COMPOUNDS
VOC TOTAL VOLATILE ORGANIC COMPOUNDS
BARTER ISLAND RADAR INSTALLATION
USAF 611th CES
FIGURE NO. 2-16
BLADDER DIESEL SPILL (SS20) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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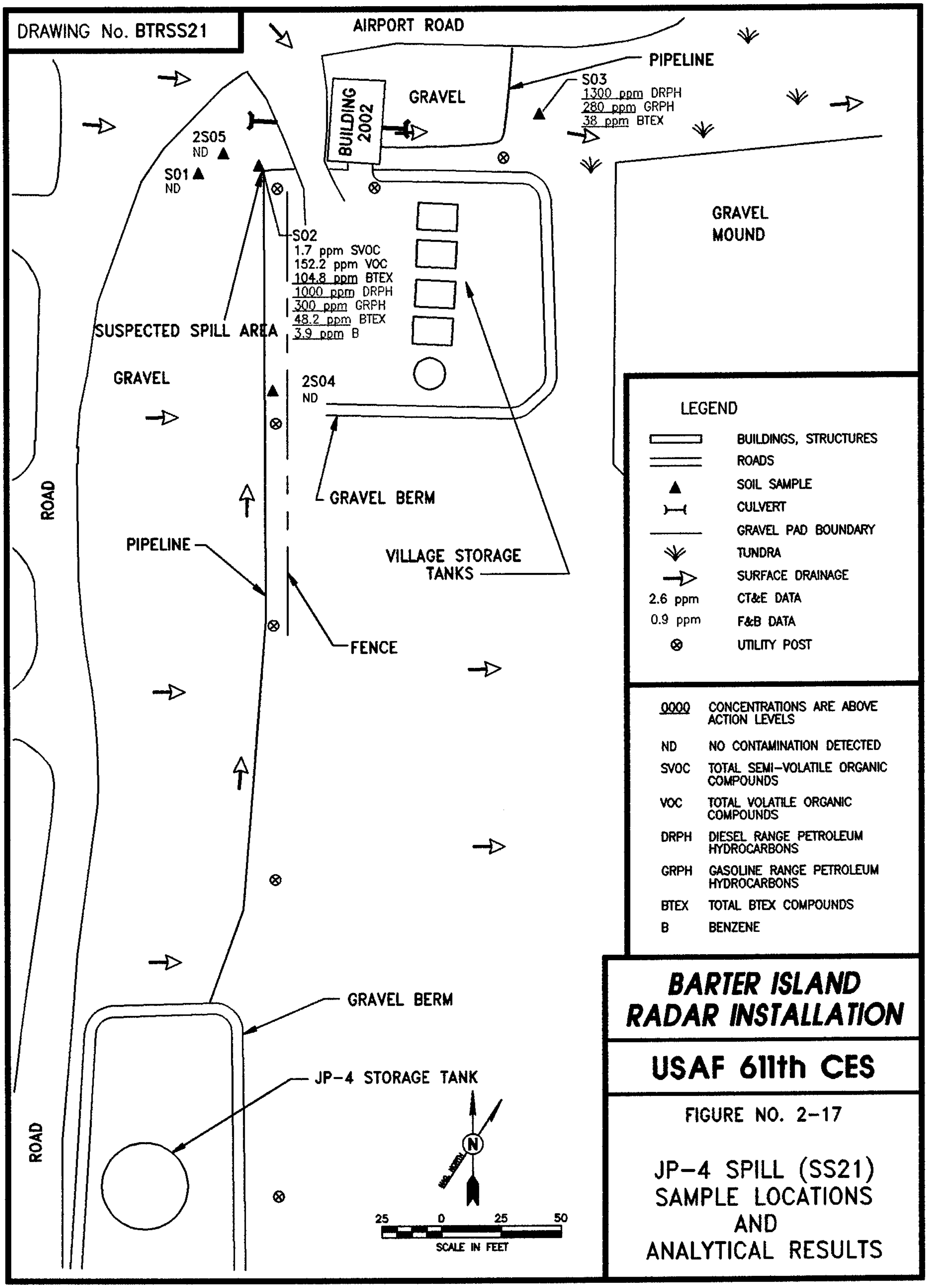

FIGURE NO. 2-17

JP-4 SPILL (SS21) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 2-3. SUMMARY OF THE CHEMICALS OF CONCERN AT BARTER ISLAND*

SITE	CHEMICALS OF CONCERN	
	SOIL/SEDIMENT	SURFACE WATER
Old Landfill (LF01)	NONE	Manganese
POL Catchment (LF03)	DRPH Tetrachloroethene	DRPH GRPH Benzene
Current Landfill (LF04)	NONE	Manganese Trichloroethene
Contaminated Ditch (SD08)	DRPH GRPH Beryllium	NONE
Old Runway Dump (LF12)	NONE	NONE
Heated Storage (SS13)	DRPH GRPH RRPH Aroclor 1254	DRPH Benzene Manganese Tetrachloroethene
Garage (SS14)	DRPH GRPH RRPH Benzene Bis(2-ethylhexyl)phthalate	NONE
Weather Station Building (SS15)	DRPH GRPH	NONE
White Alice Facility (SS16)	Aroclor 1254	NONE
POL Tanks (ST17)	DRPH GRPH	NONE
Fuel Tanks (ST18)	NONE	NONE
Old Dump Site (LF19)	DRPH RRPH	NONE
Bladder Diesel Spill (SS20)	NONE	NONE
JP-4 Spill (SS21)	DRPH GRPH Benzene	NONE

* The summary of COCs on this table includes only those chemicals detected that exceed background levels and an RBSL, ARAR, or both. COCs that exceed background levels but do not have an RBSL or ARAR are discussed in Section 2.1.5. (Page 2-9).

If one component of an exposure pathway does not exist, then exposure will not occur and there is no health risk. For example, if a shallow aquifer was contaminated with tetrachloroethylene, but that aquifer was not used as a water supply, no exposure point would exist and a ground water ingestion pathway would not be complete.

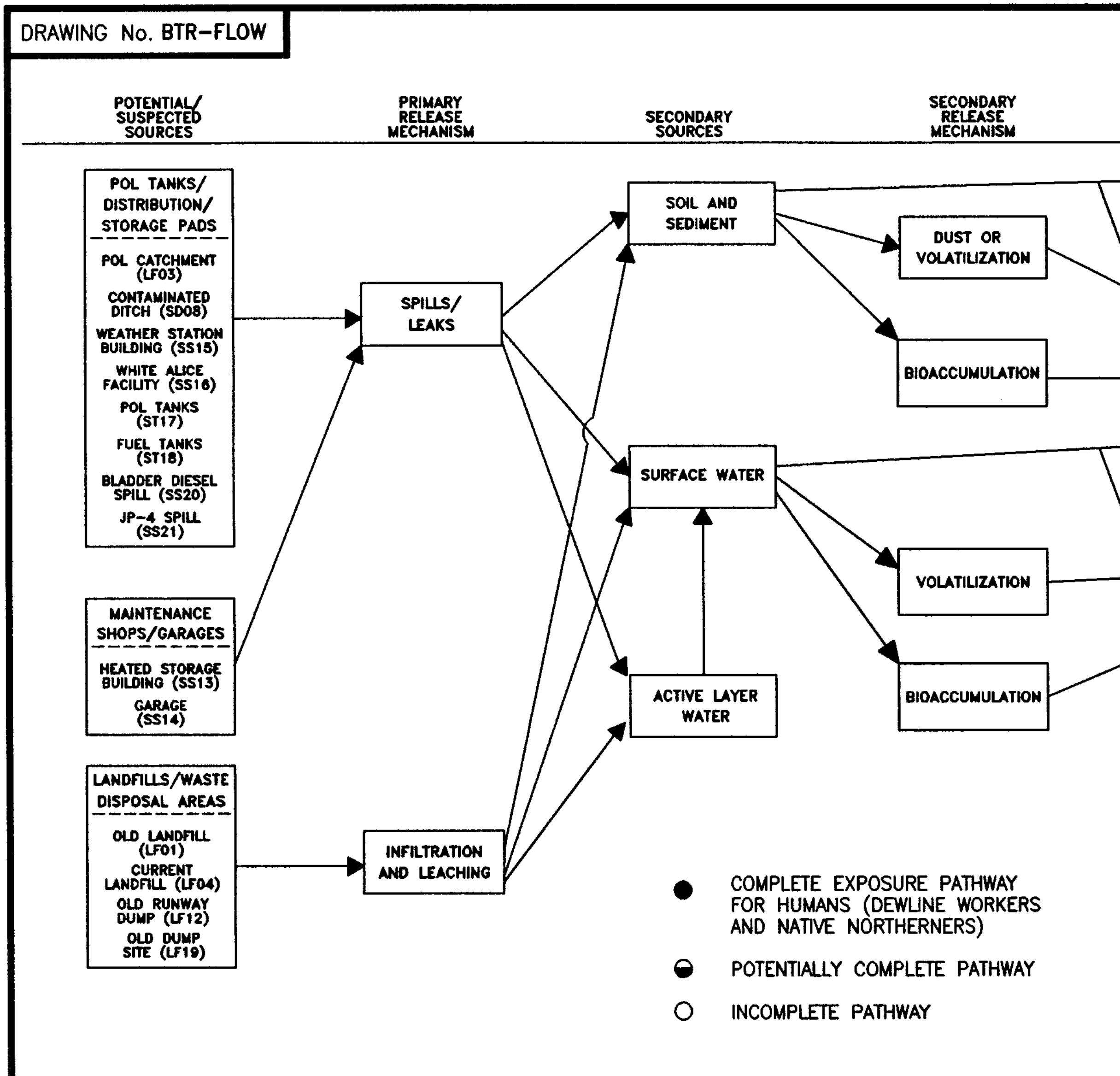
The potential exposure pathways evaluated for the Barter Island human health risk assessment are presented in Figure 2-18 and Table 2-4, and are discussed in Sections 2.2.1.1 through 2.2.1.4.

2.2.1.1 Soil and Sediment Ingestion. Barter Island installation workers and native villagers visiting the installation could potentially be exposed to contaminated soil and sediment at the installation. The most likely exposure routes are incidental ingestion of soil and dermal absorption of contaminants in the soil. Site-specific characteristics will limit the magnitude, frequency, and duration of exposures to soil and sediment. The ground is covered with snow and ice, which eliminates soil or sediment exposure, for approximately nine months of the year. In the summer months when snow cover is generally absent, cool temperatures, 30°F to 46°F (University of Alaska 1978), keep both workers and villagers in heavy, long-sleeved clothing and gloves that eliminate dermal contact with and hand-to-mouth transfer of soil. Therefore, although both the incidental soil ingestion and dermal contact pathways are considered to be potentially complete, only incidental ingestion of soil or sediment will be evaluated further in this risk assessment.

The exposure assumptions used to evaluate the soil and sediment ingestion pathway are upper bound residential scenario assumptions and, therefore, probably overestimate the true hazard or risk associated with this pathway. The purpose of using residential assumptions is to evaluate the hazard or risk associated with future residential use of the Barter Island installation. Although the Air Force has no plans to close the Barter Island radar installation, it is possible that at some time in the future the installation may be retired and released for civilian use, in which case residential use of the installation may be possible.

2.2.1.2 Inhalation. Barter Island installation workers and native villagers may be exposed to site contamination by inhalation of organic compounds that have volatilized from the soil or surface water, or by inhalation of windborne dust to which contamination has adsorbed. These exposure pathways are not considered complete for the Barter Island risk assessment because snow and ice cover the site for approximately nine months of the year, and during the summer months the high humidity, vegetative cover, and thawing of surface and active layer water significantly limit the entrainment of dust particles. The generally low temperatures and high moisture content of the soil also tend to inhibit volatilization. The inhalation pathway will not be considered further in this risk assessment.

2.2.1.3 Surface Water Ingestion. Fresh water for drinking and domestic uses is supplied to the Barter Island installation and to the village of Kaktovik from Fresh Water Lake, located south of the installation and southwest of the village. This lake is upgradient from the installation and village and is, therefore, unaffected by any potential contamination from the radar installation. Other surface water features, particularly those potentially contaminated by operations at the installation, are not likely to be used for drinking or other domestic purposes



BARTER ISLAND RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 2-18

HUMAN HEALTH RISK ASSESSMENT CONCEPTUAL SITE MODEL

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TABLE 2-4. EXPOSURE PATHWAY ANALYSIS FOR BARTER ISLAND HUMAN HEALTH RISK ASSESSMENT

POTENTIALLY CONTAMINATED MEDIUM	POTENTIAL ROUTES OF EXPOSURE	POTENTIAL RECEPTORS	PATHWAY COMPLETE?	EXPOSED POPULATION ESTIMATE
Soil	Ingestion, dermal absorption	DEW Line workers, native villagers	Ingestion, Yes Dermal Contact, No	275
Sediments	Ingestion, dermal absorption	DEW Line workers, native villagers	Ingestion, Yes Dermal Contact, No	275
Air	Inhalation of volatiles from soil or surface water or inhalation of fugitive dust	DEW Line workers, native villagers	No, volatile concentrations in soil and surface water are very low; dust generation is not likely due to marshy vegetated landscape, high humidity, and snow and ice cover most of the year.	0
Surface Water	Incidental ingestion, dermal absorption	DEW Line workers, native villagers	Maybe, drinking water supplies are either upgradient from installation or in unaffected areas; fishing occurs in unaffected areas; swimming does not occur onsite; however, incidental exposure may occur during installation operations or trespassing by native villagers.	275
Ground Water	Ingestion, dermal absorption	DEW Line workers, native villagers	No, permafrost limits presence of ground water to shallow active layer that is not used for any purpose.	0

even on an incidental basis. This is because these surface water features are not reliable, being frozen for most of the year. Ingestion of surface water will; however, be considered a potentially complete exposure pathway to reflect the upper-bound potential future risk.

2.2.1.4 Ground Water. Permafrost limits the presence of ground water to the active layer which thaws during the summer months. The water present in the active layer is not known to be used for any purpose; therefore, a ground water pathway may be eliminated from consideration in this risk assessment.

2.2.2 Migration and Fate of Chemicals of Concern

The COCs selected for Barter Island generally fall into four classes:

- refined and residual petroleum hydrocarbons (DRPH, GRPH, and RRPH);
- volatile and semi-volatile organic compounds (VOCs and SVOCs: benzene, bis(2-ethylhexyl)phthalate, tetrachloroethene, and trichloroethene);
- metals (beryllium and manganese); and
- polychlorinated biphenyls (Aroclor 1254).

This section presents a summary of the migration and fate of each of these classes given the environmental conditions at Barter Island.

Once released to the environment, the COCs are immediately subject to several processes, including evaporation and volatilization, bulk flow, soil adsorption, dissolution in surface or active layer water, biodegradation, and photo-oxidation. The extent to which the COCs undergo each of these processes depends on their chemical and physical properties (e.g., K_{oc}, K_{ow}, water solubility, vapor pressure, Henry's law constant), the volume released, soil flora, meteorological conditions, soil water, and organic carbon content.

The migration of petroleum hydrocarbons released to the gravel pads and tundra is expected to follow the rank order: GRPH > DRPH > RRPH. GRPH is generally considered to include hydrocarbons with carbon chain ranges from C5 to C12 that tend to be relatively mobile and less persistent than longer chain hydrocarbons. Depending on the length of time since a spill or leak occurred, the petroleum hydrocarbons observed in soil samples would be expected to be enriched in components that have carbon chain ranges greater than C10 or C11, have high K_{oc} and K_{ow} values, low vapor pressure and water solubility, and are not rapidly biodegradable. Petroleum components that fit this profile are higher molecular weight n-alkanes, mono- and poly-aromatics, and cycloalkanes. These components would tend to appear in laboratory analyses as diesel range or heavy oil range organics (DRPH and RRPH).

The migration of VOCs is expected to be rapid compared to the petroleum hydrocarbons. These compounds tend to have high vapor pressures which favor volatilization, high water solubility, and low K_{oc} and K_{ow} values. Therefore, the VOCs tend to be highly mobile in the environment and dissipate rapidly after a spill or leak. In the results of field sampling, VOC concentrations would be expected to be fairly low depending on the time since the spill or leak occurred. The frigid conditions on the North Slope; however, would tend to reduce the mobility due to volatilization or evaporation.

The metals observed at Barter Island are probably of natural origin and not due to the operation of or activities at the radar installation. The presence of manganese in water samples is most often associated with landfill leachate since the anaerobic and acidic conditions inside of a landfill tend to release naturally occurring manganese from the soil. Metals will tend to be persistent and of low mobility in the environment.

PCBs also have a low migratory potential. These compounds are generally of high molecular weight, low vapor pressure and water solubility, and high K_{oc} and K_{ow} values. Biodegradation of PCBs on the North Slope would also be expected to be minimal given the frigid conditions and presence of permafrost.

In conclusion, the COCs observed at the Barter Island installation are generally expected to be fairly persistent and of low mobility. Exposure by contact with soils, primarily through accidental ingestion, is expected to predominate compared to exposure by inhalation.

2.2.3 Estimation of Chemical Intake

The exposure assessment for the Barter Island DEW Line installation required the development of site-specific assumptions because of the unique location of the installation and potential receptors. This section of the report focuses on the exposure variables for which site-specific assumptions were made. These variables include:

- exposure frequency;
- exposure duration;
- ingestion of locally produced meat (e.g., caribou, fish, and birds);
- ingestion of locally produced vegetation (e.g., berries);
- soil ingestion rate; and
- rate of dermal contact with soil.

The exposure assumptions used in the human health risk assessment are presented in Table 2-5.

Three potential receptor groups will be evaluated for the Barter Island risk assessments: an adult assigned to a DEW Line installation (worker), an adult native of the North Slope of Alaska (native), and a native child (child). The first two receptor groups are considered to represent the RME that might occur at an installation that is not in close proximity to a native village. Because the Barter Island installation is close to the village of Kaktovik, a child will be considered as a potentially exposed individual.

The estimation of chemical intake requires the evaluation of several exposure variables: exposure point concentration; exposure frequency; exposure duration; ingestion of locally produced meat, fish, and vegetation; soil ingestion; drinking water ingestion; dermal contact with

TABLE 2-5. EXPOSURE ASSUMPTIONS FOR ESTIMATING CHEMICAL INTAKE

PARAMETER	DEW LINE WORKER	NATIVE NORTHERN ADULT	NATIVE NORTHERN CHILD
Exposure Frequency - Soil Ingestion (days/year)	30	30	30
Exposure Frequency - Water Ingestion (days/year)	180	180	N/A
Exposure Duration (years)	10	55[a]	6[a]
Soil Ingestion Rate (mg/day)	50	100	200
Drinking Water Ingestion Rate (L/day)	2	2	N/A
Average Body Weight (kg)	70	70	15
Averaging Time (days)	25,550 (cancer) 3,650 (noncancer)	25,550[b] (cancer) 20,075[c] (noncancer) 17,885[d] (noncancer)	2,190[d] (noncancer)

N/A Not applicable; drinking water pathway evaluated for adult only.
a Exposure duration for water ingestion pathway is 55 years. For soil ingestion, exposure duration is 6 years as a child and 49 years as an adult.
b Averaging time for the evaluation of cancer risk by the soil and water ingestion pathways.
c Averaging time for the evaluation of cancer hazard by the water ingestion pathway.
d Averaging time for the evaluation of noncancer hazard by the soil ingestion pathway.

soil; inhalation; and body weight. These exposure variables are discussed in the following sections.

2.2.3.1 Exposure Point Concentration. Based on the amount of analytical data available for the risk assessment of the Barter Island facility, and the requirement that the risk characterization be conducted individually for each of the fourteen sites, only maximum concentrations of the COCs were used for exposure point concentrations. This approach yields a conservative upper-bound estimate of the ADD to which potential receptors may be exposed.

2.2.3.2 Exposure Frequency. The exposure frequency variable is an estimate of the amount of time a potential receptor may come in to contact with contaminated media. For the DEW Line worker, the exposure frequency estimate is based on a duty rotation of eleven months onsite, one month offsite. These estimates are based on knowledge of the site worker's daily activities and vacation allowance. During the eleven months of onsite duty, it is estimated that the worker is outside for four hours per day. The remaining 20 hours is spent inside the module trains or enclosed vehicles, where exposure to contaminated media is not expected to occur. An estimated exposure frequency for the DEW Line worker is, therefore, 11 months/year x 30 days/month x 4 hours/day x 1 day/24 hours = 55 days/year. The primary environmental medium of concern is; however, contaminated soil, and this estimate of exposure frequency does not account for the number of days per year that snow covers the ground and eliminates the potential for contact with contaminated soil. Six months is a conservative average estimate of the number of months per year of snow cover at all eight DEW Line installations. To be even more conservative, it is assumed that a worker's tour of duty includes all six of the months without snow cover, thus an exposure frequency of 30 days/year for the DEW Line worker is recommended.

The exposure frequency estimate for a native adult or child of the North Slope is based on an estimate of the frequency with which the individual will visit a DEW Line installation. Such visits are most likely to occur at installations sited within the vicinity of a native village. For example, at Barter Island, native adults and children use the facility as an access route to coastal areas and for recreation. In this case, a conservative estimate of exposure would be expected to be similar to that of a worker, 4 hrs/day x 30 days per month x 1 day/24 hrs x 6 months of exposed soil = 30 days per year.

The exposure frequency for water ingestion was conservatively estimated at 180 days/year that surface water would be available (i.e., not frozen).

2.2.3.3 Exposure Duration. The exposure duration variable is an estimate of the amount of time a potential receptor will remain at or near a DEW Line installation over a lifetime. For the DEW Line worker the exposure duration is an estimate of the maximum tour of duty at an installation. A conservative estimate of the duration of a tour at a particular installation is 10 years. The duration of ten years for DEW Line workers at one installation is an estimate based on discussion with installation workers. For the potential native receptor, a conservative estimate of exposure duration is 55 years. EPA's default RME duration is 30 years; however, this is based on the overall U.S. population. Because the Alaskan natives are more likely to remain in their village for a longer period, 55 years was determined to be a more appropriate estimate.

2.2.3.4 Averaging Time. The averaging time represents the period of time over which exposure is averaged and is based on the assumption that intermittent exposure at a given contaminant concentration is equivalent to a continuous exposure at a lower concentration. For the DEW Line worker, the averaging time is based on the EPA default lifetime of 70 years for evaluation of carcinogens, and 10 years (equivalent to the exposure duration) for the evaluation of noncarcinogens. For the native northern adult receptors an averaging time of 70 years for carcinogens was also chosen. To evaluate exposure to noncarcinogens in soil and sediment for the native northern adult and child, an averaging time of 49 years as an adult and 6 years as a child was used (to account for 55 year total exposure). To evaluate the exposure of native northern receptors to noncarcinogens in water an averaging time of 55 years was used.

2.2.3.5 Ingestion of Locally Produced Meat, Fish, and Vegetation. The food supplies of DEW Line installation workers are largely imported from outside the area. Occasionally, a worker would be expected to ingest a locally caught fish or game animal, but the frequency and magnitude of this ingestion is expected to have a negligible effect on exposure to the COCs. Food supplies for the natives of Kaktovik are also largely imported from outside the area, and the reliance on hunting and fishing for subsistence is decreasing substantially as the economy moves from subsistence to wage labor (Chance 1990). Inupiats, in general, have less time to hunt and fish than in the past. Most of the hunting and fishing that is done occurs outside the village and away from the Barter Island DEW Line installation in areas unaffected by the installation. It is not likely that contamination observed at the installation has affected the mammals, birds, and vegetation that are collected for consumption. Therefore, the consumption of locally produced food is not likely to pose a significant risk of adverse health effects and will not be considered a complete exposure pathway. The ERA, Section 3.0, presents a detailed assessment of risks to ecological receptors.

2.2.3.6 Soil Ingestion Rate. A conservative approach to estimating soil ingestion rate is to assume that the EPA default soil ingestion rates of 50 mg/day for workers (EPA 1991a) and 100 mg/day for adults in a residential setting (EPA 1989a). The EPA default soil ingestion rate for children is 200 mg/day (EPA 1989a, 1991a); this is the recommended value for the risk assessment.

2.2.3.7 Drinking Water Ingestion Rate. There are no circumstances at the Barter Island installation that would invalidate the EPA default adult drinking water ingestion rate of 2 L/day. Therefore, this is the recommended value for both workers and natives. However, in most, if not all, cases drinking water is imported from offsite so this may not be a route of potential exposure.

By convention (EPA 1989a), noncancer hazard and cancer risk associated with the drinking water pathway are evaluated for an adult receptor, not a child (Table 2-5). The basis for this approach is that the ratio of drinking water ingestion rate to body weight is assumed to remain relatively constant from childhood to adulthood.

2.2.3.8 Dermal Contact with Soil Rate. Because of the harsh North Slope weather, potential receptors (both workers and natives) are expected to be heavily clothed and gloved. Observations made by RI field personnel indicate that potential human receptors were heavily clothed during the months of the field investigations (August and September 1993). Therefore, dermal exposure to contaminated soils is considered negligible. In addition, the duties of installation workers that involve soil work (excavating, grading, etc.) are conducted in equipment with enclosed cabs. Thus a dermal contact rate does not appear to be necessary for the exposure assessment.

2.2.3.9 Inhalation Rate. The inhalation pathway is not complete (Section 2.2.1.2), so no estimate for this variable is necessary.

2.2.3.10 Body Weight. There are no circumstances at the Barter Island installation that would invalidate the EPA default adult body weight of 70 kg. Therefore, this is the recommended value for both workers and natives. The recommended body weight for children is the EPA default value of 15 kg.

2.2.4 Quantifying Exposure

For each complete, or potentially complete, exposure pathway at the Barter Island facility (soils ingestion, drinking water ingestion), the ADD for estimating noncancer hazard and the lifetime average daily dose (LADD) for estimating excess lifetime cancer risk were calculated. The equations used for the calculation of ADD and LADD are presented in Table 2-6.

The exposure assumptions assigned to each variable in these equations are presented in Table 2-5. The estimates of ADD and LADD for the COCs at each site are presented in the risk characterization tables in Appendix A.

2.3 TOXICITY ASSESSMENT

The purpose of the toxicity assessment is to weigh available evidence regarding the potential for particular contaminants to cause adverse effects in exposed individuals and to provide, where possible, an estimate of the relationship between the extent of exposure to a contaminant and the increased likelihood and/or severity of adverse effects. This is done separately for noncarcinogenic effects (Section 2.3.1) and carcinogenic effects (Section 2.3.2). Toxicity summaries are presented in Section 2.3.3.

Toxicity assessment for environmental contaminants is generally accomplished in two steps: hazard identification and dose-response assessment. Hazard identification is the process of determining whether exposure to an agent can cause an increase in the incidence of a particular adverse health effect (e.g., cancer, birth defects) and whether the adverse health effect is likely to occur in humans. Hazard identification involves characterizing the nature and strength of the evidence of causation. Dose-response evaluation is the process of quantitatively evaluating the toxicity information and characterizing the relationship between the dose of the contaminant administered or received and the incidence of adverse health effects in the exposed population. From this quantitative dose-response relationship, toxicity values (e.g., RfDs and SFs) are derived that can be used to estimate the incidence or potential for adverse effects as a function of human exposure to the agent. These toxicity values are used in the risk characterization step to estimate the likelihood of adverse effects occurring in humans at particular exposure levels.

2.3.1 Toxicity Assessment for Noncarcinogenic Effects

A reference dose, or RfD, is the toxicity value used most often in evaluating noncarcinogenic effects resulting from exposures at contaminated sites. Various types of RfDs are available depending on the exposure route (oral or inhalation), the critical effect (developmental or other), and the length of exposure being evaluated (chronic, subchronic, or single event). The oral RfDs used to estimate the noncancer hazard associated with exposure to soils, sediments, and surface water at the Barter Island facility are presented in Table 2-7.

A chronic RfD is defined as an estimate (with uncertainty spanning perhaps an order of magnitude or greater) of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime. Chronic RfDs are specifically developed to be protective for long-term exposure to a compound. Chronic RfDs generally should be used to evaluate the potential noncarcinogenic effects associated with exposure periods between 7 years (approximately 10 percent of a human lifetime) and a lifetime. Many chronic RfDs have been reviewed and verified by an intra-Agency RfD Workgroup and entered into the EPA's IRIS database.

TABLE 2-6. EQUATIONS USED FOR ESTIMATING POTENTIAL DOSE

EXPOSURE ROUTE	EQUATION	PARAMETER DEFINITIONS
Ingestion of Soil	Native Northern Adults/Children $ADD \text{ or } LADD\ (mg/kg/day) = \frac{C_s * CF * EF}{AT} \sum_{i=1}^{n} \frac{IR_i * ED_i}{BW_i}$ DEW Line workers: $ADD \text{ or } LADD\ (mg/kg/day) = \frac{C_s * CF * IR * EF * ED}{BW * AT}$	$11C_s$ = concentration in soil (mg/kg) CF = conversion factor (10^{-6} kg/mg) IR = ingestion rate (mg/day) EF = exposure frequency (days/year) ED = exposure duration (years) BW = body weight (kg) AT = averaging time (days/year x years) n = number of observations
Ingestion of Surface Water	$ADD \text{ or } LADD\ (mg/kg/day) = \frac{C_w * CF * IR * EF * ED}{BW * AT}$	C_w = concentration in surface water (μg/L) CF = conversion faction (10^{-3} mg/μg) IR = ingestion rate (L/day) EF = exposure frequency (days/year) ED = exposure duration (years) BW = body weight (kg) AT = averaging time (days/year x years)

TABLE 2-7. TOXICITY CRITERIA FOR NONCANCER EFFECTS OF THE CHEMICALS OF CONCERN FOR BARTER ISLAND

CHEMICAL	ORAL REFERENCE DOSE (RfD) (mg/kg-day)	TARGET ORGAN OR CRITICAL EFFECT (species)[a]	UNCERTAINTY FACTOR[b]	ORAL RfD SOURCE[c]
Aroclor 1254	0.00002	ocular exudate and styles, immunological effects (monkeys)	300	IRIS
Benzene	NA	NA	NA	NA
Beryllium	0.005	no observed effects (rat)	100	IRIS
Bis(2-ethylhexyl)phthalate	0.02	liver effects (guinea pig)	1000	IRIS
Dichlorobenzene, 1,4-	NA	NA	NA	NA
DRPH	0.08[d]	liver effects (mice)	10,000	ECAO
GRPH	0.2[d]	decreased body weight (rats)	1000	ECAO
Manganese (water)	0.005	CNS effects (humans)	1	IRIS
PCBs	NA	NA	NA	NA
RRPH	0.08[d]	liver effects (mice)	10,000	ECAO
Tetrachloroethane	0.01	liver effects (mice)	1000	IRIS
Trichloroethene	NA	NA	NA	NA

a A target organ is the organ apparently most sensitive to the toxicity of a chemical. A critical effect is reported when EPA has not identified a target organ for the toxicity of a given chemical.

b The uncertainty factors used to develop oral reference doses are generally applied in multiples of 10 to account for shortcomings in the toxicological database. The greater the uncertainty factor, the lower the confidence level in the RfD. Factors of 10 are applied to account for human variability in toxic response, extrapolation from animal studies to humans, extrapolation of short-term exposures to long-term exposures, and for the extrapolation of a lowest observed adverse effect level (LOAEL) to a no observed adverse effect level (NOAEL).

c Sources of oral RfD values are IRIS (Integrated Risk Information System), HEAST (Health Effects Assessment Summary Tables), or ECAO (The Environmental Criterion Assessment Office of EPA).

d Oral RfD values for DRPH, GRPH, and RRPH are based on (EPA 1992d) and are considered provisional RfDs.

NA Not available.

2.3.1.1 Concept of Threshold. For many noncarcinogenic effects, protective mechanisms are believed to exist that must be overcome before the adverse effect is manifested. For example, where a large number of cells perform the same or similar function, the cell population may have to be significantly depleted before the effect is seen. As a result, a range of exposures exists from zero to some finite value that can be tolerated by the organism with essentially no chance of expression of adverse effects. In developing a toxicity value for evaluating noncarcinogenic effects (i.e., an RfD), the approach is to identify the upper bound of this tolerance range (i.e., the maximum subthreshold level). Because variability exists in the human population, attempts are made to identify a subthreshold level protective of sensitive individuals in the population. For most chemicals, this level can only be estimated; the RfD incorporates uncertainty factors (UFs) indicating the degree or extrapolation used to derive the estimated value. RfD summaries in IRIS also contain a statement expressing the overall confidence that the evaluators have in the RfD (high, medium, or low). The RfD is generally considered to have uncertainty spanning an order of magnitude or more, and therefore the RfD should not be viewed as a strict scientific demarcation between levels that are toxic and nontoxic.

2.3.2 Toxicity Assessment For Carcinogenic Effects

A slope factor and the accompanying weight-of-evidence determination are the toxicity data most commonly used to evaluate potential human carcinogenic risks. The methods EPA uses to derive these values are outlined below. Additional information can be obtained by consulting EPA's *Guidelines for Carcinogen Risk Assessment* (EPA 1986a) and IRIS Background Document #2 (IRIS 1994). The slope factors for the COCs at Barter Island are presented in Table 2-8.

2.3.2.1 Concept of Nonthreshold Effects. Risk evaluation based on the presumption of a dose-response threshold is generally thought to be inappropriate for carcinogenesis. In the evaluation of carcinogens, EPA assumes that a small number of molecular events can evoke changes in a single cell and lead to uncontrolled cellular proliferation and eventually to clinical state of disease (cancer). This hypothesized mechanism for carcinogenesis is referred to as "nonthreshold" because all levels of exposure pose some probability of generating a carcinogenic response. Thus, no dose is thought to be risk-free, and an affect threshold cannot be estimated.

2.3.2.2 Assigning a Weight-of-Evidence. In the first step of the evaluation, the available data are evaluated to determine the likelihood that the agent is a human carcinogen. The evidence is characterized separately for human studies and animal studies as sufficient, limited, inadequate, no data, or evidence of no effect. The characterizations of these two types of data are combined, and based on the extent to which the agent has been shown to be a carcinogen in experimental animals, humans, or both, the agent is given a provisional weight-of-evidence classification. EPA scientists then adjust the provisional classification upward or downward, based on other supporting evidence of carcinogenicity.

The EPA classification system for weight-of-evidence is shown in Table 2-9.

TABLE 2-8. TOXICITY VALUES FOR THE CARCINOGENICITY OF THE CHEMICALS OF CONCERN AT BARTER ISLAND

CHEMICAL	WEIGHT-OF-EVIDENCE (WOE)	TUMOR TYPE (species)	ORAL SLOPE FACTOR (kg-day/mg)	ORAL SLOPE FACTOR SOURCE[a]
Aroclor 1254	NA	NA	NA	NA
Benzene	A	leukemia (humans)	0.029	IRIS
Beryllium	B2	osteosarcoma (rabbit)	4.3	IRIS
Bis(2-ethylhexyl)phthalate	B2	liver carcinoma/adenoma (mouse)	0.014	IRIS
Dichlorobenzene, 1,4-	B2	liver tumors (mouse)	0.024	HEAST
DRPH	NA	NA	NA	NA
GRPH	C	liver adenoma/carcinoma (mouse)	0.0017	ECAO
Manganese (water)	NA	NA	NA	NA
PCBs	B2	trabecular adenoma/carcinoma (rat)	7.7	IRIS
RRPH	NA	NA	NA	NA
Tetrachloroethane	C-B2	not specified	0.052	ECAO
Trichloroethene	C-B2	not specified	0.011	ECAO

a IRIS, Integrated Risk Information System; HEAST, Health Effects Assessment Summary Tables; ECAO, Environmental Criterion Assessment Office of EPA.
NA Not available.

TABLE 2-9. EPA WEIGHT-OF-EVIDENCE CLASSIFICATION SYSTEM FOR CARCINOGENICITY

GROUP	DESCRIPTION
A	Human carcinogen.
B1 or B2	Probable human carcinogen.
	B1 indicates that limited human data are available.
	B2 indicates sufficient evidence in animals and inadequate or no evidence in humans.
C	Possible human carcinogen.
D	Not classifiable as to human carcinogenicity.
E	Evidence of noncarcinogenicity for humans.

2.3.2.3 Generating a Slope Factor. In the second part of the evaluation, based on the evaluation that the chemical is a known or probable human carcinogen, a toxicity value that defines quantitatively the relationship between dose and response (i.e., the SF) is calculated. Slope factors are typically calculated for potential carcinogens in classes A, B1, and B2. Quantitative estimation of SFs for the chemicals in class C is done on a case-by-case basis.

Generally, the SF is a plausible upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime. The SF is used in risk assessments to estimate an upper-bound lifetime probability of an individual developing cancer as a result of exposure to a particular level of a potential carcinogen. Slope factors should always be accompanied by the weight-of-evidence classification to indicate the strength of the evidence that the agent is a human carcinogen.

2.3.2.4 Identifying the Appropriate Data Set. In deriving SFs, the available information about a chemical is evaluated, and an appropriate data set is selected. In choosing appropriate data sets, human data of high quality are preferable to animal data. If animal data are used, the species that responds most similarly to humans (with respect to factors such as metabolism, physiology, and pharmacokinetics) is preferred. When no clear choice is possible, the most sensitive species is given the greatest emphasis. Occasionally, in situations where no single study is judged most appropriate yet several studies collectively support the estimate, the geometric mean of estimates from all studies may be adopted as the slope. This practice ensures the inclusion of all relevant data.

2.3.2.5 Extrapolating to Lower Doses. Because risk at low exposure levels is difficult to measure directly either by animal experiments or by epidemiologic studies, the development of an SF generally entails applying a model to the available data set and using the model to extrapolate from the relatively high doses administered to experimental animals (or the exposures noted in epidemiologic studies) to the lower exposure levels expected for human contact in the environment.

A number of mathematical models and procedures have been developed to extrapolate from carcinogenic responses observed at high doses to responses expected at low doses. Different extrapolation methods may provide a reasonable fit to the observed data but may lead to large differences in the projected risk at low dose.

In general, after the data are fit to the appropriate model, the upper 95th percent confidence limit of the slope of the resulting dose-response curve is calculated. This value is known as the SF and represents an upper 95th percent confidence limit on the probability of a response per unit intake of a chemical over a lifetime (i.e., there is only a five percent chance that the probability of a response could be greater than the estimated value on the basis of the experimental data and model used). In some cases, SFs based on human dose-response data are based on the "best" estimate instead of the upper 95th percent confidence limits. Because the dose-response curve generally is linear only in the low-dose region, the SF estimate only holds true for low doses. Information concerning the limitations on use of SFs can be found in IRIS.

2.3.2.6 Summary of Dose-Response Parameters. Toxicity values for carcinogenic effects can be expressed in several ways. The SF is generally considered to be the upper 95th percent confidence limit of the slope of the dose-response curve and is expressed as $(mg/kg\text{-}day)^{-1}$. If the extrapolation model selected is the linearized multistage model, this value is also known as the q_1^*. Thus:

$$\text{Slope factor} = \text{risk per unit dose} = \text{risk per mg/kg-day}$$

Where data permit, SFs listed in IRIS are based on absorbed doses, although many of them have been based on administered doses.

2.3.3 Summaries of the Toxicity of the Contaminants of Concern

Tables 2-7 and 2-8 present chronic cancer and noncancer health effects criteria (oral SFs and RfDs, respectively, for the COCs). The toxicological properties of the COCs and the toxicological basis of the health effects criteria listed in Tables 2-7 and 2-8 are discussed in Appendix B.

2.4 RISK CHARACTERIZATION

In the risk characterization, the toxicity and exposure assessments are summarized and integrated into quantitative and qualitative expressions of risk. To characterize potential noncarcinogenic effects, comparisons are made between projected intakes of substances and toxicity values; to characterize potential carcinogenic effects, probabilities that an individual will develop cancer over a lifetime of exposure are estimated from projected intakes and chemical-specific dose-response information. Major assumptions, scientific judgements, and to the extent possible, estimates of the uncertainties embodied in the assessment are also presented. In this section, methods of quantifying risks are discussed and applied to individual sites on the Barter Island installation.

2.4.1 Quantifying Risks

This section describes steps for quantifying risk or hazard indices for both carcinogenic and noncarcinogenic effects to be applied to each exposure pathway analyzed. The first two subsections cover procedures for individual substances, and are followed by a subsection on procedures for quantifying risks associated with simultaneous exposures to several substances.

2.4.1.1 Risks from Individual Substances - Carcinogenic Effects. For carcinogens, risks are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen (i.e., incremental or excess individual lifetime cancer risk). The guidelines provided in this section are consistent with EPA (1986b). For some carcinogens, there may be sufficient information on mechanism of action that a modification of the approach outlined below is warranted. Alternative approaches may be considered in consultation with ECAO on a case-by-case basis.

The SF converts estimated daily intakes averaged over a lifetime of exposure directly to incremental risk of an individual developing cancer. Because relatively low intakes (compared to those experienced by test animals) are most likely from environmental exposures, it generally can be assumed that the dose-response relationship will be linear in the low-dose portion of the multistage model dose-response curve. Under this assumption, the SF is a constant, and risk will be directly related to intake. Thus, the linear form of the carcinogenic risk equation is usually applicable for estimating cancer risks. This linear low-dose equation is described below.

LINEAR LOW-DOSE CANCER RISK EQUATION

$$\text{Risk} = \text{LADD} \times \text{SF}$$

where:

Risk = a unitless probability (e.g., 2×10^{-5}) of an individual developing cancer;

LADD = lifetime average daily dose averaged over 70 years (mg/kg-day); and

SF = slope factor, expressed in $(\text{mg/kg-day})^{-1}$

Because the SF is often an upper 95th percentile confidence limit of the probability of response based on experimental animal data used in the multistage model, the carcinogenic risk estimate will generally be an upper-bound estimate. This means that the "true risk" will probably not exceed the risk estimate derived through use of this model and is likely to be less than predicted.

2.4.1.2 Noncancer Hazards from Individual Substances - Noncarcinogenic Effects. The measure used to describe the potential for noncarcinogenic toxicity to occur in an individual is not expressed as the probability of an individual suffering an adverse effect. EPA does not at the present time use a probabilistic approach to estimate the potential for noncarcinogenic health effects. Instead, the potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., lifetime) with an RfD derived for a similar exposure period. This ratio of exposure to toxicity is called an HQ.

The noncancer HQ assumes there is a level of exposure (i.e., RfD) below which it is unlikely for even sensitive populations to experience adverse health effects. If the exposure level (ADD) exceeds this threshold (i.e., if ADD/RfD exceeds unity), there may be concern for potential noncancer effects. As a rule, the greater the value of ADD/RfD above unity, the greater the level of concern. Ratios of ADD/RfD should not be interpreted as statistical probabilities; a ratio of 0.001 does not mean that there is a one in one thousand chance of the effect occurring. Further, it is important to emphasize that the level of concern does not increase linearly as the RfD is approached or exceeded because RfDs do not have equal accuracy or precision and are not based on the same severity of toxic effects. Thus, the slopes of the dose-response curve in excess of the RfD can range widely depending on the substance.

NONCANCER HAZARD QUOTIENT

Noncancer Hazard Quotient = ADD/RfD

where:

ADD = average daily dose (or intake);

RfD = reference dose

ADD and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

2.4.1.3 Aggregate Risks for Multiple Substances. Estimating risk or hazard potential by considering one chemical at a time might significantly underestimate the risks associated with simultaneous exposures to several substances. To assess the overall potential for cancer and noncancer effects posed by multiple chemicals, EPA has developed *Guidelines for the Health Risk Assessment of Chemical Mixtures* (EPA 1986b) that can also be applied to the case of simultaneous exposures to several chemicals from a variety of sources by more than one exposure pathway. Information on specific mixtures; however, is rarely available. Even if such data exist, they are often difficult to use. Monitoring for "mixtures" or modeling the movement of mixtures across space and time present significant technical problems given the likelihood that individual components will behave differently in the environment (i.e., fate and transport).

Although the calculation procedures differ for carcinogenic and noncarcinogenic effects, both sets of procedures assume dose additivity in the absence of information on specific mixtures.

Carcinogenic effects. The cancer risk equation described below is used to estimate the incremental individual lifetime cancer risk for simultaneous exposure to several carcinogens and is based on EPA's risk assessment guidelines. This equation represents an approximation of the precise equation for combining risks which accounts for the joint probabilities of the same individual developing cancer as a consequence of exposure to two or more carcinogens. The difference between the precise equation and the approximation described in the equation below is negligible for total cancer risks less than 0.1. Thus, the simple additive equation is appropriate for most risk assessments.

CANCER RISK EQUATION FOR MULTIPLE SUBSTANCES

$$Risk_T = \Sigma\, Risk_i$$

where:

$Risk_T$ = the total cancer risk, expressed as a unitless probability; and

$Risk_i$ = the risk estimate for the i^{th} substance.

The risk summation techniques described in the cancer risk equation on this page assume that intakes of individual substances are small. They also assume independence of action by the compounds involved (i.e., that there are no synergistic or antagonistic chemical interactions and that all chemicals produce the same effect, i.e., cancer). If these assumptions are incorrect, over- or under-estimation of the actual multiple-substance risk could result.

A separate total cancer risk for each exposure pathway is calculated by summing the substance-specific cancer risks. Resulting cancer risk estimates should be expressed using one significant figure only.

There are several limitations to this approach. First, because each SF is an upper 95th percentile estimate of potency, and because upper 95th percentiles of probability distributions are not strictly additive, the total cancer risk estimate might become artificially more conservative as risks from a number of different carcinogens are summed. If one or two carcinogens drive the risk; however, this problem is not of concern. Second, it often will be the case that substances with different weights of evidence for human carcinogenicity are included. The cancer risk equation for multiple substances sums all carcinogens equally, giving as much weight to class B or C as to class A carcinogens. In addition, SFs derived from animal data will be given the same weight as SFs derived from human data. Finally, the action of two different carcinogens might not be independent.

Noncarcinogenic effects. To assess the overall potential for noncarcinogenic effects posed by more than one chemical, a hazard index approach has been developed based on EPA's *Guidelines for Health Risk Assessment of Chemical Mixtures* (EPA 1986b). This approach assumes that simultaneous subthreshold exposures to several chemicals could result in an adverse health effect. It also assumes that the magnitude of the adverse effect will be proportional to the sum of the ratios of the subthreshold exposures to acceptable exposures. The hazard index is equal to the sum of the HQs. When the hazard index exceeds unity, there may be concern for potential health effects. Any single chemical with an exposure level greater than the toxicity value (i.e., HQ greater than unity) will cause the hazard index to exceed unity, but for multiple chemical exposures, the hazard index can also exceed unity even if no single chemical exposure exceeds its RfD. The equation used to determine noncancer hazard index is as follows:

NONCANCER HAZARD INDEX

$$\text{Hazard Index} = ADD_1/RfD_1 + ADD_2/RfD_2 + \ldots + ADD_i/RfD_i$$

where:

ADD_i = average daily dose (or intake) for the i^{th} toxicant;

RfD_i = reference dose for the i^{th} toxicant; and

ADD and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or shorter-term).

Where appropriate, a separate chronic hazard index can be calculated from the ratios of the chronic daily intake (CDI) to the chronic RfD for individual chemicals as described below.

CHRONIC NONCANCER HAZARD INDEX

$$\text{Chronic Hazard Index} = LADD_1/RfD_1 + LADD_2/RfD_2 + \ldots + LADD_i/RfD_i$$

where:

$LADD_i$ = lifetime average daily dose for the i^{th} toxicant in mg/kg-day, and

RfD_i = chronic reference dose for the i^{th} toxicant in mg/kg-day.

There are several limitations to this approach. As mentioned earlier, the level of concern does not increase linearly as the RfD is approached or exceeded because the RfDs do not have equal accuracy or precision and are not based on the same severity of effect. Moreover, HQs are combined for substances with RfDs based on critical effects of varying toxicological significants. Also, it will often be the case that RfDs of varying levels of confidence that include different uncertainty adjustments and modifying factors will be combined (e.g., extrapolation from animals to humans, from LOAELs to NOAELs, from one exposure duration to another).

Another limitation with the hazard index approach is that the assumption of dose additivity is most properly applied to compounds that induce the same effect by the same mechanism of action. Consequently, application of the hazard index equation to a number of compounds that are not expected to induce the same type of effects or that do not act by the same mechanism could overestimate the potential for effects, although such an approach is appropriate at a screening level. This possibility is generally not of concern if only one or two substances are responsible for driving the hazard index above unity. If the hazard index is greater than unity as a consequence of summing several HQs of similar value, it would be appropriate to segregate the compounds by effect and by mechanism of action and to derive separate hazard indices for each group.

2.4.2 Site-Specific Risk Characterization

Soil and Sediment Exposures. The quantification of noncancer hazard and excess lifetime cancer risk associated with the soil ingestion pathway at Barter Island was based on analytical data from soil and sediment samples collected within the interval from ground surface to permafrost. No attempt was made to segregate surface soil samples from subsurface samples in the risk characterization.

The noncancer hazard and excess lifetime cancer risk associated with the ingestion of soil or sediment containing COCs has been estimated separately for a native northern adult, native northern child, and DEW Line worker. The noncancer hazard and the excess lifetime cancer risk associated with the ingestion of soil or sediment containing COCs has been estimated for an hypothetical native northerner based on six years of exposure as a child and 49 years of exposure as an adult. For the DEW Line worker, cancer risk has been estimated based on ten years of exposure averaged over a default lifetime of 70 years. Noncancer hazard for the DEW Line worker was based on a 10 year exposure.

Surface Water Exposures. The noncancer hazard and the excess lifetime cancer risk associated with the ingestion of surface water containing COCs has been estimated based on a native northern adult and a DEW Line worker. A native northern child receptor was not considered because, unlike exposure to soil, which is expected to be greater in a child than in an adult, the ratio of drinking water ingestion rate to body weight is assumed to be relatively constant from childhood to adulthood. Since a greater number of years is spent as an adult, estimating hazard or risk for water ingestion based on an adult is a more conservative approach. The exposure duration estimate for the DEW Line worker was 10 years and for the native northern adult, 55 years. Exposures were averaged over a 10 year period for DEW Line worker exposure to noncarcinogens, and 55 years for native northern adult exposure to noncarcinogens. Exposures were averaged over a 70 year period for both receptor groups to characterize the risk associated with exposure to carcinogens in surface water.

Ingestion of surface water by DEW Line workers or native northerners is considered to be only a potentially complete exposure pathway. The domestic water supply for the installation and the village of Kaktovik is Fresh Water Lake which is approximately one mile upgradient from the installation. Thus, under a current use scenario, surface water ingestion associated with any of the intermittent surface water sources at the installation is probably not complete (although, it is possible that children, for example, playing near the installation may stop for a drink of water from one of these surface water sources). Under a future use scenario, it is possible that these intermittent surface water sources might be used. Therefore, the exposure assumptions used to characterize the risk associated with surface water ingestion are based on residential use of surface water at the installation as a domestic water supply.

Table 2-10 contains a site-by-site summary of the COCs in each medium, and the noncancer hazard, and excess lifetime cancer risk associated with exposure to the soils/sediments and surface water. Table 2-10 does not include sites where no COCs were identified [Old Runway Dump (LF12) and Fuel Tanks (ST18)]. COCs without toxicity data are not included on Table 2-10, but are discussed in Section 2.1.5. Appendix A contains the spreadsheets used to calculate the noncancer hazard and excess lifetime cancer risk estimates presented in Table 2-10.

Risk Characterization of Petroleum Hydrocarbons. Petroleum hydrocarbons represent a primary source of contamination at the Barter Island installation. The laboratory analysis of soil, sediment, and surface water samples revealed the presence of DRPH, GRPH, and RRPH. In the process of characterizing the risk associated with exposure to these compounds, it was

TABLE 2-10. SUMMARY OF NONCANCER HAZARD AND EXCESS LIFETIME CANCER RISK FOR BARTER ISLAND

SITE	MEDIUM	CHEMICALS OF CONCERN[a]	SUMMARY OF NONCANCER HAZARD AND EXCESS LIFETIME CANCER RISK			COMMENTS
			DEW LINE WORKER	NATIVE NORTHERN ADULT	NATIVE NORTHERN ADULT/CHILD	
Old Landfill (LF01)	Soil/Sediment	None	None[b]	None	None	No COCs selected for soils at Old Landfill.
	Surface Water	Manganese	hazard index = 4.2[c] cancer risk = None[d]	hazard index = 4.2 cancer risk = None	hazard index = None cancer risk = None	Manganese entirely accounts for noncancer hazard. Cancer risk not determined because no carcinogenic COCs were selected.
POL Catchment (LF03)	Soil/Sediment	DRPH Tetrachloroethane	hazard index = 0.02 cancer risk = 2e-9	None[e]	hazard index = 0.4 cancer risk = 5e-8	DRPH and tetrachloroethane account for noncancer hazard. Tetrachloroethane entirely accounts for cancer risk. Soil ingestion hazard and risk estimated for combined adult/child receptor.
	Surface Water	DRPH GRPH Benzene	hazard index = 0.3 cancer risk = 1e-6	hazard index = 0.3 cancer risk = 1e-5	hazard index = None[f] cancer risk = None[f]	DRPH and GRPH account for noncancer hazard. GRPH and benzene account for cancer risk.
Current Landfill (LF04)	Soil/Sediment	None	None	None	None	No COCs selected for soils or sediments at the Current Landfill.
	Surface Water	Manganese Trichloroethene	hazard index = 5.1 cancer risk = 8e-7	hazard index = 5.1 cancer risk = 6e-6	hazard index = None cancer risk = None	Manganese entirely accounts for noncancer hazard. Trichloroethene entirely accounts for cancer risk.
Contaminated Ditch (SD08)	Soil/Sediment	DRPH GRPH Beryllium	hazard index = 0.002 cancer risk = 1e-7,	None	hazard index = 0.04 cancer risk = 2e-6	DRPH and GRPH account for noncancer hazard. GRPH and beryllium account for cancer risk.
	Surface Water	None	None	None	None	No COCs selected for surface water at the Contaminated Ditch.
Heated Storage (SS13)	Soil/Sediment	DRPH GRPH RRPH Aroclor 1254	hazard index = 0.01 cancer risk = 2e-7	None	hazard index = 0.3 cancer risk = 4e-6	All COCs identified here contribute to the noncancer hazard. GRPH and Aroclor 1254 (as PCB) account for cancer risk.
	Surface Water	DRPH Benzene Tetrachloroethane Manganese	hazard index = 2.6 cancer risk = 2e-6	hazard index = 2.6 cancer risk = 1e-5	hazard index = None cancer risk = None	DRPH, tetrachloroethane, and manganese account for noncancer hazard. Benzene and tetrachloroethane account for cancer risk.

TABLE 2-10. SUMMARY OF NONCANCER HAZARD AND EXCESS LIFETIME CANCER RISK FOR BARTER ISLAND (CONTINUED)

SITE	MEDIUM	CHEMICALS OF CONCERN[a]	SUMMARY OF NONCANCER HAZARD AND EXCESS LIFETIME CANCER RISK			COMMENTS
			DEW LINE WORKER	NATIVE NORTHERN ADULT	NATIVE NORTHERN ADULT/CHILD	
Garage (SS14)	Soil/Sediment	DRPH GRPH RRPH Benzene Bis(2-ethyl-hexyl)phthalate	hazard index = 0.03 cancer risk = 1e-8	None	hazard index = 0.6 cancer risk = 2e-7	DRPH, GRPH, RRPH and bis(2-ethylhexyl)phthalate account for noncancer hazard. GRPH, benzene and bis(2-ethylhexyl)phthalate account for cancer risk.
	Surface Water	None	None	None	None	No COCs selected for surface water at the Garage.
Weather Station Building (SS15)	Soil/Sediment	DRPH GRPH	hazard index = 0.006 cancer risk = 1e-8	None	hazard index = 0.1 cancer risk = 3e-7	DRPH and GRPH account for noncancer hazard. GRPH entirely accounts for cancer risk.
	Surface Water	None	None	None	None	No surface water bodies were identified at the Weather Station Building.
White Alice Facility (SS16)	Soil/Sediment	PCBs	hazard index = 0.2 cancer risk = 3e-6	None	hazard index = 3.2 cancer risk = 7e-5	Aroclor 1254 entirely accounts for noncancer hazard. Aroclor 1254 (as PCB) entirely accounts for cancer risk.
	Surface Water	None	None	None	None	No surface water bodies were identified at the White Alice Facility.
POL Tanks (ST17)	Soil/Sediment	DRPH GRPH	hazard index = 0.001 cancer risk = 4e-9	None	hazard index = 0.03 cancer risk = 9e-8	DRPH and GRPH account for noncancer hazard. GRPH entirely accounts for cancer risk.
	Surface Water	None	None	None	None	No COCs selected for surface water at the POL Tanks site.
Old Dump Site (LF19)	Soil/Sediment	DRPH RRPH	hazard index = 0.005	None	hazard index = 0.1	DRPH and RRPH entirely account for noncancer hazard. No carcinogenic COCs were selected.
	Surface Water	None	None	None	None	No COCs selected for surface water at the Old Dump Site.

TABLE 2-10. SUMMARY OF NONCANCER HAZARD AND EXCESS LIFETIME CANCER RISK FOR BARTER ISLAND (CONTINUED)

SITE	MEDIUM	CHEMICALS OF CONCERN[a]	SUMMARY OF NONCANCER HAZARD AND EXCESS LIFETIME CANCER RISK			COMMENTS
			DEW LINE WORKER	NATIVE NORTHERN ADULT	NATIVE NORTHERN ADULT/CHILD	
JP-4 Spill (SS21)	Soil/Sediment	DRPH GRPH Benzene	hazard index = 0.001 cancer risk = 5e-9	None	hazard index = 0.02 cancer risk = 1e-7	DRPH and GRPH account for noncancer hazard. GRPH and benzene account for cancer risk.
	Surface Water	None	None	None	None	No surface water bodies were identified at the JP-4 Spill site.

a All COCs are listed together regardless of whether they contribute to the hazard index, cancer risk, or both.
b None, no COCs selected.
c Hazard index, noncancer hazard index. The hazard index is the sum of the HQs for all of the COCs associated with a given medium, pathway, and receptor group.
d Cancer risk, excess lifetime cancer risk. The cancer risk is the sum of the excess lifetime cancer risks for all of the carcinogenic COCs associated with a given medium, pathway, and receptor group.
e Children are assumed to have a soil ingestion rate greater than that for adults. Therefore, under a residential scenario, the estimates of noncancer hazard and cancer risk associated with soil ingestion are estimated for a combined adult and child receptor only. This estimate is considered a conservative upper bound on the true hazard or risk.
f Drinking water ingestion, unlike soil ingestion, is evaluated for an adult receptor but not a child receptor because adults are assumed to have a longer exposure duration at a greater water ingestion rate. Therefore, the hazard or risk estimated will represent an upper bound, conservative estimate. For soil ingestion, the child soil ingestion rate is assumed to exceed that for adults. Therefore, a combination of the adult and child receptor groups is used to evaluate soil ingestion risk and hazard.

necessary to apply the provisional RfDs developed by EPA for petroleum hydrocarbons (EPA 1992d). These provisional RfDs provide the best available tool for characterizing the risk associated with exposure to the petroleum hydrocarbons. The RfD for JP-4 presented in EPA (1992d) was assumed to represent DRPH and RRPH, and the RfD and SF for unleaded gasoline was assumed to represent GRPH.

The noncancer hazard associated with exposure to DRPH, GRPH, and RRPH, was, therefore, estimated by dividing the compound- and site-specific ADD by the appropriate provisional RfD (EPA 1992d). The excess lifetime cancer risk associated with exposure to GRPH was estimated by multiplying the compound- and site-specific LADD by the SF for unleaded gasoline (EPA 1992d).

Although the provisional RfDs and SF represent the best available numerical estimate of toxicity, there is a significant amount of uncertainty associated with their use at the Barter Island installation. The RfDs and SF are based on studies in mice and rats by the inhalation route of exposure; whereas for this risk assessment, exposure of humans by the ingestion route of exposure is being evaluated. Furthermore, in the absence of a more thorough study to compare the DRPH, GRPH, and RRPH to known petroleum refinery streams, it is not clear how well the provisional toxicity values represent diesel and gasoline.

Risk Characterization of Chemicals Without RBSLs and ARARs. Chemicals detected above background levels without RBSLs or ARARs are evaluated in Section 2.1.5 (page 2-9). Based on the information in that section, and the relatively low levels detected at the sites, these chemicals are not expected to pose a health risk.

2.4.2.1 Old Landfill (LF01).

Soil and Sediments. No COCs were identified for the soil at the Old Landfill (Table 2-10). This does not indicate that exposure to chemicals in the soil at the site is without health risk, however, the concentrations measured were lower than the concentrations considered acceptable under Region 10 guidance (EPA 1991a) or federal ARARs.

Surface Water. The noncancer hazard associated with the potential future ingestion of surface water at the Old Landfill by a native northern adult or by a DEW Line worker is 4.2, based on the maximum concentration of the COC (Tables 2-10 and A-1). The presence of manganese in surface water entirely accounts for the quantifiable noncancer hazard for this receptor/pathway combination. Other chemicals detected in the surface water at the site may be carcinogenic or produce noncancer effects, however, the lack of toxicity values (RfDs or SFs) for these chemicals precludes the quantification of cancer risk or noncancer hazard.

2.4.2.2 POL Catchment (LF03).

Soil and Sediment. The noncancer hazard associated with the potential future ingestion of soil at the POL Catchment site by a hypothetical native northern adult/child is 0.4, and by DEW Line workers is 0.02, based on the maximum concentrations of the COCs (Tables 2-10 and A-2). The presence of DRPH accounts for more than 99 percent of the quantifiable noncancer hazard for these receptor/pathway combinations. The excess lifetime cancer risk associated with the ingestion of soil at the site by a hypothetical native northern adult/child is 5×10^{-8}, and by DEW Line workers is 2×10^{-9}, based on the maximum concentrations of the COCs (Tables 2-10 and A-3). The presence of tetrachloroethane entirely accounts for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations. Other chemicals detected in the soil or sediment at the site may be carcinogenic or produce noncancer effects; however, the lack of toxicity values (RfDs or SFs) for these chemicals precludes the quantification of cancer risk or noncancer hazard.

Surface Water. The noncancer hazard associated with the potential future ingestion of surface water at the POL Catchment by a native northern adult or a DEW Line worker is 0.3, based on the maximum concentrations of the COCs (Tables 2-10 and A-4). The presence of DRPH and GRPH entirely accounts for the quantifiable noncancer hazard for these receptor/pathway combinations. The excess lifetime cancer risk associated with the ingestion of surface water at the site by native northern adult is 1×10^{-5}, and by DEW Line workers is 1×10^{-6}, based on the maximum concentrations of the COCs (Tables 2-10 and A-5). The presence of GRPH and benzene entirely accounts for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations. Other chemicals detected in the surface water at the site may be carcinogenic or produce noncancer effects; however, the lack of toxicity values (RfDs or SFs) for these chemicals precludes the quantification of cancer risk or noncancer hazard.

2.4.2.3 Current Landfill (LF04).

Soil and Sediments. No COCs were identified for the soil at the Current Landfill (Table 2-10). This does not indicate that exposure to chemicals in the soil at the site is without health risk; however, the concentrations measured were lower than the concentrations considered acceptable under Region 10 guidance (EPA 1991a) or federal ARARs.

Surface Water. The noncancer hazard associated with the potential future ingestion of surface water at the Current Landfill by a native northern adult or a DEW Line worker is 5.1, based on the maximum concentration of the COC (Tables 2-10 and A-6). The presence of manganese accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations. The excess lifetime cancer risk associated with the ingestion of surface water at the site by native northern adults is 6×10^{-6}, and by DEW Line workers is 8×10^{-7}, based on the maximum concentration of the COC (Tables 2-10 and A-7). The presence of trichloroethene entirely accounts for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations. Other chemicals detected in the surface water at the site may be carcinogenic or produce noncancer effects; however, the lack of toxicity values (RfDs or SFs) for these chemicals precludes the quantification of cancer risk or noncancer hazard.

2.4.2.4 Contaminated Ditch (SD08).

Soil and Sediment. The noncancer hazard associated with the potential future ingestion of soil at the Contaminated Ditch by a hypothetical native northern adult/child is 0.04 and by DEW Line workers is 0.002, based on the maximum concentrations of the COCs (Tables 2-10 and A-8). The presence of DRPH accounts for more than 90 percent of the quantifiable noncancer hazard for these receptor/pathway combinations. The excess lifetime cancer risk associated with the ingestion of soil at the site by the hypothetical native northern adult/child is 2×10^{-6}, and by DEW Line workers is 1×10^{-7}, based on the maximum concentrations of the COCs (Tables 2-10 and A-9). The presence of GRPH and beryllium entirely accounts for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations. Other chemicals detected in the soil or sediment at the site may be carcinogenic or produce noncancer effects; however, the lack of toxicity values (RfDs or SFs) for these chemicals precludes the quantification of cancer risk or noncancer hazard.

Surface Water. No COCs were identified for surface water at the Contaminated Ditch (Table 2-10). This does not indicate that exposure to chemicals in surface water at the site is without health risk; however, the concentrations measured were lower than the concentrations considered acceptable under Region 10 guidance (EPA 1991a) or federal ARARs.

2.4.2.5 Old Runway Dump (LF12).

Soil and Sediments. No COCs were identified for the soil at the Old Runway Dump. This does not indicate that exposure to chemicals in the soil at the site is without health risk; however, the concentrations measured were lower than the concentrations considered acceptable under Region 10 guidance (EPA 1991a) or federal ARARs.

Surface Water. No surface water bodies were identified at the Old Runway Dump, therefore, no evaluation of noncancer hazard or excess lifetime cancer risk associated with ingestion of surface water was conducted.

2.4.2.6 Heated Storage (SS13).

Soil and Sediment. The noncancer hazard associated with the potential future ingestion of soil at the Heated Storage site by hypothetical native northern adult/child is 0.3, and by DEW Line workers is 0.01, based on the maximum concentrations of the COCs (Tables 2-10 and A-10). The presence of DRPH, GRPH, RRPH and Aroclor 1254 entirely accounts for the quantifiable noncancer hazard for these receptor/pathway combinations. The excess lifetime cancer risk associated with the ingestion of soil at the site by the hypothetical native northern adult/child is 4×10^{-6}, and by DEW Line workers is 2×10^{-7}, based on the maximum concentrations of the COCs (Table 2-10 and A-11). The presence of PCBs accounts for more than 95 percent of the quantifiable excess lifetime cancer risk for these receptor/pathway combinations. Other chemicals detected in the soil or sediment at the site may be carcinogenic or produce noncancer effects; however, the lack of toxicity values (RfDs or SFs) for these chemicals precludes the quantification of cancer risk or noncancer hazard.

Surface Water. The noncancer hazard associated with the potential future ingestion of surface water at the Heated Storage site by native northern adults and DEW Line workers is 2.6, based on the maximum concentrations of the COCs (Tables 2-10 and A-12). The presence of DRPH and manganese accounts for more than 99 percent of the quantifiable noncancer hazard for these receptor/pathway combinations. The excess lifetime cancer risk associated with the ingestion of surface water at the site by native northern adults is 1×10^{-5}, and by DEW Line workers is 2 x 10^{-6}, based on the maximum concentrations of the COCs (Tables 2-10 and A-13). The presence of benzene and tetrachloroethane entirely accounts for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations. Other chemicals detected in the surface water at the site may be carcinogenic or produce noncancer effects; however, the lack of toxicity values (RfDs or SFs) for these chemicals precludes the quantification of cancer risk or noncancer hazard, or the concentrations at which these chemicals were measured were lower than the RBSLs or ARARs.

2.4.2.7 Garage (SS14).

Soil and Sediment. The noncancer hazard associated with the potential future ingestion of soil at the Garage by a hypothetical native northern adult/child is 0.6 and by DEW Line workers is 0.03, based on the maximum concentrations of the COCs (Tables 2-10 and A-14). The presence of DRPH, GRPH, RRPH, and bis(2-ethylhexyl)phthalate accounts for the quantifiable noncancer hazard for these receptor/pathway combinations. The excess lifetime cancer risk associated with the ingestion of soil at the site by the hypothetical native northern adult/child is 2 x 10^{-7}, and by DEW Line workers is 1 x 10^{-8}, based on the maximum concentrations of the COCs (Tables 2-10 and A-15). The presence of GRPH accounts for more than 90 percent of the quantifiable excess lifetime cancer risk for these receptor/pathway combinations. Other chemicals detected in the soil or sediment at the site may be carcinogenic or produce noncancer effects; however, the lack of toxicity values (RfDs or SFs) for these chemicals precludes the quantification of cancer risk or noncancer hazard, or the concentrations at which these chemicals were measured were lower than the risk-based screening levels or ARARs.

Surface Water. No COCs were identified for surface water at the Garage (Table 2-10). This does not indicate that exposure to chemicals in surface water at the site is without health risk; however, the concentrations measured were lower than the concentrations considered acceptable under Region 10 guidance (EPA 1991a) or federal ARARs.

2.4.2.8 Weather Station Building (SS15).

Soil and Sediment. The noncancer hazard associated with the potential future ingestion of soil at the Weather Station Building by a hypothetical native northern adult/child is 0.1 and by DEW Line workers is 0.006, based on the maximum concentrations of the COCs (Tables 2-10 and A-16). The presence of DRPH and GRPH entirely accounts for the quantifiable noncancer hazard for these receptor/pathway combinations. The excess lifetime cancer risk associated with the ingestion of soil at the site by the hypothetical native northern adult/child is 3 x 10^{-7}, and by DEW Line workers is 1 x 10^{-8}, based on the maximum concentrations of the COCs (Tables 2-10 and A-17). The presence of GRPH entirely accounts for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations. Other chemicals detected in the soil or sediment at the site may be carcinogenic or produce noncancer effects; however, the lack of toxicity values (RfDs or SFs) for these chemicals precludes the quantification of cancer risk or noncancer hazard, or the concentrations at which these chemicals were measured were lower than the risk-based screening levels or ARARs.

Surface Water. No surface water bodies were identified at the Weather Station Building, therefore, no evaluation of noncancer hazard or excess lifetime cancer risk associated with the ingestion of surface water was conducted.

2.4.2.9 White Alice Facility (SS16).

Soil and Sediment. The noncancer hazard associated with the potential future ingestion of soil at the White Alice Facility by a hypothetical native northern adult/child is 3.2, and by DEW Line workers is 0.2, based on the maximum concentration of the COC (Tables A-10 and A-18). The presence of Aroclor 1254 accounts for the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the potential future ingestion of soil at the White Alice Facility by the hypothetical native northern adult/child is 7×10^{-5}, and by DEW Line workers is 3×10^{-6}, based on the maximum concentration of the COC (Tables 2-10 and A-19). The presence of PCBs (Aroclor 1254) entirely accounts for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

Surface Water. No surface water bodies were identified at the White Alice Facility, therefore, no evaluation of noncancer hazard or excess lifetime cancer risk associated with ingestion of surface water was conducted.

2.4.2.10 POL Tanks (ST17).

Soil and Sediment. The noncancer hazard associated with the potential future ingestion of soil at the POL Tanks site by a hypothetical native northern adult/child is 0.03, and by DEW Line workers is 0.001, based on the maximum concentrations of the COCs (Tables 2-10 and A-20). The presence of DRPH and GRPH entirely accounts for the quantifiable noncancer hazard for these receptor/pathway combinations. The excess lifetime cancer risk associated with the ingestion of soil at the site by the hypothetical native northern adult/child is 9×10^{-8}, and by DEW Line workers is 4×10^{-9}, based on the maximum concentration of the COC (Tables 2-10 and A-21). The presence of GRPH entirely accounts for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations. Other chemicals detected in the soil or sediment at the site may be carcinogenic or produce noncancer effects; however, the lack of toxicity values (RfDs or SFs) for these chemicals precludes the quantification of cancer risk or noncancer hazard, or the concentrations at which these chemicals were measured were lower than the risk-based screening levels or ARARs.

Surface Water. No surface water bodies were identified at the POL Tanks site, therefore, no evaluation of noncancer hazard or excess lifetime cancer risk associated with ingestion of surface water was conducted.

2.4.2.11 Fuel Tanks (ST18).

Soil and Sediments. No COCs were identified for the soil at the Fuel Tanks site. This does not indicate that exposure to chemicals in the soil at the site is without health risk; however, the concentrations measured were lower than the concentrations considered acceptable under Region 10 guidance (EPA 1991a) or federal ARARs.

Surface Water. No surface water bodies were identified at the Fuel Tanks site, therefore, no evaluation of noncancer hazard or excess lifetime cancer risk associated with ingestion of surface water was conducted.

2.4.2.12 Old Dump Site (LF19).

Soil and Sediment. The noncancer hazard associated with the potential future ingestion of soil at the Old Dump Site by a hypothetical native northern adult/child is 0.1 and by DEW Line workers is 0.005, based on the maximum concentrations of the COCs (Tables 2-10 and A-22). The presence of RRPH accounts for more than 90 percent of the quantifiable noncancer hazard for these receptor/pathway combinations. No carcinogenic COCs were selected for the soil and sediment at the site (Table 2-10). Therefore, a quantitative estimate of cancer risk associated with the soil ingestion pathway can not be calculated.

Surface Water. No COCs were identified for surface water at the Old Dump Site (Table 2-10). This does not indicate that exposure to chemicals in surface water at the site is without risk; however, the concentrations measured were lower than the concentrations considered acceptable under Region 10 guidance (EPA 1991a) or federal ARARs.

2.4.2.13 Bladder Diesel Spill (SS20).

Soil and Sediments. No COCs were identified for the soil at the Bladder Diesel Spill site. This does not indicate that exposure to chemicals in the soil at the site is without health risk; however, the concentrations measured were lower than the concentrations considered acceptable under Region 10 guidance (EPA 1991a) or federal ARARs.

Surface Water. No COCs were identified for surface water at the Bladder Diesel Spill site. This does not indicate that exposure to chemicals in surface water at the site is without health risk; however, the concentrations measured were lower than the concentrations considered acceptable under Region 10 guidance (EPA 1991a) or federal ARARs.

2.4.2.14 JP-4 Spill (SS21).

Soil and Sediment. The noncancer hazard associated with the potential future ingestion of soil at the JP-4 Spill site by a hypothetical native northern adult/child is 0.02, and by DEW Line workers is 0.001, based on the maximum concentrations of the COCs (Tables 2-10 and A-23). The presence of DRPH and GRPH entirely accounts for the quantifiable noncancer hazard for these receptor/pathway combinations. The excess lifetime cancer risk associated with the ingestion of soil at the site by the hypothetical native northern adult/child is 1×10^{-7}, and by DEW Line workers is 5×10^{-9}, based on the maximum concentrations of the COCs (Tables 2-10 and A-24). The presence of GRPH and benzene entirely accounts for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations. Other chemicals detected in the soil or sediment at the site may be carcinogenic or produce noncancer effects; however, the lack of toxicity values (RfDs or SFs) for these chemicals precludes the quantification of cancer risk or noncancer hazard, or the concentrations at which these chemicals were measured were lower than the risk-based screening levels or ARARs.

Surface Water. No surface water bodies were identified at the JP-4 Spill, therefore, no evaluation of noncancer hazard or excess lifetime cancer risk associated with ingestion of surface water was conducted.

2.5 SUMMARY AND CONCLUSIONS

Eight of the fourteen sites evaluated in the RI pose noncancer hazards and excess lifetime cancer risks lower than the regulatory agency benchmarks of 1.0 for noncancer HQ and 1×10^{-6} for excess lifetime cancer risk. These sites are the Old Runway Dump (LF12), Garage (SS14), Weather Station Building (SS15), POL Tanks (ST17), Fuel Tanks (ST18), Old Dump Site (LF19), Bladder Diesel Spill (SS20), and the JP-4 Spill (SS21). Of these eight, three were eliminated from further consideration in the risk assessment based on a comparison of the maximum concentrations of contaminants detected to the risk-based screening levels or ARARs or both. Thus, no COCs were selected for the Old Runway Dump (LF12), the Fuel Tanks (ST18), and the Bladder Diesel Spill (SS20) sites.

Table 2-11 presents a summary of the sites at the Barter Island installation and includes noncancer hazards and excess lifetime cancer risks for site and medium where the risks and/or hazards exceed the regulatory agency benchmark of 1.0 for noncancer hazard index and 1×10^{-6} for excess lifetime cancer risk.

The primary potential noncancer hazard at two of the six remaining sites is manganese at high concentrations in the surface water. These sites include the Old Landfill (LF01) and the Current Landfill (LF04). The noncancer hazard for manganese in surface water was calculated assuming the affected surface water would be used as a sole-source water supply for 180 days per year. Based on site-specific information; however, the manganese in surface water does not currently pose a health hazard nor is it likely to pose a hazard in the future. The surface water expressions at the installation are frozen most of the year (approximately nine months), are only intermittently filled with water during the warmer months, and are not known to be used for a water supply now or in the past. Water for domestic use at the Barter Island station and by native northerners is supplied by a fresh water lake located approximately one-half mile upgradient from the station. The distance and gradient preclude the contamination of the fresh water lake by operations at the radar station. The purpose of including the surface water ingestion pathway is to evaluate a potential future exposure scenario that might include residential use of surface water sources other than Fresh Water Lake. If the Barter Island installation is retired and released for civilian use, it is possible that residential land use would occur. This situation is highly unlikely given the long term plans to maintain the Barter Island installation as a long-range radar installation. In addition, it is highly unlikely the village of Kaktovik would move from its current location.

TABLE 2-11. SUMMARY OF NONCANCER HAZARD AND EXCESS LIFETIME CANCER RISK FOR BARTER ISLAND SITES EXCEEDING REGULATORY THRESHOLDS [Hazard Index >1, Cancer Risk >1 x 10^{-6}]

SITE	MEDIUM	CHEMICALS OF CONCERN[a]	SUMMARY OF NONCANCER HAZARD AND EXCESS LIFETIME CANCER RISK			COMMENTS
			DEW LINE WORKER	NATIVE NORTHERN ADULT	NATIVE NORTHERN ADULT/CHILD	
Old Landfill (LF01)	Surface Water	Manganese	hazard index = 4.2	hazard index = 4.2	---	Manganese entirely accounts for noncancer hazard.
POL Catchment (LF03)	Surface Water	DRPH GRPH Benzene	---	cancer risk = 1e-5	---	GRPH and benzene account for cancer risk.
Current Landfill (LF04)	Surface Water	Manganese Trichloroethene	hazard index = 5.1	hazard index = 5.1 cancer risk = 6e-6	---	Manganese entirely accounts for noncancer hazard. Trichloroethene entirely accounts for cancer risk.
Contaminated Ditch (SD08)	Soil	DRPH GRPH Beryllium	---	---	cancer risk = 2e-6	GRPH and beryllium account for cancer risk.
Old Runway Dump (LF12)	Soil	None	---	---	---	Noncancer hazard index <1 and/or excess lifetime cancer risk <1 x 10^{-6}.
Heated Storage (SS13)	Soil	DRPH GRPH RRPH Aroclor 1254/PCBs	---	---	cancer risk = 4e-6	GRPH and Aroclor 1254 (as PCB) account for cancer risk.
	Surface Water	DRPH GRPH Benzene Tetrachloroethane	hazard index = 2.55 cancer risk = 2e-6	hazard index = 2.55 cancer risk = 1e-5	---	DRPH, tetrachloroethane and manganese account for noncancer hazard. Benzene and tetrachloroethane account for cancer risk.
Garage (SS14)	Soil and Surface Water	DRPH GRPH RRPH Benzene Bis(2-ethylhexyl)phthalate Manganese	---	---	---	Noncancer hazard index <1 and/or excess lifetime cancer risk <1 x 10^{-6}.
Weather Station Building (SS15)	Soil and Surface Water	DRPH GRPH	---	---	---	Noncancer hazard index <1 and/or excess lifetime cancer risk <1 x 10^{-6}.

TABLE 2-11. SUMMARY OF NONCANCER HAZARD AND EXCESS LIFETIME CANCER RISK FOR BARTER ISLAND SITES EXCEEDING REGULATORY THRESHOLDS [Hazard Index >1, Cancer Risk >1 x 10^{-6}] (CONTINUED)

SITE	MEDIUM	CHEMICALS OF CONCERN[a]	SUMMARY OF NONCANCER HAZARD AND EXCESS LIFETIME CANCER RISK			COMMENTS
			DEW LINE WORKER	NATIVE NORTHERN ADULT	NATIVE NORTHERN ADULT/CHILD	
White Alice Facility (SS16)	Soil	Aroclor 1254/PCBs	cancer risk = 3e-6	---	hazard index = 3.2 cancer risk = 7e-5	Aroclor 1254 entirely accounts for noncancer hazard. Aroclor 1254 (as PCB) entirely accounts for cancer risk.
POL Tanks (ST17)	Soil and Surface Water	DRPH GRPH	---	---	---	Noncancer hazard index <1 and/or excess lifetime cancer risk <1 x 10^{-6}.
Fuel Tanks (ST18)	Soil and Surface Water	None	---	---	---	Noncancer hazard index <1 and/or excess lifetime cancer risk <1 x 10^{-6}.
Old Dump Site (LF19)	Soil	DRPH RRPH	---	---	---	Noncancer hazard index <1 and/or excess lifetime cancer risk <1 x 10^{-6}.
Bladder Diesel Spill (SS20)	Soil	None	---	---	---	Noncancer hazard index <1 and/or excess lifetime cancer risk <1 x 10^{-6}.
JP-4 Spill (SS21)	Soil and Surface Water	DRPH GRPH Benzene	---	---	---	Noncancer hazard index <1 and/or excess lifetime cancer risk <1 x 10^{-6}.

a All COCs are listed together regardless of whether they contribute to the hazard index, cancer risk, or both.

Surface water at two sites with excess lifetime cancer risks that slightly exceed regulatory agency benchmarks include the POL Catchment (LF03), 1×10^{-5}; Current Landfill (LF04), 6×10^{-6}; and Heated Storage (SS13), 1×10^{-5}. Again these risks are based on the surface water at these sites being used as a sole-source drinking water supply. Currently the surface water at these sites does not pose a carcinogenic risk.

The Contaminated Ditch (SD08) and Heated Storage (SS13) have cancer risks for soil ingestion that slightly exceed regulatory benchmarks. For soil ingestion at the Contaminated Ditch (SD08) the risk is 2×10^{-6}, and at the Heated Storage (SS13) the risk is 4×10^{-6}.

Except for the White Alice Facility, the noncancer hazard does not exceed one for the soil ingestion pathway at any site at the Barter Island installation. According to EPA, remedial action is generally not warranted at sites where the noncancer hazard is less than one (EPA 1991b). Therefore, on the basis of the estimated noncancer hazard, remediation of the soil at any site at the installation besides the White Alice Facility is not necessarily warranted.

The maximum excess lifetime cancer risk estimated for any site at the Barter Island installation is 7×10^{-5} and is associated with the potential exposure to PCBs through the soil ingestion pathway at the White Alice Facility (SS16). According to EPA, remedial action is generally not warranted at sites where the excess lifetime cancer risk is less than 1×10^{-4} (EPA 1991b). Therefore, on the basis of carcinogenic risk alone, remediation of the soil at any site at Barter Island is not necessarily warranted.

The excess lifetime cancer risk and hazard index for each of the sites was based on the maximum concentration of COCs detected at each site. This is a very conservative approach and had the average concentrations been used in the risk evaluation, few COCs would have been identified and risks and hazards would be below regulatory thresholds. The risk evaluation also assumed a future residential scenario where surface water at the sites would be used as a source of drinking water. Again, this is a very conservative approach as the streams and ponds at the sites are not likely to be used as a source of drinking water.

In conclusion, under current uses the COCs at the Barter Island sites pose only a minimal, if any, potential threat to human health. Based on the human health risk assessment, remedial actions/cleanup are not warranted at any of the 14 Barter Island sites.

2.6 RISK CHARACTERIZATION UNCERTAINTY

Several sources of uncertainty affect the estimates of excess lifetime cancer risk and noncancer hazard as presented in this risk assessment. The sources are generally associated with:

- Sampling and analysis of soil, sediment and surface water;
- Assigning the source of contamination;
- Exposure assumptions, including estimates of exposure point concentrations;

- Evaluation of the toxicity of the COCs; and
- Methods and assumptions used to characterize the cancer risk and noncancer hazard.

Uncertainties associated with sampling and analysis include the inherent variability (standard error) in the analysis, representativeness of the samples, sampling errors, and heterogeneity of the sample matrix. The quality assurance/quality control program used in conducting the sampling and analysis serves to reduce errors, but it can not eliminate all errors associated with sampling and analysis. There is some uncertainty in the selection of COCs with respect to sample quantitation limits for a given chemical. In some cases a chemical may have had detected values below the COC screening criteria as well as samples with quantitation limits greater than the screening criteria. In these cases it should be understood that only the samples with adequate quantitation limits are applicable to the screening process. Thus, the number of samples used to screen a chemical would be less than the total number of analyses for that chemical.

Simplifying assumptions were made about the environmental fate and transport of the site contamination, specifically, no contaminant loss or transformation has or will occur. Thus, the data chosen to represent exposure point concentrations in the sample-by-sample risk calculations is an additional source of potential error.

The depth at which a soil sample was collected was not considered in the risk characterization, so exposure to subsurface contamination was considered to be equally likely as exposure to surface contamination. This approach would tend to overestimate the true risk.

The estimation of exposure requires many assumptions to describe potential exposure situations. There are uncertainties regarding the likelihood of exposure, frequency of contact with contaminated media, the concentration of contaminants at exposure points, and the time period of exposure. These tend to simplify and approximate actual site conditions. In general, these assumptions are intended to be conservative and yield an overestimate of the true risk or hazard.

The toxicological database is also a source of uncertainty. The EPA has outlined some of the sources of uncertainty in EPA (1986a,b, 1989a). These sources include extrapolation between exposure routes, from high to low doses, and from animals to humans; species, gender, age, and strain differences in uptake, metabolism, organ distribution, and target site susceptibility; and human population variability with respect to diet, environment, activity patterns, and cultural factors. The toxicity factors from IRIS and HEAST, which are used to estimate the toxicity of the COCs, are developed using a highly conservative methodology and probably tend to overestimate the potential hazards to humans.

Use of the provisional RfDs and SF for DRPH, GRPH, and RRPH are an additional source of uncertainty in the toxicity assessment and risk characterization. Although the provisional RfDs represent the best available numerical estimate of toxicity, there is a significant amount of uncertainty associated with their use at the Barter Island installation. The RfDs and SF are based on studies in mice and rats by the inhalation route of exposure; whereas, in this risk assessment, exposure of humans by the ingestion route only is being evaluated. Furthermore, in the absence of more thorough studies to compare to toxicity of DRPH, GRPH, and RRPH to the toxicity of known refinery streams, it is not clear how well the provisional values represent the toxicity of diesel, gasoline, and residual oils in humans.

In the risk characterization, the assumption was made that the total risk of developing cancer from exposure to site contaminants is the sum of the risk attributed to each individual contaminant. Likewise, the potential for the development of noncancer adverse effects is the sum of the HQs (previously defined) estimated for exposure to each individual contaminant. This approach does not account for the possibility that chemicals act synergistically or antagonistically but probably results in an overestimate of the true risk.

In addition to the more general sources of uncertainty associated with risk assessment methodology, there are site-specific sources of uncertainty. Primarily, these sources are associated with the lifestyle of the native northerners (inhabitants of Kaktovik), the time spent on the 14 sites that were investigated during the RI, and with specific exposure assumptions (soil ingestion rate, exposure frequency, and exposure duration).

Inhabitants of Kaktovik are known to use the installation as an access route to the coast and occasionally for recreation (riding motorized vehicles). No studies have been conducted to measure the time these potential receptors spend on contaminated sites at the installation. Some of the sites with levels of contamination that exceed regulatory benchmarks are not likely to be accessed by this group (e.g., the White Alice facility, the Heated Storage, or the Garage). Therefore, the assumptions made regarding exposure frequency probably result in an overestimate of the true noncancer hazard and cancer risk.

Similarly, no studies have been conducted to measure the soil ingestion rate of potential receptors on the contaminated sites. Potentially, soil ingestion by the inhabitants of Kaktovik may be greater than the default rate of 100 mg/day for adults and 200 mg/day for children. Given the rugged, partially subsistence, lifestyle of this group, it is possible that they incidentally ingest soil at a higher rate than receptors of a similar age in the continental United States. The estimate of soil ingestion rate used in this risk assessment may over- or underestimate the true rate.

The maximum exposure duration assumed for native northerners, 55 years, is probably fairly accurate. The RME estimate for inhabitants of the continental United States is 30 years; however, native northerners are more likely to remain in their villages for a longer period. Although, the exposure duration of 55 years is an estimate, it is not expected to significantly over- or underestimate hazard or risk.

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3.0 ECOLOGICAL RISK ASSESSMENT

The objective of the ERA is to estimate potential impacts to aquatic and terrestrial plants and animals at the Barter Island DEW Line installation. This document assesses potential ecological risks at the Barter Island installation based on sampling and analyses conducted during the RI of the 14 sites located at the installation. The RI was completed during the summer of 1993 in conjunction with RIs at seven other radar installations.

Guidance documents used during preparation of this assessment include:

- Handbook to Support the Installation Restoration Program Statements of Work (U.S. Air Force 1991); and

- Framework for Ecological Risk Assessment (EPA 1992a).

The approach used to assess potential ecological impacts is conceptually similar to that for human health risks; potentially exposed populations (receptors) are identified, and then information on exposure and toxicity are combined to derive estimates of risk. The ecological assessment focuses, however, on potential impacts on a population of organisms rather than on individual organisms (except in the case of endangered species where individuals are considered). Because ecosystems are composed of a variety of species, ecological assessments evaluate potential impacts to numerous species.

Ideally, ERAs should evaluate potential risks to communities and ecosystems, as well as to individual populations. Because of the large number of species and communities present in natural systems such ecosystem-wide assessments are very complex, however, appropriate assessment methodologies have not yet been developed. In addition, dose-response data on community or ecosystem responses are generally lacking. Therefore, evaluations of potential impacts to communities or ecosystems are qualitative.

The degree to which potential ecological impacts can be characterized is highly dependent upon the data available to support such estimates. Such data include: information regarding contaminant release, transport, and fate; characteristics of potential receptor populations; and adequate supporting toxicity data for the COCs.

This ERA is intended to be at a screening level, rather than a full scale investigation of the state of the ecosystem. No specific studies of the biota were undertaken. The assessment is based on media sampling (i.e., surface water and soil/sediment samples). It is divided into six sections:

Section 3.1 - Selection of Site Contaminants;
Section 3.2 - Exposure Assessment;
Section 3.3 - Ecological Toxicity Assessment;
Section 3.4 - Risk Characterization for Ecological Receptors;
Section 3.5 - Ecological Risk Assessment Uncertainty Analysis; and
Section 3.6 - Summary of Ecological Risk.

3.1 SELECTION OF SITE CONTAMINANTS

A stressor in the environment is a chemical, physical or biological action that can cause a negative impact on an ecosystem (EPA 1992a). Only chemical stressors are evaluated as part of this ERA, and are identified as COCs. A review of the site data indicate that the chemical stressors are primarily petroleum products and solvents.

Only the sites that are thought to consist of useable habitat for potential receptors are evaluated for COCs in the ERA. Four of the 14 sites shown in Table 1-1 were eliminated from further evaluation because they are not likely to be used by ecological receptors. These sites include Weather Station Building (SS15), White Alice Facility (SS16), POL Tanks (ST17), and JP-4 Spill (SS21). The rationale for elimination and a discussion of habitat suitability are presented in Section 3.2.4. The other 10 sites, Old Landfill (LF01), POL Catchment (LF03), Current Landfill (LF04), Contaminated Ditch (SD08), Old Runway Dump (LF12), Heated Storage (SS13), Garage (SS14), Fuel Tanks (ST18), Old Dump Site (LF19), and Bladder Diesel Spill (SS20), appear to be useable habitat for representative species. Figures E-1 through E-16 in Appendix E illustrate habitat suitability at each of the sites.

COCs are chemicals detected above background concentrations and action levels, and at a high frequency. Chemicals present onsite at concentrations in excess of background concentrations and action levels (Ambient Water Quality Criteria for surface water; surface and ground water cleanup levels: AS 46.03.070, AS 46.04.020, AS 46.09.020, 18 AAC 70.020(b), and 18 AAC 75.140; the ADEC determination of cleanup levels for petroleum contaminated soils; and EPA sediment quality criteria) were evaluated for frequency of detection in onsite media. If a chemical was detected at a frequency of less than five percent, it was not considered representative of actual site conditions, and was eliminated from quantitative evaluation. If a chemical was detected only once it was eliminated from further evaluation, even if this violates the five percent screening criteria (e.g., 1 detect in 18 samples was screened out of the risk assessment). In certain cases infrequently detected chemicals were not eliminated as COCs; e.g., those with high potential for causing adverse ecological effects or those detected at a concentration significantly above the action level. If no action levels were available, the maximum detected concentration of the chemical was compared to a toxicity value derived from chronic exposure tests available in the literature. If the concentration was above this level, the compound was considered a COC. Tables 3-1 and 3-2 present the data used in the screening process for surface water and soils/sediment. These tables do not include data for sites that were eliminated from the ecological evaluation based on lack of suitable habitat.

In summary, the decisions for selecting COCs were made using the following logic:

- Is the chemical detected above the maximum detected background concentration?

  No: No longer considered a COC.
  Yes: Is the chemical detected above the action level or toxicity value?

TABLE 3-1. SUMMARY OF CHEMICALS OF CONCERN: SURFACE WATER

CHEMICALS OF CONCERN: BARTER ISLAND INSTALLATION SURFACE WATER						
CHEMICAL	RANGE OF DETECTED CONCENTRATION (µg/L)	BACKGROUND CONCENTRATION (µg/L)	ACTION LEVEL (µg/L)	FREQUENCY OF DETECTION	AVERAGE CONCENTRATION FOR COC (µg/L)	COC
ORGANICS						
DRPH	196-5,760	<200	---	8/28	719	**YES**
GRPH	6.9-367	<20.0	---	2/24	44	NO
Benzene	2.7-6.9	<1	106[a]	2/24	NA	NO
Toluene	56	<1	350[a]	1/24	NA	NO
Ethylbenzene	3.1-19	<1	640[a]	3/24	NA	NO
Xylenes (Total)	3.8-38.4	<2	66[b]	5/24	NA	NO
Chloromethane	4.2	<1	2,700-5,500[c]	1/18	0.59	NO
n-Butylbenzene	2.4	<1	---	1/14	0.64	NO
sec-Butylbenzene	1.0	<1	---	1/14	0.54	NO
1,2-Dichloroethane	9.1	1.3B-3.2B	20,000[d]	1/18	NA	NO
cis-1,2-Dichloroethene	1.5	<1	70[e]	1/14	NA	NO
Dichlorofluoromethane	3.7	<1	---	1/14	0.69	NO
Isopropylbenzene	2.9	<1	---	1/14	0.67	NO
1,2,4-Trimethylbenzene	1.4-19	<1	77.2[f]	2/14	1.89	NO
1,3,5-Trimethylbenzene	1.3-13	<1	77.2[f]	2/14	1.45	NO

NA Not applicable.
--- Not available.
a Federal Ambient Water Quality Criteria, Fresh Acute Criteria (divided by an uncertainty conversion factor of 50).
b 96 hour LC50 for Rainbow Trout divided by an uncertainty conversion factor of 50.
c Dawson et. al. 1977.
d Drinking water health advisory for reference exposure - human health.
e Federal Ambient Water Quality Criteria, Fresh chronic criteria.
f Geiger 1986.

TABLE 3-1. SUMMARY OF CHEMICALS OF CONCERN: SURFACE WATER (CONTINUED)

CHEMICALS OF CONCERN: BARTER ISLAND INSTALLATION SURFACE WATER						
CHEMICAL	RANGE OF DETECTED CONCENTRATION (μg/L)	BACKGROUND CONCENTRATION (μg/L)	ACTION LEVEL (μg/L)	FREQUENCY OF DETECTION	AVERAGE CONCENTRATION FOR COC (μg/L)	COC
Naphthalene	1.6-35	<1	620[e]	3/15	NA	NO
n-Propylbenzene	3.6	<1	---	1/14	0.72	NO
Tetrachloroethene	12	<1	840[e]	1/20	NA	NO
p-Isopropyltoluene	1.1-2.1	<1	65[g]	2/14	0.7	NO
Trichloroethene	6-36	<1	21,900[e]	2/20	NA	NO
INORGANICS[j]						
Aluminum	160-1,900	<100-350	87[e]	5/10	318	**YES**
Barium	74-150	<50-93	1,000[h]	9/10	90	NO
Calcium	5,000-190,000	4,100-88,000	---	10/10	104,820	NO
Iron	1,600-21,000	<100-2,800	1,000[e]	10/10	8,580	**YES**
Magnesium	26,000-78,000	<5,000-54,000	---	10/10	43,900	NO
Manganese	70-1,800	<50-510	200[i]	10/10	574	**YES**
Potassium	5,100-110,000	<5,000	See text	8/10	18,040	NO
Sodium	5,000-440,000	8,200-450,000	---	10/10	NA	NO

NA Not applicable.
--- Not available.
e Federal Ambient Water Quality Criteria, Fresh Chronic Criteria.
g LeBlanc 1980.
h Based on Arsenic (III); no criteria for Arsenic (total).
i Maximum contaminant level (MCL).
j Total metals.

TABLE 3-2. SUMMARY OF CHEMICALS OF CONCERN: SOILS AND SEDIMENTS

CHEMICALS OF CONCERN: BARTER ISLAND INSTALLATION SEDIMENT AND SOIL						
CHEMICAL	RANGE OF CONCENTRATION (mg/kg)	BACKGROUND CONCENTRATION (mg/kg)	ACTION LEVEL (mg/kg)[a]	FREQUENCY OF DETECTION	AVERAGE CONCENTRATION FOR COC (mg/kg)	COC
ORGANICS						
DRPH	4.76-28,600	9.55-1,150	500[b]	39/91	1,159.2	**YES**
GRPH	0.429-700	<0.4-<9	100[b]	30/88	34.4	**YES**
RRPH (Approx.)	180-27,000	<480	2,000[b]	10/59	968	**YES**
Benzene	0.72-1.4	<0.02-<0.3	0.5[b]/0.05[c]	3/86	NA	NO
Toluene	0.026-2.3	<0.02-<0.3	0.786	13/86	0.093	NO
Ethylbenzene	0.02-11	<0.02-<0.3	4.36[c]	19/86	0.13	**YES**
Xylenes (Total)	0.21-47	<0.04-<0.6	1.21	25/86	1.09	**YES**
n-Butylbenzene	0.635-4.22	<0.500	4.36[d]	4/30	0.41	NO
sec-Butylbenzene	1.24-1.62	<0.500	4.36[d]	3/30	0.36	NO
tert-Butylbenzene	.256	<0.500	---	1/30	NA	NO
cis-1,2-Dichloroethene	0.069	<0.500	---	1/30	NA	NO
1,2,4-Trichlorobenzene	0.046	<0.500	---	1/30	NA	NO
1,2,4-Trimethylbenzene	0.041-14.7	<0.500	---	5/30	0.98	NO*
1,3,5-Trimethylbenzene	0.048-9.32	<0.500	---	7/30	0.93	NO*
1,4-Dichlorobenzene	0.044	<0.500	---	1/48	NA	NO

NA Not applicable.
--- Not available.
* The rational for not selecting this chemical as a COC is presented in Sections 3.1.2.3 and 3.1.2.4.
a NOAA 1991, Sediment ER-L (Effects Range-Low).
b ADEC, Interim Guidance for non-UST contaminated soil cleanup levels, 17 July 1991.
c EPA Sediment Quality Criteria.
d EPA Sediment Quality Criteria for Ethylbenzene (see text).
e 55 FR 30798-Proposed Rule RCRA Corrective Action for SWMVs 40 CFR [Section 264.521(m)(2)(i-iv)] Health-Based Criteria for Carcinogens.

TABLE 3-2. SUMMARY OF CHEMICALS OF CONCERN: SOILS AND SEDIMENTS (CONTINUED)

CHEMICALS OF CONCERN: BARTER ISLAND INSTALLATION SEDIMENT AND SOIL						
CHEMICAL	RANGE OF CONCENTRATION (mg/kg)	BACKGROUND CONCENTRATION (mg/kg)	ACTION LEVEL (mg/kg)[a]	FREQUENCY OF DETECTION	AVERAGE CONCENTRATION FOR COC (mg/kg)	COC
Isopropylbenzene	0.409-0.681	<0.500	4.36[d]	3/30	0.08	NO
p-Isopropyltoluene	1.69-2.47	<0.500	4.36[d]	3/30	0.23	NO
n-Propylbenzene	0.918-1.17	<0.500	4.36[d]	3/30	0.097	NO
Methylene Chloride	0.225	<0.300	0.43[c]	1/48	NA	NO
Tetrachloroethene	0.023-5.42	<0.300	---	2/62	NA	NO
Isophorone	1.49	<0.23	---	1/18	0.39	NO
Fluoranthene	1.7-2.28	<0.23	6.2[c]	2/18	0.46	NO
Naphthalene	0.105-46	<0.500	0.34	5/30	2.26	**YES**
Phenanthrene	1.96-4.79	<0.23	1.8[c]	2/18	0.62	NO
Pyrene	1.26	<0.23	13.1[c]	1/18	0.87	NO
2-Methylnaphthalene	3.44-14.5	<0.23	---	3/18	1.55	NO*
Bis(2-ethylhexyl)phthalate	4.6	<0.23	50[e]	1/18	NA	NO
INORGANICS						
Aluminum	1,600-7,500	1,500-25,000	---	15/16	NA	NO
Barium	13-120	27-390	---	15/16	NA	NO
Beryllium	3.2	<2.6-6.4	---	1/16	NA	NO

NA Not applicable.
-- Not available.
* The rational for not selecting this chemical as a COC is presented in Sections 3.1.2.3 and 3.1.2.4.
c EPA Sediment Quality Criteria.
d EPA Sediment Quality Criteria for Ethylbenzene (see text).
e 55 FR 30798-Proposed Rule RCRA Corrective Action for SWMUs, 40 CFR [Section 264.521(m)(2)(i-iv)] Health-Based Criteria for Carcinogens.
f Sediment quality benchmark developed by Hull and Suter (1994).

TABLE 3-2. SUMMARY OF CHEMICALS OF CONCERN: SOILS AND SEDIMENTS (CONTINUED)

CHEMICALS OF CONCERN: BARTER ISLAND INSTALLATION SEDIMENT AND SOIL						
CHEMICAL	RANGE OF CONCENTRATION (mg/kg)	BACKGROUND CONCENTRATION (mg/kg)	ACTION LEVEL (mg/kg)[a]	FREQUENCY OF DETECTION	AVERAGE CONCENTRATION FOR COC (mg/kg)	COC
Cadmium	2.7-2.8	<3.0-<36	5	2/16	NA	NO
Calcium	2,200-33,000	360-59,000	---	16/16	NA	NO
Chromium	3-53	<4.3-47	80	16/16	NA	NO
Iron	4,700-17,000	5,400-35,000	---	16/16	NA	NO
Lead	6.1-231	<5.1-22	35	8/16	26.6	**YES**
Magnesium	990-17,000	360-7,400	---	16/16	3,528	NO
Manganese	40-380	25-290	---	16/16	106	NO
Nickel	4.3-16	4.2-46	30	16/16	NA	NO
Potassium	300-610	<300-2,200	---	9/16	NA	NO
Sodium	38-870	<160-680	---	16/16	132	NO
Vanadium	4.9-21	6.3-59	---	15/16	NA	NO
Zinc	12-500	9.2-95	120	16/16	76	**YES**
PCBs (Aroclor 1254)	0.112-2.72	<0.02-<0.1	0.17[f]	5/26	0.42	**YES**

NA Not applicable.
-- Not available.
a NOAA 1991, Sediment ER-L (Effects Range-Low).

No: No longer considered a COC.
Yes: Does the chemical have a frequency of detection greater than five percent?

No: No longer considered a COC.
Yes: Is the chemical detected more than once?

No: No longer considered a COC.
(Unless chemical has high potential for ecological effects or the one detection was at concentrations significantly above the action level.)
Yes: Chemical is classified as a COC.
(Unless chemical is an essential nutrient.)

All data for COCs were averaged according to media (arithmetic mean). In the case of non-detects averages were calculated for organic compounds and metals using one-half of the quantitation limits. Total metal concentrations were used in determining COCs in surface water. This is a conservative approach because dissolved metal concentrations are generally significantly less than total metal concentrations. Section 3.1.1 describes surface water COCs. Section 3.1.2 describes soil and sediment COCs.

3.1.1 Surface Water

Analytical results from the sites with suitable habitat were compiled and evaluated to determine the COCs. Surface water samples were collected and analyzed for contaminants likely to be present at the specific sites. Not all samples were analyzed for a "full suite" of parameters, but instead were analyzed for some combination of the following: DRPH, GRPH, RRPH, BTEX, VOCs, SVOCs, PCBs, pesticides, and metals. Complete analytical results for all sampling conducted at the installation are presented in Appendix D. The following sections present the evaluation of the surface water data, and Table 3-1 summarizes the screening results.

3.1.1.1 Petroleum Hydrocarbons. Thirty surface water samples were collected from the areas with suitable habitat and selectively analyzed for a combination of DRPH, GRPH, and RRPH. A discussion of these petroleum hydrocarbon mixtures and their toxicity is presented in Section 3.3.1.

DRPH were detected in 8 of 28 surface water samples, ranging from 196 to 5,760 μg/L. The background concentration is <200 μg/L. Because DRPH were detected in some samples at concentrations in excess of background concentrations, DRPH are retained for further analysis in the ERA. The exposure concentration used is 719 μg/L, the average concentration of DRPH in surface water.

GRPH were detected in 2 of 24 surface water samples, ranging from 6.9 to 367 μg/L. The background concentration is <20.0 μg/L. Because GRPH were detected in only two surface water samples that contained significantly higher levels of DRPH, and are not considered independently of DRPH (see discussion of petroleum toxicity, Section 3.3.1), GRPH are not considered a COC.

RRPH were not detected in any surface water samples collected from the sites evaluated.

3.1.1.2 Benzene, Toluene, Ethylbenzene and Xylenes.

Benzene was detected in 2 of 24 surface water samples at levels of 2.7 and 6.9 μg/L. The background concentration is <1 μg/L. Onsite concentrations are well below the action level of 106 μg/L (ambient water quality criteria divided by an UF of 50), so benzene is not considered a COC.

Toluene was detected in 1 of 24 surface water samples at a concentration of 56 μg/L. The background concentration for toluene in surface water is <1 μg/L. Onsite concentrations do not exceed the action level of 350 μg/L, so it is not considered a COC.

Ethylbenzene was detected in 3 of 24 surface water samples at concentrations ranging from 3.1 to 19 μg/L. The background concentration of ethylbenzene in surface water is <1 μg/L. Onsite concentrations of ethylbenzene are well below the action level of 640 μg/L, so ethylbenzene is not considered a COC.

Xylene was detected in 5 of 24 samples. Xylene concentrations ranged from 3.8 to 38.4 μg/L. The background concentration of xylene is <2 μg/L. Onsite concentrations are well below the action level of 66 μg/L, so xylene is not considered a COC.

3.1.1.3 Other Organic Compounds. Fourteen additional organic compounds were detected in surface water samples collected from Barter Island. The compounds detected were: chloromethane; n-butylbenzene; sec-butylbenzene; 1,2-dichloroethane; cis-1,2-dichloroethene; dichlorofluoromethane; isopropylbenzene; 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; naphthalene; n-propylbenzene; tetrachloroethene; p-isopropyltoluene; and trichloroethene. This section presents the evaluation of these compounds as COCs in surface water for the ERA.

Chloromethane was detected in 1 of 18 surface water samples analyzed for VOCs, at a concentration of 4.2 μg/L. The background concentration of chloromethane is <1 μg/L. Because no action levels are available for this compound, and it was detected at a frequency greater than five percent, the maximum detected concentration is compared to toxicity values reported in the literature. This compound is relatively non-toxic to aquatic organisms. Toxicity values (LC_{50}s) were 270,000 μg/L for *Menidia berylina* (inland silverside) and 550,000 μg/L for *Lepomis macrochirus* (Blue gill) (Dawson et al. 1977). Applying a conservative UF of 100 (Suter 1991) yields action levels ranging from 2,700 to 5,500 μg/L. The detected concentration is well below this toxicity-based action level range, so chloromethane is not considered a COC.

n-Butylbenzene was detected in 1 of 14 surface water samples at a concentration of 2.4 μg/L. The background concentration for this compound is <1 μg/L. There are no action levels for n-butylbenzene. This compound was detected in only one sample, so it is not considered a COC.

sec-Butylbenzene was detected in 1 of 14 surface water samples at a concentration of 1.0 µg/L. The background concentrations for this compound is <1 µg/L. There are no action levels for sec-butylbenzene. This compound was detected in only one sample, so it is not considered a COC.

1,2-Dichloroethane was detected in 1 of 18 surface water samples collected at the Barter Island facility at a concentration of 9.1 µg/L. The background concentrations of 1,2-dichloroethane in surface water are 1.3 to 3.2 µg/L, however, at least some of the blanks for the background samples also had detections. The action level of this compound is 20,000 µg/L. 1,2-dichloroethane was detected at a level substantially less than the action level, so this compound is not considered a COC.

cis-1,2-Dichloroethene was detected in 1 of 14 surface water samples. It was detected at concentrations of 1.4 and 1.5 µg/L in replicate samples obtained from the Contaminated Ditch (SD08). The background concentration of this compound is <1 µg/L. The action level is 70 µg/L. Because cis-1,2-dichloroethene was detected below action levels, it is not considered a COC.

Dichlorofluoromethane was detected in 1 of 14 samples at 3.7 µg/L. The background concentration of this compound is <1 µg/L. There are no action levels. This chemical was detected in only one sample, so it is not considered a COC.

Isopropylbenzene was detected in 1 of 14 surface water samples at a concentration of 2.9 µg/L. The background concentration is <1 µg/L. There are no action levels for this compound. This compound was detected in only one sample, so it is not considered a COC.

1,2,4-Trimethylbenzene was detected in 2 of 14 surface water samples at concentrations of 1.4 and 19 µg/L. The background concentration is <1 µg/L, and no action levels are established. It was detected at a frequency greater than five percent, so the maximum detected concentration is compared to toxicity values reported in the literature. There is not a great deal of information regarding the aquatic toxicity of 1,2,4-trimethylbenzene. One study, however, derived a 96 hr LC_{50} of 7,720 µg/L for *Pimephales promelas* (fathead minnow) (Geiger 1986). Applying a conservative UF of 100 (Suter 1991) yields an action level of 77.2 µg/L. The maximum detected concentration is below this toxicity-based action level, so 1,2,4-trimethylbenzene is not considered a COC.

1,3,5-Trimethylbenzene was detected in 2 of 14 surface water samples at concentrations of 1.3 and 13 µg/L. 1,3,5-Trimethylbenzene was not detected in the background samples. For the purposes of this ERA, the two isomers of trimethylbenzene are considered similar. Thus, the action level for this compound is 77.2 µg/L. The maximum detected concentration is below the action level, so 1,3,5-trimethylbenzene is not considered a COC.

Naphthalene was detected in 3 of 15 surface water samples at concentrations ranging from 1.6 to 35 µg/L. The background concentration is <1 µg/L. The action level established for this compound is 620 µg/L. This compound was detected at levels lower than the action level, and it is not considered a COC.

n-Propylbenzene was detected in 1 of 14 surface water samples at 3.6 µg/L. There are no action levels established for n-propylbenzene. The background concentration is <1 µg/L. This compound was detected in only one sample, so it is not considered a COC.

Tetrachloroethene was detected in 1 of 20 samples at 12 µg/L. This compound was not detected in background samples (<1 µg/L). The action level for this compound is 840 µg/L. It was detected in only one sample at concentrations below the action level, so it is not considered a COC.

p-Isopropyltoluene was detected in 2 of 14 surface water samples at concentrations of 1.1 and 2.1 µg/L. The background concentration is <1 µg/L. No action level is available for this compound. It was detected at a frequency greater than five percent, so the maximum detected concentration is compared to toxicity values reported in the literature. There is not a great deal of information regarding the aquatic toxicity of p-isopropyltoluene. One study derived a 48 hr LC_{50} of 6,500 µg/L for *Daphnia magna* (LeBlanc 1980). Applying a conservative UF of 100 (Suter 1991) yields an action level of 65 µg/L. Because the maximum detected concentration is below this toxicity-based action level, p-isopropyltoluene is not considered a COC.

Trichloroethene was detected in 2 of 20 samples at 6 and 36 µg/L. It was not detected in background samples (<1 µg/L). The action level for this compound is 21,900 µg/L. This compound was detected below action levels, so it is not considered a COC.

3.1.1.4 Metals. Eight inorganic analytes were detected in surface water samples collected from Barter Island. The metals detected were: aluminum, barium, calcium, iron, magnesium, manganese, potassium and sodium. This section presents the evaluation of these metals as COCs for the ERA. Analytes not detected in surface water samples were: antimony, beryllium, cadmium, chromium, lead, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc. All concentrations of metals discussed below are results from total metal analyses.

Aluminum was detected in 5 of 10 surface water samples. Concentrations ranged from 160 to 1,400 µg/L. Background concentrations ranged from <100 to 350 µg/L. The action level for aluminum is 87 µg/L. Aluminum is present in surface water at concentrations in excess of the action level, so it is retained as a COC. The exposure concentration evaluated in this ERA is the average concentration of 318 µg/L.

Barium was detected in 9 of 10 surface water samples. Concentrations ranged from 74 to 150 µg/L. Background concentrations of barium ranged from <50 to 93 µg/L. The action level is 1,000 µg/L. Although barium concentrations exceed background, this chemical was not retained as a COC because it does not exceed the action level.

Calcium was detected in all 10 surface water samples. Concentrations ranged from 5,000 to 190,000 µg/L. Background concentrations ranged from 4,100 to 88,000 µg/L. There is no action level for calcium, and toxicity information is limited for ecological receptors. This chemical was not retained as a COC because it is ubiquitous in the environment and not expected to present a risk to ecological receptors. In addition, this mineral is an essential nutrient and is well regulated by plants and animals.

Iron was detected in all 10 surface water samples. Concentrations ranged from 1,600 to 21,000 µg/L. Background concentrations ranged from <100 to 2,800 µg/L. Iron exceeds the background concentration in surface water and the 1,000 µg/L action level, so this metal was retained as a COC. The exposure concentration evaluated in this ERA is the average concentration of 8,580 µg/L.

Magnesium was detected in all 10 surface water samples. Concentrations ranged from 26,000 to 78,000 µg/L. Background concentrations ranged from <5,000 to 54,000 µg/L. There are no action levels for magnesium. Magnesium is not retained as a COC in the ERA because it is ubiquitous in the environment and an essential nutrient which is regulated by plants and animals.

Manganese was detected in all 10 surface water samples. Concentrations ranged from 70 to 1,800 µg/L. Background concentrations ranged from <50 to 510 µg/L. The action level for manganese is 200 µg/L. Because manganese was detected at concentrations in excess of the background and action levels, it is retained as a COC. The exposure concentration evaluated in this ERA is the average concentration of 574 µg/L.

Potassium was detected in 8 of 10 surface water samples. Concentrations ranged from 5,100 to 110,000 µg/L, which all exceeded the background concentration of <5,000 µg/L. There is no action level for potassium, so the maximum detected concentration was compared to toxicity values in the literature. As potassium is an essential nutrient, regulated by plants and animals, toxicity information was sparse. Concentrations of potassium at 391,000 µg/L were found to inhibit enzymes in freshwater algae (Matson et al. 1972). Potassium was toxic to the freshwater amphipod (*Gammarus lacustris*) at concentrations of 53,200 µg/L (De March 1988). There is some discrepancy between these toxicity values, so a review of the analytical data was conducted. The maximum detected concentration of potassium was found in a waterway that is connected to the Beaufort Sea (LF01-SW04). This sample location lies in a waterway that drains to the ocean approximately 300 feet away. The concentration of potassium in seawater is 390,000 µg/L [U.S. Geological Survey (USGS) 1985]. Because this sample location is hydrologically connected to the ocean, it is likely that these elevated levels of potassium are attributable to the influence of saltwater. The average concentration of potassium onsite is 18,040 µg/L (this includes the maximum detected concentration). This concentration is within the normal range of potassium concentrations in surface waters (USGS 1985). As a result of this review, potassium was not included as a COC.

Sodium was detected in all 10 surface water samples. Concentrations ranged from 5,000 to 440,000 µg/L, exceeding the background concentrations of 8,200 to 450,000 µg/L. There is no action level for sodium. Sodium is ubiquitous in the environment and is not expected to present a threat to ecological receptors. Thus, sodium is not considered a COC for the ERA.

3.1.2 Soils and Sediments

The following sections present the evaluation of soil and sediment data for the sites with usable habitat. Table 3-2 summarizes the screening results for soils and/or sediment.

3.1.2.1 Petroleum Hydrocarbons. Ninety-two soil and/or sediment samples were collected from the ten sites and selectively analyzed for a combination of DRPH and GRPH. Fifty-nine soil and/or sediment samples were collected and analyzed for RRPH. A discussion of these petroleum hydrocarbon mixtures and their toxicity is presented in Section 3.3.1.

DRPH were detected in 39 of 91 soil and/or sediment samples ranging from 4.76 to 28,600 mg/kg; the background concentrations were 9.55 to 1,150 mg/kg. The action level for DRPH in soils/sediments is 500 mg/kg. Because 22 percent of onsite samples exceeded the action level, DRPH are retained as a COC. The exposure concentration used in the risk assessment is the average concentration of 1,159.2 mg/kg.

GRPH were detected in 30 of 88 soil and/or sediment samples ranging from 0.429 to 700 mg/kg. The background concentrations ranged from <0.4 to <9 mg/kg. The action level for GRPH is 100 mg/kg. GRPH were detected at concentrations above action levels, so they are considered a COC.

RRPH were detected in 10 of 59 samples ranging from 180 to 27,000 mg/kg. The background concentration for RRPH is <480 mg/kg; the action level is 2,000 mg/kg. RRPH were detected at concentrations above action levels, so they are considered a COC.

3.1.2.2 Benzene, Toluene, Ethylbenzene and Xylenes.

Benzene was detected in 3 of 86 soil and/or sediment samples at concentrations of 0.72 to 1.4 mg/kg. Although the action level of benzene is 0.5 mg/kg, and background concentration is <0.3 mg/kg, benzene is not considered a COC because of the low frequency of detection (three percent).

Toluene was detected in 13 of 86 soil and/or sediment samples ranging from 0.026 to 2.3 mg/kg. The background concentration is <0.3 mg/kg. Only one detected concentration exceeded the action level (0.786 mg/kg). The detected toluene above the action level is at the Garage site in a gravel pad not expected to be frequented by ecological receptors. Therefore, toluene is not considered to be a threat to ecological receptors and is not considered a COC.

Ethylbenzene was detected in 19 of 86 soil and/or sediment samples at concentrations ranging from 0.02 to 11 mg/kg. The background concentration of ethylbenzene is <0.3 mg/kg for soil and sediment; the action level is 4.36 mg/kg. Onsite concentrations exceed action levels, so ethylbenzene is considered a COC. The exposure concentration used in this ERA is the average concentration of 0.13 mg/kg.

Xylene was detected in 25 of 86 samples. Xylene concentrations ranged from 0.21 to 47 mg/kg. The background concentration of xylene is <0.6 mg/kg. The action level is 1.21 mg/kg. Xylene is considered a COC as onsite concentrations are above action levels. The exposure concentration used in this ERA is the average concentration of 1.09 mg/kg.

3.1.2.3 Volatile Organic Compounds. Thirteen VOCs were detected in soil and/or sediment samples collected from Barter Island. The compounds detected were: n-butylbenzene;

sec-butylbenzene; tert-butylbenzene; cis-1,2-dichloroethene; 1,2,4-trichlorobenzene; 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; 1,4-dichlorobenzene; isopropylbenzene; p-isopropyltoluene; n-propylbenzene; tetrachloroethene; and methylene chloride. This section presents the evaluation of these compounds as COCs for the ERA.

n-Butylbenzene was detected in 4 of 30 soil and/or sediment samples analyzed for VOCs. The range of concentrations detected was 0.635 to 4.22 mg/kg. The background concentration of n-butylbenzene is <0.5 mg/kg. There are no action levels for this compound. n-Butylbenzene is an alkyl-substituted benzene, and the action level of 4.36 mg/kg for a similar compound, ethylbenzene, was used. Onsite concentrations do not exceed the action level, so it is not considered a COC.

sec-Butylbenzene was detected in 3 of 30 soil and/or sediment samples analyzed for VOCs. The range of concentrations detected was 1.24 to 1.62 mg/kg. The background concentration of sec-butylbenzene is <0.5 mg/kg. There are no action levels for this compound, so the action level of 4.36 mg/kg for a similar compound, ethylbenzene, was used. Onsite concentrations do not exceed the action level, so it is not considered a COC.

tert-Butylbenzene was detected in 1 of 30 soil and/or sediment samples analyzed for VOCs at a concentration of 0.256 mg/kg. The background concentration of tert-butylbenzene is <0.5 mg/kg. There are no action levels for this compound. Since tert-butylbenzene is an alkyl-substituted benzene, the action level of 4.36 mg/kg for ethylbenzene was used for this compound. The chemical was only detected once and onsite concentrations do not exceed the action level, so it is not considered a COC.

cis 1,2-Dichloroethene was detected in 1 of 30 soil and/or sediment samples collected at the Barter Island facility, at concentrations of 0.069 mg/kg. The background concentration of cis 1,2-dichloroethene in soil and sediment is <0.5 mg/kg. There are no action levels for cis 1,2-dichloroethene. The compound was only detected in one sample (<5 percent detection frequency), so it is not considered a COC.

1,2,4-Trichlorobenzene was detected in 1 of 30 soil and/or sediment samples, at a concentration of 0.046 mg/kg. The background concentration of this compound is <0.5 mg/kg. There is no action level for this compound. 1,2,4-Trichlorobenzene was only detected in one sample, so it is not considered a COC.

1,2,4-Trimethylbenzene was detected in 5 of 30 samples at concentrations of 0.041 to 14.7 mg/kg. The background concentration of this compound is <0.5 mg/kg. There is no action level for this compound. 1,2,4-Trimethylbenzene is classed as an alkylbenzene, which is a typical constituent of fuel oil (i.e, DRPH) [Agency for Toxic Substances and Disease Registry (ATSDR 1993a)]. As a result, 1,2,4-trimethylbenzene is not selected as a COC because it is assumed that the evaluation of the toxicity of DRPH (evaluated at a concentration of 1,160 mg/kg) will conservatively account for the incremental risk associated with 1,2,4-trimethylbenzene.

1,3,5-Trimethylbenzene was detected in 7 of 30 samples at concentrations of 0.048 and 9.32 mg/kg. The background concentration of this compound is <0.5 mg/kg. There is no action level for this compound. 1,3,5-Trimethylbenzene is classed as an alkylbenzene, which is a typical constituent of fuel oil (i.e., DRPH) (ATSDR 1993a). As a result, 1,3,5-trimethylbenzene is not selected as a COC because it is assumed that the evaluation of the toxicity of DRPH (evaluated at a concentration of 1,160 mg/kg) will conservatively account for the incremental risk associated with 1,3,5-trimethylbenezene.

1,4-Dichlorobenzene was detected in 1 of 48 samples at a concentration of 0.044 mg/kg. The background concentration of this compound is <0.5 mg/kg. There is no action level for this compound. This chemical had a low frequency of detection (two percent) and was only detected in one sample, so it is not considered a COC.

Isopropylbenzene was detected in 3 of 30 soil and/or sediment samples at concentrations between 0.409 and 0.681 mg/kg. The background concentration is <0.5 mg/kg. There are no action levels for this compound. Isopropylbenzene is an alkyl-substituted benzene, and the action level of 4.36 mg/kg for a similar compound, ethylbenzene, was used. This compound was detected below the action level, so it is not considered a COC.

p-Isopropyltoluene was detected in 3 of 30 soil and/or sediment samples at concentrations between 1.69 and 2.47 mg/kg. The background concentration is <0.5 mg/kg. There are no action levels for this compound. The action level of 4.36 mg/kg for a similar compound, ethylbenzene, was used. Because this compound was detected below the action level, it is not considered a COC.

n-Propylbenzene was detected in 3 of 30 soil and/or sediment samples at concentrations between 0.918 and 1.17 mg/kg. The background concentration is <0.5 mg/kg. There are no action levels for this compound, so the action level of 4.36 mg/kg for a similar compound, ethylbenzene, was used. Because this compound was detected below the action level, it is not considered a COC.

Methylene chloride was detected in 1 of 48 soil and/or sediment samples at a concentration of 0.255 mg/kg. The background concentration is <0.3 mg/kg. The action level for this compound is 90 mg/kg. This compound was detected below the action level, so it is not considered a COC.

Tetrachloroethene was detected in 2 of 62 soil and/or sediment samples at concentrations of 0.023 and 5.42 mg/kg. The background concentration is <0.3 mg/kg. There is no action level for this compound. It had at a low frequency of detection (three percent), so it is not considered a COC.

3.1.2.4 Semivolatile Organic Compounds. Seven semivolatile compounds were detected in samples from the Barter Island installations: isophorone; fluoranthene; naphthalene; phenanthrene; pyrene; 2-methylnaphthalene; and bis(2-ethylhexyl)phthalate. This section presents the evaluation of these compounds as COCs for the ERA.

Isophorone was detected in 1 of 18 soil and/or sediment samples at a concentration of 1.49 mg/kg. The background concentration is <0.23 mg/kg. There is no action level for this compound. It was only detected in one sample, so it is not considered a COC.

Fluoranthene was detected in 2 of 18 soil and/or sediment samples at concentrations of 1.7 and 2.28 mg/kg. The background concentrations is <0.23 mg/kg; the action level for fluoranthene is 6.2 mg/kg. This compound was detected at concentrations below the action level, so it is not considered a COC.

Naphthalene was detected in 5 of 30 soil and/or sediment samples at concentrations of 0.105 to 46 mg/kg. The background concentration is <0.5 mg/kg. The action level for this compound is 0.34 mg/kg. It was retained as a COC, and the exposure concentration evaluated in this ERA is the average concentration of 2.26 mg/kg.

Phenanthrene was detected in 2 of 18 soil and/or sediment samples at concentrations of 1.96 and 4.79 mg/kg. The background concentrations ranged from <0.23 to <3.5 mg/kg. The action level for this compound is 1.8 mg/kg. Four additional soil/sediment samples in the area of the samples where phenanthrene was detected were all non-detect (<0.21 to <2.1 mg/kg). Therefore, the average concentration of phenanthrene in the immediate area is below action level, and installation wide the average concentration is significantly below action level. Patton and Dieter (1980) found no mortality or signs of toxicity when mallards were fed a diet that contained 4,000 mg/kg polynuclear aromatic hydrocarbons (PAHs) (as napthalenes and phenanthrene) over a period of seven months. The action level for this compound is 1.8 mg/kg (EPA Sediment Quality Criteria). The first sample location (4.79 mg/kg) is in close proximity to structures and is unlikely to be used on a regular basis for foraging or nesting. The other sample location, while less contaminated, may offer more suitable (and less regularly disturbed) habitat for local fauna, but the toxicity standard presented is so much higher than the sample concentration, that phenanthrene is not expected to present a risk to ecological receptors and is not considered a COC.

Pyrene was detected in 1 of 18 soil and/or sediment samples at a concentration of 1.26 mg/kg. The background concentration is <0.23 mg/kg. The action level for pyrene is 13.1 mg/kg. This compound was detected at a concentration below the action level, so it is not considered a COC.

2-Methylnaphthalene was detected in 3 of 18 samples at concentrations ranging from 3.44 to 14.5 mg/kg. The background concentration of this compound is <0.23 mg/kg. There are no action levels for this compound. Naphthalenes are constituents of fuel oils (i.e., DRPH) (ATSDR 1993a). As a result, the evaluation of the toxicity of DRPH (evaluated at a concentration of 1,160 mg/kg) will conservatively account for the incremental risk associated with 2-methylnapthalene.

Bis(2-ethylhexyl)phthalate was detected in 1 of 18 samples at a concentration of 4.6 mg/kg. The background concentration of this compound is <0.23 mg/kg. The action level for this compound is 50 mg/kg. This chemical was detected below the action level, so it is not considered a COC.

3.1.2.5 Metals. Seventeen inorganic analytes were detected in soil and/or sediment samples collected from Barter Island. The metals detected were: aluminum; barium; beryllium; cadmium; calcium; chromium; iron; lead; magnesium; manganese; nickel; potassium; sodium; vanadium; and zinc. This section presents the evaluation of these metals as COCs for the ERA.

Aluminum was detected in 15 of 16 soil and/or sediment samples. Concentrations ranged from 1,600 to 7,500 mg/kg. Background concentrations ranged from 1,500 to 25,000 mg/kg. There is no action level for aluminum. Onsite concentrations did not exceed background concentrations, so aluminum was not retained as a COC.

Barium was detected in 15 of 16 soil and/or sediment samples at concentrations between 13 and 120 mg/kg. The background concentrations of barium ranged from 27 to 390 mg/kg. There is no action level for barium. Onsite concentrations did not exceed background concentrations, so barium was not retained as a COC.

Beryllium was detected in 1 of 16 soil and/or sediment samples at a concentration of 3.2 mg/kg. The maximum background concentration of barium is 6.4 mg/kg. There is no action level for beryllium. Beryllium was not retained as a COC because onsite concentrations did not exceed background concentrations.

Cadmium was detected in 2 of 16 soil and/or sediment samples at a concentrations of 2.7 and 2.8 mg/kg. Cadmium was not detected in background samples (<3.0 - <36 mg/kg). The action level for cadmium is 5 mg/kg. Cadmium was not retained as a COC because the detected concentrations were below the action level.

Calcium was detected in all 16 soil and/or sediment samples. Concentrations ranged from 2,200 to 33,000 mg/kg. Background concentrations ranged from 360 to 59,000 mg/kg. There is no action level for calcium. Onsite concentrations did not exceed background concentrations, so this chemical was not retained as a COC.

Chromium was detected in all 16 soil and/or sediment samples. Concentrations ranged from 3 to 53 mg/kg. The maximum background concentration is 47 mg/kg. The action level for chromium is 87 mg/kg. The detected concentrations did not exceed the action level, so this metal is not retained as a COC.

Iron was detected in all 16 soil and/or sediment samples. Concentrations ranged from 4,700 to 17,000 mg/kg. The background concentrations ranged from 5,400 to 35,000 mg/kg. There is no action level for iron. This metal was not retained as a COC because onsite concentrations did not exceed background concentrations.

Lead was detected in 8 of 16 soil and/or sediment samples. Concentrations ranged from 6.1 to 231 mg/kg. The maximum background concentration for lead is 22 mg/kg. The action level for lead is 35 mg/kg. Lead concentrations detected exceeded background and action levels; therefore, lead is retained as a COC. The exposure concentration evaluated in this ERA is the average concentration of 26.6 mg/kg.

Magnesium was detected in all 16 soil and/or sediment samples. Concentrations ranged from 990 to 17,000 mg/kg. The background concentrations for magnesium ranged from 360 to 7,400 mg/kg. There is no action level for magnesium. Because magnesium is an essential nutrient and is ubiquitous in the environment it was not retained as a COC.

Manganese was detected in all 16 soil and/or sediment samples. Concentrations ranged from 40 to 380 mg/kg. The background concentrations for manganese ranged from 25 to 290 mg/kg. There are no action levels for manganese. This trace mineral is not retained as a COC because it was only detected above background in a single sample.

Nickel was detected in all 16 soil and/or sediment samples ranging in concentration from 4.3 to 16 mg/kg. The background concentrations ranged from 4.2 to 46 mg/kg. The action level for nickel is 30 mg/kg. This metal was not retained as a COC because onsite concentrations did not exceed the background concentration or action level.

Potassium was detected in 9 of 16 soil and/or sediment samples. Concentrations ranged from 300 to 610 mg/kg. The background concentrations ranged from <300 to 2,200 mg/kg. There is no action level for potassium. This metal was not retained as a COC because onsite concentrations were below background concentrations.

Sodium was detected in all 16 soil and/or sediment samples. Concentrations detected ranged from 38 to 870 mg/kg, which slightly exceeded the maximum background concentration of 680 mg/kg. There is no action level for sodium. This metal was not retained as a COC because sodium was detected only once above background and the sample did not significantly exceed the background concentration. In addition, sodium is ubiquitous in the environment and is not expected to pose a threat to ecological receptors.

Vanadium was detected in 15 of 16 soil and/or sediment samples ranging in concentration from 4.9 to 21 mg/kg. The background concentrations ranged from 6.3 to 59 mg/kg. There is no action level for vanadium. This metal was not retained as a COC because onsite concentrations were below background concentrations.

Zinc was detected in all 16 soil and/or sediment samples at concentrations from 12 to 500 mg/kg. The background concentrations for zinc ranged from 9.2 to 95 mg/kg. The action level for zinc is 120 mg/kg. Zinc was detected in excess of the action level, so zinc was retained as a COC. The exposure concentration evaluated in this ERA is the average concentration of 76 mg/kg.

3.1.2.6 Polychlorinated Biphenyls. Twenty-seven soil and/or sediment samples were collected and analyzed for PCBs. PCBs were detected in five samples at levels ranging from 0.112 to 2.72 mg/kg. The background concentrations of PCBs in soils ranged from <0.02 to <0.1 mg/kg. The action level for PCBs is 0.17 mg/kg (Hull and Suter 1994). Because concentrations of PCBs exceeded action levels, they are considered a COC. The exposure concentration is the average concentration of 0.42 mg/kg. (Note: These PCB concentrations do not include PCB detections at sites that were eliminated from further evaluation because of the lack of suitable habitat.)

3.2 ECOLOGICAL EXPOSURE ASSESSMENT

The vegetation of the Arctic Coastal Plain and the ecosystems it characterizes have developed primarily as a result of the low relief and harsh environment. The growing season is short, typically extending from June through mid-September. Winters are long, cold, dry, and dark. Air temperatures that average below freezing for most of the year result in a permafrost layer that begins near the surface and reaches to depths as great as 610 meters. Seasonal thawing results in an active layer between ground surface and 3.7 meters below the surface (Hart Crowser 1987).

The impervious permafrost layer prevents percolation and infiltration of water below the active layer, and the generally flat terrain provides poor drainage. As a result, the ecosystems of the Arctic Coastal Plain are often defined not only by their plant associations but also by the degree of water found in and on them. Hart Crowser (1987) describes five major ecosystems for the classification of tundra and Arctic Coastal Plain communities:

- Marine zones: these include lagoons, estuaries, barrier islands, strands and beaches. The abundance of vegetation along the marine coastal zone is inversely related to the amount of beach scouring by waves and ice. Mainland beaches support a variety of vegetation, including sedges, grasses, and forbs.

- Wet sedge meadows: an association of meadows, ponds and lakes also known as "wet tundra". This system, with its associated wetlands, is dominant in the area extending west from the Colville River to the Chukchi Sea (including the Point Lonely, Point Barrow, Wainwright, Point Lay, and Cape Lisburne installations). Differences in vegetation within this ecosystem are related to moisture and microrelief.

- Tussock tundra: or "moist tundra" consisting primarily of areas dominated by tussock-forming cottongrass. This system covers significant portions of the Arctic Coastal Plain.

- Riverine systems and floodplains: including riparian shrubland on recent and old alluvium. Being better drained than surrounding lands, the riparian environment supports a distinctive "shrub thicket" vegetation.

- Alpine tundra: including rocky upland areas of sparse, mat-forming or fell-field vegetation.

The species associated with each ecosystem at the Barter Island DEW Line installation are potential receptors.

3.2.1 Potential Receptors

Both the potential receptors and the representative species selected will be characteristic of the Barter Island installation as well as the seven installations to be assessed in the future.

The Barter Island installation is located along the northern boundary of the Arctic Coastal Plain. Hart Crowser (1987) and Woodward-Clyde (1993) have listed the species likely to occur along the coastal plain based on site-specific studies and a review of the literature. The marine zone, wet sedge meadows, tussock tundra, and riverine/riparian are the primary ecosystems found at the Barter Island installation. Alpine tundra is minimal at the site and is not evaluated further.

3.2.1.1 Plants. Plants commonly associated with the marine zone are sedges, grasses, and forbs. *Carex subspathacea* and *C. aquatilis* are dominant plants in the coastal wetlands.

The wet sedge meadow (also known as "wet tundra") is characterized by a variety of sedges and grasses. Typical species include: cottongrass, *Eriophorum* spp.; tundra grass, *Dupontia fischeri*; and mosses, *Sphagnum* spp. Marsh marigold, *Caltha palustris*; and horsetail, *Equisetum* spp. may be found in wetter areas (Hart Crowser 1987).

The tussock tundra (or moist tundra) is drier than the wet sedge meadow/wet tundra association. Tussock-forming cottongrass is the dominant plant species. Grasses, sedges, dwarf shrubs, mosses, and lichens are scattered throughout the tussock complex. These species include: willows, *Salix* spp.; Labrador tea, *Ledum palustri*; blueberry and lingonberry, *Vaccinium* spp.; and lousewort, *Pedicularis* spp (NPRA Task Force 1978; Bergman et al. 1977).

Riverine/riparian systems are composed of a diversity of habitat types and species. The dominant plants here are shrubs with a scattered understory of grasses, herbs, and lower growing shrubs. Larkspur, *Delphinum brachycentrum*; cinquefoil, *Potentilla* spp.; bearberry, *Arctostaphylus* spp.; and wormword, *Artemesia arctica* are common species (NPRA Task Force 1978; Bergman et al. 1977).

3.2.1.2 Aquatic Organisms. Sixty-six species of fish inhabiting marine, estuarine, and freshwater systems have been identified in the arctic region (Hart Crowser 1987). Marine species habitating the nearshore and offshore waters include: boreal smelt, *Osmerus eperlanus*; Pacific herring, *Clupea harengus*; arctic cod, *Boreogagus saida*; and fourhorn sculpin, *Myoxocephalus quadricornis*. Anadromous species using arctic rivers for spawning include the arctic cisco, *Coregonus autumnalis*; arctic char, *Salvelinus alpinus*; and occasional pink and chum salmon, *Onchorhynchus* spp. Lack of overwintering habitat is a significant limiting condition for both anadromous and freshwater fish of the arctic region. The principal freshwater fish found in the region are grayling, *Thymallus arcticus*; lake trout, *Salvelinus namaycush*; burbot, *Lota lota*; and nine-spined stickleback, *Pungitius pungitius* (Hart Crowser 1987).

Invertebrates that may be present in the waters and wet habitats of the Arctic Coastal Plain are well represented by the crustaceans (i.e., copepods, isopods, amphipods, and decapods).

3.2.1.3 Birds. There are approximately 180 species of birds seasonally associated with the habitats of the Arctic Coastal Plain. Of these, 36 are considered to be regular migratory breeders along the Beaufort Sea coast and 17 are intermittent breeders (Koranda and Evans 1975).

Waterfowl, seabirds, and shorebirds are numerous and the dominant components of the coastal plain avifauna. Bird use of the coastal plain is highly seasonal and associated with typical avian breeding and migration cycles. Shoreline habitats are used significantly in association with molting, pre-migratory staging, and post breeding movement. These habitats are considered critical by the U.S. Fish and Wildlife Service (USFWS 1982). Principal species include: glaucous gull, *Larus hyperboreus*; red phalarope, *Phalaropus fulicaria*; dunlin, *Calidris alpina*; loons, *Gavia* spp.; sandpipers, *Calidris* spp.; eiders, *Somateria* spp.; and geese, *Branta* spp. and *Chen* spp. Among the migratory passerine species using the coastal habitats are the Savannah sparrow, *Passerculus sandwichensis*; common and hoary redpolls, *Carduelis* spp.; snow bunting, *Plectrophenax nivalis*; and Lapland longspur, *Calcarius lapponicus* (Woodward-Clyde 1993).

3.2.1.4 Mammals. The mammalian fauna of the Arctic Coastal Plain and adjacent waters is relatively simple compared to faunas at lower latitudes. A review of species lists indicates a total of 38 species that commonly occur in the arctic; 11 of these are marine mammals (Hart Crowser 1987). A sampling of the terrestrial mammals geographically associated with the DEW Line stations, including Barter Island, consists of: brown lemming, *Lemmus trimucronatus*; masked shrew, *Sorex cinerus*; arctic fox, *Alopex lagopus*; red fox, *Vulpes vulpes*; weasels, *Mustela* spp.; tundra vole, *Microtus oeconomus*; caribou, *Rangifer tarandus*; and grizzly bear, *Ursus arctos* (Hart Crowser 1987; Woodward-Clyde 1993).

Marine mammals of the arctic coast include six species of whales; polar bear, *Ursus maritimus*; five species of seals; and walrus, *Odobenus rosmarus*. The most common of these are: beluga, *Delphinapterus leucas*; bowhead whale, *Balaena mysticetus*; polar bear; gray whale, *Eschrichtius robustus*; ringed seal, *Phoca hispida*; bearded seal, *Erignathus barbatus*; and walrus (Hensel et al. 1984).

3.2.1.5 Endangered and Threatened Species. Species of the Arctic Coastal Plain and nearby waters that are protected by federal and state designations include: bowhead whale; fin whale, *Balaenoptera physalus*; sei whale, *Balaenoptera borealis*; and hump-backed whale, *Megaptera novaeangliae*. Avian species include the spectacled eider, *Somateria fischeri* (threatened) and Steller's eider, *Polysticta stelleri* (candidate for listing). No plant species in the vicinity of Barter Island are currently protected.

3.2.2 Representative Species

It is impractical to evaluate all of these receptors individually because of the great diversity of plants and animals at a given site. Thus, for ERAs, a set of "representative species" is selected for further evaluation. The representative species are selected based primarily on the species' likelihood of exposure based on their preferred habitat and feeding habits. The abundance of a species, relative to the areal extent of the sites, is also considered. The representative species encompass a range of ecological niches in order to achieve the best characterization of the ecosystems being examined. In addition, species are selected, in part, as a result of the availability of toxicity, exposure, and life history information. Species that may be sensitive to environmental impacts, such as endangered or threatened species, are also evaluated.

For the DEW Line stations, a number of groups of receptors are evaluated including plants, aquatic invertebrates, fish, birds, and mammals. Potential risks to representative species are estimated by evaluating sampling data for the relevant exposure media (i.e., soil, sediments, and surface water). For the birds and mammals selected, exposures are estimated by evaluating their potential dietary intakes of COCs.

The similarity of ecosystems at each of the station sites allows the use of the same set of representative species for all installations. It may be possible that a representative species may inhabit the general area of an installation, but not occur specifically on the installation property. When and if this situation occurs, it will be noted. Table 3-3 presents the representative species for the DEW Line installation sites (including Barter Island) and Table 3-4 lists the threatened and endangered species considered in the ERA. The USFWS was consulted in the selection of the threatened and endangered species evaluated. Any threatened or endangered species evaluated in the ERA are not considered representative of the Arctic Coastal Plain or the DEW line installations. These species are evaluated to provide information about whether they face potential risks from exposure to COCs.

3.2.2.1 Representative Plants. Plants selected as representative species are: sedges, *Carex* spp.; willows, *Salix* spp.; and cottongrass, *Eriophorum* spp. These species are selected because they are abundant on all the sites, are important links in the trophic structure of the ecosystems of the arctic, and represent a major percentage of the primary production along the coastal plain. The blueberry, huckleberry, and lingonberry, *Vaccinium* spp., are evaluated because of their roles as forage plants and as subsistence species.

3.2.2.2 Representative Aquatic Invertebrates and Fish. The invertebrates selected as representative species are *Daphnia* spp. The fish species chosen are the arctic char and the nine-spined stickleback. *Daphnia* spp. are abundant and represent a portion of the diet of the selected fish species (Johnson and Burns 1984; Wootton 1976), and toxicity information is readily available for them. The arctic char is a common anadromous species (exposed to both fresh and saltwater) and is a valuable recreation and subsistence resource (Johnson and Burns 1984).

The nine-spined stickleback is a freshwater species that also uses brackish habitats, nests in aquatic vegetation, and is prey for other fish and bird species (Wootton 1976).

3.2.2.3 Representative Birds. The avian species selected as representative are: Lapland longspur; brant, *Branta bernicla*; glaucous gull; and pectoral sandpiper, *Calidris melanotos*. The Lapland longspur is a passerine belonging to a terrestrial feeding guild (including sandpipers, turnstones, and phalaropes) (Custer and Pitelka 1978). The longspur's diet of insects and seeds (Custer and Pitelka 1978) makes it an important link in the arctic trophic web. The brant nests and molts among the numerous ponds in the tussock tundra and grazes on sedges and cottongrass (Palmer 1976). It is considered to be an important subsistence resource. The glaucous gull is a predatory scavenger that feeds on small mammals, young birds, carrion and garbage, and breeds along the Arctic Coastal Plain (Farrand 1983). The pectoral sandpiper is an abundant shorebird that is primarily insectivorous and breeds on the Arctic Coastal Plain.

TABLE 3-3. REPRESENTATIVE SPECIES AT THE DEW LINE INSTALLATION SITES

COMMON NAME	GENUS AND SPECIES
Sedge	*Carex* spp.
Cottongrass	*Eriophorum* spp.
Willow	*Salix* spp.
Berries	*Vaccinium* spp.
Water fleas	*Daphnia* spp.
Nine-spined stickleback	*Pungitius pungitius*
Arctic char	*Salvelinus alpinus*
Lapland longspur	*Calcarius lapponicus*
Brant	*Branta bernicla*
Glaucous gull	*Larus hyperboreus*
Pectoral sandpiper	*Calidris melanotos*
Brown lemming	*Lemmus trimucronatus*
Arctic fox	*Alopex lagopus*
Barren-ground caribou	*Rangifer tarandus*

TABLE 3-4. THREATENED AND ENDANGERED SPECIES TO BE CONSIDERED IN THE ECOLOGICAL RISK ASSESSMENT

COMMON NAME	GENUS AND SPECIES
Spectacled eider[a]	*Somateria fischeri*

[a] threatened status

All avian species in the ERA are migratory, and as such, are protected under the Migratory Bird Treaty Act of 1978. This is reflected by the use of a protected species factor of 2 in the calculation of avian Toxicity Reference Values.

3.2.2.4 Representative Mammals. The representative species of mammals selected are the brown lemming, arctic fox, and the barren-ground caribou. The brown lemming is the predominant small mammal at all sites. The lemming consumes more vegetation than expected for an animal its size, due to its low assimilation efficiency, the low nutrient value of winter forage, and the high metabolic demands of the arctic environment (Chappell 1980). The arctic fox is a representative species because it is ubiquitous along the coastal plain and its carnivorous diet (mostly lemmings) places it near the top of the trophic structure in the arctic. Eberhardt et al. (1982) note that in fall and winter, and to a lesser extent in summer, the arctic fox frequently uses areas near development. This tendency may expose the fox to potential pathways of contamination. Additionally the fox, a relatively common furbearer, can be an important subsistence resource. The caribou is selected as a representative species because it uses areas on, or near, a number of the sites during migration and for calving and summering grounds. In addition, the caribou is a significant subsistence resource (USFWS 1982; Cuccarese et al. 1984; Hensel et al. 1984).

3.2.2.5 Threatened and Endangered Species. The threatened and endangered species that potentially occur at the DEW Line installations are the spectacled eider and Stellar's eider. The spectacled eider is federally listed as threatened, and Steller's eider is a candidate for listing as threatened. The U.S. Fish and Wildlife Service indicated that Steller's eider was likely to be listed as threatened sometime in 1995 (Ambrose 1994 pers. comm.), but a federal moratorium on additions to the threatened and endangered lists was in effect. The spectacled eider's potential exposure to COCs will be quantified and will serve as a surrogate evaluation for Steller's eider because of the ecological similarity of the species.

3.2.3 Exposure Pathways

This section discusses potential exposure pathways for ecological receptors. In addition, methods used to quantify exposures to selected species of plants, aquatic organisms, birds, and mammals are presented. Quantitative estimates of exposure will be used with toxicity reference values (TRVs) derived in Section 3.3 to estimate risks in the risk characterization section (Section 3.4).

Ecological receptors can be exposed to COCs through abiotic and biotic media. Potential exposure pathways for terrestrial and aquatic organisms are summarized in Figure 3-1. The following sections describe the potential exposure routes and a determination of pathways evaluated in the risk assessment.

Potential risks to plants from exposure to COCs in soil and water will be addressed. The most significant route of exposure for plants is direct contact with soil at the site.

Aquatic organisms such as fish and invertebrates are primarily exposed through direct contact with surface water. Surface water is in direct contact with dermal surfaces as well as gills and other respiratory structures. Fish and invertebrates also may be exposed to COCs through ingestion of plant and animal items in the diet, and incidental ingestion of sediments while foraging. Direct contact is the primary exposure route, however, and these secondary routes will not be evaluated for aquatic organisms.

Wildlife, such as birds and mammals, may be exposed to COCs through a variety of pathways including ingestion of surface water used for drinking, ingestion of plant and animal diet items, and incidental ingestion of surface soils and sediments while foraging. Wildlife is not expected to be exposed to COCs via inhalation because the surface soils are well vegetated and moist during the growing season and frozen and/or snow covered the remainder of the year. Therefore, this pathway is not evaluated in the ERA.

Insufficient information is available for the representative species to quantify exposures from dermal contact with soil or sediments; therefore, these pathways are not quantitatively evaluated. Because soils and sediments represent potential pathways, total exposures for the representative species could be underestimated. This represents one of the uncertainties in this risk assessment that are discussed in Section 3.5.

3.2.4 Habitat Suitability for Representative Species

In order to assess the representative species' degree of exposure to the COCs, the habitat suitability of each of the 14 separate sites was evaluated. The habitat suitability evaluation considered each representative aquatic, bird, and mammal species.

Not all habitats in the sites are suitable for the representative species. This habitat suitability evaluation avoids unnecessarily quantifying a species' exposure to COCs in unsuitable habitats.

Habitat suitability for the representative species is based on availability of food, water, cover, resting places, and breeding or nesting sites. Life history information and the habitat preferences and needs of the representative species were used to determine the habitat suitability of the sites. The preferences and needs give a general indication of areas where a species is likely to occur. In situations where there was uncertainty about the likelihood of a species' occurrence, a conservative approach was used, and it was assumed that the species use the area.

The sites at the Barter Island installation were evaluated using site plans developed for Barter Island and photographs taken during the RI. No site-specific studies were done at the Barter Island installation to assist in the habitat evaluation. In some cases, chemical sampling locations are limited to a small portion of the area of concern, while other areas are sampled along potential chemical migration pathways. The extent of the area sampled was used as a general guide for the bounds of a particular area. Professional judgement was used to make assumptions and decisions regarding the suitability of a particular area for each species.

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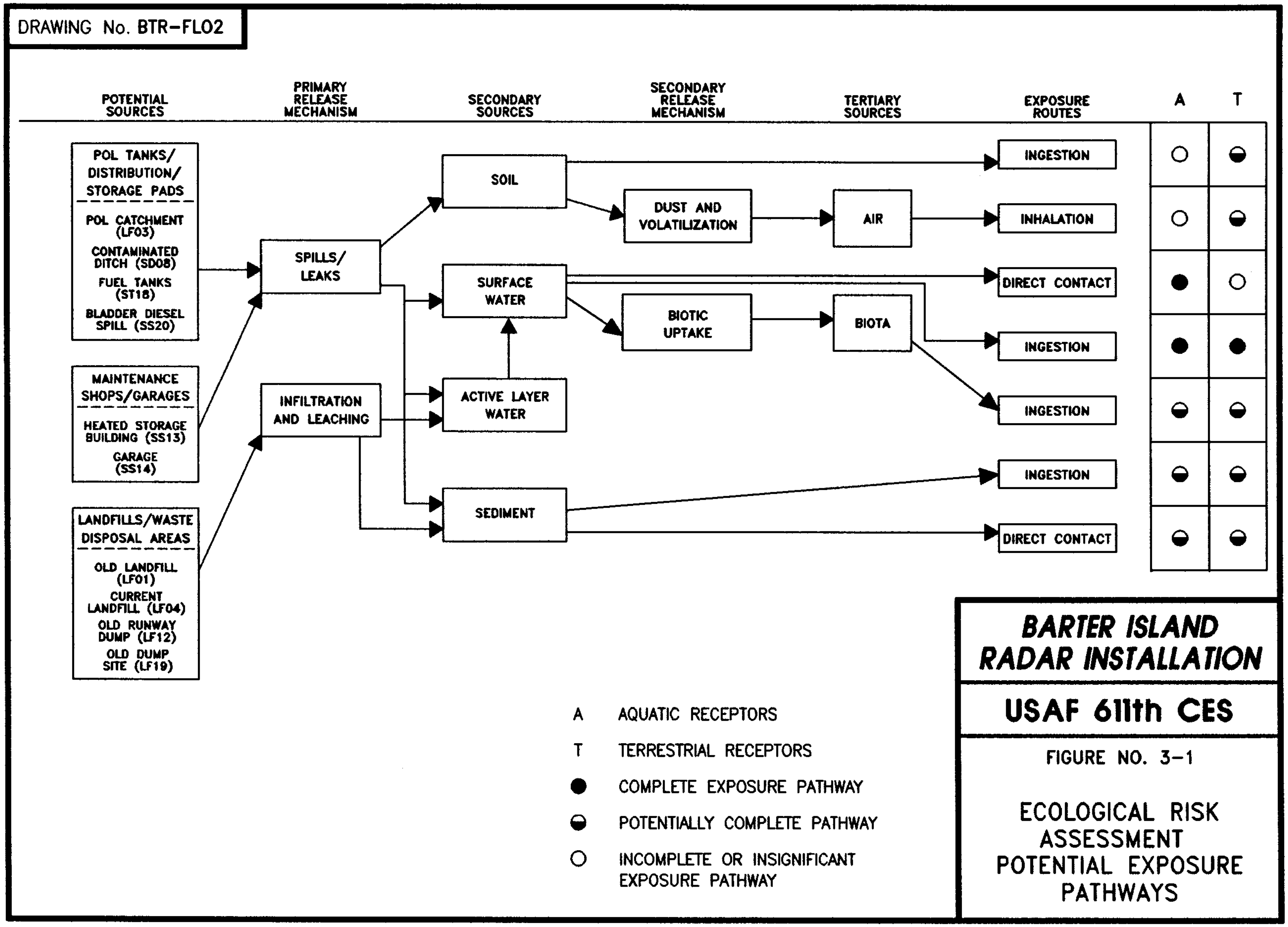
DRAWING No. BTR-FL02
POTENTIAL SOURCES
PRIMARY RELEASE MECHANISM
SECONDARY SOURCES
SECONDARY RELEASE MECHANISM
TERTIARY SOURCES
EXPOSURE ROUTES
A
T
POL TANKS/ DISTRIBUTION/ STORAGE PADS
POL CATCHMENT (LF03)
CONTAMINATED DITCH (SD08)
FUEL TANKS (ST18)
BLADDER DIESEL SPILL (SS20)
MAINTENANCE SHOPS/GARAGES
HEATED STORAGE BUILDING (SS13)
GARAGE (SS14)
LANDFILLS/WASTE DISPOSAL AREAS
OLD LANDFILL (LF01)
CURRENT LANDFILL (LF04)
OLD RUNWAY DUMP (LF12)
OLD DUMP SITE (LF19)
SPILLS/ LEAKS
INFILTRATION AND LEACHING
SOIL
SURFACE WATER
ACTIVE LAYER WATER
SEDIMENT
DUST AND VOLATILIZATION
BIOTIC UPTAKE
AIR
BIOTA
INGESTION
INHALATION
DIRECT CONTACT
INGESTION
INGESTION
INGESTION
DIRECT CONTACT
A AQUATIC RECEPTORS
T TERRESTRIAL RECEPTORS
COMPLETE EXPOSURE PATHWAY
POTENTIALLY COMPLETE PATHWAY
INCOMPLETE OR INSIGNIFICANT EXPOSURE PATHWAY
BARTER ISLAND RADAR INSTALLATION
USAF 611th CES
FIGURE NO. 3-1
ECOLOGICAL RISK ASSESSMENT POTENTIAL EXPOSURE PATHWAYS

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In particular, note that the habitat at the JP-4 Spill is classified as unsuitable under current conditions. One sample location, S03 (see Figure 2-17), is located in an area that may be viewed as potentially suitable habitat (disturbed tundra). The remaining samples at the JP-4 Spill site are characterized by a gravel pad and classified as unsuitable habitat. Overall the site is deemed to be unsuitable habitat, however, it is evaluated as potentially suitable habitat in a future scenario in Section 3.4.5, Potential Future Risks.

A summary of the habitat suitability evaluation is presented in Table 3-5. Figures E-1 through E-16 in Appendix E illustrate habitat suitability at each of the sites. The criteria and rationale used to characterize habitat suitability for each of the representative species follow.

3.2.4.1 Aquatic Organisms.

Arctic char. The arctic char is an anadromous species. Exposure of the char to COCs is only possible in streams that flow from the Barter Island installation to the Beaufort Sea. Sites associated with such streams are the Old Landfill, Current Landfill, Contaminated Ditch, and Old Dump Site.

Areas that do not have water access to the sea, and do not provide habitat for the arctic char are the POL Catchment, Old Runway Dump, Heated Storage, Garage, Weather Station Building, White Alice Facility, POL Tanks, Fuel Tanks, Bladder Diesel Spill, and JP-4 Spill.

Nine-spined stickleback. The nine-spined stickleback is a freshwater fish species, although it will tolerate some degree of brackish water. It needs ponds, lakes, or streams with vegetation for breeding. Such environment is present at the Old Landfill, Current Landfill, Contaminated Ditch, Heated Storage, Garage, Fuel Tanks, Old Dump Site, and Bladder Diesel Spill.

Areas that do not have sufficient water to provide habitat for nine-spined sticklebacks are the POL Catchment, Old Runway Dump, Weather Station Building, White Alice Facility, POL Tanks, and JP-4 Spill.

***Daphnia* spp**. Aquatic invertebrates, like the crustacean, *Daphnia* spp., may be found throughout the Barter Island installation wherever there is sufficient standing water. These sites include the Old Landfill, POL Catchment, Current Landfill, Contaminated Ditch, Heated Storage, Garage, Fuel Tanks, Old Dump Site, and Bladder Diesel Spill.

Areas that probably do not support viable *Daphnia* populations are the Old Runway Dump, Weather Station Building, White Alice Facility, POL Tanks, and JP-4 Spill.

3.2.4.2 Birds.

Lapland longspur. The Lapland longspur is a migratory passerine that shares a feeding guild with shorebirds (sandpipers and phalaropes) (Custer and Pitelka 1978). Its Alaskan diet consists mainly of seeds in May and August, and primarily insects when they are abundant in June and July. Competition between the longspur and the shorebirds is mitigated by the longspurs' preference for a more upland, or drier habitat than the shorebirds.

TABLE 3-5. HABITAT POTENTIAL FOR REPRESENTATIVE SPECIES AT THE BARTER ISLAND DEW LINE INSTALLATION

SITE	LF01	LF03	LF04	SD08	LF12	SS13	SS14	SS15	SS16	ST17	ST18	LF19	SS20	SS21
SPECIES														
Arctic char	**YES**	NO	**YES**	**YES**	NO	NO	NO	NO	NO	NO	NO	**YES**	NO	NO
Nine-spined stickleback	**YES**	NO	**YES**	**YES**	NO	**YES**	**YES**	NO	NO	NO	**YES**	**YES**	**YES**	NO
Daphnia spp.	**YES**	**YES**	**YES**	**YES**	NO	**YES**	**YES**	NO	NO	NO	**YES**	**YES**	**YES**	NO
Lapland longspur	**YES**	**YES**	**YES**	**YES**	NO	**YES**	**YES**	NO	NO	NO	**YES**	**YES**	**YES**	NO
Brant	**YES**	**YES**	NO	NO	NO	**YES**	**YES**	NO	NO	NO	NO	**YES**	**YES**	NO
Glaucous gull	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	NO	NO	NO	**YES**	**YES**	**YES**	NO
Pectoral sandpiper	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	NO	NO	NO	**YES**	**YES**	**YES**	NO
Spectacled eider	**YES**	**YES**	NO	NO	**YES**	**YES**	**YES**	NO	NO	NO	NO	**YES**	**YES**	NO
Brown lemming	**YES**	NO	**YES**	**YES**	NO	**YES**	NO	NO	NO	NO	**YES**	**YES**	**YES**	NO
Arctic fox	**YES**	NO	**YES**	**YES**	**YES**	**YES**	NO	NO	NO	NO	**YES**	**YES**	**YES**	NO
Caribou	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

LF01 = Old Landfill
LF03 = POL Catchment
LF04 = Current Landfill
SD08 = Contaminated Ditch
LF12 = Old Runway Dump
SS13 = Heated Storage
SS14 = Garage

SS15 = Weather Station Building
SS16 = White Alice Facility
ST17 = POL Tanks
ST18 = Fuel Tanks
LF19 = Old Dump Site
SS20 = Bladder Diesel Spill
SS21 = JP-4 Spill

Areas that potentially meet the habitat needs of the Lapland longspur include the Old Landfill, POL Catchment, Current Landfill, Contaminated Ditch, Heated Storage, Garage, Fuel Tanks, Old Dump Site, and Bladder Diesel Spill.

The longspur is not likely to use the habitats of the Old Runway Dump, Weather Station Building, White Alice Facility, POL Tanks, or JP-4 Spill. These areas are mostly gravel and lack vegetation to provide cover, forage or nest sites.

Brant. The brant is a migratory waterfowl species that nests in cottongrass/sedge communities on islands or peninsulas in large shallow ponds along the coastal plain (Cross 1993). It is mainly herbivorous, with small amounts of crustaceans, insects, and mollusks in its diet (Palmer 1976). Breeding pairs of brant are territorial and can become dense in suitable habitat (Hansen and Nelson 1957 in Palmer 1976).

The areas that contain potential brant habitat include the Old Landfill, POL Catchment, Heated Storage, Garage, Old Dump Site, and Bladder Diesel Spill.

The brant is not likely to be found at the Current Landfill, Contaminated Ditch, Old Runway Dump, Weather Station Building, White Alice Facility, POL Tanks, Fuel Tanks, or JP-4 Spill sites. The primary considerations for excluding these areas is the lack of ponds or lakes and the scarcity of vegetation for foraging, cover, or nest sites.

Glaucous gull. The glaucous gull is a migratory species that is both predatory and a scavenger. Its diet is varied, consisting of fish, birds, insects, crustaceans, mollusks, and garbage. The glaucous gull is opportunistic and will feed when and wherever prey, carrion or refuse is available.

The areas that have suitable habitat for the glaucous gull include the Old Landfill, POL Catchment, Current Landfill, Contaminated Ditch, Old Runway Dump, Heated Storage, Garage, Fuel Tanks, Old Dump Site, and Bladder Diesel Spill.

Areas that are not expected to provide suitable habitat for glaucous gulls include the Weather Station Building, White Alice Facility, POL Tanks, and JP-4 Spill. These sites are mostly gravel and are not likely to have any of the prey species or other habitat needs for the gull.

Pectoral sandpiper. The pectoral sandpiper is a migratory shorebird that feeds along the wet margins of lakes, ponds, and streams (Scott 1983). Suitable habitat on the coastal plain tundra is abundant, as are the insects it feeds on. Other diet items include mollusks, crustaceans, worms and plant debris (Pitelka 1959).

Areas with suitable pectoral sandpiper habitat are the Old Landfill, POL Catchment, Current Landfill, Contaminated Ditch, Old Runway Dump, Heated Storage, Garage, Fuel Tanks, Old Dump Site, and Bladder Diesel Spill.

The pectoral sandpiper is not likely to find suitable habitat at the Weather Station Building, White Alice Facility, POL Tanks, or JP-4 Spill. As with the other species, these habitats are unsuitable for the sandpiper because of the lack of foraging areas (mostly gravel) and inappropriate areas for breeding (lack of cover).

Threatened and endangered species. The Barter Island installation was evaluated for habitat suitability for threatened and endangered species using site maps, photographs, and information from the literature. Professional judgement was used to integrate the evidence and make an informed decision regarding suitability of the habitat for threatened and endangered species. In addition, the Air Force had surveys conducted for spectacled and Steller's eiders at most DEW Line stations on the North Slope (including Barter Island) and concluded there was a low probability that either species was currently nesting or raising broods in the vicinity of the Barter Island installation; although historical records do indicate that spectacled and Steller's eiders have been present in the vicinity (Alaska Biological Research 1994). The ERA evaluated potential exposure to COCs for the spectacled eider. This evaluation will serve as a surrogate evaluation for Steller's eider if present at the installation.

Spectacled eider. The spectacled eider is a migratory waterfowl species that is listed as threatened under the Federal Endangered Species Act. The spectacled eider's habitat is primarily marine outside of the breeding season. This species is being evaluated for the Barter Island installation because it may nest on islets in tundra ponds and lakes, as well as on the coastal plain around the DEW Line site (Palmer 1976).

The sites that contain potential habitat for the spectacled eider are the Old Landfill, POL Catchment, Old Runway Dump, Heated Storage, Garage, Old Dump Site, and Bladder Diesel Spill.

Areas that are unlikely to provide habitat for the spectacled eider are the Current Landfill, Contaminated Ditch, Weather Station Building, White Alice Facility, POL Tanks, Fuel Tanks, and JP-4 Spill. These areas do not provide adequate expanses of water or sufficient vegetation for foraging or nesting cover to accommodate the spectacled eider.

3.2.4.3 Mammals.

Brown lemming. The brown lemmings' home range may average 0.5 hectare (ha), 1.23 acres, (Nowak 1991). Some of the sites are large enough to encompass the lemmings' entire home range. The lemming needs thick vegetation to support its foraging demands (Chappell 1980) and to use as cover from predators. Additionally, the soil must be well-drained and have enough cohesion to keep tunnels and burrows from collapsing.

The sites that have suitable habitat for brown lemmings are the Old Landfill (LF01), Current Landfill (LF04), Contaminated Ditch (SD08), Heated Storage (SS13), Fuel Tanks (ST18), Old Dump Site (LF19), and Bladder Diesel Spill (SS20). The Heated Storage, Fuel Tanks, and Old Dump Site areas are questionable habitats, but sample locations linked to these areas are in the drainage pathways from these sites. The drainage pathways and the adjacent land provides good lemming habitat.

Areas lacking suitable lemming habitat include the POL Catchment (LF03), Old Runway Dump (LF12), Garage (SS14), Weather Station Building (SS15), White Alice Facility (SS16), POL Tanks (ST17), and Bladder Diesel Spill (SS21). These areas lack dense vegetation and are principally gravel mounds that do not meet the food, cover and burrowing requirements of the lemming.

Arctic fox. The arctic foxes' home range can be very extensive. Depending on the abundance of prey (primarily lemmings), the fox may range over 20 km^2 (Eberhardt et al. 1982). Combined with the foxes' preference for sandy-loam soils (unlike the gravel pads) for denning (Chesemore 1967) and the likelihood that the fox will den away from areas of human interference, this limits the use of the sites by the arctic fox.

Areas that provide potentially suitable habitat for the arctic fox include the Old Landfill, Current Landfill, Contaminated Ditch, Old Runway Dump, Heated Storage, Fuel Tanks, Old Dump Site, and Bladder Diesel Spill.

The sites that are not likely to be suitable habitat for the arctic fox are the POL Catchment, Garage, Weather Station Building, White Alice Facility, POL Tanks, and JP-4 Spill. These sites are not likely to have fox prey populations or the foxes' preferred soils for denning.

Caribou. The major migration route and staging areas for barren-ground caribou are to the south of Barter Island. Caribou, a representative species for all the DEW Line installations, will not be evaluated in the risk assessment for the Barter Island installation because they are uncommon, rarely making the crossing to the island. Those that do cross are likely to avoid the developed area around the installation (Cameron et al. 1992). Caribou are an important subsistence resource, and any caribou venturing near the DEW Line installation, and the village of Kaktovik, would probably be harvested by the local people.

3.2.4.4 Summary of Habitat Characterization and Screening. Based on the evaluations of habitat suitability, none of the representative species are expected to use habitat at four of the sites: the Weather Station Building, White Alice Facility, POL Tanks, or JP-4 Spill. The exposure pathways are not complete for the representative species at these sites, so they are screened from the ERA. The potential future ecological risks associated with the sites, should they become suitable habitat in the future, is presented in Section 3.4.5. The remaining 10 sites are assumed to have suitable habitat for at least some of the representative species.

The ERA is being conducted for the entire Barter Island installation, but only a small portion of the facility consists of sites. If the ERA considered the entire installation to be of concern, potential exposures may be overestimated. However, overestimated exposures may be mitigated by taking into account the spatial extent of the sites in relation to the size of the entire installation, in addition to screening via the habitat evaluation. The areal extent of the Barter Island DEW Line installation is estimated to be 140 ha. The sites that have habitat suitable for the representative species are estimated to total less than 3.5 ha., and those areas that have been determined to be unsuitable for all the representative species total less than 0.2 ha. In general, based on professional judgement and onsite observations, but not on site-specific surveys, the installation provides habitat less suitable than nearby areas because of the numerous roads, gravel pads, and overall development. The spatial extent of the sites was considered when estimating the onsite dietary intake (IS) in Section 3.2.7.2.

Although some of the sites may provide suitable habitat for the representative species, development and activities at the installation may lessen the overall attractiveness of these sites. Human presence and activity will deter many species from using the habitats. The region surrounding the installation meets the needs of the representative species, and it is likely that the species will show a preference for the undeveloped areas over the installation lands. On the other hand, there may be some sites that are more attractive to wildlife. An example is the landfill, where refuse may attract carrion eaters. Without detailed study and research, habitat selection behavior is not quantifiable.

3.2.5 Exposure Assessment for Representative Species of Plants

The harsh environment of the Arctic Coastal Plain imposes many restrictions on plant life. The presence of permafrost limits infiltration and percolation of water, so the water table is often at or above the surface. The vast majority of plant species are perennial, with much of their biomass (50 to 98 percent) underground (Raven et al. 1986). The potential pathways of contamination for plants are through the soil/sediment and surface water.

Carex spp., *Salix* spp., and *Eriophorum* spp. all store food reserves in rhizomes. Mychorrhizal fungi play an important role in the transport and delivery of nutrients to the rhizomes and the roots of these species. This underground system is most likely a development in response to the harsh aboveground arctic environment. As a result, surface water contaminated with lighter than water chemicals (i.e., petroleum and its derivatives) does not present a greatly increased hazard to the below ground portion of plants. This has been shown experimentally by exposing arctic coast vegetation to petroleum products (Walker et al. 1978). The experiments showed that sedges, willows and cottongrass plants were not adversely affected by low to moderate amounts of petroleum (12 liters/square meter) in wet environments. Thus, soil will be considered the primary pathway of potential contamination for plants. The chemical concentration used in the risk characterization (Section 3.4) is the average concentration of the COC in the soil/sediment.

3.2.6 Exposure Assessment for Representative Aquatic Organisms

Organisms that dwell in an aquatic environment are exposed to chemicals contained in the water column. For this reason, the exposure assessment considers the concentrations in surface water to be the exposure concentrations to aquatic organisms. The risk assessment compares the average concentration of the COCs found in surface waters to toxicity data for the representative aquatic species to calculate the risk estimate.

3.2.7 Exposure Estimates for Representative Bird and Mammal Species

Exposure estimates for the representative species of mammals and birds (expressed as a unit of chemical ingested per unit of body weight) are based on their total exposure to COCs from diet, soils and surface water using the following equation:

$$EE = [(FI \times CF) + (WI \times CW) + (SI \times CS \times ROA)] \times UCF \times IS / BW$$

where:

EE	=	estimated exposure (mg/kg-bw/day).
FI	=	food intake rate (g/day); rates are derived in the Life History Tables. Diets (both vegetable and animal components) are proportioned according to the diet composition information in the life history tables and are presented below.
CF	=	chemical concentration in food (mg/kg); based on concentrations for each group of food items.
WI	=	water intake rate (L/day); rates are derived in the life history tables.
CW	=	chemical concentration in water (μg/L); see Section 3.1 for calculations of concentrations.
SI	=	soil/sediment intake rate (g/day); based on a percentage of food intake.
CS	=	chemical concentration in soil/sediment (mg/kg); see Section 3.1 for calculations of concentrations.
ROA	=	relative oral availability; default to 1.0 (lack of information). This value assumes that the bioavailability of the chemical in the test medium is the same as for the medium onsite.
UCF	=	0.001; unit conversion factor used in conversion of g to kg, μg to mg, and L to ml, to ensure EE is reported in mg/kg-bw/day.
IS	=	fraction of dietary intake at potentially contaminated sites (by weight).
BW	=	body weight (kg)

In the case of species that have partial herbivorous dietary intakes, the CD value is multiplied by the proportion of vegetation in their diet. Those species and their respective proportions are: Lapland longspur, 0.25; brant, 0.90; glaucous gull, 0.10; pectoral sandpiper, 0.10; and spectacled eider, 0.25 (see the Life History tables, 3-7 to 3-11, for references regarding the proportion of vegetation in the species' diets). The estimated exposure calculations for bird and mammal receptors (including bioconcentration and concentration in food calculations) are presented in Appendix C.

3.2.7.1 Potential Bioaccumulation of COC in Representative Species. The potential risk from secondary exposure to the COCs is difficult to determine because of the complexity of the trophic web. Inputs to the exposure estimate equation include concentrations of contaminants in water and soil, ingestion rates for water, food and soil, range of the species and onsite areas, and body weight. The food ingested, in the case of higher level consumers, may be composed of elements from different levels of the trophic web. For example, a contaminant may be taken up by a plant, which is eaten by a lemming, which is then eaten by an arctic fox. The amount of contaminant to which the fox is exposed, without supporting empirical data at each trophic level, is not readily quantified. Based on this and the lack of data to assist in quantifying bioaccumulation, the risk assessment does not account for bioaccumulation in the animal portion of the trophic web.

For illustrative purposes, bioconcentration factors (BCFs) were calculated (Veith et al. 1979) for the organic COCs and presented in Table 3-6.

TABLE 3-6. BIOCONCENTRATION FACTORS FOR SELECTED ORGANIC COMPOUNDS IN WATER

CHEMICAL	Log K_{ow}	BCF
1,2-Dichloroethane	1.45	7.5
Phenol	1.48	7.9
Methylene chloride	1.51	8.3
Benzene	2.13	24.5
Toluene	2.69	65.2
Ethylbenzene	3.15	146
2-methylnaphthalene	3.87	514
Naphthalene	3.36	211
Trimethylbenzene	3.78	439
Xylene	3.16	149
Pyrene	5.18	5,091
DRPH	5.30	6,238
Hexachlorobenzene	5.5	8,913
Endrin	5.61	10,804
Benzo(a)anthracene	5.61	10,804
Chrysene	5.61	10,804
DDT	5.98	20,644
Benzo(a)pyrene	6.25	33,113
Benzo(g,h,i)perylene	6.51	52,191
PCB (Aroclor 1254)	6.94	110,764

Note: BCF calculated from Log K_{ow} according to the following equation:

$\text{Log BCF} = 0.76 \text{ Log } K_{ow} - 0.23$ (Veith et al. 1979 in Spacie and Hamelink 1985)

K_{ow} = octanol/water partition coefficient

The metals that are of concern at Barter Island (aluminum, iron, lead, manganese, and zinc) are evaluated for plant uptake quantitatively, as discussed in Section 3.2.5. The bioaccumulation of metals in the animal portion of the trophic web is not amenable to quantification without sample concentrations at each level of consumer. This does not present as large a problem as it initially seems because the bioaccumulative properties of the metals of concern can be addressed qualitatively.

Aluminum is not likely to bioaccumulate because, taken orally, it is poorly absorbed through the gastrointestinal tract. Most ingested aluminum leaves an animal's body in the feces, and the little that does enter the bloodstream is excreted in urine (ATSDR 1990a).

Information about the bioaccumulation of iron is not available in the literature, but because iron is an essential nutrient, it is likely that the metabolic processes that make use of iron will prevent undue bioaccumulation.

Lead tends to accumulate in bone (Talmadge and Watson 1991), so ingestion of animal tissue would not contribute greatly to increased lead concentrations. Food chain biomagnification of lead is uncommon in terrestrial communities (Eisler 1988). Kraus (1989) showed that in environments that were high in lead, the concentration of lead in insects and the tissues of insectivorous birds was low. Thus, lead is not likely to bioaccumulate to a degree that could contribute to risk at Barter Island.

Manganese and zinc are considered essential nutrients (ATSDR 1990b; Eisler 1993). It is not likely that the concentrations of these metals found at the Barter Island installation could bioaccumulate because animal systems are conditioned to regulate these minerals for metabolic use.

The exposure estimates for organic chemicals do not include potential bioaccumulation of chemicals in the animal portion of the trophic web. The estimates are at least one order of magnitude below the TRVs. It is unlikely that the organic chemicals will bioaccumulate (based on the concentrations reported in the soil and water), such that the exposure estimates would exceed, or even approach, the TRVs.

The BCF for PCBs is high (>110,000), which indicates that bioaccumulation may be significant. The HQs (comparison of the COC exposure of a species to the Toxicity Reference Value, presented in Table 3-23) for PCBs, however, are three to seven orders of magnitude less than one. Thus, development of adverse effects in ecological receptors under current conditions is not likely and the bioaccumulation of PCBs will probably not be sufficient to produce an HQ greater than one.

3.2.7.2 Estimation of Percent Ingested Onsite. The habitat suitability evaluation determines the sites a given species might use. The evaluation provides species-specific "exposure areas". This information, combined with home range data and the extent of the sites, can be used to estimate the percent of dietary intake that a species gets from the sites. This estimate is referred to as the "percent of dietary intake at sites" (IS) value in the exposure estimate equation. The IS value is the total extent of the sites (3.5 ha) as a percentage of the reported home range size. When home range information for a species is not available, population density values have been converted to estimate areal extent of the species. The representative species are most likely to be present at Barter Island during the breeding season. During the breeding season, most species become territorial. These territories are represented in the density of the population and may be used as substitute values for home range areas. This presents an added degree of uncertainty (see Section 3.5.3). If the home range (or converted population density value) is less than 3.5 ha, the maximum value for IS will be 1.0. The IS values for the representative bird and mammal species are:

Birds. Lapland longspur. IS = 0.5; Derksen et al. (1981) report a breeding density of 38.6/km^2. This corresponds to about 1 bird/2.6 ha. Potentially, the longspur could meet all its dietary demands within the sites only if they are all contiguous. Nevertheless, an IS value of 0.5 is used because the longspur prefers drier upland habitat over the wetter areas where the majority of the contaminant pathways occur.

Brant. IS = 0.18; density of breeding pairs reported by Derksen et al. (1981) is 5.0/km^2. At this density of 1 brant/20 ha, the total extent of the sites is about 18 percent of the area a brant might use.

Glaucous gull. IS = 0.30; the density for the glaucous gull is reported by Derksen et al. (1981) as 0.8/km^2. This density, about 1 gull/125 ha, yields a value of three percent (about 35 times the area of the sites). This may be misleading because the gull is attracted to refuse and areas where scavenging opportunities are high. The landfills and potential for mishandling of refuse may attract the glaucous gull. To compensate for this, the IS has been adjusted by a factor of 10, from 0.03 to 0.30.

Pectoral sandpiper. IS = 0.78; the density of the pectoral sandpiper along the Arctic Coastal Plain is reported by Derksen et al. (1981) as 22.4/km^2. This density equates to one sandpiper/4.5 ha, and an IS value of 0.78.

Spectacled eider. IS = 0.01; Derksen et al. (1981) report an average population density of 0.32/km^2 for the spectacled eider. The resulting density of 1 bird/312.5 ha in 1981 may currently be too high, considering the decline in the species' population. The spectacled eider is a threatened species, so the overestimation of exposure is appropriate in evaluation of a sensitive species.

Mammals. Brown lemming. IS = 0.5; the lemming's home range is reported as 0.5 ha (Nowak 1991). It is possible that several lemmings may consume all their dietary needs within the bounds of a site. However, the lemming is not likely to use the wetter sites (which constitute well over 50 percent of the total extent of the sites), which have the majority of the contaminant pathways. The sites are mostly gravel pads that have been constructed for development purposes, support little or no vegetation, and offer a poor matrix for the lemming to use for burrowing. For these reasons the IS used for the brown lemming is 0.5 rather than 1.0.

Arctic fox. IS = 0.01; the home range of the fox is extremely variable. Eberhardt et al. (1982) report a home range of 3.7 to 20.8 km^2 for juvenile and adult arctic foxes, respectively. Even the lower end of this range is much greater than the extent of the sites.

3.2.7.3 Exposure Assessment for Representative Species of Birds. In this section the methods for quantifying exposures to the selected representative species of birds are presented. The threatened and endangered bird species, spectacled eider, is included in this section.

In order to estimate exposures of the representative species of birds, life history information was compiled for the selected species. This information includes: occurrence at the DEW Line sites, habitat, average body weight, estimated food intake rate, estimated WI rate, diet composition, and population density. This life history information was used to estimate the representative species' potential exposure to the COC.

Plant uptake of contaminants has been quantified for use in the exposure estimations for herbivores (bird and mammal species). Herbivores are potentially exposed to contamination directly from ingestion of soil and water intake as well as through their diet. The dietary component (CD in the exposure estimate equation) is calculated by multiplying the contaminant's soil concentration by the BCF, B_v. B_v is defined as the ratio of the concentration in aboveground parts of a plant (mg of compound/kg of dry plant) to the concentration in soil (mg of compound/kg of dry soil). The B_v can be used to predict the level of a potential contaminant taken up by a plant, and this information can then be used to assess the potential transport of the contaminant in the trophic web.

The uptake of metals by plants is quantified using the B_v values in Baes et al. (1984). The approach for organic chemicals is basically the same, except that the B_vs for organic chemicals are derived through a regression equation (Travis and Arms 1988). The equation is:

$$\log B_v = 1.588 - 0.578(\log K_{ow})$$

where:

B_v = the BCF (unitless); and

K_{ow} = the octanol-water partition coefficient of the chemical (unitless);

In order to calculate the potential uptake of DRPH by plants, the K_{ow} of diesel fuel was estimated. The estimation of the K_{ow} was conducted using equation 2-3 in Lyman et al. (1982):

$$\log S = -0.922 \log K_{ow} + 4.184$$

where:

S = solubility (mg/L)

K_{ow} = octanol/water partition coefficient (unitless)

This equation estimates the solubility of an organic chemical in water. However, it may also be manipulated arithmetically to calculate the log K_{ow} based on the known solubility:

$$\log K_{ow} = \frac{\log S - 4.184}{-0.922}$$

The solubility of diesel fuel (0.2 mg/L) (Custance et al. 1992) was used to calculate the log K_{ow} of diesel fuel. The log K_{ow} is calculated to be 5.29.

Life history information for the Lapland longspur, brant, glaucous gull, and pectoral sandpiper is presented in Tables 3-7 through 3-10. Life history information for the spectacled eider is presented in Table 3-11.

Information is not available on the daily food intake rate (grams/day) and water intake rate (liters/day) for the representative bird species in the arctic habitat. Therefore, this information was estimated using regression equations associated with body weight. The severity of the arctic climate may impose higher metabolic demands on animals. As a result, the food and water intake rates should be considered to be estimates only and their uncertainty should be kept in mind. The food intake rate was estimated using Nagy's (1987) equations:

Passerine birds:

$$\text{FI (g/day dry matter)} = 0.398 \times (\text{body weight in grams})^{0.850}$$

All other birds:

$$\text{FI (g/day dry matter)} = 0.648 \times (\text{body weight in grams})^{0.651}$$

The water intake rate was estimated using the equation developed by Calder and Braun (1983):

All birds:

$$\text{WI (liters/day)} = 0.059 \times (\text{body weight in kilograms})^{0.67}$$

As animals forage they may incidentally ingest soil and sediment particles. The average concentration of contaminants in soil/sediment can be multiplied by the amount of soil/sediment ingested to estimate the potential uptake of contaminants by this route. Soil intake rates have been reported for just a few wildlife species (Beyer et al. 1991). The soil ingestion rates for the representative species are extrapolated from Beyer et al. (1991) by using similar species with reported values. The rates are reported as percentages of total diet. Table 3-12 lists the representative bird species, the species used as surrogates, and the estimated percentages of soil ingested in quantifying exposure to contaminants. Species that forage directly in the soil or sediment, such as the sandpiper or goose, show relatively high percentages of soil in their diet.

The Lapland longspur does not have appropriate surrogate species with soil ingestion data. The foraging habits of the longspur minimizes its soil contact and its estimates of soil ingestion reflect this. The glaucous gull ingests stones and sand as a mechanical addition to its diet (Belopol'skii 1961).

3.2.7.4 Exposure Assessment for Representative Species of Mammals. This section assesses exposure to contaminants for the selected representative species of mammals (brown lemming and arctic fox; barren-ground caribou are not included in the exposure assessment as noted previously). Tables 3-13 (brown lemming) and 3-14 (arctic fox) present life history data that were used to evaluate the representative species and their potential pathways of exposure to contaminants. Table 3-15 (barren-ground caribou) is included as information on a representative

TABLE 3-7. LIFE HISTORY INFORMATION FOR THE LAPLAND LONGSPUR, *Calcarius lapponicus*

PARAMETER	VALUE	NOTES	REFERENCE
OCCURRENCE AT DEW LINE SITES	seasonal breeder at all eight sites	dominant breeding passerine	USAF 1993a
HABITAT	breeds on arctic coastal tundra		Scott 1983
BODY WEIGHT	27.3 g (0.027 kg)	mean of 68 specimens	Dunning 1984
FOOD INTAKE RATE	6.6 g/day dry matter	$FI=0.398(BWg)^{0.850}$	Nagy 1987
WATER INTAKE RATE	0.005 liters/day	$WI=0.059(BWkg)^{0.67}$	Calder and Braun 1983
DIET COMPOSITION	during breeding (June and July): insects (craneflies); pre- and post-breeding (May and August): seeds (grasses); average 25 percent vegetation in diet	passerine member of insectivorous foraging guild which includes shorebirds	Custer and Pitelka 1978
POPULATION DENSITY	$38.6/km^2$	varies with changing predation pressures	Derksen et al. 1981

TABLE 3-8. LIFE HISTORY INFORMATION FOR THE BRANT, *Branta bernicla*

PARAMETER	VALUE	NOTES	REFERENCE
OCCURRENCE AT DEW LINE SITES	seasonal, breeds at or near all eight sites	breeding, migratory sp., subsistence sp.	USAF 1993a
HABITAT	breeds on Arctic Coastal Plain	prefers low, barren, wet, coastal terrain	Palmer 1976
BODY WEIGHT	1,305 g (1.305 kg)	mean of 791 specimens	Dunning 1984
FOOD INTAKE RATE	69.2 g/day dry matter	$FI=0.648(BWg)^{0.651}$	Nagy 1987
WATER INTAKE RATE	0.07 liters/day	$WI=0.059(BWkg)^{0.67}$	Calder and Braun 1983
DIET COMPOSITION	sedges, grasses; average 90 percent vegetation in diet	some insects during breeding (June and July)	Palmer 1976
POPULATION DENSITY	$5.0/km^2$	average from three coastal sites	Derksen et al. 1981

TABLE 3-9. LIFE HISTORY INFORMATION FOR THE GLAUCOUS GULL, *Larus hyperboreus*

PARAMETER	VALUE	NOTES	REFERENCE
OCCURRENCE AT DEW LINE SITES	seasonal breeder and migrant at all eight sites		Woodward-Clyde 1993
HABITAT	coastal tundra, lakes, ponds, and marine environment	breeds on arctic coast	Farrand 1983
BODY WEIGHT	1,445 g (1.445 kg)	mean of 65 specimens	Dunning 1984
FOOD INTAKE RATE	73.9 g/day dry matter	$FI=0.648(BWg)^{0.651}$	Nagy 1987
WATER INTAKE RATE	0.08 liters/day	$WI=0.059(BWkg)^{0.67}$	Calder and Braun 1983
DIET COMPOSITION	small fish, birds, insects, crustaceans, mollusks, garbage; average 10 percent of vegetation in diet	predatory scavenger	Martin et al. 1961
POPULATION DENSITY	$0.8/km^2$	average from three coastal sites	Derksen et al. 1981

TABLE 3-10. LIFE HISTORY INFORMATION FOR THE PECTORAL SANDPIPER, *Calidris melanotos*

PARAMETER	VALUE	NOTES	REFERENCE
OCCURRENCE AT DEW LINE SITES	seasonal breeder at all eight sites	abundant on Arctic Coastal Plain	Woodward-Clyde 1993
HABITAT	grassy margins of wet meadows, marshes, riparian areas, ponds	nests hidden on well-drained grassy sites	Scott 1983; Martin et al. 1961
BODY WEIGHT	79 g (0.079 kg)	mean of 35 specimens	Dunning 1984
FOOD INTAKE RATE	11.1 g/day dry matter	$FI=0.648(BWg)^{0.651}$	Nagy 1987
WATER INTAKE RATE	0.01 liters/day	$WI=0.059(BWkg)^{0.67}$	Calder and Braun 1983
DIET COMPOSITION	insects, mollusks, crustaceans, worms, vegetable debris; average 10 percent vegetation in diet	craneflies are major diet component	Martin et al. 1961; Pitelka 1959
POPULATION DENSITY	$22.4/km^2$	average from three coastal sites	Derksen et al. 1981

TABLE 3-11. LIFE HISTORY INFORMATION FOR THE SPECTACLED EIDER, *Somateria fischeri*

PARAMETER	VALUE	NOTES	REFERENCE
OCCURRENCE AT DEW LINE SITES	potential seasonal breeder at all sites	winter whereabouts unknown	Woodward-Clyde 1993
HABITAT	marine when not breeding, nests on coastal tundra	nests on islets in tundra ponds and lakes, as well as ashore	Palmer 1976
BODY WEIGHT	1,375 g (1.375 kg)	mean of 32 specimens	Dunning 1984
FOOD INTAKE RATE	71.6 g/day dry matter	$FI=0.648(BWg)^{0.651}$	Nagy 1987
WATER INTAKE RATE	0.07 liters/day	$WI=0.059(BWkg)^{0.67}$	Calder and Braun 1983
DIET COMPOSITION	75 percent insects, mollusks, crustaceans; average of 25 percent plant matter in diet	mostly insects when they are abundant; June and July	Kistchinski and Flint 1974
POPULATION DENSITY	$0.32/km^2$	average of three coastal sites	Derksen et al. 1981

TABLE 3-12. SOIL INGESTION BY REPRESENTATIVE BIRD SPECIES

REPRESENTATIVE SPECIES	SURROGATE SPECIES	ESTIMATED PERCENT OF SOIL IN DIET
Lapland longspur	no suitable surrogate	<2.0
Brant	Canada goose	8.2
Glaucous gull[a]	Siberian glaucous gull	7.6
Pectoral sandpiper	4 sandpiper species	13.1 (average)
Spectacled eider	Canada goose	8.2

Source: Beyer et al. 1991
[a] information from Belopol'skii 1961.

TABLE 3-13. LIFE HISTORY INFORMATION FOR THE BROWN LEMMING, *Lemmus trimucronatus*

PARAMETER	VALUE	NOTES	REFERENCE
OCCURRENCE AT DEW LINE SITES	resident at all eight sites	dominant small mammal	USAF 1993a
HABITAT	tundra and alpine meadows	nests aboveground in winter, below in summer	Burt and Grossenheider 1976
BODY WEIGHT	55 g (0.055 kg)		Chappell 1980
FOOD INTAKE RATE	24-45 g/day dry matter	has low assimilation efficiencies (31-36 percent), variation also related to seasons	Chappell 1980
WATER INTAKE RATE	0.007 liters/day	$WI=0.099(BWkg)^{0.90}$	Calder and Braun 1983
DIET COMPOSITION	sedges, grasses, lichens, roots, leaves, bark, berries		Nowak 1991
HOME RANGE SIZE (AVG)	0.5 ha (females) 1.0 ha (males)	0.5 ha used in assessment	Nowak 1991
POPULATION DENSITY	0 to 325/ha	populations have large fluctuations on a 3-5 year cycle; currently populations are low	Nowak 1991; Snyder-Conn 1994

TABLE 3-14. LIFE HISTORY INFORMATION FOR THE ARCTIC FOX, *Alopex lagopus*

PARAMETER	VALUE	NOTES	REFERENCE
OCCURRENCE AT DEW LINE SITES	resident at all eight sites	ubiquitous	USAF 1993a
HABITAT	tundra and coastal plain	dens in sandy mounds >1 m high	Chesemore 1967
BODY WEIGHT	4950 g (4.95 kg)		Burt and Grossenheider 1976
FOOD INTAKE RATE	256 g/day dry matter	FI= $0.235(BWg)^{0.822}$	Nagy 1987
WATER INTAKE RATE	0.42 liters/day	WI= $0.099(BWkg)^{0.90}$	Calder and Braun 1983
DIET COMPOSITION	brown lemming (summer), nesting birds, carrion, seal pups, non-food items	brown lemming in >85 percent of all scats, n=224	Chesemore 1967; Nowak 1991
HOME RANGE SIZE (AVG)	20.8 km^2 adult 3.7 km^2 juvenile (<1 yr)	adult range used in assessment	Eberhardt et al. 1982

TABLE 3-15. LIFE HISTORY INFORMATION FOR THE BARREN-GROUND CARIBOU, *Rangifer tarandus*

PARAMETER	VALUE	NOTES	REFERENCE
OCCURRENCE AT DEW LINE SITES	seasonal, at or near all eight sites during migrations	some sites used for calving	USAF 1993a
HABITAT	tundra in summer, open coniferous forest in winter	varies much related to migration	Burt and Grossenheider 1976
BODY WEIGHT	95.5 kg	mean for adults, male and female	Nowak 1991
FOOD INTAKE RATE	2.9 kg/day dry matter	$FI= 0.0687(BW)^{0.822}$	Nagy 1987
WATER INTAKE RATE	6.0 liters/day	$WI= 0.099(BW)^{0.90}$	Calder and Braun 1983
DIET COMPOSITION	willows, sedges, cottongrass, lichens	selection based on plant phenology	Skogland 1980; White and Trudell 1980
POPULATION DENSITY	1.41 km^2	undisturbed calving area	Cameron et al. 1992
	0.31 km^2	within 1 km of road	
	4.53 km^2	within 5-6 km of road (this value to be used at Barter Island)	

species at the DEW Line installations, although caribou are not expected to occur at the Barter Island installation. Home range and/or population density has been listed for the representative mammal species, depending on appropriateness and availability.

Information on the daily food intake rates of the arctic fox is not available. The rate has been estimated using regression equations associated with average body weights (Nagy 1987). The food intake rates for the fox were estimated using the following equation developed by Nagy (1987) for mammals in general.

Arctic fox:

$$FI \text{ (g/day dry matter)} = 0.235 \times (\text{body weight in grams})^{0.822}$$

Because of very low assimilation efficiencies, the low nutrient content of winter forage, and the high metabolic demands in arctic habitats (Chappell 1980), the equation for food intake rate significantly underestimates the rate for the brown lemming. A more appropriate rate for the brown lemming is reported by Chappell (1980).

The rates for water intake of the representative mammals were estimated using the equation generated by Calder and Braun (1983) because of the unavailability of species-specific information in the literature. The equation is:

$$WI \text{ (liters/day)} = 0.099 \times (\text{body weight in kilograms})^{0.90}$$

Incidental soil intake was evaluated for mammals in the same manner as for birds (Section 3.2.7.3 and Table 3-12). Table 3-16 shows the percent of soil ingested for the representative mammal species.

TABLE 3-16. SOIL INGESTION FOR REPRESENTATIVE MAMMAL SPECIES

REPRESENTATIVE SPECIES	SURROGATE SPECIES	ESTIMATED PERCENT OF SOIL IN DIET
Brown lemming	prairie dog	2.7
Arctic fox	fox (species unreported)	2.8
Caribou	elk	<2.0

Source: Beyer et al. 1991

3.3 ECOLOGICAL TOXICITY ASSESSMENT

This section presents toxicity information for each COC in surface water and soils/sediments. COCs in surface water (Section 3.1.1) are DRPH, aluminum, iron, and manganese. COCs in soils/sediment (Section 3.1.2) are DRPH, GRPH, RRPH, ethylbenzene, xylenes, naphthalene, lead, zinc, and PCBs. Sections 3.3.1 through 3.3.10 discuss the toxicity of all COCs to the receptor groups. Section 3.3.11, presents the derivation of TRVs used for this ERA.

3.3.1 Petroleum Hydrocarbons

Section 3.1 presented the COCs for sites at the Barter Island installation. DRPH were identified as a COC in surface water, and DRPH, GRPH, and RRPH were identified as COCs in soils and/or sediments. This section is a discussion of the chemical differences between DRPH, GRPH, and RRPH, and the toxicity of these three petroleum mixtures.

Crude petroleum contains thousands of different chemical compounds. Gasoline and diesel oil are refined petroleum products. The composition of gasoline and diesel fuel depends not only on the origin of the crude oil from which the gasoline is derived, but also the process technique and the blending scheme (Von Burg 1993). Once gasoline or diesel fuel is released to the environment, weathering and volatilization further alter its composition.

GRPH contain hydrocarbon molecules with 4 to 10 carbon atoms and include the following chemical classes: paraffins (straight-chained alkanes), olefins (straight-chained alkenes), naphthenes (cycloalkanes and alkenes), and aromatic hydrocarbons (alkylbenzenes and polynuclear) (Von Burg 1993). As many as 140 compounds have been identified as constituents of gasoline. The methods used by the analytical laboratory detected GRPH with six to nine carbon atoms. Diesel fuel is a complex, variable mixture of the same classes of compounds containing 6 to 21 carbon atoms. The analytical method detected DRPH with 10 to 24 carbon atoms. As many as 45 compounds have been identified as constituents of diesel fuel (Von Burg 1993). The concentration of RRPH was calculated by subtracting the GRPH and DRPH concentrations from the total petroleum hydrocarbon (TPH) concentration. Therefore, the RRPH could include many different types of chemicals, although the majority of molecules would include 24 carbon atoms or more.

Table 3-17 presents the chemical classes and weight percent for GRPH and DRPH. Generally, gasoline contains more aromatic compounds and simple chained alkanes, whereas diesel fuel is characterized by cycloparaffins (or cycloalkanes). Both gasoline and diesel fuel will be affected by the environment. Weathering will change the chemical composition of petroleum and, specifically, concentrations of aromatic compounds such as benzene will decrease as a result of volatilization.

Available toxicity test data have been derived from pure, fresh product and therefore, the applicability to the weathered product encountered at Barter Island is questionable. Gasoline is the most studied of the petroleum products, however, most data are based on inhalation studies. Gasoline was classified by EPA (1992b) as a Group C (possible human) carcinogen whereas diesel oil was classified as Group D (not classifiable as to human carcinogenicity). Presumably,

TABLE 3-17. CHEMICAL CLASSES OF GRPH AND DRPH

CHEMICAL CLASS	WEIGHT PERCENT (%)[a]
GRPH[b]	
Normal paraffins (n-alkanes)	19.3-38.4 (28.8)
Isoparaffins (isoalkanes)	11.5-50.3 (30.9)
Naphthenes (cycloparaffins or cycloalkanes)	1.0-2.8 (1.9)
Aromatics (benzene, toluene, pyrene)	9.7-54.7 (32.2)
DRPH[c]	
Normal paraffins (n-alkanes)	5.6
Isoparaffins (isoalkanes)	11.1
Naphthenes (cycloparaffins or cycloalkanes)	46.3
Aromatics (benzene, toluene, pyrene)	33.3
Nitrogen, sulfur and oxygen compounds	3.7

a Average shown in parentheses.
b Heath et al. 1993.
c Weeks et al. 1988.

this classification of gasoline is due to benzene which, under the conditions of environmental exposure, would volatilize more rapidly than any other constituent. The gasoline and diesel petroleum hydrocarbon data from surface water and sediment samples collected at Barter Island indicate that benzene was not detected frequently at concentrations above either background or action levels. Physical-chemical data from the literature indicates that TPH in soil would reflect all constituents with eventual loss of aromatic (e.g., BTEX) components first, lighter alkanes second, lighter PAHs third, followed by naphthalenes. For an old spill, TPH measurements may reflect predominantly trace amounts of high molecular weight PAHs or higher molecular-weight and branched alkanes [Massachusetts Department of Environmental Protection (MDEP) 1993].

For the purposes of ranking the toxicity of GRPH, DRPH, and RRPH, it is assumed that BTEX and lighter-weight alkanes were significantly weathered from exposure to the arctic environment, and that toxicity is more dependent upon noncarcinogenic endpoints associated with alkanes and cycloalkanes. MDEP (1993) reviewed noncarcinogenic toxicological endpoints and determined that diesel oil was an order of magnitude more toxic than gasoline. Other sources indicate that the toxicity of alkanes and cycloalkanes is similar (Armstrong Laboratory 1994; Sax and Lewis 1989). Based on the MDEP review and the chemical data reported for the Barter Island surface water and sediment samples, DRPH are evaluated and used to represent ecological risks from petroleum hydrocarbon contamination conservatively.

As discussed above, diesel is comprised of a complex mixture of paraffins (straight-chained alkanes), olefins (straight-chained alkenes), naphthenes (cycloalkanes and alkenes), and aromatic (alkylbenzenes, and polynuclear) petroleum hydrocarbons containing 6 to 21 carbon atoms. Hydrocarbons containing 8 to 18 carbon atoms predominate (Von Burg 1993). There are six grades of diesel fuel (Diesel Oil No. 1, Diesel Oil No. 2, Diesel Oil No. 4, Fuel Oil No. 1, Fuel Oil No. 2 and Home Heating Oil) (Von Burg 1993). The specific components of diesel are expected to change from source to source, so the toxicity of diesel fuels is expected to be variable.

3.3.1.1 Plants. Petroleum released to the aquatic environment is expected to be toxic to aquatic plants. Toxicity tests have shown that the water soluble components of petroleum are toxic to an algal species (*Chlorella vulgaris*) (Kauss and Hutchinson 1975). However, in this specific study, the toxicity was short term. The algal community recovered after a "lag phase". It was theorized (Kauss and Hutchinson 1975) that this trend was due to the loss of highly volatile fractions from the testing chamber over time. Exposure to water extracts of No. 2 Fuel Oil depressed algal biomass in communities and resulted in blue-green algal dominance and decreased diatom occurrence (Bott and Rogenmuser 1978).

3.3.1.2 Aquatic Organisms. Moles et al. (1979) tested the acute toxicity of Prudhoe Bay crude oil to several Alaskan freshwater and anadromous fish. Salmonids were the most sensitive species tested, and demonstrated median tolerance limits (the concentration at which one half the organisms survive in 96 hours: LC_{50}) ranging from 2.7 to 4.4 mg/L. The three-spined stickleback was more tolerant, with an LC_{50} of 10.4 mg/L. Klein and Jenkins (1983) studied the toxicity of the water soluble fraction of jet fuel to fish. Growth of fry was retarded by 1.5 mg/L of the water soluble fraction of JP-8 (jet fuel with de-icer). In a study conducted by Hedtke and Puglisis (1982), the method of introducing the oil to the test chamber was an important variable driving toxicity. Emulsified oils were substantially more toxic than either floating oils or the water soluble fraction. The 96 hour LC_{50} for fathead minnows (*Pimephales promelas*) exposed to the emulsion of No. 2 Jet Fuel was 38.6 mg/L (dose used to calculate TRV).

Aquatic organisms other than fish may also be exposed to diesel fuel in the environment. Studies have shown that freshwater arctic zooplankton may be more sensitive to oil pollution than any other arctic freshwater organisms (O'Brien 1978). Geiger and Buikema (1981) estimated an LC_{50} of No. 2 Fuel oil to *Daphnia pulex* of 5.6 mg/L (dose used to calculate TRV). Wong et al. (1981) determined that concentrations of crude oil as low as 1 ppm affect the reproduction of *Daphnia pulex*.

3.3.1.3 Birds. Petroleum hydrocarbons in the environment may affect bird reproduction. External application of No. 2 Fuel Oil to mallard (*Anas platyrhynchos*) and eider (*Somateria mollissima*) eggs significantly increased embryo mortality (Albers 1977; Szaro and Albers 1977). Mallard eggs were treated with 1, 5, 10, 20, and 50 μl of fuel oil. Ingestion of crude oil by mallards at a concentration of five percent in the diet resulted in depressed growth (Szaro et al. 1978). Hartung (1964) demonstrated a decrease in weight gain in mallards during the first 10 days after receiving 6,000 mg/kg No. 2 Fuel oil (dose used to calculate TRV). However, after 34 days, there was no difference between treatment groups and the controls.

3.3.1.4 Mammals. The available literature does not present a great deal of information regarding the toxicity of diesel fuel to mammals. The toxicity of diesel fuel to mammals can be represented by the toxicity of the compound to rats. Diesel fuel is slightly toxic to rats based on an acute oral LD_{50} of 7,380 mg/kg (Beck et al. 1982) (dose used to calculate TRV). A dermal LD_{50} in rabbits was reported as >4,290 mg (Beck et al. 1982).

3.3.2 Ethylbenzene

Ethylbenzene is a COC in soil and/or sediment at the Barter Island installation. It is a VOC, and most toxicity information in the literature relates to its inhalation.

3.3.2.1 Plants. In a cell multiplication inhibition test using *Microcystis aeruginosa* (algae) the toxicity threshold of ethylbenzene was 33,000 μg/L; The toxicity threshold of *Scenedesmus quadricauda* (green algae) to ethylbenzene was >160,000 μg/L (Verschueren 1983). Galassi et al. (1988 in AQUIRE 1994) reported an EC_{50} (growth) of 4,600 μg/L for *Selenastrum capricornutum* (green algae).

3.3.2.2 Aquatic Organisms. Ethylbenzene was a COC in soil and/or sediment but not in water. As a result, no quantitative presentation of water exposure was conducted in this ERA.

3.3.2.3 Birds. There is no information in the literature regarding the toxicity of ethylbenzene to birds.

3.3.2.4 Mammals. One study regarding the toxicity of ethylbenzene administered orally to rats reported an LD_{50} of 5,460 mg/kg (Budavari 1989) (dose used to calculate TRV).

3.3.3 Xylenes

Xylene is a COC in soil and/or sediment at the Barter Island installation. It is a VOC, and most toxicity information in the literature relates to the inhalation of xylene.

3.3.3.1 Plants. In a study of the green algae, *Selenastrum capricornutum*, xylene decreased growth at concentrations of 72,000 μg/L (Gaur 1988 in AQUIRE).

3.3.3.2 Aquatic Organisms. Xylene is not a COC in surface waters, so the toxicity to aquatic organisms is not presented.

3.3.3.3 Birds. When mallard eggs were immersed in xylene (1 and 10 percent) for 30 seconds, there were no significant effects at concentrations of 10 percent on embryonic weight & length when compared to controls [Hoffman and Eastin 1981 in Hazardous Substance Data Bank (HSDB) 1994]. Japanese quail (*Coturnix japonica*) fed xylene demonstrated no sign of toxicity up to 5,000 ppm (USFWS 1986). The LC_{50} was >20,000 ppm (USFWS 1986). Hill and

Camardese (1986) report a maximum dietary exposure level for Japanese quail of 625 mg/kg total xylenes (dose used to calculate TRV).

3.3.3.4 Mammals. Ingestion of xylene in mammals may cause prenatal mortality, growth inhibition, and malformations, primarily cleft palate. The LD_{50} for ingestion of xylene (rat) was reported as 4,300 mg/kg (Clayton and Clayton 1981) (dose used to calculate TRV).

3.3.4 Naphthalene

Naphthalene was determined to be a COC in soils/sediments, but not in surface water. Naphthalene belongs to the group of chemical compounds known as PAHs. PAHs are hydrogen and carbon atoms combined to form two or more fused benzene rings (Eisler 1987). The structure of naphthalene is a two-ring, unsubstituted molecule ($C_{10}H_8$). Specific toxicity data for naphthalene is generally lacking, so the following discussion may include toxicity information for other PAH compounds.

3.3.4.1 Plants. Specific toxicity information for plants exposed to naphthalene or other PAHs is not available. Some general trends have been observed by researchers (EPA 1980; Lee and Grant 1981; Wang and Meresz 1982; Edwards 1983; Sims and Overcash 1983 cited in Eisler 1987). PAHs may be absorbed from soil through plant roots and can be translocated to other parts of the plant. The factors that appear to govern plant uptake include soil concentration, water solubility, and soil type.

3.3.4.2 Aquatic Organisms. Naphthalene was not found to be a COC in water so it is not quantitatively evaluated in terms of exposure of aquatic organisms.

3.3.4.3 Birds. There is limited information regarding the toxicity of PAHs to birds. In a study conducted by Patton and Dieter (1980), mallards fed 4,000 mg PAHs/kg for 7 months demonstrated increased liver weight and blood flow to the liver. The PAH mixture tested contained naphthalenes, naphthenes, and phenanthrene. A TRV for naphthalene was not extrapolated from this PAH data because the data were not specific to naphthalene. However, potential risks associated with naphthalene toxicity are addressed in Section 3.4.3.

3.3.4.4 Mammals. Some PAHs are animal carcinogens. However, unsubstituted PAHs with fewer than four rings (as is naphthalene) have not been shown to induce tumorigenic activity (Eisler 1987). In addition, although unsubstituted PAHs are highly lipid soluble, they do not accumulate in mammalian tissue because of ready metabolization by animals (EPA 1980; Lee and Grant 1981). Specific studies regarding the toxicity of naphthalene to mammals are limited. 1,780 mg/kg body weight of naphthalene caused acute oral toxicity in rats (Sims and Overcash 1983 in Eisler 1987). The HSDB (1994) reports a NOAEL dose of 50 mg/kg naphthalene (dose used to calculate TRV) for a laboratory rat.

3.3.5 Polychlorinated Biphenyls

PCBs are COCs in the soil and/or sediment at the Barter Island installation. PCBs are a group of aromatic hydrocarbons halogenated with chlorine atoms. The toxicity of PCBs is influenced primarily by the octanol/water partition coefficient (K_{ow}), and the position and number of substituted chlorine atoms. Generally, the PCBs that have the highest K_{ow} and a high number of chlorine atoms in adjacent positions are the most toxic (Eisler 1986). PCBs cause reproductive failure, tumors, liver disorders, and birth defects. They are bioaccumulative and may magnify in the food web (Eisler 1986).

3.3.5.1 Plants. In a study conducted by Klekowski (1982 in Eisler 1986), a significant increase in mutations was noted in plants (*Matteuccia struthiopteris*) growing on sediments that contained concentrations of 26 mg/kg PCBs compared to the same species of plants collected from a control area.

3.3.5.2 Aquatic Organisms. PCBs were not detected in surface waters, so they are not quantitatively evaluated for exposure of aquatic organisms.

3.3.5.3 Birds. Birds that ingest PCBs in the diet may exhibit abnormal growth patterns, reproduction, metabolism or behavior (Eisler 1986). PCBs may accumulate in birds. Concentrations of PCBs in liver of birds (mg/kg fresh weight) were correlated to the feeding niche of the bird. Birds that fed on fish had the highest liver concentrations (900 mg/kg fresh weight), species that fed on small birds and mammals had the second highest levels (50 mg/kg fresh weight), and birds whose diet is composed of invertebrates had levels of 0.65 mg/kg fresh weight. Herbivorous species demonstrated the lowest accumulation of 0.2 mg/kg fresh weight [National Academy of Science (NAS) 1979 in Eisler 1986)]. The toxicity of PCBs to different species of birds was investigated by Heath et al. (1972 in Eisler 1986). The LD_{50}s for birds fed PCBs (Aroclor 1254) for five days, then untreated for three days were: Northern bobwhite (*Colinus virginianus*) 604 mg/kg diet; Mallard (*Anas platyrhynchos*) 2,699 mg/kg diet (dose used to calculate TRV).; Ring-necked pheasant (*Phasianus colchicus*) 1,091 mg/kg diet; Japanese quail (*Coturnix coturnix japonica*) 2,898 mg/kg diet.

3.3.5.4 Mammals. The toxicity of PCBs to mammals varies widely between species. Mink (*Mustela vison*) are the most sensitive mammals to PCB exposure, with an LD_{50} of 6.7 mg/kg diet (as Aroclor 1254) (Ringer 1983 in Eisler 1986). The cottontail rabbit's (*Sylvilagus floridanus*) LD_{50} for Aroclor 1254 was >10 mg/kg diet (Zepp and Kirkpatrick 1976 in Eisler 1986). The raccoon (*Procyon lotor*) displayed an LD_{50} of >50 mg/kg diet when exposed to Aroclor 1254 (Montz et al. 1982 in Eisler 1986). Rats were more sensitive: LD_{50} of >75 mg/kg diet for Aroclor 1254 (Hudson et al. 1984 in Eisler 1986) (dose used to calculate TRV).

3.3.6 Aluminum

Aluminum was found to be a COC in surface water, but not in soils/sediments. Aluminum is an ubiquitous naturally occurring element. It is amphoteric, with solubility lowest at a pH of 5.5 and increasing as pH deviates from 5.5 in either direction (EPA 1988). Attempts to relate toxicity to pH have yielded diverse results. Some researchers reported a direct correlation between increased aluminum toxicity and increased pH (Freeman and Everhardt 1971; Hunter et al. 1980 in EPA 1988), although other researchers have reported decreased toxicity (Call 1984; Boyd 1979; Kimball unpublished in EPA 1988).

3.3.6.1 Plants. According to the EPA (1988), single-celled plants are more sensitive to aluminum exposure than other plants. Concentrations of 810 μg/L inhibited the growth of the diatom *Cyclotella meneghiniana* (Rao and Subramanian 1982 in EPA 1988). The green alga, *Selenastrum capricornutum* (Call 1984 in EPA 1988) was affected by concentrations of aluminum of 460 μg/L. The Eurasian watermilfoil demonstrated decreased root weight when exposed to aluminum concentrations of 2,500 μg/L. Concentrations of aluminum of 8,000 μg/L in culture solutions resulted in toxic threshold concentrations in rice shoots and soybean leaves of 20 and 30 mg/kg, respectively (Wallace and Romney 1977 in Gough et al. 1979). Most of the aluminum remained in the roots of the plant.

3.3.6.2 Aquatic Organisms. Aluminum is toxic to carp (*Cyprinus carpio*) at 4,000 μg/L (48-hr LC_{50}) (Muramoto 1981 in EPA 1988). A 96-hr LC_{50} of 3,680 μg/L (dose used to calculate TRV) was reported for the brook trout (*Salvelinus fontinalis*) (Decker and Menendez 1974 in EPA 1988). TRVs for the arctic char and nine-spined stickleback are based on this value. In a chronic toxicity test with *Daphnia magna*, a reduction in survival (29 percent) was shown at to occur at concentrations of 1,020 μg/L (Kimball unpublished in EPA 1988). The organisms that survived this test did not exhibit any adverse effect on reproduction.

3.3.6.3 Birds. In a toxicity study conducted using red-winged blackbirds as the test organism, aluminum concentrations >111 mg/kg body weight were toxic (LD_{50}) (Schafer et al. 1983). In a study conducted by Cakir et al. (1978 in NAS 1980) a no-effect concentration of 486 ppm aluminum was reported for both turkeys and chicks. Studies reported in U.S. Army Corps of Engineers (COE) (1991) show a dose of 60.8 mg/kg-bw/day to be a LD_{50} (dose used to calculate TRV).

3.3.6.4 Mammals. No toxicity study using wild mammalian species was located in the literature. Calves and sheep fed 1,200 and 1,000 ppm (respectively) of aluminum in the diet showed no adverse effects (Valdivia et al. 1978; Bailey 1977 in NAS 1980). Studies reported in ATSDR (1990a) indicate an acute systemic NOAEL for rats exposed to aluminum of 108 mg/kg-bw/day (dose used to calculate TRV).

3.3.7 Iron

Iron is an essential trace element required by both plants and animals. It is a COC in surface water at the Barter Island installation.

3.3.7.1 Plants. In a study conducted by Foy et al. (1978 in EPA 1985), concentrations of 100 to 500 ppm soluble iron in soil were toxic to rice.

3.3.7.2 Aquatic Organisms. Iron may be a threat in aquatic environments as precipitates can destroy habitat, coat gills, and inhibit oxygen uptake. The EPA uses 1,000 μg/L as the chronic ambient water quality criterion protective of aquatic life (dose used to calculate TRV). In a study conducted by Warnick and Bell (1969 in EPA 1976) mayflies, stoneflies, and caddisflies were affected by iron concentrations of 320 μg/L (96-hr LC_{50}). Doudoroff and Katz (1953 in EPA 1976) found iron concentrations of 1,000 to 2,000 μg/L toxic to *Esox lucius* (northern pike) and trout (unknown species).

3.3.7.3 Birds. There are few studies available that address the toxicity of iron to species of wild birds. There were no adverse effects produced in turkeys at concentrations of 440 ppm (Woerpel and Balloun 1964 in NAS 1980). NAS (1980) recommends that the maximum tolerable level of dietary iron of 1,000 ppm be used for poultry. The 1,000 ppm dose converts to 125.0 mg/kg for a maximum tolerable dietary level for a chicken (dose used to calculate TRV).

3.3.7.4 Mammals. At high concentrations, iron is toxic to livestock and interferes with phosphorus metabolism (NAS 1974 in EPA 1976). Cattle fed 477 μg/g iron demonstrated a slight decrease in weight gain; concentrations of 1,677 μg/g of iron produced a significant decline in growth rate (EPA 1985). Shanas and Boyd (1969 in NAS 1980) report an acute LD_{50} dose of iron for the rat to be 1,000 mg/kg (dose used to calculate TRV for brown lemming and arctic fox).

3.3.8 Lead

Lead was found to be a COC in soils/sediments, but not in surface water.

3.3.8.1 Plants. Lead inhibits plant growth, reduces photosynthesis and reduces mitosis and water absorption (Eisler 1988). Concentrations of 500 mg/kg in soils were found to result in reduced pollen germination in several weed species, but the same study found that 46 mg/kg lead concentrations in soil did not have adverse effects on pollen germination (COE 1991).

3.3.8.2 Aquatic Organisms. Lead was not found to be a COC in surface water and, as a result, aquatic organisms are not evaluated quantitatively for lead exposure in the ERA.

3.3.8.3 Birds. The bulk of the toxicity information in the literature regarding avian exposure to lead concerns waterfowl that have ingested spent lead shot and died. These results are reported as body burdens of lead. There is, however, limited dose-response information available for some species. Mautino and Bell (1987) reported neurological effects in mallard ducks that had ingested and absorbed lead shot for a total intake of 423.8 mg/kg body weight. In young American kestrels (1 day old) ingesting 125 and 625 mg/kg body weight, growth and hematocrit values were significantly depressed (Hoffman et al. 1985). Based on a review of several studies, 12.0 mg/kg is the highest chronic NOAEL lead dose for many species of birds (dose used to calculate TRV).

3.3.8.4 Mammals. Lead may affect the survival, growth, development and metabolism of animal species. Rats are affected by 5 to 108 mg/kg body weight (acute oral dose); dogs by 0.32 mg/kg body weight daily (chronic oral dose); and horses by chronic dietary concentrations of 1.7 mg/kg (Eisler 1988). Azar et al. (1973 in Opresko et al. 1994) report an oral dose of 8.0 mg/kg-bw/day as a chronic NOAEL for laboratory rats (dose used to calculate TRV for brown lemming and arctic fox).

3.3.9 Manganese

Manganese was determined to be a COC in surface water, but not in soils/sediments. Manganese is considered to be an essential nutrient for animals (ATSDR 1990a), and it is important for growth and reproduction. The toxicity of manganese can be affected by pH and water hardness.

3.3.9.1 Plants. In a four-day study conducted using duckweed (*Lemna minor*), an EC_{50} (reduction in growth) was reported of 31,000 µg/L (Wang 1986 in AQUIRE 1990). Lewis et al. (1979) studied the species composition of freshwater phytoplankton populations when exposed to manganese. Population composition was altered at 0.1 mg/L manganese. Soil concentrations of 1,500 to 3,000 mg/kg were reported as phytotoxic to all plant species (Kabata-Pendias and Pendias 1984).

3.3.9.2 Aquatic Organisms. In a study conducted by Doudoroff and Katz (1953), brook trout were killed within 24 hours when exposed to concentrations of manganese of 6,250 µg/L. Rainbow trout have a reported LC_{50} of 2,910 µg/L (Pickering et al. 1983) (dose used to calculate TRV). *Daphnia* spp. have a reported 16 percent reproductive impairment in water with concentrations of 4,100 µg/L (Biesinger and Christensen 1972 in Lewis et al. 1979) (dose used to calculate TRV).

3.3.9.3 Birds. Vohra and Kratzer (1968 in NAS 1980) exposed young turkeys to dietary manganese for 21 days. A No Observed Effect Level (NOEL) of 4,080 ppm was derived. The maximum tolerable levels of manganese that are recommended by the NAS are 2,000 ppm (250 mg/kg body weight) for poultry. This dose is used as a NOAEL for the derivation of the TRV for birds.

3.3.9.4 Mammals. A NOAEL of 930 mg/kg-bw/day is reported for rats in ATSDR (1990b). The TRVs for brown lemming and arctic fox are based on the 930 mg/kg dose.

3.3.10 Zinc

Zinc was determined be a COC in soils/sediments, but not in surface water. Zinc is considered to be an essential nutrient for animals Eisler (1993), and is necessary for plant growth. Deficiencies of zinc in the diet may retard growth in animals (Eisler 1993).

3.3.10.1 Plants. According to information presented in Eisler (1993), plants that are sensitive to zinc concentrations die when soil levels are in excess of 100 mg/kg. Plant tissue content is also toxic in excess of 178 mg/kg (Eisler 1988). The amount of zinc absorbed from soil in plants is dependent upon soil specific characteristics. COE (1991) report that several species of plants find average concentrations of zinc of 270 mg/kg in soil to be phytotoxic.

3.3.10.2 Aquatic Organisms. Zinc was determined not to be a COC in water and as a result, aquatic organisms are not evaluated quantitatively.

3.3.10.3 Birds. When ducks were fed 2,500 to 3,000 mg/kg ration of zinc, or alternately, force-fed zinc at 742 mg/kg body weight, survival was reduced (Eisler 1993). Chickens were more resistant to zinc exposure; 8,000 mg zinc/kg ration was lethal to chicks (Eisler 1993). Elevated levels of zinc (20 g zinc/kg ration) are given to poultry to induce molting and subsequently reduce egg deposition (Eisler 1993). A four-week study conducted by Roberson and Schaible (1960 in NAS 1980) calculated a NOAEL of 1,000 ppm for 1-day old chicks. This value was used to calculate the avian TRV.

3.3.10.4 Mammals. According to Eisler (1993), zinc is relatively non-toxic to mammals (as might be expected for an essential trace element). There is a large range in concentrations between normal dietary intakes and those concentrations expected to cause harm. Adult male rats, when fed zinc at levels of 500 mg/kg diet, were adversely affected; spermatogenesis was arrested, and testes enlarged (Eisler 1993). Zinc concentrations of 6,820 mg zinc/kg ration suppressed rat growth and produced changes in the pancreas (Eisler 1993). A chronic NOAEL for laboratory rats of 160 mg/kg-bw/day is reported by Schlicker and Cox (1968 in Opresko et al. 1994). The TRVs for the brown lemming and arctic fox are derived from this toxicity value.

3.3.11 Characterization of Effects

In this section toxicity information is presented for representative ecological receptors that will be evaluated in the Risk Characterization section (3.4) of this report. Potential impacts to aquatic receptors are evaluated by comparing exposure concentrations to TRVs. Potential impacts to terrestrial wildlife are evaluated for selected representative species based on comparisons of estimated exposures to TRVs. TRVs for the representative aquatic species are presented in Table 3-18. Exposure to the selected representative species will be primarily through diet; which may include plants, fish and aquatic invertebrates, soils and surface water. TRVs are derived for COCs that are elevated in surface water and soil/sediments. TRVs for the representative bird species are presented in Table 3-19, and for the representative mammal species in Table 3-20.

3.3.11.1 Toxicity Reference Values. TRVs are derived by selecting toxicity values from the literature and then extrapolating to the species of concern. UFs and body scaling factors (SIFs) (SIF calculations are in Appendix C) are used in the extrapolation process as described below. Tables 3-18 to 3-20 present the information used to derive the TRVs.

(1) The first step is to select an appropriate toxicity value from the scientific literature for each combination of chemical and representative or protected species. Test species most similar to the species of concern are preferred. A secondary emphasis is given to tests conducted over a significant portion of the animal's natural lifespan (e.g., chronic tests), when available. It should be kept in mind that the goal of the risk assessment is to evaluate the ecological significance of any potential contamination and the use of TRVs is in keeping with this goal.

(2) The toxicity value is then modified through application of UFs associated with the quality of toxicity data to derive a NOAEL. If a chronic NOAEL is available, then the toxicity value is used with an UF of one (i.e., no adjustment) because these values have the lowest uncertainty. If chronic data are unavailable, acute or subchronic toxicity data are modified by UFs to extrapolate to chronic effects. Based on Harding Lawson Associates (1992), the following strategy was derived for UFs for extrapolating study results to chronic NOELs: 10 for chronic LOEL values, 10 for subchronic NOEL values, and 20 for subchronic LOEL values. LC_{50} and LD_{50} values are extrapolated to chronic NOELs by a factor of 20.

TABLE 3-18. TOXICITY REFERENCE VALUES FOR REPRESENTATIVE SPECIES OF AQUATIC ORGANISMS AT THE BARTER ISLAND INSTALLATION

CHEMICAL OF CONCERN	REPRESENTATIVE SPECIES	STUDY TYPE	DOSE $\mu g/L$	TEST SPECIES	NOAEL UF	INTERSPECIES UF	PROTECTED SPECIES UF	TRV mg/L	REFERENCE
Aluminum	arctic char	LC_{50}	3,680	brook trout	20	2	1	92.0	COE 1991
Aluminum	nine-spined stickleback	LD_{50}	3,680	brook trout	20	2	1	92.0	COE 1991
Aluminum	*Daphnia* spp.	chronic reproductive impairment LOAEL	1,020	*D. magna*	10	1	1	102.0	COE 1991
Manganese	arctic char	LC_{50}	2,910	rainbow trout	20	2	1	73.0	COE 1991
Manganese	nine-spined stickleback	LC_{50}	2,910	rainbow trout	20	2	1	73.0	COE 1991
Manganese	*Daphnia* spp.	reproductive impairment LOAEL	4,100	*Daphnia* spp.	20	1	1	205.0	COE 1991
Iron	arctic char	EPA chronic water quality criteria	1,000	all aquatic life	1	1	1	1,000.0	COE 1991
Iron	nine-spined stickleback	EPA chronic water quality criteria	1,000	all aquatic life	1	1	1	1,000.0	COE 1991
Iron	*Daphnia* spp.	EPA chronic water quality criteria	1,000	all aquatic life	1	1	1	1,000.0	COE 1991
DRPH	arctic char	LC_{50}	38,600	fathead minnow	20	2	1	965.0	Hedtke and Puglisis 1982
DRPH	nine-spined stickleback	LC_{50}	38,600	fathead minnow	20	2	1	965.0	Hedtke and Puglisis 1982
DRPH	*Daphnia* spp.	LOAEL	5,600	*D. pulex*	20	1	1	280.0	Hedtke and Puglisis 1982

TABLE 3-19. TOXICITY REFERENCE VALUES FOR REPRESENTATIVE AND SENSITIVE SPECIES OF BIRDS AT THE BARTER ISLAND INSTALLATION

CHEMICAL OF CONCERN	REPRESENTATIVE SPECIES	STUDY TYPE	DOSE mg/kg-BW/DAY	TEST SPECIES	NOAEL UF	SCALING FACTOR	INTERSPECIES UF	PROTECTED SPECIES UF	TRV mg/kg-BW/DAY	REFERENCE
Aluminum	Lapland longspur	LD_{50}	60.8	chicken	20	0.26	2	2	2.9	COE 1991
Aluminum	brant	LD_{50}	60.8	chicken	20	0.93	2	2	0.8	COE 1991
Aluminum	glaucous gull	LD_{50}	60.8	chicken	20	0.97	2	2	0.8	COE 1991
Aluminum	pectoral sandpiper	LD_{50}	60.8	chicken	20	0.37	2	2	2.1	COE 1991
Aluminum	spectacled eider	LD_{50}	60.8	chicken	20	0.95	2	2	0.8	COE 1991
Iron	Lapland longspur	maximum tolerable dietary level	125.0	chicken	10	0.26	2	2	12.0	NAS 1980
Iron	brant	maximum tolerable dietary level	125.0	chicken	10	0.93	2	2	3.4	NAS 1980
Iron	glaucous gull	maximum tolerable dietary level	125.0	chicken	10	0.97	2	2	3.2	NAS 1980
Iron	pectoral sandpiper	maximum tolerable dietary level	125.0	chicken	10	0.37	2	2	8.4	NAS 1980
Iron	spectacled eider	maximum tolerable dietary level	125.0	chicken	10	0.95	2	2	3.3	NAS 1980
Lead	Lapland longspur	NOAEL	12.0	all birds	1	NA	NA	2	6.0	COE 1991
Lead	brant	NOAEL	12.0	all birds	1	NA	NA	2	6.0	COE 1991
Lead	glaucous gull	NOAEL	12.0	all birds	1	NA	NA	2	6.0	COE 1991
Lead	pectoral sandpiper	NOAEL	12.0	all birds	1	NA	NA	2	6.0	COE 1991
Lead	spectacled eider	chronic NOAEL	12.0	all birds	1	NA	NA	2	6.0	COE 1991
Manganese	Lapland longspur	maximum tolerable dietary level	250	chicken	1	0.26	2	2	240.30	NAS 1980
Manganese	brant	maximum tolerable dietary level	250	chicken	1	0.93	2	2	67.0	NAS 1980

TABLE 3-19. TOXICITY REFERENCE VALUES FOR REPRESENTATIVE AND SENSITIVE SPECIES OF BIRDS AT THE BARTER ISLAND INSTALLATION (CONTINUED)

CHEMICAL OF CONCERN	REPRESENTATIVE SPECIES	STUDY TYPE	DOSE mg/kg-BW/DAY	TEST SPECIES	NOAEL UF	SCALING FACTOR	INTERSPECIES UF	PROTECTED SPECIES UF	TRV mg/kg-BW/DAY	REFERENCE
Manganese	glaucous gull	maximum tolerable dietary level	250	chicken	1	0.97	2	2	64.0	NAS 1980
Manganese	pectoral sandpiper	maximum tolerable dietary level	250	chicken	1	0.37	2	2	169.0	NAS 1980
Manganese	spectacled eider	maximum tolerable dietary level	250	chicken	1	0.95	2	2	66	NAS 1980
Zinc	Lapland longspur	subchronic dietary NOAEL	175	chicken	10	0.32	2	2	14	Roberson and Schaible 1960 in NAS 1980
Zinc	brant	subchronic dietary NOAEL	175	chicken	10	1.18	2	2	3.7	Roberson and Schaible 1960 in NAS 1980
Zinc	glaucous gull	subchronic dietary NOAEL	175	chicken	10	1.22	2	2	9.5	Roberson and Schaible 1960 in NAS 1980
Zinc	pectoral sandpiper	subchronic dietary NOAEL	175	chicken	10	0.46	2	2	3.6	Roberson and Schaible 1960 in NAS 1980
Zinc	spectacled eider	subchronic dietary NOAEL	175	chicken	10	1.20	2	2	3.6	Roberson and Schaible 1960 in NAS 1980
DRPH	Lapland longspur	decreased weight gain LOAEL	6000	mallard	10	0.29	2	2	517.0	Hartung 1964
DRPH	brant	decreased weight gain LOAEL	6000	mallard	10	1.07	2	2	140.0	Hartung 1964
DRPH	glaucous gull	decreased weight gain LOAEL	6000	mallard	10	1.10	2	2	136.0	Hartung 1964
DRPH	pectoral sandpiper	decreased weight gain LOAEL	6000	mallard	10	0.42	2	2	357.0	Hartung 1964
DRPH	spectacled eider	decreased weight gain LOAEL	6000	mallard	10	1.08	2	2	139.0	Hartung 1964

TABLE 3-19. TOXICITY REFERENCE VALUES FOR REPRESENTATIVE AND SENSITIVE SPECIES OF BIRDS AT THE BARTER ISLAND INSTALLATION (CONTINUED)

CHEMICAL OF CONCERN	REPRESENTATIVE SPECIES	STUDY TYPE	DOSE mg/kg-BW/DAY	TEST SPECIES	NOAEL UF	SCALING FACTOR	INTERSPECIES UF	PROTECTED SPECIES UF	TRV mg/kg-BW/DAY	REFERENCE
Ethylbenzene	Refer to Section 3.4.3 for a discussion of avian toxicity to ethylbenzene.									
Naphthalene	Refer to Section 3.4.3 for a discussion of avian toxicity to naphthalene.									
PCBs	Lapland longspur	LD_{50}	2,699	mallard	20	0.29	2	2	116.0	Heath et al. 1972
PCBS	brant	LD_{50}	2,699	mallard	20	1.07	2	2	32.0	Heath et al. 1972
PCBs	glaucous gull	LD_{50}	2,699	mallard	20	1.10	2	2	31.0	Heath et al. 1972
PCBs	pectoral sandpiper	LD_{50}	2,699	mallard	20	0.42	2	2	80.0	Heath et al. 1972
PCBs	spectacled eider	LD_{50}	2,699	mallard	20	1.08	2	2	31.0	Heath et al. 1972
Xylenes (total)	Lapland longspur	maximum dietary exposure level	625	Japanese quail	10	0.60	2	2	26.0	Hill and Camardese 1986
Xylenes (total)	brant	maximum dietary exposure level	625	Japanese quail	10	2.16	2	2	7.2	Hill and Camardese 1986
Xylenes (total)	glaucous gull	maximum dietary exposure level	625	Japanese quail	10	2.23	2	2	7.0	Hill and Camardese 1986
Xylenes (total)	pectoral sandpiper	maximum dietary exposure level	625	Japanese quail	10	0.85	2	2	18.4	Hill and Camardese 1986
Xylenes (total)	spectacled eider	maximum dietary exposure level	625	Japanese quail	10	2.19	2	2	7.1	Hill and Camardese 1986

TABLE 3-20. TOXICITY REFERENCE VALUES FOR REPRESENTATIVE SPECIES OF MAMMALS AT THE BARTER ISLAND INSTALLATION

CHEMICAL OF CONCERN	REPRESENTATIVE SPECIES	STUDY TYPE	DOSE mg/kg-BW/DAY	TEST SPECIES	NOAEL UF	SCALING FACTOR	INTERSPECIES UF	PROTECTED SPECIES UF	TRV mg/kg-BW/DAY	REFERENCE
Aluminum	brown lemming	acute systemic NOAEL	108	rat	10	0.65	2	1	8.0	ATSDR 1990a
Aluminum	arctic fox	acute systemic NOAEL	108	rat	10	2.91	2	1	2.0	ATSDR 1990a
Iron	brown lemming	Acute LD_{50}	1,000	rat	20	0.60	2	1	42	Shanas and Boyd 1969 in NAS 1980
Iron	arctic fox	Acute LD_{50}	1,000	rat	20	2.70	2	1	9	Shanas and Boyd 1969 in NAS 1980
Lead	brown lemming	reproductive NOAEL	8	rat	1	0.60	2	1	7	Azar et al. 1973 in Opresko et al. 1994
Lead	arctic fox	reproductive NOAEL	8	rat	1	2.70	2	1	1	Azar et al. 1973 in Opresko et al. 1994
Manganese	brown lemming	chronic systemic NOAEL	rat	930	1	2.70	2	1	170	Hejtmanick et al. 1987 in ATSDR 1990
Manganese	arctic fox	chronic systemic NOAEL	rat	930	1	0.60	2	1	780	Hejtmanick et al. 1987 in ATSDR 1990
Zinc	brown lemming	chronic reproductive LOAEL	rat	160	1	0.60	2	1	133	Schlickler and Cox 1968 in Opresko et al. 1994
Zinc	arctic fox	chronic reproductive LOAEL	rat	160	1	2.70	2	1	30	Schlickler and Cox 1968 in Opresko et al. 1994

TABLE 3-20. TOXICITY REFERENCE VALUES FOR REPRESENTATIVE SPECIES OF MAMMALS AT THE BARTER ISLAND INSTALLATION (CONTINUED)

CHEMICAL OF CONCERN	REPRESENTATIVE SPECIES	STUDY TYPE	DOSE mg/kg-BW/DAY	TEST SPECIES	NOAEL UF	SCALING FACTOR	INTERSPECIES UF	PROTECTED SPECIES UF	TRV mg/kg-BW/DAY	REFERENCE
DRPH	brown lemming	LD_{50}	7,380	rat	20	0.65	2	1	284.0	Beck et al. 1982
DRPH	arctic fox	LD_{50}	7,380	rat	20	2.91	2	1	63.0	Beck et al. 1982
Ethylbenzene	brown lemming	LD_{50}	5,460	rat	20	0.65	2	1	210.00	Clayton and Clayton 1981
Ethylbenzene	arctic fox	LD_{50}	5,460	rat	20	2.91	2	1	47.0	Clayton and Clayton 1981
Naphthalene	brown lemming	NOAEL	50	rat	1	0.65	2	1	38.0	HSDB 1994
Naphthalene	arctic fox	NOAEL	50	rat	1	2.91	2	1	9.0	HSDB 1994
PCBs	brown lemming	LD_{50}	>75	rat	20	0.65	2	1	3.0	Hudson et al. 1984
PCBs	arctic fox	LD_{50}	>75	rat	20	2.91	2	1	0.6	Hudson et al. 1984
Xylenes (total)	brown lemming	LD_{50}	4,300	rat	20	0.65	2	1	165.0	Clayton and Clayton 1981
Xylenes (total)	arctic fox	LD_{50}	4,300	rat	20	2.91	2	1	37.0	Clayton and Clayton 1981

(3) A body SIF is used to extrapolate the estimated NOEL for the test species to a NOEL for the species of concern. Klaassen et al. (1986) have indicated that dose expressed on a per unit surface area basis may be more appropriate than dose per unit body weight. The underlying assumption is that a toxicant acts on a physiologic surface and that the toxic effect increases as the ratio of chemical to surface area increases. The SIF accounts for differences in the mass to surface area ratios between species. In this assessment the SIF is calculated using the following equation (Mantel and Schneiderman 1975): SIF = $(\text{weight of representative species/weight of test species})^{1/3}$.

(4) A UF of 2 is used to account for interspecies variation in sensitivity. This value is based on the methodology used in Harding Lawson Associates (1992).

(5) A UF of 2 was used to account for additional sensitivity of state and/or federally protected species. This value is based on Harding Lawson Associates (1992). Migratory birds are Federally protected and include all the representative avian and protected species (i.e., spectacled eider) selected for this assessment.

The relationships between the values given in the tables can be summarized as:

DOSE, divided by NOAEL UF, divided by SCALING FACTOR (if applicable), divided by INTERSPECIES UF, divided by PROTECTED SPECIES UF equals TRV.

The TRVs for birds and mammals in this assessment were derived using the five steps described above. The process is similar for the representative aquatic organisms, with the exception of the SIF. SIFs are not necessary for aquatic species because they are in direct contact with the medium (i.e., water) that is the contaminant pathway.

3.4 RISK CHARACTERIZATION FOR ECOLOGICAL RECEPTORS

In this section, potential risks to ecological receptors are evaluated. Potential risks to plants are evaluated based on the contaminant concentrations in the soil/sediment and information from the literature. Potential risks to aquatic organisms, birds, and mammals are estimated by comparing estimated exposures to TRVs. This method is known as the Quotient Method (EPA 1992a). The Quotient Method divides the estimated exposure concentration by the associated TRV to derive the HQ. If the HQ is less than 1.0, then adverse effects are not expected. Conversely, if the HQ is equal to or greater than 1.0, a potential for adverse effects exists. The confidence level of the risk estimate is increased as the magnitude of the ratio departs from 1.0. For example, there is greater confidence in a risk estimate where the HQ is 0.1 or 10, than in a HQ such as 0.9 or 1.1.

The characterization of risk focuses on the Assessment and Measurement Endpoints. These endpoints are selected and discussed in keeping with the Framework for Ecological Risk Assessment guidance (EPA 1992a). The Assessment Endpoints for the Barter Island ERA are changes in: the populations of the plant representative species (*Carex* spp., *Salix* spp., *Eriophorum* spp., and *Vacciaium* spp.); the populations of aquatic representative species

(*Daphnia* spp., nine-spined stickleback and arctic char); the populations of avian representative species (Lapland longspur, brant, glaucous gull and pectoral sandpiper); and, the populations of mammalian representative species (brown lemming and arctic fox). In addition, individual (as opposed to populations for other species) spectacled eiders are Assessment Endpoints because of their federal listing as threatened species. The Measurement Endpoints are the species themselves, used to characterize risk through the comparison of the estimated exposures to COCs (presented in the Ecological Exposure Assessment, Sections 3.2.5 to 3.2.7) with the TRVs.

Potential ecological risks are presented in the following sections: Section 3.4.1 addresses representative species of plants; Section 3.4.2 considers aquatic organisms; Section 3.4.3 addresses representative species of birds (and endangered and threatened species); and Section 3.4.4 discusses representative species of mammals. The potential ecological risks are summarized in Tables 3-21 through 3-23.

3.4.1 Potential Risks to Representative Species of Plants

In determining the risks to plants at the Barter Island installation, a qualitative comparison was made of soil/sediment and surface water chemical concentrations and plant toxicity information in the literature. Table 3-21 summarizes these comparisons. There is a great deal of uncertainty in this phase of the assessment because of the differences in degree of uptake between plant species (Walker et al. 1978). However, the concentrations of contaminants onsite can be compared on the level of orders of magnitude. This comparison allows broad trends to be observed in order to determine whether a potential risk may exist.

Information is generally lacking concerning the toxicity of the COC at Barter Island and how they relate to the representative species of plants. As a result, when comparisons of TRVs for site-specific species and chemicals are not possible, comparisons of related chemicals with other plant species are made.

As seen in Table 3-21, the concentrations of metals, except zinc, found in the soil/sediment and water at Barter Island are at least one order of magnitude lower than reported toxicity values for various plants. Concentrations of zinc at the site are substantially lower than the reported toxicity values. Zinc uptake by plants was shown to be significantly lower at 16° than at 32° C (Giordano and Mortvedt 1980). These comparisons are not definitive in judging the toxicity of metals to the specific representative plant species, but the risk to *Carex* spp., *Salix* spp., *Eriophorum* spp., and *Vaccinium* spp. is likely to be low. The concentrations of VOCs at the site are substantially lower than toxicity values reported by Galassi et al. (1988 in COE 1991) and Hutchinson et al. (1980 in COE 1991) and listed in Table 3-21. These VOCs are not expected to be present at significant levels in most plants because of their volatility, absorption to soil particles, metabolism, or degradation rates in soil (Kostecki and Calabrese 1989). Overall, the potential risk to representative species of plants can be characterized as low.

TABLE 3-21. COMPARISON OF CONCENTRATIONS OF POTENTIAL CONTAMINANTS TO TOXICITY INFORMATION FOR PLANTS AT THE BARTER ISLAND INSTALLATION

CHEMICAL (COC media)	PLANT	EXPOSURE LEVEL	EFFECT ON PLANT	BARTER ISLAND EXPOSURE	REFERENCE
ALUMINUM (COC in water)	Eurasian milfoil	2,500 µg/L in water	decreased root weights	318 µg/L	COE 1991
	rice/soybeans	8,000 µg/L in water	toxic to shoot	313 µg/L	COE 1991
IRON (COC in water)	rice	100,000-500,000 µg/L; >500,000 µg/L	toxic; highly toxic	8,580 µg/L	COE 1991
MANGANESE (COC in water)	duckweed	31,000 µg/L in water	EC_{50}	574 µg/L	COE 1991
LEAD (COC in soil)	weed spp.	500 mg/kg in soil	reduced pollen germination	26.5 mg/kg	COE 1991
	weed spp.	46 mg/kg	normal germination	26.5 mg/kg	COE 1991
ZINC (COC in soil)	several spp.	270 mg/kg (avg) in soil	phytotoxic	77.3 mg/kg	COE 1991
VOCs	green algae	4,600 µg/L for ethylbenzene 2,290,000 µg/L for methylene chloride, in water	EC_{50}	821 µg/L as DRPH	COE 1991

TABLE 3-22. RISK CHARACTERIZATION OF REPRESENTATIVE SPECIES OF AQUATIC ORGANISMS AT THE BARTER ISLAND INSTALLATION

SPECIES	ESTIMATED EXPOSURE CONCENTRATION µg/liter	TRV µg/liter	HAZARD QUOTIENT (HQ)
ALUMINUM			
arctic char	3E+02	92.0	3E+00
nine-spined stickleback	3E+02	92.0	3E+00
Daphnia spp.	3E+02	102.0	3E+00
IRON			
arctic char	9E+03	1,000.0	9E+00
nine-spined stickleback	9E+03	1,000.0	9E+00
Daphnia spp.	9E+03	1,000.0	9E+00
MANGANESE			
arctic char	6E+02	73.0	8E+00
nine-spined stickleback	6E+02	73.0	8E+00
Daphnia spp.	6E+02	205.0	3E+00
DRPH			
arctic char	7E+02	965.0	7E-01
nine-spined stickleback	7E+02	965.0	7E-01
Daphnia spp.	7E+02	280.0	3E+00

TABLE 3-23. RISK CHARACTERIZATION OF REPRESENTATIVE BIRD, MAMMAL, AND PROTECTED SPECIES AT THE BARTER ISLAND INSTALLATION

SPECIES	ESTIMATED DAILY DOSE mg/kg-bw/day	TRV mg/kg-bw/day	HAZARD QUOTIENT (HQ)
ALUMINUM			
Lapland longspur	3E-02	2.9	1E-02
brant	3E-03	0.8	4E-03
glaucous gull	5E-03	0.8	7E-03
pectoral sandpiper	3E-02	2.1	1E-02
spectacled eider	2E-04	0.8	2E-04
brown lemming	2E-02	8.0	3E-03
arctic fox	3E-04	2.0	1E-04
IRON			
Lapland longspur	8E-01	12.0	7E-02
brant	8E-02	3.4	2E-02
glaucous gull	1E-01	125.0	1E-03
pectoral sandpiper	8E-01	8.4	1E-01
spectacled eider	4E-03	3.3	1E-03
brown lemming	5E-01	42.0	1E-02
arctic fox	7E-03	9.0	8E-04
LEAD			
Lapland longspur	2E-01	6.0	4E-02
brant	3E-02	6.0	5E-03
glaucous gull	3E-02	12.0	3E-03
pectoral sandpiper	5E-01	6.0	9E-02
spectacled eider	1E-03	6.0	2E-04
brown lemming	8E-01	7.0	1E-01
arctic fox	4E-04	1.0	4E-04
MANGANESE			
Lapland longspur	5E-02	240.0	2E-04
brant	5E-03	67.0	8E-05
glaucous gull	9E-03	64.0	1E-04
pectoral sandpiper	6E-02	169.0	3E-04
spectacled eider	3E-04	66	4E-06

NC Not calculated because toxicity values were not available.

TABLE 3-23. RISK CHARACTERIZATION OF REPRESENTATIVE BIRD, MAMMAL, AND PROTECTED SPECIES AT THE BARTER ISLAND INSTALLATION (CONTINUED)

SPECIES	ESTIMATED DAILY DOSE mg/kg-bw/day	TRV mg/kg-bw/day	HAZARD QUOTIENT (HQ)
brown lemming	4E-02	780.0	5E-05
arctic fox	5E-04	170.0	3E-06
ZINC			
Lapland longspur	1E+01	14.0	1E+00
brant	1E+00	3.7	3E-01
glaucous gull	3E-01	3.6	7E-02
pectoral sandpiper	3E+00	9.5	3E-01
spectacled eider	2E-02	3.6	5E-03
brown lemming	5E+01	133.3	4E-01
arctic fox	1E-03	30.0	4E-05
DRPH			
Lapland longspur	8E+00	517.0	2E-02
brant	1E+00	140.0	9E-03
glaucous gull	1E+00	136.0	1E-02
pectoral sandpiper	2E+01	357.0	7E-02
spectacled eider	6E-02	139.0	4E-04
brown lemming	3E+01	284.0	1E-01
arctic fox	2E-02	63.0	3E-04
ETHYLBENZENE			
Lapland longspur	1E-02	NC	NC
brant	8E-04	NC	NC
glaucous gull	3E-04	NC	NC
pectoral sandpiper	3E-03	NC	NC
spectacled eider	2E-05	NC	NC
brown lemming	3E-02	210.0	2E-04
arctic fox	2E-06	47.0	4E-08
NAPHTHALENE			
Lapland longspur	1E-01	NC	NC
brant	1E-02	NC	NC

NC Not calculated because toxicity values were not available.

TABLE 3-23. RISK CHARACTERIZATION OF REPRESENTATIVE BIRD, MAMMAL, AND PROTECTED SPECIES AT THE BARTER ISLAND INSTALLATION (CONTINUED)

SPECIES	ESTIMATED DAILY DOSE mg/kg-bw/day	TRV mg/kg-bw/day	HAZARD QUOTIENT (HQ)
glaucous gull	4E-04	NC	NC
pectoral sandpiper	6E-02	NC	NC
spectacled eider	2E-04	NC	NC
brown lemming	4E-01	38.0	1E-02
arctic fox	3E-05	9.0	4E-06
PCBs			
Lapland longspur	1E-03	116.0	1E-05
brant	3E-04	32.0	1E-05
glaucous gull	5E-04	31.0	2E-05
pectoral sandpiper	8E-03	80.0	1E-04
spectacled eider	2E-05	31.0	6E-07
brown lemming	5E-03	3.0	2E-03
arctic fox	6E-06	0.6	1E-05
XYLENES			
Lapland longspur	1E-01	26.0	5E-03
brant	1E-02	7.2	1E-03
glaucous gull	3E-03	7.0	4E-04
pectoral sandpiper	3E-02	18.4	2E-03
spectacled eider	2E-04	7.1	3E-05
brown lemming	4E-01	165.0	3E-03
arctic fox	2E-05	37.0	4E-07

NC Not calculated because toxicity values were not available.

3.4.2 Potential Risks to Representative Species of Aquatic Organisms

Estimates of exposure for aquatic organisms are based on the average concentrations of each COC in surface water samples (Section 3.1). The TRVs for aquatic species are presented in Table 3-18. The HQs are calculated by dividing the estimated exposure concentration by the TRV. Table 3-22 presents the results of the risk characterization for aquatic organisms. The following paragraphs summarize the potential risks to aquatic organisms from each COC in surface water (DRPH, aluminum, iron, and manganese).

The HQs for aluminum in surface water were 3. These HQs indicate that a potential risk to aquatic organisms may exist from aluminum concentrations in surface water. Although these HQs indicate a potential risk to aquatic species, some qualifying factors should be considered. Aluminum was selected as a COC because it exceeded the action level concentration of 87 μg/L (Federal Ambient Water Quality Criteria). The concentration of aluminum used as the exposure estimate (318 μg/L) is within the range of the background concentrations (100 to 350 μg/L). In addition, aluminum was detected in only 5 of 10 samples. These facts, combined with the UFs used in establishing the TRV, suggest minimal risk to aquatic species from aluminum in surface waters.

Iron HQs are nine for the three aquatic organisms. Although these elevated HQs may indicate risk, it is not likely that the arctic char or nine-spined stickleback are found in the locations where iron concentrations are elevated (i.e., intermittent drainages). Also, the HQs are based on total iron concentrations. The risk to *Daphnia* spp. may be better represented by dissolved iron concentrations. The background concentrations for dissolved iron are from several DEW Line installations and range from 100 to 1,600 μg/L. The average concentration of dissolved iron in the Barter Island detected samples is 1,421 μg/L. Not only is the average dissolved iron concentration below the maximum background concentration at the DEW Line installations, iron is an essential nutrient and the uncertainties used in establishing the TRV value may overestimate the toxicity of iron. With these facts in mind, iron should be viewed as a non-significant risk to the aquatic organisms.

Manganese HQs range from three for *Daphnia* spp. to eight for the arctic char and the nine-spined stickleback. This indicates a potential risk to these species; however, some mitigating factors should be considered. The average manganese concentration at the Barter Island installation of 574 μg/L is only slightly greater than the maximum background concentration of 510 μg/L. These background concentrations approximate normal manganese concentrations in surface waters (USGS 1985). Therefore, it is likely the potential risk to aquatic species from manganese at the Barter Island installation is minimal.

The HQs for DRPH in surface water range from 0.7 to 3 (Table 3-22). The HQs for the fish species exposed to DRPH is 0.7. This indicates that DRPH do not pose potential risks to the arctic char and nine-spined stickleback. The DRPH HQ for *Daphnia* spp. is 3. This ratio indicates that *Daphnia* spp. may be at risk in surface water. However, given the uncertainties of the risk assessment and the TRV, and the presence of elevated levels of DRPH in only 8 of 28 samples, the likelihood of negative effects to entire *Daphnia* spp. populations is relatively low.

3.4.3 Potential Risks to Representative Species of Birds

The avian HQs for aluminum, iron, lead, manganese, DRPH, PCBs, and xylenes are below 1.0 for all species of birds evaluated, including the protected species (spectacled eider) (see Table 3-23). The HQ for zinc (1) indicates that the Lapland longspur may be at risk, however, the average concentration of 76 mg/kg is below the maximum background concentration. In addition, the essential nutrient status of zinc and the low magnitude of the HQ combine to mitigate risks to the Lapland longspur population.

Quantitative evaluations of ethylbenzene and naphthalene were not possible because avian toxicity studies for these COCs were not available. However, it is possible to compare avian and mammalian toxicity and make inferences concerning the potential risk to avian species when only mammalian data are available. A discussion of the relative toxicity of these chemicals provides a basis for making qualitative statements concerning their toxicity to avian species. Smith (1987) provides the following ranking of relative toxicities based on median lethal doses (LD_{50}s).

I. Extremely toxic (LD_{50} ≤40 mg/kg)
II. Highly toxic (LD_{50} 41-200 mg/kg)
III. Moderately toxic (LD_{50} 201-1,000 mg/kg)
IV. Slightly toxic (LD_{50} 1,001-5,000 mg/kg)
V. Relatively nontoxic (LD_{50} >5,000 mg/kg)

Table 3-24 shows the relative toxicity rankings of ethylbenzene and naphthalene, based on Smith (1987).

Using the relative toxicities of these COCs, the exposure estimates for avian and mammalian species, and the HQs that were calculated for mammalian species (see Table 3-23 for exposure estimates and HQs), it is possible to make inferences concerning the potential risk to avian species.

There is limited information available on the relative toxicologic sensitivities of birds compared to mammals. Based upon a review of the species and chemicals tested (Smith 1987; Hudson et al. 1979; Tucker and Leitzke 1979), it appears in general that avian and mammalian sensitivities (via oral exposure) fall within the same range, with birds being slightly more sensitive than mammals. There are, of course, exceptions to this general observation and for a number of chemicals mammals are more sensitive than birds. For cases where birds are more sensitive, most avian toxicity values fall well within one order of magnitude of the mammalian toxicity values.

As noted, avian toxicity values are not available for some COCs in this ERA. However, based on the information presented above, these chemicals are not expected to be significantly more toxic to birds than to mammals. Birds are not expected to be at risk given that there are no HQs for ethylbenzene or naphthalene above one for mammals, and the estimated exposures for birds are sufficiently lower than those for mammals to offset the possibility that some birds may be

TABLE 3-24. RELATIVE TOXICITY RANKINGS FOR COMPARISON OF MAMMALIAN AND AVIAN TOXICITY

COC	STUDY TYPE	DOSE mg/kg/day	RELATIVE TOXICITY
ethylbenzene	oral rat LD_{50}	5,460[a]	relatively non-toxic
naphthalene	oral rat LD_{50}	4,170[b]	slightly toxic

a Clayton and Clayton 1981.
b Sax and Lewis 1989.

more sensitive than mammals to these selected COCs. This qualitative discussion and the inter-taxa toxicity estimates introduce additional elements of uncertainty to the risk assessment. See Section 3.5, Uncertainty Analysis, for more discussion of this topic.

Overall, the risk to birds from exposure to COCs at the Barter Island installation is not estimated to significant.

3.4.4 Potential Risks to Representative Species of Mammals

HQs for the brown lemming and the arctic fox were less than one for all the COCs. As a result, no significant risks are expected to result from exposure to COCs by mammals at the Barter Island installation.

3.4.5 Potential Future Risks

Future ecological risks at the Barter Island installation were based on the assumption that all the gravel pads will remain in place. Future risks at the ten sites (with the exception of risks from PCB contamination at the Heated Storage site discussed in the risk estimate paragraph below) that have potentially suitable habitat for the representative species are expected to be as low as or lower than current risks because the exposure pathways are not likely to change, and the concentrations of COCs are likely to diminish over time. These sites include the Old Landfill (LF01), POL Catchment (LF03), Current Landfill (LF04), Contaminated Ditch (SD08), Old Runway Dump (LF12), Heated Storage (SS13), Garage (SS14), Fuel Tanks (ST18), Old Dump Site (LF19), and Bladder Diesel Spill (SS20).

The remaining four sites, the Weather Station Building (SS15), White Alice Facility (SS16), POL Tanks (ST17), and JP-4 Spill (SS21) were not included in the ERA because suitable habitats are not present at these sites under current conditions. Each of these sites is characterized by gravel pads and is generally devoid of vegetation and surface water. The lack of suitable habitat precludes complete exposure pathways. It is possible that pathways could exist in the future.

Two factors play key roles in determining the potential future risks at these sites: the revegetation of the gravel pads and the fate of the COCs over time.

Revegetation of gravel pads in arctic Alaska has been studied by Bishop and Chapin (1989a, 1989b) and the information that follows is based on their research. Revegetation is dependent on several factors, including the availability of water and mineral nutrients and the dispersal ability of the recolonizing species. The large particle size found in gravel pad soils contributes to reduced moisture retention (in an environment with only 10-20 cm annual precipitation) and low organic matter content that restricts germination of prospective colonizing seeds. If revegetation occurs as a result of natural processes, riparian species are the most likely to successfully colonize gravel pads. Typically, none of the predominant species in the wet or moist tundra habitats are responsible for natural revegetation on gravel pads. Riparian gravel bars are similar in physical composition to gravel pads and riparian areas are subject to frequent natural disturbance, resulting in a characteristic flora that has a higher proportion of pioneer species. Bishop and Chapin (1989b) found that at 16 gravel pads abandoned for 10 years, the average revegetative cover was 2.7 percent. Half these gravel pads were within 0.2 km of the Sagavanirktok River and its riparian habitat provided the seed sources for revegetation.

Based on the relatively low availability of riparian recolonizing seed sources near the Barter Island sites and the inherent low water and mineral nutrient availability at the gravel pads, the time required for revegetation to provide suitable habitat for the representative species at the sites is expected to be at least 20 years, with revegetation times of 50 to 100 years possible. During this time, any COCs present may undergo changes that affect the potential exposure and risk to representative species. These changes will vary with the nature of specific COC. The COCs at the four sites are DRPH, GRPH, VOCs and SVOCs characteristic of DRPH (e.g., toluene, isopropyltoluene, ethylbenzene, xylenes, naphthalene, 2-methylnaphthalene, and substituted benzenes), and PCBs.

DRPH and GRPH are complex mixtures of aliphatic and aromatic hydrocarbons with exposure potentials based on the environmental fate of individual components of the mixture. DRPH are hydrocarbon molecules with more carbon atoms than GRPH; therefore, DRPH is relatively less volatile than GRPH. Most GRPH will evaporate from soil, whereas DRPH will biodegrade in soil. For example, a single application of about 21, 14, or 13 g/kg soil of home heating oil No. 2 to outdoor plots consisting of silt loam, sandy loam and clay loam was degraded by 86, 90, and 86 percent, respectively, after one year (Raymond et al. 1975, 1976 in ATSDR 1993a).

Jet fuel (JP-4) is highly volatile, however, in soil volatilization accounted for 7 percent of the hydrocarbon loss compared with 93 percent for biodegradation (Coho 1990 in ATSDR 1993b). Soil type, temperature and jet fuel concentration affected biodegradation, but the half-life of JP-4 in clay at 27°C was shown to be 3.5 weeks (ATSDR 1993b).

PCBs, on the other hand, have very high chemical, thermal, and biological stability in addition to low vapor pressure (Manahan 1994). Conversion of highly substituted PCBs to molecules with one or two chlorines is done relatively slowly by anaerobic bacteria (Manahan 1994). Therefore, biodegradation may not be an effective process for reducing the PCB concentrations at White Alice Facility to be protective of the environment. In addition, PCBs have a high potential for bioaccumulation (see Section 3.2.7.1 and Table 3-6 for information on bioaccumulation), which may result in exposure to PCBs of ecological receptors in the trophic web.

Risk estimates for potential future exposures at these sites are presented below. The estimates are based on the revegetation information and changes that can be expected to occur to the COCs. The hydrocarbons and related volatile and semivolatile compounds (DRPH, GRPH, VOCs, and SVOCs) detected at the Weather Station Building, White Alice Facility, POL Tanks, and JP-4 Spill may undergo volatilization and biodegradation such that their concentrations over 20 to 50 years will diminish to levels that are not expected to present significant risk to ecological receptors. The 20 to 50-year time span is a conservative estimate of the time required for these sites to provide suitable habitat for representative species and for potential exposure pathways to develop. The potential future risk attributable to PCBs found at the White Alice Facility is estimated to be high at the S01, S06, S07, and 2S09 sample locations (see Figure 2-12 for the sample locations). The risk estimate is based on elevated concentrations of PCBs (exceeding action levels), which are unlikely to degrade and have a potential for bioaccumulation. The four sample locations are grouped together, adjacent to the concrete pad on which the transformer sits. PCBs are also found at the S01, S02, S03, S04 and SD01 sample locations at the Heated Storage site (SS13). Future risk that may be associated with the potential bioaccumulation of PCBs at these locations is estimated to be moderate.

3.5 ECOLOGICAL RISK ASSESSMENT UNCERTAINTY ANALYSIS

As with any risk assessment, there is great uncertainty associated with the estimates of ecological risk for the sites at the Barter Island installation. The risk estimates are based on a number of assumptions regarding exposure and toxicity. In general, the primary sources of uncertainty are the following:

- Environmental Sampling and Analysis;
- Selection of COC;
- Exposure Parameter Estimation; and
- Toxicological Data.

A complete understanding of the uncertainties associated with risk estimates is critical to placing the predicted risks in proper perspective. The most significant sources of uncertainty associated with the estimates of risk for the Barter Island installation sites are summarized in the following sections.

3.5.1 Environmental Sampling and Analysis

The principal source of uncertainty in the analytical data (for the ERA) stems from the sampling approach and the subsequent calculation of exposure concentrations. Sampling at the Barter Island installation was conducted in a systematic manner, designed to characterize localized contaminated areas or "hot spots". The site's potential source areas are, therefore, well characterized; however, there are limited data regarding the peripheral areas (areas to which ecological receptors are most likely to be exposed). In order to compensate for this non-random sampling methodology in the calculation of exposure concentrations, the exposure assessment used the average concentration of COCs.

The methods of calculating the average concentrations were the same for organic and inorganic data. In calculating the average concentration of chemicals at the site, non-detected chemicals were entered at one-half of the quantitation limit, as per EPA guidance (EPA 1989a). Sampling was designed to characterize "hot spots" at each of the sites. Therefore, the average concentrations of COCs tend to be biased high because sampling was generally concentrated in areas of the site where significant contamination exists or was suspected. The use of total metal concentrations in surface water to estimate risk is a conservative approach because dissolved metal concentrations are generally significantly less than total metal concentrations. Therefore, the average concentrations used to estimate exposure to metals in surface water may overestimate potential risk.

In addition, there is uncertainty inherent in using measurements of TPH (or DRPH, GRPH, and RRPH) for risk assessments. The analytical techniques are not specific to petroleum (i.e., they detect other organics, including naturally-occurring ones) (Von Burg 1993). Moreover, the toxicity of these groups of petroleum hydrocarbons is determined by the toxicity of their individual constituents. When petroleum compounds are released to the environment, they tend to weather or transform readily. For example, the lighter fractions (such as BTEX) will volatilize to the atmosphere more readily than the heavier fractions (such as decane, pyrene or benzo(a)pyrene). The lighter fractions are thought to be the more toxic (Wong et al. 1981; O'Brien 1978; Kauss and Hutchinson 1975; Soto et al. 1975). Therefore, the toxicity of DRPH, GRPH, and RRPH is expected to change over time, depending upon the attenuation mechanisms occurring in the environment. As a result, the toxicity of the petroleum hydrocarbons measured at the Barter Island installation is unknown. Use of toxicity values reported in the literature probably contributes to an overestimation of the risk, because it is likely that the most toxic components of the mixtures detected have volatilized to the atmosphere over time.

3.5.2 Selection of Chemicals for Evaluation

The selection of COCs in the ERA was based upon a comparison to background concentrations and action levels, and an evaluation of the frequency of detection. This provided a conservative screen of COCs; therefore, it is unlikely that any chemicals presenting an ecological risk were omitted.

3.5.3 Exposure Assessment

Exposures were estimated based on literature-based life history information for the selected representative species. There is moderate uncertainty associated with the exposure information. Food and water ingestion rates were not available for some animals and had to be estimated from regression equations. Incidental ingestion of soils and sediments may occur while animals are foraging in these media, and it is uncertain how much soil and/or sediment is actually ingested. There are significant uncertainties associated with the estimates of how extensively a receptor will use the site, which were based on home range information and site-specific considerations of habitat quality. As noted in the discussion of Estimation of Percent Ingested

Onsite, Section 3.2.7.2, the conversion of population density values as substitutes for home ranges adds uncertainty to the risk assessment. The conversion was necessary because home range data is lacking for some of the representative species. In addition, there is uncertainty associated with the habitat suitability determinations. These determinations were made using installation and site maps and photographs taken on the ground by the sampling team. The final determination of habitat suitability was based on the professional judgement of a wildlife biologist.

There is some uncertainty associated with the diet compositions estimated from information obtained from the literature. A good example of this type of uncertainty is the unpredictable fluctuation in the populations of the brown lemmings and their predators (i.e., arctic fox, glaucous gull). As the numbers of prey increase, predator populations may experience numerical and density increases well beyond the values reported in the literature. When prey populations decrease, predation pressure can shift to diet items that are not considered "normal", and do not represent dietary intakes reported in the literature. Wildlife, and their interactions with the environment around them, are dynamic. Stochastic events, natural or anthropogenic, may cause behavior and/or habits to differ markedly from the "expected or norm". Deviations from typical behavior cause uncertainty when evaluating wildlife and ecosystems.

There is some uncertainty associated with exposure estimates for plants. Plant uptake of COC was derived from a regression equation using the K_{ow} of the COC (Table 3-6). This calculation estimates the concentration of chemicals in the vegetative portion of plants. Actual concentrations of the COC in plant tissue will vary depending upon actual chemical uptake, species of plant, and other site-specific factors (such as soil organic carbon). It is important to note that maximum acceptable tissue concentrations in plants were not available for comparison with these estimated concentrations. As a result, it is uncertain whether the estimates are phytotoxic. However, the overall effect of this source of uncertainty in the risk assessment is low as is the ecological risk to plants.

3.5.4 Toxicological Data

One of the largest sources of uncertainty in risk assessment is from the toxicological data. Often there are not relevant studies for the specific representative species or endpoints. As a result, extrapolations are made, which introduce uncertainty into the risk estimate. These extrapolations incorporate UFs into the calculation of TRVs. The purpose of the UFs is to incorporate some margin of error into the risk estimate, in order to arrive at a "safe" level of exposure to which onsite exposure concentrations may be compared. These techniques introduce into the risk assessment a tendency to overestimate rather than underestimate the risk, as conservative estimates were made in estimating toxicity values.

Toxicity values for plants, water, soils and sediments are based on literature values. Toxicity in soils and sediments is affected by the bioavailability of a given chemical. Toxicity of metals in water is based, in part, upon the speciation of the element. As a result, site-specific bioavailability or toxicity may differ from that in the studies used to estimate potential toxic effects. Therefore, actual toxicity of chemicals at the Barter Island installation may be different from the values reported in the literature. In addition, the sensitivity of receptors on site may be different from the sensitivity of the species reported in the literature. This contributes to the overall uncertainty of the risk assessment.

There is also a great deal of uncertainty in assessing the toxicity of a mixture of chemicals. In this ERA, the effects of exposure from each contaminant have been considered separately. However, these substances occur together at the site and organisms may be exposed to mixtures of the chemicals. Prediction of how these mixtures of toxicants will interact must be based on an understanding of the mechanisms of such interactions. The interactions of the individual components of chemical mixtures may occur during absorption, distribution, metabolism, excretion, or activity at the receptor site. Individual compounds may interact chemically, yielding a new toxic component or causing a change in the biological availability of an existing component, or may interact by causing different effects at different receptor sites. Suitable data are not currently available to characterize rigorously the effects of chemical mixtures, so chemicals present at the site were evaluated independently. This approach of assessing risk associated with mixtures of chemicals does not account for any additive, synergistic or antagonistic interactions among the chemicals considered. However, as discussed in Section 3.6, the risk assessment yielded a low potential for ecological risks and it is unlikely that additive effects of chemicals are a concern.

3.6 SUMMARY OF ECOLOGICAL RISK

The potential risks to ecological receptors are summarized in this section based on the information presented in Sections 3.1 through 3.5. The reader is referred to these sections for more details on the assessment. Conclusions regarding potential risks must be viewed in the context of the uncertainties associated with the assessment and the available risk information. The available risk information includes chemical data, exposure estimates, and literature-based toxicity information.

Table 3-25 presents a summary of the ecological risks at the Barter Island installation. The table includes COCs contributing to risk (if any), the current risk potential, and an estimate of future risk potential for each of the sites.

3.6.1 Potential Risks to Representative Plants

A qualitative comparison was made of site soil/sediment chemical concentrations and plant toxicity information. The risk to plants is characterized by using comparative information from the literature and BCF (B_v).

The spacial distribution of the contaminants at Barter Island is very uneven. The locations that have elevated concentrations of potential contaminants are few and spatially distinct. In addition, during the RI field activities, no stressed vegetation was observed and Alaska cotton grass (*Eriophorum* species) was flourishing in heavily contaminated areas of the POL Catchment, site LF03. Based on visual observations and the ecological assessment, risks to plants are not significant.

TABLE 3-25. SUMMARY OF ECOLOGICAL RISK ESTIMATES AT THE BARTER ISLAND DEW LINE INSTALLATION

SITE	COC CONTRIBUTING TO RISK	CURRENT RISK POTENTIAL	FUTURE RISK POTENTIAL
Old Landfill (LF01)	none	not significant	not likely
POL Catchment (LF03)	none	not significant	not likely
Current Landfill (LF04)	none	not significant	not likely
Contaminated Ditch (SD08)	none	not significant	not likely
Old Runway Dump (LF12)	none	not significant	not likely
Heated Storage (SS13)	Aroclor 1254 (future)	not significant	potential to increase over current estimate*
Garage (SS14)	none	not significant	not likely
Weather Station Building (SS15)	site not evaluated for ecological risk **		
White Alice Facility (SS16)	site not evaluated for ecological risk **		PCBs may contribute to future risk*
POL Tanks (ST17)	site not evaluated for ecological risk **		
Fuel Tanks (ST18)	none	not significant	not likely
Old Dump Site (LF19)	none	not significant	not likely
Bladder Diesel Spill (SS20)	none	not significant	not likely
JP-4 Spill (SS21)	site not evaluated for ecological risk **		

* Current risk estimate is not significant, but this may change due to potential bioaccumulation of PCBs in the future.

** The site is not likely to be used by ecological receptors because the areal extent of contamination is relatively small and suitable habitat is not currently present at the site. Thus, the site was not evaluated in the ERA.

3.6.2 Potential Risks to Representative Aquatic Species

Potential risks to aquatic species were evaluated by comparing toxicity information from the literature with the average exposure concentrations of potential contaminants in surface water. HQs for aquatic organisms indicate that risks may exist from aluminum, iron, manganese, and DRPH (*Daphnia* spp. only). In the case of the metals, the average concentrations that were used as estimated exposure point concentrations were near, or in some cases within, the ranges of the background concentrations compiled from studies done at seven DEW Line installations. It is possible that the metals detected are representative of elevated natural background concentrations rather than a result of any activities at the Barter Island installation.

In addition, the potential risks to aquatic species was based on total metal concentrations, although it is likely that any adverse effects are the result of dissolved concentrations. Dissolved metal concentrations for aluminum, iron, and manganese were significantly lower than total concentrations, thus mitigating the HQ-based risk estimates. [See Current Landfill (LF04), sample SW01, Appendix D, Page D-32, and Contaminated Ditch (SD08), sample SW01, Appendix D, page D-40.]

The DRPH HQ for *Daphnia* spp. is 1. This indicates that risk may exist, but the small number of locations that are contaminated indicates that the risk to the aquatic ecosystem is low.

3.6.3 Potential Risks to Representative Species of Birds and Mammals

The risks to representative species of birds and mammals were evaluated using the Quotient Method. This method compares the estimated COC exposures to the TRVs. The resulting HQs may indicate that risk to birds and mammals is present if the HQ is equal to, or greater than, one. The only HQ equal to, or greater than one, was the zinc HQ for the Lapland longspur, with a value of one. Considering the uncertainties in the risk assessment, the essential nutrient status of zinc, and the unlikely event that the Lapland longspur would be repeatedly exposed to sediments at one location, the risk to the longspur population is minimal. Based on the results of the assessment, risks to bird and mammal populations are not expected to be at risk from exposure to COCs at the Barter Island DEW Line installation.

3.6.4 Potential Ecological Risks

The objective of this ERA is to evaluate the potential risk to the representative species at the sites at the Barter Island DEW Line installation. This assessment indicates that, although there are a few instances of minimal potential risk to individual species, overall the potential risks presented by the COCs are very low.

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APPENDIX A

RISK CHARACTERIZATION SPREADSHEETS

TABLE A-1. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Water Ingestions
Endpoint: Noncancer
Assumptions: Site-specific
Installation: Barter Island
Site: Old Landfill (LF01)
File: LF01WANC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Water Ingestion	(L/day)	2	2	NA
Exposure Frequency	(days/year)	180	180	NA
Exposure Duration	(years)	10	55	NA
Conversion Factor	(kg/kg)	1	1	NA
Body Weight	(kg)	70	70	NA
Averaging Time	(days)	3,650	20,075	NA

Chemical	Oral RfD	Concentration Water (mg/L)	ADD by Receptor Group (mg/kg-day)			Hazard Quotient		
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult	Native Northern Child
Manganese	0.005	1.5	2.11e-02	2.11e-02	NA	4.23e+00	4.23e+00	NA
					HAZARD INDEX	4.227	4.227	NA

TABLE A-2. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestions
Endpoint: Noncancer
Assumptions: Site-specific
Installation: Barter Island
Site: POL Catchment (LF03)
File: LF03SONC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	30	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(days)	3,650	17,885	2,190

Chemical	Oral RfD	Concentration Soil (mg/kg)	ADD by Receptor Group (mg/kg-day)			Hazard Quotients	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
DRPH	0.08	28,600	1.68e-03	3.36e-03	3.13e-02	2.10e-02	4.34e-01
Tetrachloro-ethene	0.01	5.42	3.18e-07	6.36e-07	5.94e-06	3.18e-05	6.58e-04
					HAZARD INDEX	0.021	0.434

TABLE A-3. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestions
Endpoint: Cancer
Assumptions: Site-specific
Installation: Barter Island
Site: POL Catchment (LF03)
File: LF03SOCA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	30	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(days)	25,550	25,550	25,550

Chemical	Carcinogen Oral Slope Factor	Concentration Soil (mg/kg)	LADD by Receptor Group (mg/kg-day)			Cancer Risk	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
Tetrachloro-ethene	0.052	5.42	4.55e-08	4.45e-07	5.09e-07	2.36e-09	4.96e-08
					CANCER RISK	2e-09	5e-08

TABLE A-4. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Water Ingestions
Endpoint: Noncancer
Assumptions: Site-specific
Installation: Barter Island
Site: POL Catchment (LF03)
File: LF03WANC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Water Ingestion	(L/day)	2	2	NA
Exposure Frequency	(days/year)	180	180	NA
Exposure Duration	(years)	10	55	NA
Conversion Factor	(kg/mg)	1	1	NA
Body Weight	(kg)	70	70	NA
Averaging Time	(days)	3,650	20,075	NA

Chemical	Oral RfD	Concentration Water (mg/L)	ADD by Receptor Group (mg/k-day)			Hazard Quotient		
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult	Native Northern Child
DRPH	0.08	1.77	2.49e-02	2.49e-02	NA	3.12e-01	3.12e-01	NA
GRPH	0.2	0.367	5.17e-03	5.17e-03	NA	2.59e-02	2.59e-02	NA
					HAZARD INDEX	0.338	0.338	NA

TABLE A-5. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Water Ingestions
Endpoint: Cancer
Assumptions: Site-specific
Installation: Barter Island
Site: POL Catchment (LF03)
File: LF03WACA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Water Ingestion	(L/day)	2	2	NA
Exposure Frequency	(days/year)	180	180	NA
Exposure Duration	(years)	10	55	NA
Conversion Factor	(kg/mg)	1	1	NA
Body Weight	(kg)	70	70	NA
Averaging Time	(days)	25,550	20,075	NA

Chemical	Carcinogen Oral Slope Factor	Concentration Water (mg/L)	LADD by Receptor Group (mg/k-day)			Cancer Risk		
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult	Native Northern Child
GRPH	0.0017	0.367	7.39e-04	5.17e-03	NA	1.26e-06	8.79e-06	NA
Benzene	0.029	0.0027	5.43e-06	3.80e-05	NA	1.58e-07	1.10e-06	NA
					CANCER RISK	1e-06	1e-05	NA

TABLE A-6. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Water Ingestions
Endpoint: Noncancer
Assumptions: Site-specific
Installation: Barter Island
Site: Current Landfill (LF04)
File: LF04WANC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Water Ingestion	(L/day)	2	2	NA
Exposure Frequency	(days/year)	180	180	NA
Exposure Duration	(years)	10	55	NA
Conversion Factor	(kg/mg)	1	1	NA
Body Weight	(kg)	70	70	NA
Averaging Time	(days)	3,650	20,075	NA

			ADD by Receptor Group (mg/k-day)			Hazard Quotient		
Chemical	Oral RfD	Concentration Water (mg/L)	DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult	Native Northern Child
Manganese	0.005	1.8	2.54e-02	2.54e-02	NA	5.07e+00	5.07e+00	NA
					HAZARD INDEX	5.072	5.072	NA

TABLE A-7. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Water Ingestions
Endpoint: Cancer
Assumptions: Site-specific
Installation: Barter Island
Site: Current Landfill (LF04)
File: LF04WACA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Water Ingestion	(L/day)	2	2	NA
Exposure Frequency	(days/year)	180	180	NA
Exposure Duration	(years)	10	55	NA
Conversion Factor	(kg/mg)	1	1	NA
Body Weight	(kg)	70	70	NA
Averaging Time	(days)	25,550	20,075	NA

			LADD by Receptor Group (mg/k-day)			Cancer Risk		
Chemical	Carcinogen Oral Slope Factor	Concentration Water (mg/L)	DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult	Native Northern Child
Trichloro-ethene	0.011	0.036	7.25e-05	5.07e-04	NA	7.97e-07	5.58e-06	NA
					CANCER RISK	8e-07	6e-06	NA

TABLE A-8. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestions
Endpoint: Noncancer
Assumptions: Site-specific
Installation: Barter Island
Site: Contaminated Ditch (SD08)
File: SD08SONC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	30	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(days)	3,650	17,885	2,190

			ADD by Receptor Group (mg/kg-day)			Hazard Quotients	
Chemical	Oral RfD	Concentration Soil (mg/kg)	DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
DRPH	0.08	2,260	1.33e-04	2.65e-04	2.48e-03	1.66e-03	3.43e-02
GRPH	0.2	171	1.00e-05	2.01e-05	1.87e-04	5.02e-05	1.04e-03
Beryllium	0.005	3.2	1.88e-07	3.76e-07	3.51e-06	3.76e-05	7.77e-04
					HAZARD INDEX	0.002	0.036

TABLE A-9. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestions
Endpoint: Cancer
Assumptions: Site-specific
Installation: Barter Island
Site: Contaminated Ditch (SD08)
File: SD08SOCA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	30	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(days)	25,550	25,550	25,550

Chemical	Carcinogen Oral Slope Factor	Concentration Soil (mg/kg)	LADD by Receptor Group (mg/kg-day)			Cancer Risk	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
GRPH	0.0017	171	1.43e-06	1.41e-05	1.61e-05	2.44e-09	5.12e-08
Beryllium	4.3	3.2	2.68e-08	2.63e-07	3.01e-07	1.15e-07	2.42e-06
					CANCER RISK	1e-07	2e-06

TABLE A-10. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestions
Endpoint: Noncancer
Assumptions: Site-specific
Installation: Barter Island
Site: Heated Storage (SS13)
File: SS13SONC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	30	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(days)	3,650	17,885	2,190

			ADD by Receptor Group (mg/kg-day)			Hazard Quotients	
Chemical	Oral RfD	Concentration Soil (mg/kg)	DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
DRPH	0.08	3,580	2.10e-04	4.20e-04	3.92e-03	2.63e-03	5.43e-02
GRPH	0.2	423	2.48e-05	4.97e-05	4.64e-04	1.24e-04	2.57e-03
RRPH	0.08	2400	1.41e-04	2.82e-04	2.63e-03	1.76e-03	3.64e-02
Aroclor 1254	0.00002	2.72	1.60e-07	3.19e-07	2.98e-06	7.98e-03	1.65e-01
					HAZARD INDEX	0.012	0.258

TABLE A-11. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestions
Endpoint: Cancer
Assumptions: Site-specific
Installation: Barter Island
Site: Heated Storage (SS13)
File: SS13SOCA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	30	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(days)	25,550	25,550	25,550

Chemical	Carcinogen Oral Slope Factor	Concentration Soil (mg/kg)	LADD by Receptor Group (mg/kg-day)			Cancer Risk	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
GRPH	0.0017	423	3.55e-06	3.48e-05	3.97e-05	6.03e-09	1.27e-07
PCBs	7.7	2.72	2.28e-08	2.24e-07	2.55e-07	1.76e-07	3.69e-06
					CANCER RISK	2e-07	4e-06

TABLE A-12. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Water Ingestions
Endpoint: Noncancer
Assumptions: Site-specific
Installation: Barter Island
Site: Heated Storage (SS13)
File: SS13WANC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Water Ingestion	(L/day)	2	2	NA
Exposure Frequency	(days/year)	180	180	NA
Exposure Duration	(years)	10	55	NA
Conversion Factor	(kg/mg)	1	1	NA
Body Weight	(kg)	70	70	NA
Averaging Time	(days)	3,650	20,075	NA

			ADD by Receptor Group (mg/k-day)			Hazard Quotient		
Chemical	Oral RfD	Concentration Water (mg/L)	DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult	Native Northern Child
DRPH	0.08	5.76	8.12e-02	8.12e-02	NA	1.01e+00	1.01e+00	NA
Tetrachloro-ethene	0.01	0.012	1.69e-04	1.69e-04	NA	1.69e-02	1.69e-02	NA
Manganese	0.005	0.54	7.61e-03	7.61e-03	NA	1.52e+00	1.52e+00	NA
					HAZARD RISK	2.55	2.55	NA

TABLE A-13. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Water Ingestions
Endpoint: Cancer
Assumptions: Site-specific
Installation: Barter Island
Site: Heated Storage (SS13)
File: SS13WACA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Water Ingestion	(L/day)	2	2	NA
Exposure Frequency	(days/year)	180	180	NA
Exposure Duration	(years)	10	55	NA
Conversion Factor	(kg/mg)	1	1	NA
Body Weight	(kg)	70	70	NA
Averaging Time	(days)	25,550	20,075	NA

Chemical	Carcinogen Oral Slope Factor	Concentration Water (mg/L)	LADD by Receptor Group (mg/k-day)			Cancer Risk		
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult	Native Northern Child
Benzene	0.029	0.0069	1.39e-05	9.72e-05	NA	4.03e-07	2.82e-06	NA
Tetrachloro-ethene	0.052	0.012	2.42e-05	1.69e-04	NA	1.26e-06	8.79e-06	NA
					CANCER RISK	2e-06	1e-05	NA

TABLE A-14. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestions
Endpoint: Noncancer
Assumptions: Site-specific
Installation: Barter Island
Site: Garage (SS14)
File: SS14SONC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	30	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(days)	3,650	17,885	2,190

			ADD by Receptor Group (mg/kg-day)			Hazard Quotients	
Chemical	Oral RfD	Concentration Soil (mg/kg)	DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
DRPH	0.08	12,400	7.28e-04	1.46e-03	1.36e-03	9.10e-03	1.88e-01
RRPH	0.08	27,000	1.59e-03	3.17e-03	2.96e-02	1.98e-02	4.09e-01
GRPH	0.2	700	4.11e-05	8.22e-05	7.67e-04	2.05e-04	4.25e-03
bis-(2ethylhexyl) phthalate	0.02	4.6	2.70e-07	5.40e-07	5.04e-06	1.35e-05	2.79e-04
					HAZARD INDEX	0.029	0.602

TABLE A-15. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestions
Endpoint: Cancer
Assumptions: Site-specific
Installation: Barter Island
Site: Garage (SS14)
File: SS14SOCA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	30	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(days)	25,550	25,550	25,550

Chemical	Carcinogen Oral Slope Factor	Concentration Soil (mg/kg)	LADD by Receptor Group (mg/kg-day)			Cancer Risk	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
GRPH	0.0017	700	5.87e-06	5.75e-05	6.58e-05	9.98e-09	2.10e-07
Benzene	0.029	1.4	1.17e-08	1.15e-07	1.32e-07	3.41e-10	7.15e-09
bis(2-ethylhexyl) phthalate	0.014	4.6	3.86e-08	3.78e-07	4.32e-07	5.40e-10	1.13e-08
					CANCER RISK	1e-08	2e-07

TABLE A-16. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestions
Endpoint: Noncancer
Assumptions: Site-specific
Installation: Barter Island
Site: Weather Station Building (SS15)
File: SS15SONC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	30	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(days)	3,650	17,885	2,190

			ADD by Receptor Group (mg/kg-day)			Hazard Quotients	
Chemical	Oral RfD	Concentration Soil (mg/kg)	DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
DRPH	0.08	8,420	4.94e-04	9.89e-04	9.23e-03	6.18e-03	1.28e-01
GRPH	0.2	1,020	5.99e-05	1.20e-04	1.12e-03	2.99e-04	6.19e-03
					HAZARD INDEX	0.006	0.134

TABLE A-17. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestions
Endpoint: Cancer
Assumptions: Site-specific
Installation: Barter Island
Site: Weather Station Building (SS15)
File: SS15SOCA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	30	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(days)	25,550	25,550	25,550

Chemical	Carcinogen Oral Slope Factor	Concentration Soil (mg/kg)	LADD by Receptor Group (mg/kg-day)			Cancer Risk	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
GRPH	0.0017	1,020	8.55e-06	8.38e-05	9.58e-05	1.45e-08	3.05e-07
					CANCER RISK	1e-08	3e-07

TABLE A-18. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestions
Endpoint: Noncancer
Assumptions: Site-specific
Installation: Barter Island
Site: White Alice Facility (SS16)
File: SS16SONC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	30	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(days)	3,650	17,885	2,190

Chemical	Oral RfD	Concentration Soil (mg/kg)	ADD by Receptor Group (mg/kg-day)			Hazard Quotients	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
Aroclor 1254	0.00002	52	3.05e-06	6.11e-06	5.70e-05	1.53e-01	3.15e+00
					HAZARD INDEX	0.153	3.155

TABLE A-19. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestions
Endpoint: Cancer
Assumptions: Site-specific
Installation: Barter Island
Site: White Alice Facility (SS16)
File: SS16SOCA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	30	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(days)	25,550	25,550	25,550

Chemical	Carcinogen Oral Slope Factor	Concentration Soil (mg/kg)	LADD by Receptor Group (mg/kg-day)			Cancer Risk	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
PCB	7.7	52	4.36e-07	4.27e-06	4.88e-06	3.36e-06	7.05e-05
					CANCER RISK	3e-06	7e-05

TABLE A-20. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestions
Endpoint: Noncancer
Assumptions: Site-specific
Installation: Barter Island
Site: POL Tanks (ST17)
File: ST17SONC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	30	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(days)	3,650	17,885	2,190

Chemical	Oral RfD	Concentration Soil (mg/kg)	ADD by Receptor Group (mg/kg-day)			Hazard Quotients	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
DRPH	0.08	1,670	9.80e-05	1.96e-04	1.83e-03	1.23e-03	2.53e-02
GRPH	0.2	295	1.73e-05	3.46e-05	3.23e-04	8.66e-05	1.79e-03
					HAZARD INDEX	0.001	0.027

TABLE A-21. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestions
Endpoint: Cancer
Assumptions: Site-specific
Installation: Barter Island
Site: POL Tanks (ST17)
File: ST17SOCA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	30	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(days)	25,550	25,550	25,550

Chemical	Carcinogen Oral Slope Factor	Concentration Soil (mg/kg)	LADD by Receptor Group (mg/kg-day)			Cancer Risk	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
GRPH	0.0017	295	2.47e-06	2.42e-05	2.77e-05	4.21e-09	8.83e-08
					CANCER RISK	4e-09	9e-08

TABLE A-22. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route:	Soil Ingestions
Endpoint:	Noncancer
Assumptions:	Site-specific
Installation:	Barter Island
Site:	Old Dump Site (LF19)
File:	LF19SONC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	30	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(days)	3,650	17,885	2,190

Chemical	Oral RfD	Concentration Soil (mg/kg)	ADD by Receptor Group (mg/kg-day)			Hazard Quotients	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
RRPH	0.08	5,800	3.41e-04	6.81e-04	3.36e-03	4.26e-03	8.80e-02
DRPH	0.08	580	3.41e-05	6.81e-05	6.36e-04	4.26e-04	8.80e-03
					HAZARD INDEX	0.005	0.097

TABLE A-23. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestions
Endpoint: Noncancer
Assumptions: Site-specific
Installation: Barter Island
Site: JP-4 Spill (SS21)
File: SS21SONC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	30	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(days)	3,650	17,885	2,190

Chemical	Oral RfD	Concentration Soil (mg/kg)	ADD by Receptor Group (mg/kg-day)			Hazard Quotients	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
DRPH	0.08	1,300	7.63e-05	1.53e-04	1.42e-03	9.54e-04	1.97e-02
GRPH	0.2	300	1.76e-05	3.52e-05	3.29e-04	8.81e-05	1.82e-03
					HAZARD INDEX	0.001	0.022

TABLE A-24. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestions
Endpoint: Cancer
Assumptions: Site-specific
Installation: Barter Island
Site: JP-4 Spill (SS21)
File: SS21SOCA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	30	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(days)	25,550	25,550	25,550

			LADD by Receptor Group (mg/kg-day)			Cancer Risk	
Chemical	Carcinogen Oral Slope Factor	Concentration Soil (mg/kg)	DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
GRPH	0.0017	300	2.52e-06	2.47e-05	2.82e-05	4.28e-09	8.98e-08
Benzene	0.029	3.9	3.27e-08	3.21e-07	3.66e-07	9.49e-10	1.99e-08
					CANCER RISK	5e-09	1e-07

APPENDIX B

TOXICITY PROFILES

BENZENE

Benzene is readily absorbed following oral and inhalation exposure (EPA 1985). The toxic effects of benzene in humans and other animals following exposure by inhalation include central nervous system effects, hematological effects, and immune system depression. In humans, acute exposures to high concentrations of benzene vapors have been associated with dizziness, nausea, vomiting, headache, drowsiness, narcosis, coma, and death (NAS 1976). Chronic exposure (at least 20 years of worker exposure) to benzene vapors [1 to 100 ppm 8-hour time-weighted-average (TWA)] can produce reduced leukocyte, platelet, and red blood cell counts (EPA 1993). Benzene induced tumors of the zymbal gland, oral cavity, leukemia and lymphoma in rodents chronically exposed by gavage to doses in the range of 25 to 500 mg/kg/day (Huff et al. 1989; NTP 1986; Maltoni et al. 1989). Many studies have also described a causal relationship between exposure to benzene by inhalation (either alone or in combination with other chemicals) and leukemia in humans (IARC 1982; Rinsky et al. 1981; Ott et al. 1978; Wong et al. 1983).

Applying EPA's criteria for evaluating the overall evidence of carcinogenicity to humans, benzene is classified in Group A (Human Carcinogen) based on adequate evidence of carcinogenicity from epidemiological studies. EPA (1993) derived an oral cancer slope factor of 2.9×10^{-2} $(mg/kg/day)^{-1}$ and an inhalation unit risk of 8.3×10^{-6} $(ug/m^3)^{-1}$ for benzene. These values were based on several studies in which increased incidence of nonlymphocytic leukemia were observed in humans occupationally exposed to benzene principally by inhalation (Rinsky et al. 1981; Ott et al. 1978; Wong et al. 1983). Equal weight was given to cumulative dose and weighted cumulative dose as well as to relative and absolute risk model forms (EPA 1993). EPA (1993) is currently reviewing both oral and inhalation RfDs for benzene, for which the status is pending.

The National Research Council's Committee on Toxicology has set a one-hour Emergency Exposure Guidance Level (EEGL), for benzene at 50 ppm (200 mg/m^3) (NRC 1986). Formerly known as just EEL, the EEGL is defined as a ceiling limit for an unpredicted single exposure lasting one to 24 hours whose occurrence is expected to be rare in the lifetime of any person. It is designed to avoid substantial decrements in performance during emergencies and takes into account the statistical likelihood of a non-incapacitative, reversible effect in exposed populations (NRC 1986). A health criterion for acute inhalation exposure to benzene of 20 mg/m^3 can be derived from the EEGL by combining it with a safety factor of 10 to account for the healthy worker effect which assumes employed persons are generally healthier than the general population.

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BIS(2-ETHYLHEXYL)PHTHALATE

Bis(2-ethylhexyl)phthalate, also known as di-ethylhexyl phthalate (DEHP), is readily absorbed following oral or inhalation exposure (EPA 1980). Acute oral exposure (600 - 2,000 mg/kg/day DEHP) of rodents, guinea pigs and monkeys has resulted in adverse effects to the liver and kidney (weight changes and enzyme induction, respectively) (ATSDR 1991). Chronic exposure to relatively high concentrations (200 mg/kg/day) of DEHP in the diet can cause retardation of growth and increased liver and kidney weights in laboratory animals (NTP 1982; EPA 1980; Carpenter et al. 1953). Cellular effects on the liver were noted in rats at doses as low as 10 to 50 mg/kg/day DEHP (Ganning et al. 1989; Mitchell et al. 1985; Short et al. 1987) while dogs receiving doses of 59 mg/kg/day DEHP for one year had no observed changes in liver weight or structure (Carpenter et al. 1953; ATSDR 1991). Single oral doses of 4,882 and 9,756 mg/kg DEHP administered to pregnant rats on day 12 of gestation caused a dose-related increase in dead and resorbed fetuses and a number of malformations in the survivors (Ritter et al. 1989). DEHP is lipophilic and has the potential to be transported in maternal milk and thus have an impact on postnatal development (ATSDR 1991). Studies in rodents exposed to doses in the range of 200 to 2,800 mg/kg/day DEHP indicate that the testes are a primary target tissue resulting in increased testicular weights, tubular atrophy, decreased male fertility and abnormal sperm (ATSDR 1991). Several chronic feeding studies in rodents indicate that lifetime exposure to 300 to 1,000 mg/kg/day DEHP can cause liver tumors in rats and mice (Kluwe et al. 1982; Rao et al. 1987, 1990).

EPA (1993a) classified DEHP in Group B2--Probable Human Carcinogen. EPA (1993) calculated an oral cancer slope factor for DEHP of 1.4×10^{-2} $(mg/kg/day)^{-1}$ based on data from the NTP (1982) study in which liver tumors were noted in mice. EPA recommended an oral reference dose (RfD) for DEHP of 2×10^{-2} mg/kg/day for both chronic (EPA 1993a) and subchronic (EPA 1993b) exposures based on a study by Carpenter et al. (1953) in which increased liver weight was observed in female guinea pigs exposed to 19 mg/kg bw/day in the diet for one year; an uncertainty factor of 1,000 was used to develop both RfDs.

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BERYLLIUM

Beryllium is not readily absorbed by any route of exposure. Occupational exposure to beryllium results in bone, liver, and kidney depositions (EPA 1986). In humans, acute respiratory effects due to beryllium exposure include rhinitis, pharyngitis, tracheobronchitis, and acute pneumonitis. Dermal exposure to soluble beryllium compounds can cause contact dermatitis, ulceration, and granulomas (Hammond and Beliles 1980). Ocular effects include conjunctivitis and corneal ulceration from splash burns. The most common clinical symptom caused by chronic beryllium exposure is granulomatous lung inflammation (IARC 1980; EPA 1986). Chronic skin lesions sometimes appear after a long latent period in conjunction with the pulmonary effects. Systemic effects from beryllium exposure may include right heart enlargement with accompanying cardiac failure, liver and spleen enlargement, cyanosis, digital clubbing, and kidney stone development (EPA 1986; Schroeder and Mitchner 1975). Beryllium has been shown to be carcinogenic in experimental animals resulting primarily in lung and/or bone tumors when given by injection, intratracheal administration, or inhalation (EPA 1986). Following lifetime exposure in drinking water, slight increases in the incidence of gross tumors of all sites combined were observed in rats (Schroeder and Mitchner 1975). Several epidemiological studies have suggested that occupational exposure to beryllium may result in an increased lung cancer risk although the data are inconclusive (EPA 1986; Wagoner et al. 1980).

EPA (1993a) classified beryllium in Group B2--(Probable Human Carcinogen) based on increased incidences of lung cancer and osteosarcomas in animals. EPA (1993) calculated an inhalation cancer unit risk of 2.4×10^{-3} $(ug/m^3)^{-1}$ based on the relative risk for lung cancer, estimated from an epidemiological study by Wagoner et al. (1980). EPA (1993) established an oral cancer slope factor of 4.3 $(mg/kg/day)^{-1}$ based on the induction of gross tumors (all sites combined) in rats chronically administered beryllium sulfate in their drinking water (Schroeder and Mitchner 1975). EPA (1993) also developed an oral reference dose (RfD) for beryllium of 5×10^{-3} mg/kg/day based on a study by Schroeder and Mitchner (1975) in which rats exposed to 0.54 mg/kg/day beryllium sulfate (the highest dose tested) in drinking water for a lifetime did not exhibit adverse effects. An uncertainty factor of 100 was used to develop the RfD.

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DIESEL FUEL (DRPH)

GENERAL DATA

Petroleum fuels are classified into light, middle and heavy distillate fuels. Gasoline is a typical light distillate fuel while diesel fuel is considered to be a middle distillate material obtained from the distillation of crude oil. Included in this category of middle distillate fuels are jet fuel, kerosene and #2 fuel oils. As a result, many of the ecological and toxicological effects of these materials are very similar.

The chemical composition of diesel fuel is extremely variable and depends upon the crude oil source, types of processing and refining, blending and additives employed. These fuels are formulated to meet physical characteristics and not a specific chemical composition. Viscosity and volatility are the principal determinants of the fuel specifications. Diesel #1 is primarily a kerosene type of fuel and produced mainly from straight run middle distillates. Diesel #2 also contains straight run middle distillate but is also blended with straight run kerosene, straight run gas oils, light vacuum distillate and light thermally and/or catalytically cracked streams (IARC 1989).

As with other petroleum derived fuels, the chemical composition of diesel fuels consists of paraffins, olefins, cycloparaffins, isoparaffins and aromatics as well as additives. Additives can include amyl nitrates and alcohols, n-hexyl nitrate and octyl nitrate at levels of 0.1 to 0.2 percent that are used as cetane number enhancers (Kirk-Othmer 1984). The total aromatic content of diesel fuel is also variable but levels between 23 and 38 percent have been reported. The average total aromatic is probably in the range of 25 percent. The concentration of the principal aromatic species of toxicological significance is presented in Table 1.

TABLE 1. REPRESENTATIVE VALUES FOR TOXICOLOGICALLY SIGNIFICANT AROMATIC CONTENT FOR DIESEL FUEL #2.

COMPONENT	APPROXIMATE CONCENTRATION
Benzene	<50 ppm with an average of 10 ppm
Ethylbenzene	300 ppm
Toluene	200 ppm (max)
Xylene (mixed)	2400 ppm

(personal communication, Chevron Corp.)

The odor threshold of diesel fuel is approximately 0.8 ppm.

FATE AND TRANSPORT

Microbial degradation, plus evaporation, can remove up to 90 percent of the added diesel fuel to soil. Depending on the soil characteristics, the half-life of diesel fuel in soil ranges for one to eight weeks (Song 1988). Volatilization to the air occurs and diesel fuel can be detected by its odor in the air. However, a vapor pressure value could not be located in the literature. Diesel fuel will percolate through the soil and float on the ground water. When spilled onto surface water, diesel fuels can be toxic to fish, waterfowl and algae.

TOXICITY DATA

Human Toxicological Profile

Like other solvents, diesel fuel can be expected to have central nervous system (CNS) depressant activity. However, since this fuel is not as volatile as gasoline, breathing vapors at concentrations sufficient to achieve a level of intoxication is not likely at normal temperatures and pressures. An attempt to generate a kerosene (diesel) laden atmosphere only resulted in an ambient concentration of 14 ppm (Carpenter et al. 1976). However, under certain occupational settings like tank cleaning, it may be possible to generate mists or aerosols that can lead to symptoms of overexposure. As with kerosene, these symptoms may include headache, dizziness, weakness, confusion, drowsiness and possibly death (HSDB 1991).

Ingestion of diesel fuel can occur during siphoning, accidentally or intentionally and from contaminated well-water. Ingestion may be accompanied by a burning sensation in the mouth, pharynx and chest, gastrointestinal hypermotility and diarrhea (Gosselin et al. 1984), and possibly nausea and vomiting. A serious complication is the aspiration of hydrocarbons into the lung which produces a potentially-lethal hemorrhagic pneumonitis (Lee and Seymour 1979).

There have been reports of acute renal failure following persons exposed to diesel fuel (Barrientos et al. 1977; Crisp et al. 1979). Kryzanovskij (1971) reports that workers cleaning diesel storage tanks have an increased incidence of disease in general and cardiovascular disease and bronchitis, in specific, over control shipyard workers.

Animal Toxicology and Significant Studies

The acute oral and dermal LD_{50} of diesel fuel is in the range of 9 ml/kg body weight. Eye irritation properties were minimal, but the primary skin irritation score of a marketplace sample was 6.8 indicating that this material is a strong skin irritant (Beck et al. 1982) Chronic skin contact can be expected to produce defatting, fissuring and cracking. There are no readily available reports on hypersensitivity response to diesel fuels can be expected to occur since products on either side of diesel fuels distillation range have been reported to produce hypersensitivity reactions (Beck et al. 1982). Dermal absorption of gasoline is unlikely to result in systemic toxicity, but chronic poisoning of the readily absorbable alkyl lead additives is possible.

Exposure of CD-1 mice to diesel vapor for eight hours per day on five consecutive days resulted in a decrement of performance on the roto-rod test, square box activity test and hot plate test. However, the corneal reflex and inclined plane test was unaffected. General observations noted vasodilation, ataxia, poor grooming and in some cases tremor (Kainz and White 1982).

Exposure of rats to aerosolized diesel fuel at concentrations up to 6 mg/L produced direct toxic effects on the lungs but did not produce any neurotoxicity (Dalbey et al. 1987).

Reproductive Toxicity

Female rats were exposed 6 hours per day to air concentrations of 0, 100, and 400 ppm during days 6 through 15 of gestation. Neither jet fuel or number 2 fuel oil produced any significant detrimental effects on the reproductive parameters of the experimental animals (Beliles and Mecler 1982). Neither Jet Fuel A or diesel fuel at exposure levels of 400 ppm, 6 hrs per day, 5 day per week for 8 weeks reduced the fertility of CD-1 male mice (API 1980a, 1980b).

Genotoxicity

Kerosene, jet fuel and diesel fuel all tested negatively in the standard Ames bioassay. However, the "Modified Ames Assay" (Blackburn et al. 1988) on two straight run gas oils did demonstrate mutagenicity. (Straight run gas oil can be considered similar to diesel oils). Diesel fuel was also negative in the mouse lymphoma assay but positive on the rat bone marrow cytogenetics assay when administered by intraperitoneal injection (Conaway et al. 1982). Heating oil #2 did produce a positive Ames test as well as positive results in two other short term bioassays (Rothman and Emmett 1988). Dominant lethal testing of Jet fuel A and diesel fuel was negative at 400 ppm to male CD-1 mice (API 1980a, 1980b).

Carcinogenicity

In a classical mouse skin painting bioassay, all petroleum fractions derived from a crude oil source that boiled between 120 and 700°F showed a low level of tumorigenic activity (Lewis et al. 1982). Home heating oil also showed a low level of tumorigenicity in a more recent mouse skin painting assay (Witschi et al. 1987).

In a case referent study, Seimiatycki et al. (1987) reported an increase of several specific cancers associated with exposures to different petroleum products. Leaded gasoline was associated with stomach cancer; aviation gasoline with kidney cancer; diesel fuel with non adenocarcinoma of the lung and prostate cancer and mineral spirits with squamous cell lung cancer. However not all parameters of concern were properly controlled, excluded or assessed making conclusions from this study inappropriate.

IARC (1989) has classified diesel fuel as having limited evidence of carcinogenicity in animals. Light diesel fuels are not classifiable as to their carcinogenicity to humans (Group 3).

REGULATIONS AND STANDARDS

Neither the American Conference of Governmental Industrial Hygienists (ACGIH) nor OSHA have recommended or established permissible exposure standards (PELs) for diesel fuels. However, NIOSH, has recommended a 10 hour TWA of 100 mg/m^3 for kerosene or 14 ppm (NIOSH 1977). Because of the complexity and variability in composition, OSHA regulates the toxic components by their respective PELs (i.e., n-hexane, benzene, etc.).

Diesel fuels, as such, are not mentioned in HEAST, 1990, nor identified for a specific cancer Potency Factor (CPF) or reference dose (RfD). However, individual components such as benzene, other aromatics and for n-hexane having CPF or RfD values should be evaluated by themselves.

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GASOLINE (GRPH)

GENERAL DATA

The chemical composition of gasoline is extremely variable, depending upon the crude oil starting material, types of processing and refining, blending and additives employed. Gasolines are formulated to meet fuel performance specifications, not to achieve a specific chemical composition. Volatility must be within a certain range to avoid vapor lock (too high) or sluggish acceleration (too low). In addition, the air-fuel mixture within the cylinder must burn uniformly to prevent "pinging" or "knocking." Often small quantities of butanes, pentanes, organo lead compounds or branched chain hydrocarbons are added to achieve uniform burning rates. McDermott and Killiany (1978) published a detailed gas chromatographic analysis of a premium grade gasoline listing 21 components which accounted for 92 percent of the gasoline vapors (Table 1). Low-volatility hydrocarbons (high carbon numbers) were not well represented.

Gasoline additives include organic lead (tetraethyl lead and tetramethyl lead) to a concentration of 0.1 g/gallon (7 ppm). Alkyl lead vapors have low volatility (vapor pressure = 0.4 mm Hg) compared to gasoline (400 to 775 mm Hg), so lead compounds should not be acutely hazardous by inhalation. To prevent accumulation of lead deposits, scavenging agents are added to fuels: ethylene dichloride (EDC) and ethylene dibromide (EDB), usually in a molar ratio EDC/EDB/Pb = 2:2:1.

FATE AND TRANSPORT

Gasoline released into the environment would be expected to evaporate rapidly due to its high vapor pressure (400 to 477 mm Hg). Studies of gasoline fate when added to soils show that the main clearance mechanism was evaporation which can account for up to 75 percent removal from surface soils (Donaldson 1990). Microbial degradation, plus evaporation, can remove up to 90 percent of the added gasoline (Song 1988). Benzene, a volatile gasoline component of major toxicological interest, has a half life in the air of less than one day (Korte and Klein 1982). Gasoline has appreciable water solubility (12 to 16 percent) so it would be transported in ground water and may be found in well water.

TOXICITY DATA

Human Toxicological Profile

Like other solvents, gasoline has potent central nervous system (CNS) depressant activity. Breathing vapors at concentrations achieved during "huffing" or occupational overexposures has led to a variety of neurological symptoms: hallucinations, encephalopathy, ataxia, convulsions, Tourette's Disease, vertigo and nystagmus and peripheral neuropathy (Von Burg 1989). Many of these symptoms may be attributed to n-hexane or alkyl lead compounds.

TABLE 1. COMPOSITION OF A PREMIUM-GRADE GASOLINE

COMPOUND	VOL %
Propane	0.8
n-Butane	38.1
Isobutane	5.2
n-Pentane	7.0
Cyclopentane	0.7
2,3-DM-butane	0.7
2-M-pentane	2.1
3-M-pentane	1.6
n-Hexane	1.5
M-cyclopentane	1.3
2,4-DM-pentane	0.4
2,3-DM-pentane	0.7
2,2,4-TM-pentane	0.5
Isobutylene	1.1
2-M-1-butane	1.6
c-2-pentene	1.2
2-M-2-butene	1.7
Benzene	0.7
Toluene	1.8
Xylene (m,p,o)	0.5
Total %	**92.1**

Ingestion of gasoline can occur during siphoning, abuse situations or from contaminated well-water. Ingestion is accompanied by a burning sensation in the mouth, pharynx and chest. Swallowing large amounts of gasoline leads to coma and death by respiratory depression. A serious complication is the aspiration of hydrocarbons into the lung which produces a potentially-lethal hemorrhagic pneumonitis (Lee and Seymour 1979).

Three epidemiologic studies of refinery workers showed no increased cancer risk in refinery workers (Hanis et al. 1982; Kaplan 1986; and Wong 1987). In an epidemiological study of refinery workers and gasoline handlers, Thomas et al. (1982), found a significant increase in stomach and brain cancer with a trend to increased leukemia and cancer of the skin, prostate and pancreas.

Animal Toxicology and Significant Studies

The acute dermal LD_{50} of gasoline in rabbits is reported to be <5 ml/kg (Von Burg 1989). Liquid gasoline is considered a primary skin irritant because of repeated contact with skin and the defatting and fissuring which occurs. Hypersensitivity response to gasoline can occur. Dermal absorption of gasoline is unlikely to result in systemic toxicity, but chronic poisoning of the readily absorbable alkyl lead additives is possible. Although acutely irritating to the eye, animal studies indicate no effect lasting longer than seven days.

Inhalation of gasoline vapors in routine dispensing produces low exposures (<5 ppm). However, exposure to concentrations of 1,000 - 5,000 ppm for 15-60 minutes can produce CNS depression. A 5-minute exposure to 20,000 ppm (20 percent) has been reported to be fatal (Von Burg 1989).

MacFarland (1982), reported on a chronic inhalation study of gasoline in Fischer 344 rats and $B6C3F_1$ mice. Exposure levels were 0, 67, 292 and 2,056 ppm for 6 hours/day, 5 days/week for 103 to 113 weeks. Male (but not female) rats exhibited a progressive renal tubular disease and renal carcinomas in all dose groups; renal effects in mice were within the expected range of control. High dose female mice had an increased incidence of hepatocellular tumors (48 percent), but the spontaneous incidence of these tumors is also high (14 percent); males showed no increase (44 percent high dose vs. control 45 percent).

Reproductive Toxicity

Male rats exposed intermittently to about 650 ppm unleaded petrol for two months showed endocrine changes which were attributed to stress. Pregnant females exposed to 0, 400 and 1,600 ppm unleaded gasoline on days 6-15 of gestation for 6 hrs/day did not show any teratogenic or fetotoxic effects. Mental retardation has been reported among gasoline sniffing mothers.

Genotoxicity

Several common fuels were found to be negative when tested in the Ames Salmonella typhimurium assay, mouse lymphoma, and the rat bone marrow chromosomal aberration assay (Lebowitz, et al. 1979). Unleaded gasoline was unable to induce unscheduled and replicative DNA synthesis in the male rat kidney at doses known to be nephrotoxic.

Carcinogenicity

As indicated earlier, chronic gasoline exposures produces renal tumors in rats.

COMPOUND CAS NO.	ACGIH TLV ppm	RfD (inhal) mg/kg/day	RfD (oral) mg/kg/day	SLOPE FACTOR mg/kg/day	SLOPE FACTOR mg/kg/day
Benzene 71-43-2	0.1	N/A	N/A	2.9E-2	2.9E-2
Ethylene Dibromide 106-93-4	A2[1]	N/A	N/A	7.6E-1	8.5E+1
Ethylene Dichloride 107-06-2	10	N/A	N/A	9.1E-2	9.1E-2
n-Hexane 110-54-3	50	6E-1	2E-1	N/A	N/A
Tetraethyl Lead 78-00-2	0.1[2]	1E-7	2.9E-8	N/A	N/A

1 A2 - Substance classed as a suspected human carcinogen, no ACGIH TLV listed.
2 mg/m^3, not ppm.

REGULATIONS AND STANDARDS

The American Conference of Governmental Industrial Hygienists (ACGIH 1990) adopted a threshold limit value (TLV) of 300 ppm (mg/m^3) for gasoline vapors. Because of the complexity and variability in composition, OSHA has no standard but regulates the toxic components by their respective PELs (i.e., n-hexane, benzene, alkyl lead).

Gasoline as such is not mentioned in HEAST (1990) as having a specific cancer slope factor (CSF) or reference dose (RfD). However, individual components such as benzene, aromatics, n-hexane having CSF or RfD values should be evaluated by themselves.

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TRICHLOROETHENE

Absorption of trichloroethene (TCE) from the gastrointestinal tract is virtually complete. Absorption following inhalation exposure is proportional to concentration and duration of exposure (EPA 1985). TCE is a central nervous system depressant following acute and chronic exposures. In humans, single oral doses of 15 to 25 ml (21 to 35 grams) of TCE have resulted in vomiting and abdominal pain, followed by transient unconsciousness (Stephens 1945). High-level exposure can result in death due to respiratory and cardiac failure (EPA 1985). Hepatotoxicity has been reported in human and animal studies following acute exposure to TCE (EPA 1985). Nephrotoxicity has been observed in animals following acute exposure to TCE vapors (ACGIH 1986; Torkelson and Rowe 1981). Subacute inhalation exposures of mice have resulted in transient increased liver weights (Kjellstrand et al. 1983a,b). Industrial use of TCE is often associated with adverse dermatological effects including reddening and skin burns on contact with the liquid form, and dermatitis resulting from vapors. These effects are usually the result of contact with concentrated solvent, however, and no effects have been reported following exposure to TCE in dilute, aqueous solutions (EPA 1985). TCE has caused significant increases in the incidence of hepatocellular carcinomas in mice (NCI 1976) and renal tubular-cell neoplasms in rats exposed by gavage (NTP 1983), and pulmonary adenocarcinomas in mice following inhalation exposure (Fukuda et al. 1983; Maltoni et al. 1986). TCE was mutagenic in *Salmonella typhimurium* and in *E. coli* (strain K-12), utilizing liver microsomes for activation (Greim et al. 1977).

EPA is currently reviewing the carcinogenicity of TCE. The EPA Environmental Criterial and Assessment Office (ECAO) currently classifies TCE as a Group B2/C--Probable/Possible Human Carcinogen based on inadequate evidence in humans and sufficient evidence of carcinogenicity from animal studies. ECAO (1992) reported an oral cancer potency factor of $1.1x10^{-2}$ $(mg/kg/day)^{-1}$ based on two gavage studies conducted in mice in which an increased incidence of liver tumors were observed (Maltoni et al. 1986; Fukuda et al. 1983). An inhalation cancer unit risk of $1.7x10^{-6}$ $(\mu g/m^3)^{-1}$ has been derived for TCE based on an increased incidence of lung tumors in mice exposed via inhalation (ECAO 1992; NCI 1976). The cancer estimates are currently under review by EPA. EPA (1987) developed an oral reference dose (RfD) of $7.35x10^{-3}$ mg/kg/day based on a subchronic inhalation study in rats in which elevated liver weights were observed following exposure to 55 ppm, 5 days/week for 14 weeks (Kimmerle and Eben 1973). A safety factor of 1,000 was used to calculate the RfD. However, this RfD is currently under review by EPA.

The National Research Council's Committee on Toxicology has set a one-hour Emergency Exposure Guidance Level (EEGL), for trichloroethene at 200 ppm (1,000 mg/m^3) (NRC 1988). Formerly known as just EEL, the EEGL is defined as a ceiling limit for an unpredicted single exposure lasting one to 24 hours whose occurrence is expected to be rare in the lifetime of any person. It is designed to avoid substantial decrements in performance during emergencies and takes into account the statistical likelihood of a non-incapacitative, reversible effect in exposed populations (NRC 1988). A health criterion for acute inhalation exposure to trichloroethene of 100 mg/m^3 can be derived from the EEGL by combining it with a safety factor of 10 to account for the healthy worker effect which assumes employed persons are generally healthier than the general population.

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POLYCHLORINATED BIPHENYLS (PCBs, including Aroclor 1254)

PCBs are complex mixtures of chlorinated biphenyls. The commercial PCB mixtures that were manufactured in the United States were given the trade name of "Aroclor." Aroclors are distinguished by a four-digit number (for example, Aroclor 1260). The last two digits in the Aroclor 1200 series represent the average percentage by weight of chlorine in the product.

PCBs are readily and extensively absorbed through the gastrointestinal tract and somewhat less readily through the skin; PCBs are presumably readily absorbed from the lungs, but few data are available that experimentally define the extent of absorption after inhalation (EPA 1985). Studies have found oral efficiency on the order of 75 to >90 percent in rats, monkeys and ferrets (Albro and Fishbein 1972; Allen et al. 1974; Tanabe et al. 1981; Bleavens et al. 1984; Clevenger et al. 1989). PCBs distribute preferentially to adipose tissue and concentrate in human breast milk due to its high fat content (ATSDR 1991). Dermatitis and chloracne (a disfiguring and long-term skin disease) have been the most prominent and consistent findings in studies of occupational exposure to PCBs. Several studies examining liver function in exposed humans have reported disturbances in blood levels of liver enzymes. Reduced birth weights, slow weight gain, reduced gestational ages, and behavioral deficits in infants were reported in a study of women who had consumed PCB-contaminated fish from Lake Michigan (EPA 1985). Reproductive, hepatic, immunotoxic, and immunosuppressive effects appear to be the most sensitive end points of PCB toxicity in nonrodent species, and the liver appears to be the most sensitive target organ for toxicity in rodents (EPA 1985). For example, adult monkeys exposed to dietary concentrations of 0.028 mg/kg-day Aroclor 1016 for approximately 22 months showed no evidence of overt toxicity; however, the offspring of these monkeys exhibited decreased birth weight and possible neurological impairment (Barsotti and Van Miller 1984; Levin et al. 1988; Schantz et al. 1989 1991). A number of studies have suggested that PCB mixtures are capable of increasing the frequency of tumors including liver tumors in animals exposed to the mixtures for long periods (Kimbrough et al. 1975; NCI 1978; Schaeffer et al. 1984; Norback and Weltman 1985). Studies have suggested that PCB mixtures can act to promote or inhibit the action of other carcinogens in rats and mice (EPA 1985). It is known that PCB congeners vary greatly in their potency in producing biological effects, such as cancer however, EPA (1993) generally considers Aroclor 1260 to be representative of all PCB mixtures for the evaluation of carcinogenic effects. There is some evidence that mixtures containing highly chlorinated biphenyls are more potent inducers of heptacellular carcinoma in rats than are mixtures containing less chlorine by weight (EPA 1993).

EPA (1993) classified PCBs as a Group B2 agent (Probable Human Carcinogen) based on sufficient evidence in animal bioassays and inadequate evidence from studies in humans. The EPA (1993) calculated an oral cancer potency factor of 7.7 $(mg/kg/day)^{-1}$ for PCBs based on the incidence of hepatocellular carcinomas (91 percent) and neoplastic nodules (4 percent) in female Sprague-Dawley rats exposed to a diet containing Aroclor 1260 as reported in a study by Norback and Weltman (1985). In the same study, males exhibited a much lower incidence of malignant tumors but a higher incidence of benign tumors (neoplastic nodules). EPA (1993) also calculated a slope factor of 5.7 $(mg/kg\text{-}day)^{-1}$ for malignant tumors alone, which is supported by a risk estimate based on the data of Kimbrough et al. (1975). EPA (1993) derived an oral RfD of $7x10^{-5}$ mg/kg/day for Aroclor 1016 based on a 21.8 month oral study conducted in monkeys

(Barsotti and Van Miller 1984; Levin et al. 1988; Schantz et al. 1989, 1991). A no-observed-adverse-effect level of 0.25 ppm (0.007 mg/kg/day) for decreased birth weight in offspring was identified from these studies. A safety factor of 100 (3 to account for interspecies extrapolation, 3 to account for sensitive individuals, 3 to account for limitations in the database, and 3 to account for extrapolation from a subchronic to a chronic RfD) was used to calculate the RfD.

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TETRACHLOROETHENE

Tetrachloroethene is absorbed following inhalation (IARC 1979) and oral (EPA 1985a,b) exposure. Tetrachloroethene vapors and liquid also can be absorbed through the skin (EPA 1985a,b). The principal toxic effects of tetrachloroethene in humans and animals following acute and longer-term exposures include central nervous system (CNS) depression and fatty infiltration of the liver and kidney with concomitant changes in serum enzyme activity levels indicative of tissue damage (EPA 1985a,b; Buben and O'Flaherty 1985). Humans exposed to doses of between 136 and 1,018 mg/m^3 for 5 weeks develop central nervous system effects, such as lassitude and signs of inebriation (Stewart et al. 1974). The offspring of female rats and mice exposed to high concentrations of tetrachloroethene for 7 hours daily on days 6-15 of gestation developed toxic effects, including a decrease in fetal body weight in mice and a small but significant increase in fetal resorption in rats (Schwetz et al. 1975). Mice also exhibited developmental effects, including subcutaneous edema and delayed ossification of skull bones and sternebrae (Schwetz et al. 1975). In a National Cancer Institute bioassay (NCI 1977), increased incidence of hepatocellular carcinoma were observed in both sexes of B6C3F1 mice administered tetrachloroethylene in corn oil by gavage for 78 weeks. Increased incidence of mononuclear cell leukemia and renal adenomas and carcinomas (combined) have also been observed in long term bioassays in which rats were exposed to tetrachloroethene by inhalation (NTP 1986).

Tetrachloroethene is currently under review by the Carcinogen Risk Assessment Verification Endeavor (CRAVE) and estimates of cancer potency were recently withdrawn by EPA (1992b). However, the EPA Environmental Criteria and Assessment Office (ECAO) (1992a) currently classifies tetrachloroethene as a Group B2/C carcinogen (Probable/Possible Human Carcinogen). ECAO (1992a) has reported an oral slope factor of 5.2×10^{-2} (mg/kg/day)$^{-1}$ based on liver tumors observed in the NCI (1977) gavage bioassay for mice. An inhalation cancer unit risk of 5.8×10^{-7} (μg/m^3)$^{-1}$ is based on an NTP (1986) bioassay in rats and mice in which leukemia and liver tumors were observed (ECAO 1992a). Both the cancer slope factor and unit risk are currently under review by EPA. EPA (1993) also derived an oral reference dose (RfD) of 1×10^{-2} mg/kg/day for tetrachloroethene based on a 6-week gavage study by Buben and O'Flaherty (1985). In this study, liver weight/body weight ratios were significantly increased in mice and rats treated with 71 mg/kg-day tetrachloroethene but not in animals treated with 14 mg/kg-day. Using a NOAEL of 14 mg/kg/day and applying an uncertainty factor of 1,000 the RfD was derived. EPA (1992b) established a subchronic oral RfD of 1×10^{-1} mg/kg/day, using an uncertainty factor of 100 and based on the same study and effect of concern.

The American Conference of Governmental Industrial Hygienists (ACGIH) has set a Short-Term Exposure Level -- Threshold Limit Value of 200 ppm (1,000 mg/m^3) for tetrachloroethene (ACGIH 1991). The STEL-TLV is defined as a 15-minute time-weighted average which should not be exceeded at any time during a work day. A health criterion for acute inhalation exposure to tetrachloroethene of 100 mg/m^3 can be derived from the STEL-TLV by combining it with a safety factor of 10 to account for the healthy worker effect which assumes that employed persons are generally healthier than the general population.

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MANGANESE

Manganese is considered to be among the least toxic of the trace metals and, in fact, is considered to be an essential element (NRC 1989). The oral absorption of dietary manganese ranges from 3 to 10 percent (EPA 1993). However, manganese is absorbed to a greater extent following inhalation exposures. The National Research Council has established a provisional recommended dietary allowance for adults of 2 to 5 mg/day (NRC 1989). The effects following acute exposure to manganese are unknown.

Chronic occupational exposure to manganese dust (0.02 - 2.6 mg/m^3) has been associated with respiratory symptoms and pneumonitis (Chandra et al. 1981, 1990) and higher levels have been associated with a condition known as manganism, a progressive neurological disease characterized by speech disturbances, tremors, and difficulties in walking. For example, male workers exposed to manganese dioxide, tetroxide and various salts [time-weighted-average (TWA) of total airborne manganese dust ranged from 0.07-8.61 mg/m^3] experienced an increased incidence of psychomotor disturbances (e.g., reaction time, hand-eye coordination and hand steadiness) (Roels et al. 1987). Other effects observed in humans occupationally exposed to manganese dust include hematological (Chandra et al. 1981; Flinn et al. 1941; Kesic and Hausler 1954), cardiovascular (Saric and Hrustic 1975) and reproductive effects (Cook et al. 1974; Emara et al 1971; Lauwerys et al 1985; Rodier 1955).

In adults, a safe intake of manganese from dietary sources ranges from 2-10 mg/day (10 mg/day = 0.14 mg/kg/day) (WHO 1973, NRC 1989l; Schroeder et al. 1966). Individuals who chronically ingested drinking water from natural wells containing manganese concentrations of 1,600 to 2,300 ug/L (0.06 mg/kg/day), showed a statistically significant increase in minor neurologic effects (neurologic exam scores) (Kondakis et al. 1989). Higher concentrations in drinking water (0.8 mg/kg/day) have resulted in symptoms including lethargy, increased muscle tonus, tremor and mental disturbances (Kawamura et al. 1941).

The apparent differences in manganese toxicity following dietary and drinking water exposures can be attributed to the greater bioavailability of manganese from water (EPA 1993). Chronic oral exposure of rats to manganese chloride can also result in central nervous system dysfunction (Leung et al. 1981; Lai et al. 1982). Chronic inhalation exposure of experimental animals (monkeys, rats, mice, hamsters) has resulted in respiratory effects; however, other studies have demonstrated that these effects may be immunological in origin (ATSDR 1992).

Manganese has not been reported to be teratogenic; however, this metal has been observed to cause depressed reproductive performance and reduced fertility in humans and experimental animals (EPA 1984a). Certain manganese compounds have been shown to be mutagenic in a variety of bacterial tests. Manganese chloride and potassium permanganate can cause chromosomal aberrations in mouse mammary carcinomal cells. Manganese was moderately effective in enhancing viral transformation of Syrian hamster embryo cells (EPA 1984a,b).

EPA (1993a) established a weight-of-evidence classification for manganese of D (not classifiable as to human carcinogenicity). EPA (1993a) derived two separate oral reference doses (RfD). The separate RfDs for food and water indicate a potentially higher bioavailability of manganese from drinking water than from the diet. The RfD associated with oral exposure to drinking water is $5x10^{-3}$ mg/kg/day based on a no-observed-adverse-effect-level (NOAEL) of $5x10^{-3}$ mg/kg/day for humans (Kondakis et al. 1989). EPA (1993a) also derived an RfD of $1.4x10^{-1}$ mg/kg/day for manganese in food based on a NOAEL of 0.14 mg/kg/day (10 mg/day) in humans chronically exposed to dietary levels (WHO 1973; Schroeder et al. 1966; NRC 1989). The effect of concern was the central nervous system, and an uncertainty factor of one was used to derive both RfDs. The chronic RfD in food was adopted as the subchronic RfD (EPA 1993b). EPA (1993a) derived a chronic inhalation reference concentration (RfC) of $4x10^{-4}$ mg/m^3 based upon an occupational study conducted by Roels et al. (1987) in which respiratory symptoms and psychomotor disturbances were observed. EPA (1993b) adopted the chronic RfC as the subchronic RfC. An uncertainty factor of 900 was used to derive both RfCs.

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WASTE OIL (RRPH)

GENERAL DATA

The term Waste Oil is a broad classification and generic term used in common practice by refiners, hazardous waste specialists, law enforcement agencies, fire departments and lay public. As can be seen in the "synonym" section above, it can encompass a very broad selection of chemicals, ranging from grease to fuels. The rationale for selecting the above terms as representative of Waste Oil is that these terms will most likely provide the sources of the material that will be presented to a waste site operator.

Lubricating oil is produced in vast quantities, as much as one to two percent of the world's refined crude oil, (24 million tons, Vazquez-Duhalt 1989). The chemical composition of any heterogeneous material is often difficult to assess. For the purposes of this "brief", it is assumed that "waste oil" was originally generated from petroleum. As with fuels, the composition of waste oil will be extremely variable and depend upon the original crude oil source, type of processing and refining, blending, additives and use history. The waste oil may therefore range from virgin oil accidentally spilled to used machine or automotive oil.

Petroleum oils are produced from the middle to heavy distillate fractions of crude oil. Due to the high boiling points for these fractions, the aromatic hydrocarbons benzene, ethylbenzene, toluene and xylenes, typically found in fuels, will not be present in oils at significant quantities. These fractions may be further processed or treated to remove unwanted materials such as nitrogen, sulfur, metals, or polynuclear aromatic hydrocarbons (PAHs). For the most part, oils destined for the consumer market have been laundered to a very low content of PAHs. However, oils in refinery spills may contain several hundred ppm of PAHs. Used motor oil contains Pb, Zn, Cu, Cd, Cr, Ni, and other metals. Lead is the most abundant metal in motor oil up to a maximum of one percent lead (Vazquez-Duhalt 1989).

FATE AND TRANSPORT

Oil with characteristics (e.g. vapor pressure, viscosity) closer to fuel oils may volatilize to some extent to the air. However, microbial degradation will, more than likely, be the primary mechanism for the mineralization of the spilt material. As much as 90 percent of the material resembling jet fuel may be removed by a combination of evaporation and microbial degradation with a half-life of one to eight weeks; in contrast, heavier fractions which resemble bunker oil (C_{15} and above) may only be degraded 25-30 percent and be extremely persistent in soils. (Song 1988). Given the correct circumstances, waste oils can percolate through the soil and float on the ground water. When spilled onto surface water, waste oils can be toxic to fish, waterfowl and algae. However, these possibilities are highly dependent upon the characteristics of the oily material and the size of the spill.

Approximately 30 percent of waste motor oil and lubricants produced are released into the environment. Because of the large quantities involved, the persistence of oil residues in the environment, and the potential for ecotoxicity, waste oils are an important environmental concern (Vazquez-Duhalt 1989).

When petroleum oil is spilt onto soil, it fill the spaces between the soil particles and hampers oxygen access, thereby promoting anaerobic zones. On the periphery of these oil-soiled zones, aerobic, bacteria are promoted. Hence these outer zones show increased nitrifying, denitrifying, ammonifying and hydrocarbon oxidizing microorganisms. The activity of these organisms in the outer zones increases the concentration of easily accessible substrates which stimulates an increase in the numbers of anaerobic nitrogen fixing bacteria (Vasques-Duhalt 1989). Thus under certain circumstances, oil addition to soil can function as an amendment thereby increasing the productivity of the soil.

TOXICITY DATA

Human Toxicology

In general, most oily materials derived from petroleum have a low order of toxicity. Inhalation of components of waste oil at concentrations sufficient to achieve a level of intoxication is not likely at normal temperatures and pressures. An attempt to generate a kerosene (diesel) laden atmosphere only resulted in an ambient concentration of 14 ppm (Carpenter et al. 1976). However, under certain occupational settings like tank cleaning, it may be possible to generate mists or aerosols that can lead to symptoms of overexposure. These symptoms may include headache, dizziness, nausea, gastrointestinal symptoms, shortness of breath, weakness, confusion, drowsiness and possibly death (HSDB 1991). A single report on a chronic repeated exposure to an oil mist for 17 years was considered to be the cause of lipid pneumonia in a workers "heavily"exposed (Proctor et al. 1989).

Ingestion of petroleum waste oil (other than fuel oil) either accidentally, intentionally or from contaminated well-water is not expected to have a significant effect except perhaps induction of some gastrointestinal hypermotility and diarrhea (MacFarland et al. 1982), and possibly nausea and vomiting. Other than ingestion of fuel oils, ingestion of the heavier waste oils is not expected to be complicated by aspiration into the lung which produces a potentially-lethal hemorrhagic pneumonitis (Lee and Seymour 1979).

Mammalian Toxicology and Significant Studies

The acute oral and dermal LD_{50} of petroleum waste oil is expected to demonstrate only a low order of toxicity; certainly greater than 5 g/kg or practically non toxic. Diesel fuel has an acute oral LD50 is in the range of 9 ml/kg body weight. New or used motor oil has an LD50 of 25 ml/kg as does heavy fuel #6. Other properties such as eye irritation have ratings of practically non irritating to mildly irritating. Skin irritation scores are similarly low ranging from non irritating to mildly irritating (Beck et al. 1982). There are no readily available reports on hypersensitivity responses to waste oils but sensitization can be an expected outcome since refined products in this distillation range have been reported to produce hypersensitivity reactions (Beck et al. 1982). Dermal absorption of oil can also be expected but the oil itself is unlikely to be the cause of a systemic toxicity. Any toxicity is more likely to be attributable to a concomitant absorption of some non oil contaminant.

Exposure of CD-1 mice to diesel vapor for eight hours per day on five consecutive days resulted in a decrement of performance on the roto-rod test, square box activity test and hot plate test. However, the corneal reflex and inclined plane test was unaffected. General observations noted vasodilation, ataxia, poor grooming and in some cases tremor (Kainz and White 1982).

Exposure of rats to aerosolized diesel fuel at concentrations up to 6 mg/L produced direct toxic effects on the lungs but did not produce any neurotoxicity (Dalbey et al. 1987).

Reproductive Toxicity

Female rats were exposed 6 hours per day to air concentrations of 0, 100, and 400 ppm during days 6 through 15 of gestation. Neither jet fuel or number 2 fuel oil produced any significant detrimental effects on the reproductive parameters of the experimental animals (Beliles and Mecler 1982). Neither Jet Fuel A or diesel fuel at exposure levels of 400 ppm, 6 hrs per day, 5 day per week for 8 weeks reduced the fertility of CD-1 male mice (API 1980a, 1980b).

External application of new or used motor oil to the egg shell of a number of bird species indicated embryotoxicity and lethality. The used motor oil was more toxic than the new motor oil (Hoffman et al. 1982).

Genotoxicity

Ames testing of several common fuel oils produced mainly negative results. However, the "Modified Ames Assay" introduced by Blackburn et al. (1988) did demonstrate mutagenicity in two straight run gas oils that were previously considered to be negative. Diesel fuel was negative in a mouse lymphoma assay but positive on the rat bone marrow cytogenetics assay when administered by intraperitoneal injection (Conaway et al. 1982). Heating oil #2 did produce a positive Ames test as well as positive results in two other short term bioassays (Rothman and Emmett 1988).

Used motor oil has been shown to be highly mutagenic to Salmonella bacteria (Peake and Parker 1980). New crankcase motor oil initially tested negative with the standard Ames Assay but after an extraction procedure to remove "interfering chemicals", a dose dependent mutagenic response was observed with both gasoline and diesel crankcase oils. The extracts of the new motor oils however, are considerably less mutagenic than the Used Cankcase Oil extracts. This effect can be explained by the fact that during engine operation, the oil accumulates combustion dust and PAH formed in the combustion process or directly from the fuel (Thony et al. 1975). Extracts from the diesel and gasoline type engines were about equally potent (Dutcher et al. 1986).

Carcinogenicity

In classical mouse skin painting bioassays, all petroleum fractions derived from a crude oil source that boiled between 120 and 700°F showed a low level of tumorigenic activity (Lewis et al. 1982). Home heating oil also showed a low degree of tumorigenicity in a more recent mouse skin painting assay (Witschi et al. 1987). Topical application of used motor oil from gasoline driven vehicles increased the incidence of local tumors in a dose related fashion. The application of new motor oil to mouse skin did not induce skin tumors (Saffiotti and Shubik 1963). This information plus the demonstrated mutagenic potential of used motor oils and their polynuclear aromatic hydrocarbon (PAH) content, allows a determination that such oils can be considered to be potentially carcinogenic (IARC 1984).

In a case referent study, Seimiatycki et al. (1987) reported an increase of several specific cancers associated with exposures to different petroleum products. Leaded gasoline was associated with stomach cancer; aviation gasoline with kidney cancer; diesel fuel with non adenocarcinoma of the lung and prostate cancer and mineral spirits with squamous cell lung cancer. However not all parameters of concern were properly controlled, excluded or assessed making conclusions from this study inappropriate.

IARC (1989) has classified gasoline, diesel fuel, and residual oil Category 2B, having limited evidence of carcinogenicity in animals and inadequate evidence in humans. Used motor oil (crankcase oil) is also classified as a category 2B. Light fuel oils, crude oil and jet fuels have been classified as Category 3, having inadequate evidence of carcinogenicity in either animals or humans.

REGULATIONS AND STANDARDS

Neither the American Conference of Governmental Industrial Hygienists (ACGIH) nor OSHA have recommended or established permissible exposure standards (PELs) for diesel fuels or waste oils. NIOSH has recommended a 10 hour TWA of 100 mg/m^3 for kerosene or 14 ppm (MMWR. 37:24). The ACGIH (1991) and OSHA (1985) recommend a TLV of 5 mg/m^3 for Oil Mists.

Diesel fuels, as such, are not mentioned in HEAST, 1990, nor identified for a specific cancer Slope Factor (CSF) or reference dose (RfD). However, individual components such as benzene, other aromatics and for n-hexane having CSF or RfD values should be evaluated by themselves.

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APPENDIX C

ESTIMATED EXPOSURE EQUATION FOR BIRDS AND MAMMALS

ESTIMATED EXPOSURE (EE) = ({[(CF*FI) + (CS*SI*ROA) + (CW*WI)] *.001}* IS) / BW

INSTALLATION Barter Island / SPECIES arctic fox	COC Conc. Food Items (CF)*	Food Intake Rate (FI)	(CF*FI)	Soil/Sed. Intake % (SI%)	COC Conc. Soil /Sed. (CS)	Soil/Sed. Ingestion Rate (SI)	(CS*SI)	COC Conc. Water (CW)	Water Intake Rate (WI)	(CW*WI)	(A+B+C)	Conver. Units 0.001	Percent Ingested at Site (IS)	Body Weight (BW)	ESTIMATED EXPOSURE (D*IS/BW=EE)
COC	(mg/kg)	(g/day)	(A)	% of FI	(mg/kg)	(g/day)	(B)	(ug/L)	(L/day)	(C)	(D)	(D)*.001	(unitless)	(kg)	(mg/kg-bw/day)
Inorganics															
Aluminum		256	0	0.028	0.00	7.17	0.00	320.00	0.42	134.4	134.40	0.13	0.01	4.95	0.0003
Iron		256	0	0.028	0.00	7.17	0.00	8600.00	0.42	3612	3612.00	3.61	0.01	4.95	0.0073
Lead		256	0	0.028	27.00	7.17	193.54	0.00	0.42	0	193.54	0.19	0.01	4.95	0.0004
Manganese		256	0	0.028	0.00	7.17	0.00	570.00	0.42	239.4	239.40	0.24	0.01	4.95	0.0005
Zinc		256	0	0.028	76.00	7.17	544.77	0.00	0.42	0	544.77	0.54	0.01	4.95	0.0011
Organics															
DRPH		256	0	0.028	1200.00	7.17	8601.60	720.00	0.42	302.4	8904.00	8.90	0.01	4.95	0.0180
Ethylbenzene		256	0	0.028	0.13	7.17	0.93	0.00	0.42	0	0.93	0.001	0.01	4.95	0.000002
Xylenes (total)		256	0	0.028	1.10	7.17	7.88	0.00	0.42	0	7.88	0.01	0.01	4.95	0.00002
Naphthalene		256	0	0.028	2.30	7.17	16.49	0.00	0.42	0	16.49	0.02	0.01	4.95	0.00003
Aroclor 1254		256	0	0.028	0.42	7.168	3.01	0.00	0.42	0	3.01	0.003	0.01	4.95	0.00001

*Concentration in Food cannot be calculated for the arctic fox because COC data are not available for animal portion of the trophic web.

ESTIMATED EXPOSURE EQUATION FOR BIRDS AND MAMMALS

ESTIMATED EXPOSURE (EE) = ({[(CF*FI) + (CS*SI*ROA) + (CW*WI)] *.001}* IS) / BW

INSTALLATION Barter Island / SPECIES brown lemming / COC	COC Conc. Food Items (CF)* (mg/kg)	Food Intake Rate (FI) (g/day)	(CF*FI) (A)	Soil/Sed. Intake % (SI%) % of FI	COC Conc. Soil /Sed. (CS) (mg/kg)	Soil/Sed. Ingestion Rate (SI) (g/day)	(CS*SI) (B)	COC Conc. Water (CW) (ug/L)	Water Intake Rate (WI) (L/day)	(CW*WI) (C)	(A+B+C) (D)	Conver. Units 0.0010 (D)*.001	Percent Ingested at Site (IS) (unitless)	Body Weight (BW) (kg)	**ESTIMATED EXPOSURE (D*IS/BW=EE) (mg/kg-bw/day)**
Inorganics															
Aluminum	0.00	45	0.00	0.027	0.00	1.22	0.00	320.00	0.007	2.24	2.24	0.00	0.5	0.055	0.020
Iron	0.00	45	0.00	0.027	0.00	1.22	0.00	8600.00	0.007	60.2	60.20	0.06	0.5	0.055	0.547
Lead	1.22	45	54.68	0.027	27.00	1.22	32.81	0.00	0.007	0	87.48	0.09	0.5	0.055	0.795
Manganese	0.00	45	0.00	0.027	0.00	1.22	0.00	570.00	0.007	3.99	3.99	0.00	0.5	0.055	0.036
Zinc	114.00	45	5130.00	0.027	76.00	1.22	92.34	0.00	0.007	0	5222.34	5.22	0.5	0.055	47.476
Organics															
DRPH	40.16	45	1807.15	0.027	1200.00	1.22	1458.00	720.00	0.007	5.04	3270.19	3.27	0.5	0.055	29.729
Ethylbenzene	0.08	45	3.42	0.027	0.13	1.22	0.16	0.00	0.007	0	3.58	0.00	0.5	0.055	0.033
Xylenes (total)	1.07	45	48.03	0.027	1.10	1.22	1.34	0.00	0.007	0	49.37	0.05	0.5	0.055	0.449
Naphthalene	1.02	45	45.80	0.027	2.30	1.22	2.79	0.00	0.007	0	48.59	0.05	0.5	0.055	0.442
Aroclor 1254	0.00	45	0.07	0.027	0.42	1.22	0.51	0.00	0.007	0	0.58	0.00	0.5	0.055	0.005

ESTIMATED EXPOSURE EQUATION FOR BIRDS AND MAMMALS

ESTIMATED EXPOSURE (EE) = ({[(CF*FI) + (CS*SI*ROA) + (CW*WI)] *.001}* IS) / BW

INSTALLATION Barter Island / SPECIES Lapland longspur / COC	COC Conc. Food Items (CF)* (mg/kg)	Food Intake Rate (FI) (g/day)	(CF*FI) (A)	Soil/Sed. Intake % (SI%) % of FI	COC Conc. Soil /Sed. (CS) (mg/kg)	Soil/Sed. Ingestion Rate (SI) (g/day)	(CS*SI) (B)	COC Conc. Water (CW) (ug/L)	Water Intake Rate (WI) (L/day)	(CW*WI) (C)	(A+B+C) (D)	Conver. Units 0.0010 (D)*.001	Percent Ingested at Site (IS) (unitless)	Body Weight (BW) (kg)	**ESTIMATED EXPOSURE (D*IS/BW=EE) (mg/kg-bw/day)**
Inorganics															
Aluminum	0.00	6.6	0.00	0.02	0.00	0.13	0.00	320.00	0.005	1.60	1.60	0.00	0.5	0.027	0.030
Iron	0.00	6.6	0.00	0.02	0.00	0.13	0.00	8600.00	0.005	43.00	43.00	0.04	0.5	0.027	0.796
Lead	1.22	6.6	8.02	0.02	27.00	0.13	3.56	0.00	0.005	0.00	11.58	0.01	0.5	0.027	0.215
Manganese	0.00	6.6	0.00	0.02	0.00	0.13	0.00	570.00	0.005	2.85	2.85	0.00	0.5	0.027	0.053
Zinc	114.00	6.6	752.40	0.02	76.00	0.13	10.03	0.00	0.005	0.00	762.43	0.76	0.5	0.027	14.119
Organics															
DRPH	40.16	6.6	265.05	0.02	1200.00	0.13	158.40	720.00	0.005	3.60	427.05	0.43	0.5	0.027	7.908
Ethylbenzene	0.08	6.6	0.50	0.02	0.13	0.13	0.02	0.00	0.005	0.00	0.52	0.00	0.5	0.027	0.010
Xylenes (total)	1.07	6.6	7.04	0.02	1.10	0.13	0.15	0.00	0.005	0.00	7.19	0.01	0.5	0.027	0.133
Naphthalene	1.02	6.6	6.72	0.02	2.30	0.13	0.30	0.00	0.005	0.00	7.02	0.01	0.5	0.027	0.130
Aroclor 1254	0.00	6.6	0.01	0.02	0.42	0.13	0.06	0.00	0.005	0.00	0.07	0.00	0.5	0.027	0.001

ESTIMATED EXPOSURE EQUATION FOR BIRDS AND MAMMALS

ESTIMATED EXPOSURE (EE) = ({[(CF*FI) + (CS*SI*ROA) + (CW*WI)] *.001}* IS) / BW

INSTALLATION Barter Island / SPECIES glaucous gull	COC Conc. Food Items (CF)*	Food Intake Rate (FI)	(CF*FI)	Soil/Sed. Intake % (SI%)	COC Conc. Soil /Sed. (CS)	Soil/Sed. Ingestion Rate (SI)	(CS*SI)	COC Conc. Water (CW)	Water Intake Rate (WI)	(CW*WI)	(A+B+C)	Conver. Units 0.0010	Percent Ingested at Site (IS)	Body Weight (BW)	**ESTIMATED EXPOSURE (D*IS/BW=EE)**
COC	(mg/kg)	(g/day)	(A)	% of FI	(mg/kg)	(g/day)	(B)	(ug/L)	(L/day)	(C)	(D)	(D)*.001	(unitless)	(kg)	**(mg/kg-bw/day)**
Inorganics															
Aluminum	0.00	73.9	0.00	0.076	0.00	5.62	0.00	320.00	0.08	25.60	25.60	0.03	0.3	1.45	0.005
Iron	0.00	73.9	0.00	0.076	0.00	5.62	0.00	8600.00	0.08	688.00	688.00	0.69	0.3	1.45	0.142
Lead	0.12	73.9	8.98	0.076	27.00	5.62	151.64	0.00	0.08	0.00	160.62	0.16	0.3	1.45	0.033
Manganese	0.00	73.9	0.00	0.076	0.00	5.62	0.00	570.00	0.08	45.60	45.60	0.05	0.3	1.45	0.009
Zinc	11.40	73.9	842.46	0.076	76.00	5.62	426.85	0.00	0.08	0.00	1269.31	1.27	0.3	1.45	0.263
Organics															
DRPH	4.02	73.9	296.77	0.076	1200.00	5.62	6739.68	720.00	0.08	57.60	7094.05	7.09	0.3	1.45	1.468
Ethylbenzene	0.01	73.9	0.56	0.076	0.13	5.62	0.73	0.00	0.08	0.00	1.29	0.00	0.3	1.45	0.000
Xylenes (total)	0.11	73.9	7.89	0.076	1.10	5.62	6.18	0.00	0.08	0.00	14.07	0.01	0.3	1.45	0.003
Naphthalene	0.10	73.9	7.52	0.076	2.30	5.62	12.92	0.00	0.08	0.00	20.44	0.02	0.3	1.45	0.004
Aroclor 1254	0.00	73.9	0.01	0.076	0.42	5.62	2.36	0.00	0.08	0.00	2.37	0.00	0.3	1.45	0.0005

ESTIMATED EXPOSURE EQUATION FOR BIRDS AND MAMMALS

ESTIMATED EXPOSURE (EE) = ({[(CF*FI) + (CS*SI*ROA) + (CW*WI)] *.001}* IS) / BW

INSTALLATION Barter Island / SPECIES brant / COC	COC Conc. Food Items (CF)* (mg/kg)	Food Intake Rate (FI) (g/day)	(CF*FI) (A)	Soil/Sed. Intake % (SI%) % of FI	COC Conc. Soil /Sed. (CS) (mg/kg)	Soil/Sed. Ingestion Rate (SI) (g/day)	(CS*SI) (B)	COC Conc. Water (CW) (ug/L)	Water Intake Rate (WI) (L/day)	(CW*WI) (C)	(A+B+C) (D)	Conver. Units 0.0010 (D)*.001	Percent Ingested at Site (IS) (unitless)	Body Weight (BW) (kg)	ESTIMATED EXPOSURE (D*IS/BW=EE) (mg/kg-bw/day)
Inorganics															
Aluminum	0.00	69.2	0.00	0.082	0.00	5.67	0.00	320.00	0.07	22.4	22.40	0.02	0.18	1.31	0.003
Iron	0.00	69.2	0.00	0.082	0.00	5.67	0.00	8600.00	0.07	602	602.00	0.60	0.18	1.31	0.083
Lead	1.09	69.2	75.67	0.082	27.00	5.67	153.21	0.00	0.07	0	228.88	0.23	0.18	1.31	0.031
Manganese	0.00	69.2	0.00	0.082	0.00	5.67	0.00	570.00	0.07	39.9	39.90	0.04	0.18	1.31	0.005
Zinc	102.60	69.2	7099.92	0.082	76.00	5.67	431.25	0.00	0.07	0	7531.17	7.53	0.18	1.31	1.035
Organics															
DRPH	36.14	69.2	2501.09	0.082	1200.00	5.67	6809.28	720.00	0.07	50.4	9360.77	9.36	0.18	1.31	1.286
Ethylbenzene	0.07	69.2	4.74	0.082	0.13	5.67	0.74	0.00	0.07	0	5.48	0.01	0.18	1.31	0.001
Xylenes (total)	0.96	69.2	66.48	0.082	1.10	5.67	6.24	0.00	0.07	0	72.72	0.07	0.18	1.31	0.010
Naphthalene	0.92	69.2	63.39	0.082	2.30	5.67	13.05	0.00	0.07	0	76.44	0.08	0.18	1.31	0.011
Aroclor 1254	0.00	69.2	0.0987	0.082	0.4200	5.6744	2.38	0.00	0.07	0	2.48	0.00	0.18	1.31	0.0003

ESTIMATED EXPOSURE EQUATION FOR BIRDS AND MAMMALS

ESTIMATED EXPOSURE (EE) = ({[(CF*FI) + (CS*SI*ROA) + (CW*WI)] *.001}* IS) / BW

INSTALLATION Barter Island / SPECIES pectoral sandpiper / COC	COC Conc. Food Items (CF)* (mg/kg)	Food Intake Rate (FI) (g/day)	(CF*FI) (A)	Soil/Sed. Intake % (SI%) % of FI	COC Conc. Soil /Sed. (CS) (mg/kg)	Soil/Sed. Ingestion Rate (SI) (g/day)	(CS*SI) (B)	COC Conc. Water (CW) (ug/L)	Water Intake Rate (WI) (L/day)	(CW*WI) (C)	(A+B+C) (D)	Conver. Units 0.0010 (D)*.001	Percent Ingested at Site (IS) (unitless)	Body Weight (BW) (kg)	ESTIMATED EXPOSURE (D*IS/BW=EE) (mg/kg-bw/day)
Inorganics															
Aluminum	0.00	11.1	0.00	0.181	0.00	2.01	0.00	320.00	0.01	3.2	3.20	0.00	0.78	0.08	0.031
Iron	0.00	11.1	0.00	0.181	0.00	2.01	0.00	8600.00	0.01	86	86.00	0.09	0.78	0.08	0.839
Lead	0.12	11.1	1.35	0.181	27.00	2.01	54.25	0.00	0.01	0	55.59	0.06	0.78	0.08	0.542
Manganese	0.00	11.1	0.00	0.181	0.00	2.01	0.00	570.00	0.01	5.7	5.70	0.01	0.78	0.08	0.056
Zinc	11.40	11.1	126.54	0.181	76.00	2.01	152.69	0.00	0.01	0	279.23	0.28	0.78	0.08	2.723
Organics															
DRPH	4.02	11.1	44.58	0.181	1200.00	2.01	2410.92	720.00	0.01	7.2	2462.70	2.46	0.78	0.08	24.011
Ethylbenzene	0.01	11.1	0.08	0.181	0.13	2.01	0.26	0.00	0.01	0	0.35	0.00	0.78	0.08	0.003
Xylenes (total)	0.11	11.1	1.18	0.181	1.10	2.01	2.21	0.00	0.01	0	3.39	0.00	0.78	0.08	0.033
Naphthalene	0.10	11.1	1.13	0.181	2.30	2.01	4.62	0.00	0.01	0	5.75	0.01	0.78	0.08	0.056
Aroclor 1254	0.00	11.1	0.00	0.181	0.4200	2.0091	0.84	0.00	0.01	0	0.85	0.00	0.78	0.08	0.008

ESTIMATED EXPOSURE EQUATION FOR BIRDS AND MAMMALS

ESTIMATED EXPOSURE (EE) = ({[(CF*FI) + (CS*SI*ROA) + (CW*WI)] *.001}* IS) / BW

INSTALLATION Barter Island / SPECIES spectacled eider	COC Conc. Food Items (CF)*	Food Intake Rate (FI)	(CF*FI)	Soil/Sed. Intake % (SI%)	COC Conc. Soil /Sed. (CS)	Soil/Sed. Ingestion Rate (SI)	(CS*SI)	COC Conc. Water (CW)	Water Intake Rate (WI)	(CW*WI)	(A+B+C)	Conver. Units 0.0010	Percent Ingested at Site (IS)	Body Weight (BW)	**ESTIMATED EXPOSURE (D*IS/BW=EE)**
COC	(mg/kg)	(g/day)	(A)	% of FI	(mg/kg)	(g/day)	(B)	(ug/L)	(L/day)	(C)	(D)	(D)*.001	(unitless)	(kg)	**(mg/kg-bw/day)**
Inorganics															
Aluminum	0.00	71.6	0.0000	0.082	0.00	5.87	0.00	320.00	0.07	22.4	22.40	0.02	0.01	1.375	0.0002
Iron	0.00	71.6	0.0000	0.082	0.00	5.87	0.00	8600.00	0.07	602	602.00	0.60	0.01	1.375	0.0044
Lead	0.30	71.6	21.7485	0.082	27.00	5.87	158.52	0.00	0.07	0	180.27	0.18	0.01	1.375	0.0013
Manganese	0.00	71.6	0.0000	0.082	0.00	5.87	0.00	570.00	0.07	39.9	39.90	0.04	0.01	1.375	0.0003
Zinc	28.50	71.6	2040.6000	0.082	76.00	5.87	446.21	0.00	0.07	0	2486.81	2.49	0.01	1.375	0.0181
Organics															
DRPH	10.04	71.6	718.8434	0.082	1200.00	5.87	7045.44	720.00	0.07	50.4	7814.68	7.81	0.01	1.375	0.0568
Ethylbenzene	0.02	71.6	1.3617	0.082	0.13	5.87	0.76	0.00	0.07	0	2.13	0.00	0.01	1.375	0.00002
Xylenes (total)	0.27	71.6	19.1067	0.082	1.10	5.87	6.46	0.00	0.07	0	25.57	0.03	0.01	1.375	0.0002
Naphthalene	0.25	71.6	18.2180	0.082	2.30	5.87	13.50	0.00	0.07	0	31.72	0.03	0.01	1.375	0.0002
Aroclor 1254	0.00	71.6	0.0284	0.082	0.4200	5.8712	2.47	0.00	0.07	0	2.49	0.00	0.01	1.375	0.00002

CONTAMINANT CONCENTRATION IN FOOD CALCULATIONS

PLANT UPTAKE AND DIETARY PROPORTION OF VEGETATION CALCULATIONS
CF = CS*Bv*%V

INSTALLATION Barter Island SPECIES brown lemming COC	COC Concentration Soil/Sediment (CS) mg/kg	Bioconcentration Factor (Bv) unitless	Proportion of vegetation in diet (%V) %/100	COC Concentration in diet (CF) mg/kg
Inorganics				
Aluminum	0	0.004	1.00	0.00
Iron	0	0.004	1.00	0.00
Lead	27	0.05	1.00	1.22
Manganese	0	0.25	1.00	0.00
Zinc	76	1.50	1.00	114.00
Organics				
DRPH	1200	0.03	1.00	40.16
Ethylbenzene	0.13	0.59	1.00	0.08
Xylenes (total)	1.1	0.97	1.00	1.07
Naphthalene	2.3	0.44	1.00	1.02
Aroclor 1254	0.42	0.004	1.00	0.002

CONTAMINANT CONCENTRATION IN FOOD CALCULATIONS

PLANT UPTAKE AND DIETARY PROPORTION OF VEGETATION CALCULATIONS
CF = CS*Bv*%V

INSTALLATION Barter Island / SPECIES Lapland longspur / COC	COC Concentration Soil/Sediment (CS) mg/kg	Bioconcentration Factor (Bv) unitless	Proportion of vegetation in diet (%V) %/100	COC Concentration in diet (CF) mg/kg
Inorganics				
Aluminum	0	0.004	1.00	0.00
Iron	0	0.004	1.00	0.00
Lead	27	0.05	1.00	1.22
Manganese	0	0.25	1.00	0.00
Zinc	76	1.50	1.00	114.00
Organics				
DRPH	1200	0.03	1.00	40.16
Ethylbenzene	0.13	0.59	1.00	0.08
Xylenes (total)	1.1	0.97	1.00	1.07
Naphthalene	2.3	0.44	1.00	1.02
Aroclor 1254	0.42	0.004	1.00	0.002

CONTAMINANT CONCENTRATION IN FOOD CALCULATIONS

PLANT UPTAKE AND DIETARY PROPORTION OF VEGETATION CALCULATIONS
CF = CS*Bv*%V

INSTALLATION Barter Island / SPECIES glaucous gull / COC	COC Concentration Soil/Sediment (CS) mg/kg	Bioconcentration Factor (Bv) unitless	Proportion of vegetation in diet (%V) %/100	COC Concentration in diet (CF) mg/kg
Inorganics				
Aluminum	0	0.004	0.10	0.00
Iron	0	0.004	0.10	0.00
Lead	27	0.05	0.10	0.12
Manganese	0	0.25	0.10	0.00
Zinc	76	1.50	0.10	11.40
Organics				
DRPH	1200	0.03	0.10	4.02
Ethylbenzene	0.13	0.59	0.10	0.01
Xylenes (total)	1.1	0.97	0.10	0.11
Naphthalene	2.3	0.44	0.10	0.10
Aroclor 1254	0.42	0.004	0.10	0.0002

CONTAMINANT CONCENTRATION IN FOOD CALCULATIONS

PLANT UPTAKE AND DIETARY PROPORTION OF VEGETATION CALCULATIONS
CF = CS*Bv*%V

INSTALLATION Barter Island SPECIES brant COC	COC Concentration Soil/Sediment (CS) mg/kg	Bioconcentration Factor (Bv) unitless	Proportion of vegetation in diet (%V) %/100	COC Concentration in diet (CF) mg/kg
Inorganics				
Aluminum	0	0.004	0.90	0.00
Iron	0	0.004	0.90	0.00
Lead	27	0.05	0.90	1.09
Manganese	0	0.25	0.90	0.00
Zinc	76	1.50	0.90	102.60
Organics				
DRPH	1200	0.03	0.90	36.14
Ethylbenzene	0.13	0.59	0.90	0.07
Xylenes (total)	1.1	0.97	0.90	0.96
Naphthalene	2.3	0.44	0.90	0.92
Aroclor 1254	0.42	0.004	0.90	0.001

CONTAMINANT CONCENTRATION IN FOOD CALCULATIONS

PLANT UPTAKE AND DIETARY PROPORTION OF VEGETATION CALCULATIONS
CF = CS*Bv*%V

INSTALLATION Barter Island SPECIES pectoral sandpiper COC	COC Concentration Soil/Sediment (CS) mg/kg	Bioconcentration Factor (Bv) unitless	Proportion of vegetation in diet (%V) %/100	COC Concentration in diet (CF) mg/kg
Inorganics				
Aluminum	0	0.004	0.10	0.00
Iron	0	0.004	0.10	0.00
Lead	27	0.05	0.10	0.12
Manganese	0	0.25	0.10	0.00
Zinc	76	1.50	0.10	11.40
Organics				
DRPH	1200	0.03	0.10	4.02
Ethylbenzene	0.13	0.59	0.10	0.01
Xylenes (total)	1.1	0.97	0.10	0.11
Naphthalene	2.3	0.44	0.10	0.10
Aroclor 1254	0.42	0.004	0.10	0.000

CONTAMINANT CONCENTRATION IN FOOD CALCULATIONS

PLANT UPTAKE AND DIETARY PROPORTION OF VEGETATION CALCULATIONS

CF = CS*Bv*%V

INSTALLATION Barter Island / SPECIES spectacled eider / COC	COC Concentration Soil/Sediment (CS) mg/kg	Bioconcentration Factor (Bv) unitless	Proportion of vegetation in diet (%V) %/100	COC Concentration in diet (CF) mg/kg
Inorganics				
Aluminum	0	0.004	0.25	0.00
Iron	0	0.004	0.25	0.00
Lead	27	0.05	0.25	0.30
Manganese	0	0.25	0.25	0.00
Zinc	76	1.50	0.25	28.50
Organics				
DRPH	1200	0.03	0.25	10.04
Ethylbenzene	0.13	0.59	0.25	0.02
Xylenes (total)	1.1	0.97	0.25	0.27
Naphthalene	2.3	0.44	0.25	0.25
Aroclor 1254	0.42	0.004	0.25	0.0004

BIOCONCENTRATION FACTOR CALCULATIONS for ORGANIC CHEMICALS

CALCULATION OF Bv FOR ORGANIC CHEMICALS IN SOIL				
COC	log Kow	1.588 - 0.578 log Kow	log Bv	Bv
DRPH	5.30	-1.475	-1.475	0.033
Ethylbenzene	3.15	-0.233	-0.233	0.585
Xylenes (total)[a]	2.77	-0.013	-0.013	0.970
Naphthalene	3.36	-0.354	-0.354	0.443
Aroclor 1254	6.94	-2.423	-2.423	0.004

[a] log Kow for ortho-xylene used.

SCALING FACTOR CALCULATIONS

Scaling factor (SF) = (representative species average body weight/ test species average body weight)$^{1/3}$
based on the mass to surface area ratios of the test species and the representative species
(Mantel and Schneiderman 1975)

Representative Species	Average Body Weight (kg)	Test Species	Average Body Weight (kg)	Scaling Factor (SF)
brown lemming	0.055	mouse	0.025	1.30
	0.055	rat	0.25	0.60
arctic fox	4.95	mouse	0.025	5.82
	4.95	rat	0.25	2.70
	4.95	mink	1.0	1.70
Lapland longspur	0.027	chicken	0.8	0.32
	0.027	mallard	1.08	0.29
	0.027	Japanese quail	0.10	0.65
	0.027	ringed dove	0.155	0.56
	0.027	ring-necked pheasant	1.14	0.29
brant	1.305	chicken	0.8	1.18
	1.305	mallard	1.08	1.07
	1.305	Japanese quail	0.10	2.35
	1.305	ringed dove	0.155	2.03
	1.305	ring-necked pheasant	1.14	1.05
glaucous gull	1.445	chicken	0.8	1.22
	1.445	mallard	1.08	1.10
	1.445	Japanese quail	0.10	2.43
	1.445	ringed dove	0.155	2.10
	1.445	ring-necked pheasant	1.14	1.08
pectoral sandpiper	0.079	chicken	0.8	0.46
	0.079	mallard	1.08	0.42
	0.079	Japanese quail	0.10	0.92
	0.079	ringed dove	0.155	0.80
	0.079	ring-necked pheasant	1.14	0.41
spectacled eider	1.375	chicken	0.8	1.20
	1.375	mallard	1.08	1.08
	1.375	Japanese quail	0.10	2.39
	1.375	ringed dove	0.155	2.07
	1.375	ring-necked pheasant	1.14	1.06

APPENDIX D

REMEDIAL INVESTIGATION ANALYTICAL DATA

1

TABLE D-1. SUMMARY OF SAMPLING AND ANALYSES CONDUCTED

ANALYSES	HVOC*	VOC 8010	BTEX*	VOC 8260	SVOC	Metals[b]	TPH-Diesel[b] Range 3510/3550	TPH
ANALYTICAL METHOD	SW8010M	SW8010	SW8020	SW8260	SW8270	SW3050 (Soil) 3005 (Water)/6010	Diesel 8100M	Gas
BARTER ISLAND (BAR-M)								
Background	1 Soil	5 Soil 2 Water	6 Soil 2 Water	3 Soil 2 Water	2 Soil 2 Water	2 Soil 2 Water (Total) 2 Water (Dissolved)	7 Soil 2 Water	
Landfill (LF01)	3 Soil 4 Water	NA	3 Soil 4 Water	2 Soil 2 Water	1 Soil 2 Water	2 Soil 2 Water (Total) 2 Water (Dissolved)	4 Soil 8 Water	
POL Catchment (LF03)	NA	7 Soil 1 Water	13 Soil 3 Water	3 Soil 2 Water	3 Soil 2 Water	NA	15 Soil 3 Water	
Current Landfill (LF04)	6 Soil 3 Water	NA	6 Soil 3 Water	4 Soil 3 Water	2 Water	2 Soil 2 Water (Total) 2 Water (Dissolved)	7 Soil 6 Water	
Contaminated Ditch (SD08)	NA	5 Soil	17 Soil 4 Water	2 Soil 2 Water	1 Soil 2 Water	2 Soil 2 Water (Total) 2 Water (Dissolved)	17 Soil 4 Water	
Old Runway Dump (LF12)	3 Soil	NA	3 Soil	1 Soil	1 Soil	1 Soil	3 Soil	
Heated Storage (SS13)	NA	9 Soil 3 Water	13 Soil 5 Water	5 Soil 2 Water	2 Soil 2 Water	2 Soil 2 Water (Total) 2 Water (Dissolved)	14 Soil 5 Water	
Garage (SS14)	5 Soil 1 Water	NA	8 Soil 1 Water	5 Soil	2 Soil 1 Water	2 Soil 1 Water (Total) 1 Water (Dissolved)	9 Soil 1 Water	
Weather Building (SS15)	NA	NA	8 Soil	1 Soil	NA	NA	8 Soil	
White Alice Facility (SS16)	NA	NA	NA	NA	NA	NA	4 Soil	
POL Tanks (ST17)	NA	NA	4 Soil	1 Soil	1 Soil	NA	4 Soil	
Fuel Tanks (ST18)	NA	NA	11 Soil 1 Water	3 Soil 1 Water	3 Soil 1 Water	NA	12 Soil	
Old Dump Site (LF19)	10 Soil	NA	10 Soil 1 Water	2 Soil 1 Water	2 Soil 1 Water	2 Soil 1 Water (Total) 1 Water (Dissolved)	10 Soil	
Bladder Diesel Spill (SS20)	NA	NA	5 Soil 2 Water	3 Soil 1 Water	3 Soil 1 Water	3 Soil	5 Soil 2 Water	
JP-4 Spill (SS21)	5 Soil	NA	5 Soil	1 Soil	1 Soil	NA	5 Soil	
Total Field Analyses	33 Soil 8 Water	26 Soil 6 Water	112 Soil 26 Water	36 Soil 16 Water	22 Soil 16 Water	18 Soil 12 Water (Total) 12 Water (Dissolved)	124 Soil 31 Water	

NA Not analyzed.
* These analyses were completed on a quick turnaround basis.
[a] The number of soil sample includes sediment samples collected from surface water features.
[b] Some of these analysis were completed on a 24-hour turnaround at a temporary fixed laboratory at Barrow, Alaska.

(2)

; CONDUCTED FOR BARTER ISLAND REMEDIAL INVESTIGATIONS[a]

PH-Diesel[b] Range 3510/3550	TPH - Gasoline[b] Range	TPH Residual Range*	PCB*	Pesticides*	TDS	TSS	TOC	TCLP	TOTAL SAMPLES
iesel 8100M	Gas 5030/8015M	Diesel 8100M	SW8080/8080M	SW8080/8080M	E160.1	E160.2	SW9060	SW1311	
7 Soil 2 Water	7 Soil 2 Water	1 Soil	5 Soil 2 Water	5 Soil 2 Water	2 Water	2 Water	2 Soil 2 Water	NA	6 Soil 2 Water
4 Soil 8 Water	3 Soil 4 Water	4 Soil 8 Water	4 Soil 4 Water	NA	2 Water	2 Water	1 Soil 2 Water	NA	4 Soil 8 Water
15 Soil 3 Water	13 Soil 3 Water	3 Soil	NA	NA	2 Water	2 Water	1 Soil 2 Water	NA	13 Soil 3 Water
7 Soil 6 Water	7 Soil 4 Water	6 Soil 5 Water	4 Soil 2 Water	NA	2 Water	2 Water	2 Soil 2 Water	NA	6 Soil 5 Water
17 Soil 4 Water	17 Soil 4 Water	5 Soil	NA	1 Soil	2 Water	2 Water	2 Soil 2 Water	NA	17 Soil 4 Water
3 Soil	3 Soil	3 Soil	3 Soil	1 Soil	NA	NA	1 Soil	NA	3 Soil
14 Soil 5 Water	14 Soil 5 Water	3 Soil	7 Soil	NA	NA	NA	NA	NA	13 Soil 5 Water
9 Soil 1 Water	9 Soil 1 Water	8 Soil 1 Water	4 Soil	1 Soil 1 Water	NA	NA	NA	NA	8 Soil 1 Water
8 Soil	8 Soil	3 Soil	NA	NA	NA	NA	NA	NA	8 Soil
4 Soil	NA	4 Soil	11 Soil	NA	NA	NA	NA	NA	11 Soil
4 Soil	4 Soil	4 Soil	NA	NA	NA	NA	NA	NA	4 Soil
12 Soil	11 Soil 1 Water	12 Soil	NA	NA	1 Water	1 Water	2 Soil 1 Water	NA	12 Soil 1 Water
10 Soil	10 Soil 1 Water	10 Soil	5 Soil	2 Soil	1 Water	1 Water	1 Soil 1 Water	NA	10 Soil 1 Water
5 Soil 2 Water	5 Soil 2 Water	5 Soil 2 Water	NA	NA	1 Water	1 Water	3 Soil 1 Water	NA	5 Soil 2 Water
5 Soil	5 Soil	5 Soil	NA	1 Soil	NA	NA	1 Soil	NA	5 Soil
124 Soil 31 Water	116 Soil 27 Water	76 Soil 16 Water	43 Soil 8 Water	11 Soil 3 Water	13 Water	13 Water	16 Soil 13 Water		125 Soil 32 Water

TABLE D-1. SUMMARY OF SAMPLING AND ANALYSES FOR BARTE

ANALYSES	HVOC*	VOC 8010	BTEX*	VOC 8260	SVOC	Metals[b]	TPH-Diesel[b] Range 3510/3550	TPH
ANALYTICAL METHOD	SW8010M	SW8010	SW8020	SW8260	SW8270	SW3050 (Soil) 3005 (Water)/6010	Diesel 8100M	Gas
QA/QC SAMPLES								
Trip Blanks	2 Water	2 Water	4 Water	4 Water	NA	NA	NA	
Equipment Blanks	5 Water	2 Water	9 Water	8 Water	6 Water	6 Water (Total) 2 Water (Dissolved)	10 Water	
Ambient Condition Blanks	2 Water	1 Water	3 Water	2 Water	NA	NA	NA	
Field Replicates	3 Soil	3 Soil	11 Soil	4 Soil	4 Soil	3 Soil	12 Soil	
Field Duplicates	NA	NA	2 Water	1 Water	1 Water	1 Water (Total) 1 Water (Dissolved)	2 Water	
Total Site Analyses	36 Soil 17 Water	29 Soil 11 Water	123 Soil 44 Water	40 Soil 31 Water	26 Soil 23 Water	21 Soil 19 Water (Total) 15 Water (Dissolved)	136 Soil 43 Water	

NA Not analyzed.
* These analyses were completed on a quick turnaround basis.
a The number of soil sample includes sediment samples collected from surface water features.
b Some of these analysis were completed on a 24-hour turnaround at a temporary fixed laboratory at Barrow, Alaska.

S FOR BARTER ISLAND REMEDIAL INVESTIGATIONS (CONTINUED)

TPH-Diesel[b] Range 3510/3550	TPH - Gasoline[b] Range	TPH Residual Range*	PCB*	Pesticides*	TDS	TSS	TOC	TCLP	TOTAL SAMPLES
Diesel 8100M	Gas 5030/8015M	Diesel 8100M	SW8080/8080M	SW8080/8080M	E160.1	E160.2	SW9060	SW1311	
NA	2 Water	NA	NA	NA	NA	NA	NA	NA	5 Water
10 Water	11 Water	4 Water	6 Water	5 Water	2 Water	2 Water	6 Water	NA	9 Water
NA	2 Water	NA	NA	NA	NA	NA	NA	NA	3 Water
12 Soil	11 Soil	8 Soil	5 Soil	1 Soil	NA	NA	2 Soil	NA	13 Soil
2 Water	2 Water	1 Water	NA	NA	1 Water	1 Water	1 Water	NA	2 Water
136 Soil 43 Water	127 Soil 44 Water	84 Soil 21 Water	48 Soil 14 Water	12 Soil 8 Water	16 Water	16 Water	18 Soil 20 Water	1 Water	138 Soil 52 Water

TABLE D-2. BACKGROUND ANALYTICAL DATA SUMMARY

Installation: Barter Island
Site: Background (BKGD)
Matrix: Soil/Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range	Environmental Samples						Field Blanks			Lab Blanks	
					S01 & S04 (Replicates)		S02	S03	SD01	SD02	AB01	EB01	TB02		
Laboratory Sample ID Numbers					4203-5	4203-4	4175-2 4203-6	4199-4	4199-1 4179-4	4199-7	4197-6 4173-9	4175-3 4203-8	4179-5 4199-13	4203 4179 4175 4173	4203 4199 4179 4175
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	9.55-1,150	588[cd]	466[cd]	384J[cd]	116[c]	9.55J[c]	195[c]	NA	<200	NA	<200	<4.00
GRPH	0.400	0.400-9	100	<0.400-<9	<1.40	<1.20	<0.800	<6.0	<0.400	<5.00	NA	<20	NA	<20	<0.400
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.325	<0.750	<0.250	<1.500	<0.100	<1.250					
Benzene	0.020	0.020-0.300	0.5	<0.020-<0.300	<0.065	<0.150	<0.050	<0.300	<0.020	<0.250	<1	<1	<1	<1	<0.020
Toluene	0.020	0.020-0.300		<0.020-<0.300	<0.065	<0.150	<0.050	<0.300	<0.020	<0.250	1.2	<1	<1	<1	<0.020
Ethylbenzene	0.020	0.020-0.300		<0.020-<0.300	<0.065	<0.150	<0.050	<0.300	<0.020	<0.250	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.040-0.600		<0.040-<0.600	<0.130	<0.300	<0.100	<0.600	<0.040	<0.500	<2	<2	<2	<2	<0.040
VOC 8010	0.020	0.020-0.300		<0.020-<0.300	<0.065	<0.150	<0.050	<0.300	<0.020	<0.300	<1-9.8	<1-2.5	<1	<1	<0.020
VOC 8260	0.020	0.025-0.050		<0.025-<0.500	NA	NA	<0.050	NA	<0.025	NA	<1-1.6	<1J-4.4J	<1	<1	<0.020
SVOC 8270	0.200	0.230-3.50		<0.230-<3.50	NA	NA	<3.50	NA	<0.230-<0.406	NA	NA	<10	NA	<10	<0.200
Pesticides	0.001	0.001-0.100		<0.001-<0.100	<0.06	<0.060	<0.005-<0.050	<0.100	<0.001	<0.080	NA	<0.1-<1	NA	<0.1-<1	<0.001-<0.020
PCBs	0.020	0.020-0.100	10	<0.020-<0.100	<0.060	<0.60	<0.050J	<0.100	<0.020	<0.020	NA	<1	NA	<1	<0.020
TOC				32,000-199,000	NA	NA	199,000	NA	32,000	NA	NA	7,800	NA	<5,000	NA

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.
c The laboratory reported that the Extractable Petroleum Hydrocarbon (EPH) pattern in this sample was not consistent with a middle distillate fuel.
d Laboratory reported that the sample is moss, and the EPH pattern may be due to biogenic hydrocarbons.

TABLE D-2. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Background (BKGD)
Matrix: Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range	Environmental Sample	Field Blanks		Lab Blanks	
					2SD03	AB03	EB08		
Laboratory Sample ID Numbers					1746 4616-17	1712	1720 4616-13	#5-9693 #1&2-9693 #1&2-9493 4616	#6-9593 4616
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	9.55-1,150	1,150[cd]	NA	<1,000J[b]	<1,000J	<4.00
GRPH	0.400	9.0	100	<0.400-<9.0	<9.0[c]	<50J[b]	<50J[b]	<20	<0.400
RRPH (Approx.)	4.8	480	2,000[a]	<480	<480	NA	<2000	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.5				
Benzene	0.01	0.1	0.5	<0.020-<0.300	<0.1	<1	<1	NA	<0.02
Toluene	0.01	0.1		<0.020-<0.300	<0.1	<3J	<1J	NA	<0.02
Ethylbenzene	0.01	0.1		<0.020-<0.300	<0.1	<2J	<1	NA	<0.02
Xylenes (Total)	0.02	0.2		<0.040-<0.600	<0.2	<5J	<2	NA	<0.04
HVOC (8010 Mod.)	0.05	0.5		<0.5J	<0.5J	<9J	<5	NA	<0.1J
VOC 8260	0.020	0.500		<0.025-<0.500	<0.500	NA	<1	<1-6.6	<0.020

☐ CT&E Data.
▩ F&B Data.
N/A Not available.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c These samples were analyzed by F&B also; and DRPH and GRPH were detected at <240[b] and <5J[b] mg/kg, respectively.
d Laboratory reported that the EPH result indicates possible biogenic hydrocarbon contamination; sample was a very wet moss.

TABLE D-2. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Background (BKGD)
Matrix: Soil/Sediment
Units: mg/kg
METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Bkgd. Range	Environmental Samples					Field Blank		Lab Blanks
						S02	SD01				EB01		
Laboratory Sample ID Numbers						4175-2	4179-4				4175-3		4179 4175
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg				µg/L		µg/L
Aluminum	0.35	2		1,500-25,000	1,700-8,700	8,700	1,700				<100		<100
Antimony	N/A	2		<7.8-<230	<59-<91	<91	<59				<100		<100
Arsenic	0.11	2-9.1		<4.9-8.5	<9.1-7	<9.1	7				<100		<100
Barium	0.024	1		27-390	27-120	120	27				<50		<50
Beryllium	N/A	3.0-4.6		<2.6-6.4	<3.0-<4.6	<4.6	<3.0				<50		<50
Cadmium	0.33	3.0-4.6		<3.0-<36	<3.0-<4.6	<4.6	<3.0				<50		<50
Calcium	0.69	4		360-59,000	5,100-12,000	5,100	12,000				<200		<200
Chromium	0.066	1		<4.3-47	3-14	14	3.0				<50		<50
Cobalt	N/A	9.1-59		<5.1-12	<9.1-<59	<9.1	<59				<100		<100
Copper	0.045	1-3.0		<2.7-45	<3.0-14	14	<3.0				<50		<50
Iron	0.50	2		5,400-35,000	7,000-11,000	11,000	7,000				<100		<100
Lead	0.13	5.9-9.1		<5.1-22	<5.9-<9.1	<9.1	<5.9				<100		<100
Magnesium	0.96	4		360-7,400	2,500-4,800	2,500	4,800				<200		<200
Manganese	0.025	1		25-290	76	76	76				<50		<50
Molybdenum	N/A	3.0-4.6		<2.5-<11	<3.0-<4.6	<4.6	<3.0				<50		<50
Nickel	0.11	1		4.2-46	4.2-14	14	4.2				<50		<50
Potassium	23	100-300		<300-2,200	<300-970	970	<300				<5,000		<5,000
Selenium	1.2	9.1-59		<7.8-<170	<9.1-<59	<9.1	<59				<100		<100

☐ CT&E Data.
NA Not available.

TABLE D-2. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Background (BKGD)
Matrix: Soil/Sediment
Units: mg/kg
METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Bkgd. Range	Environmental Samples					Field Blank		Lab Blanks
						S02	SD01				EB01		
Laboratory Sample ID Numbers						4175-2	4179-4				4175-3		4179 4175
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg				µg/L		µg/L
Silver	0.53	3.0-4.6		<3-<110	<3.0-<4.6	<4.6	<3.0				<50		<50
Sodium	0.55	5		<160-680	71-230	230	71				<250		<250
Thallium	0.011	0.3-0.45		<0.2-<1.2	<0.3-<0.45	<0.45	<0.3J				<5		<5
Vanadium	0.036	1		6.3-59	7.7-22	22	7.7				<50		<50
Zinc	0.16	1		9.2-95	11-24	24	11				<50		<50

☐ CT&E Data.
J Result is an estimate.

TABLE D-2. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Surface Water Site: Background (BKGD) Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range	Environmental Samples				Field Blanks			Lab Blanks
					SW01	SW02			AB01	EB02	TB02	
Laboratory Sample ID Numbers					4199-6 4179-2	4199-5 4179-3			4197-6 4173-9	4179-1 4206-4	4197-5 4199-13	4173 4199 4179
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L			µg/L	µg/L	µg/L	µg/L
DRPH	100	200		<200	<200	<200			NA	<100	NA	<200
GRPH	20	20		<20	<20	<20			NA	<20	NA	<20
BTEX (8020/8020 Mod.)												
Benzene	1	1	5	<1	<1	<1			<1	<1	<1	<1
Toluene	1	1	1,000	<1	<1	<1			1.2	<1	<1	<1
Ethylbenzene	1	1	700	<1	<1	<1			<1	<1	<1	<1
Xylenes (Total)	2	2	10,000	<2	<2	<2			<2	<2	<2	<2
VOC 8010												
Chloroform	1	1		<1-1.1	<1	1.1			<1	<1-9	<1	<1
1,2-Dichloroethane	1	1	5	1.3B-2.8B	1.3B	2.8B			1.2	2.9	<1	<1
VOC 8260												
1,2-Dichloroethane	1	1	5	3U-3.2B	3U	3.2B			1.6	3.0	<1	<1
SVOC 8270	10	10		<10	<10	<10			NA	<11	NA	<10
Pesticides	0.05	1		<1	<1	<1			NA	<0.1-<1	NA	<0.1-<1

☐ CT&E Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
U Compound is not present above the concentration listed.

TABLE D-2. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Surface Water Site: Background (BKGD) Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range	Environmental Samples				Field Blanks			Lab Blanks
					SW01	SW02			AB01	EB02	TB02	
Laboratory Sample ID Numbers					4199-6 4179-2	4199-5 4179-3			4197-6 4173-9	4179-1 4206-4	4197-5 4199-13	4199 4179
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L			µg/L	µg/L	µg/L	µg/L
PCBs	1	1	0.5	<1	<1	<1			NA	<1	NA	<1
TOC	5,000	5,000		<5,000-12,700	<5,000	12,700			NA	<5,000	NA	<5,000
TSS	100	100-30,000		<30,000-8,000	8,000J	<30,000			NA	4,000	NA	<100
TDS	10,000	10,000-352,000		<352,000-328,000	328,000	<352,000			NA	30,000	NA	<10,000

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.

TABLE D-2. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Background (BKGD)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Bkgd. Levels	Environmental Samples					Field Blank			Lab Blank
						SW01	SW02					EB02		
Laboratory Sample ID Numbers						4179-2	4179-3					4179-1		4179
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L		µg/L
Aluminum	17.4	100		<100-350 (<100-340)	<100 (<100)	<100 (<100)	<100 (<100)					<100 (<100)		<100 (<100)
Antimony	N/A	100	6	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)					<100 (<100)		<100 (<100)
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)					<100 (<100)		<100 (<100)
Barium	1.2	50	2,000	<50-93 (<50-91)	<50-69 (<50-68)	69 (68)	<50 (<50)					<50 (<50)		<50 (<50)
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)		<50 (<50)
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)		<50 (<50)
Calcium	34.5	200		4,500-88,000 (4,100-86,000)	21,000-38,000 (21,000-38,000)	38,000 (38,000)	21,000 (21,000)					<200 (<200)		<200 (<200)
Chromium	3.29	50	100	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)		<50 (<50)
Cobalt	N/A	100		<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)					<100 (<100)		<100 (<100)
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)		<50 (<50)
Iron	25	100		180-2,800 (<100-1,600)	280-700 (<100-360)	280 (<100)	700 (360)					<100 (<100)		<100 (<100)
Lead	6.6	100	15	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)					<100 (<100)		<100 (<100)

☐ CT&E Data.
N/A Not available.

TABLE D-2. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Background (BKGD)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Bkgd. Levels	Environmental Samples					Field Blank			Lab Blank
						SW01	SW02					EB02		
Laboratory Sample ID Numbers						4179-2	4179-3					4179-1		4179
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L		µg/L
Magnesium	47.8	200		<5,000-53,000 (2,600-54,000)	12,000-14,000 (13,000-14,000)	14,000 (14,000)	12,000 (13,000)					<200 (<200)		<200 (<200)
Manganese	1.24	50		<50-510 (<50-120)	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)		<50 (<50)
Molybdenum	N/A	50		<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)		<50 (<50)
Nickel	5.5	50	100	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)		<50 (<50)
Potassium	1,154	5,000		<5,000 (<5,000)	<5,000 (<5,000)	<5,000 (<5,000)	<5,000 (<5,000)					<5,000 (<5,000)		<5,000 (<5,000)
Selenium	62.4	100	50	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)					<100 (<100)		<100 (<100)
Silver	2.6	50	50	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)		<50 (<50)
Sodium	27.7	250		8,400-410,000 (8,200-450,000)	47,000-49,000 (50,000-57,000)	49,000 (50,000)	47,000 (57,000)					<250 (<250)		<250 (<250)
Thallium	0.57	5	2	<5 (<5)	<5 (<5)	<5 (<5)	<5 (<5)					<5J (<5)J		<5 (<5)
Vanadium	1.8	50		<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)		<50 (<50)
Zinc	8.2	50		<50-160 (<50)	<50 (<50)	<50 (<50)	<50 (<50)					<50 (<50)		<50 (<50)

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE D-3. OLD LANDFILL ANALYTICAL DATA SUMMARY

Installation: Barter Island
Site: Old Landfill (LF01)
Matrix: Soil/Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks					Lab Blanks	
					S01	SD01	SD02	SD03	AB02	EB04	EB05	TB04	TB05		
Laboratory Sample ID Numbers					322 4303-2	1340	1342	1344 4286-5	315 4303-1	311 4302-10	332 392 4303-5	1346 4302-9	375	#3&4-82493 #3&4-83193 #1&2-82493 4302/4303	#6-82493 #6-83193 #1&2-83193 4303
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-11	50-110	500[a]	9.55-1,150	<50R[b]	<50[b]	<110[b]	<110J[b]	NA	NA	<1,000[b]	NA	NA	NA	<70J
GRPH	0.2-0.4	2-4	100	<0.4-<9	NA	<2J[b]	<4J[b]	<4J[b]	<100J[b]	<100J[b]	<100J[b]	<100J[b]	<50J	<50J-<100J	<2J
RRPH (Approx.)	10-22	100-220	2,000[a]	<480	<100	<110	<220	530	NA	NA	<1,000	NA	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	NA	<0.10	<0.20	<0.20							
Benzene	0.002-0.004	0.02-0.04	0.5	<0.020-<0.300	NA	<0.02	<0.04	<0.04	<1	<1	<1	<1	<1	<1	<0.02
Toluene	0.002-0.004	0.02-0.04		<0.020-<0.300	NA	<0.02	<0.04	<0.04	<1	<1	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002-0.004	0.02-0.04		<0.020-<0.300	NA	<0.02	<0.04	<0.04	<1	<1	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004-0.008	0.04-0.08		<0.040-<0.600	NA	<0.04	<0.08	<0.08	<2	<2	<2	<2	<2	<2	<0.04
HVOC (8010 Mod.)	0.002-0.004	0.02-0.04		<0.5J	NA	<0.02J	<0.04J	<0.04J	<1	<1	<1	<1J	<1	<1J	NA
VOC 8260															
1,4-Dichloro-benzene	0.020	0.025-0.030		<0.025-<0.500	<0.025J	NA	NA	0.044	<1	<1	<1	<1	NA	<1	<0.020
Naphthalene	0.020	0.025-0.030		<0.025-<0.500	<0.025J	NA	NA	0.105	<1	<1	<1	<1	NA	<1	<0.020
1,2,4-Trichloro-benzene	0.020	0.025-0.030		<0.025-<0.500	<0.025J	NA	NA	0.048	<1	<1	<1	<1	NA	<1	<0.020
1,2,4-Trimethyl-benzene	0.020	0.025-0.030		<0.025-<0.500	<0.025J	NA	NA	0.041	<1	<1	<1	<1	NA	<1	<0.020
Xylenes (Total)	0.040	0.050-0.060		<0.050-<1.000	<0.050J	NA	NA	0.033[c]	<2	<2	<2	<2	NA	<2	<0.020

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
R Result has been rejected.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c Result is indicative of p & m xylenes only.

TABLE D-3. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Landfill (LF01)

Matrix: Soil/Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks					Lab Blanks	
					S01	SD01	SD02	SD03	AB02	EB04	EB05	TB04	TB05		
Laboratory Sample ID Numbers					322 4303-2	1340	1342	1344 4286-5	315 4303-1	311 4302-10	332 392 4303-5	1346 4302-9	375	#5-82493 4302/4303	#6-82393 4303
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/kg
SVOC 8270	0.200	0.230		<0.23-<3.5	<0.230R	NA	NA	NA	NA	<25-75	<11	NA	NA	<10	<0.200
PCBs	0.01	0.1	10	<0.020-<0.100	<0.3R	<0.1	<0.1	<0.1	NA	NA	<10	NA	NA	NA	<0.1-<0.5
TOC				32,000-199,000	820	NA	NA	NA	NA	<5,000	<5,000J	NA	NA	<5,000	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
R Result has been rejected.

TABLE D-3. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Landfill (LF01)

Matrix: Soil/Sediment
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples					Field Blanks			Lab Blanks
					S01	SD03				EB04	EB05		
Laboratory Sample ID Numbers					4303-2	4286-5				4302-10	4303-5		4286 4302
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg				µg/L	µg/L		µg/L
Aluminum	0.35	2		1,500-25,000	1,900	3,600				<100	<100		<100
Antimony	N/A	56-64		<7.8-<230	<56	<64				<100	<100		<100
Arsenic	0.11	5.6-6.4		<4.9-8.5	<5.6	<6.4				<100	<100		<100
Barium	0.024	1		27-390	19	76				<50	<50		<50
Beryllium	N/A	2.8-3.2		<2.6-6.4	<2.8	<3.2				<50	<50		<50
Cadmium	0.33	2.8-3.2		<3.0-<36	<2.8	<3.2				<50	<50		<50
Calcium	0.69	4		360-59,000	4,650	10,600				<200	<200		<200
Chromium	0.066	1		<4.3-47	4.1	6.6				<50	<50		<50
Cobalt	N/A	5.6-6.4		<5.1-12	<5.6	<6.4				<100	<100		<100
Copper	0.045	1		<2.7-45	3.3	14				<50	<50		<50
Iron	0.50	2		5,400-35,000	5,000	12,000				<100	200		<100
Lead	0.13	2-5.6		<5.1-22	<5.6	29				<100	<100		<100
Magnesium	0.96	4		360-7,400	990	2,700				<200	<200		<200
Manganese	0.025	1		25-290	52	170				<50	<50		<50
Molybdenum	N/A	2.8-3.2		<2.5-<11	<2.8	<3.2				<50	<50		<50
Nickel	0.11	1		4.2-46	4.3	8.6				<50	<50		<50
Potassium	23	100-280		<300-2,200	<280	610				<5,000	<5,000		<5,000
Selenium	1.2	5.6-64		<7.8-<170	<5.6	<64				<100	<100		<100

☐ CT&E Data.
N/A Not analyzed.

TABLE D-3. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Landfill (LF01)

Matrix: Soil/Sediment
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples					Field Blanks			Lab Blanks
					S01	SD03				EB04	EB05		
Laboratory Sample ID Numbers					4303-2	4286-5				4302-10	4303-5		4286 4302
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg				µg/L	µg/L		µg/L
Silver	0.53	2.8-3.2		<3-<110	<2.8	<3.2				<50	<50		<50
Sodium	0.55	5		<160-680	78	160				<250	<250		<250-267
Thallium	0.011	0.27-0.28		<0.2-<1.2	<0.27	<0.28				<5	<5		<5
Vanadium	0.036	1		6.3-59	4.9	11				<50	<50		<50
Zinc	0.16	1		9.2-95	12	55				<50	<50		<50

☐ CT&E Data.

TABLE D-3. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Landfill (LF01)

Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks				Lab Blanks
					SW01	SW02	SW03	SW04	AB02	EB04	EB05	TB04	
Laboratory Sample ID Numbers					1372 1374	1368 1370	1362 1364 4285-2	1348 1354 4285-1	315 4303-1	311 4302-10	332 392 4303-5	1346 4302-9	#3&4-83193 #3&4-82493 4285 4302/4303
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
DRPH	100	1,000		<200	<1,000R^b	<1,000^b	<1,000^b	<1,000^b	NA	NA	<1,000^b	NA	NA
GRPH	10	100		<20	<100J^b	<100J^b	<100J^b	<100J^b	<100J^b	<100J^b	<100J^b	<100J^b	<100J
RRPH (Approx.)	200	2,000		NA	<2,000	<2,000	<2,000	<2,000	NA	NA	<1,000	NA	NA
BTEX (8020/8020 Mod.)													
Benzene	0.1	1	5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	0.1	1	1,000	<1	56	<1	<1	<1	<1	<1	<1	<1	<1
Ethyl-benzene	0.1	1	700	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
HVOC 8010	0.1	1		<0.5J	<1	<1	<1	<1	<1	<1	<1	<1J	<1J
VOC 8260													
1,2-Dichloroethane	1	1	5	3U-3.2B	NA	NA	3.9B	3.9B	6.3	1.5	3.2	<1	<1
p-Isopropyltoluene	1	1		<1	NA	NA	1.7	<1	<1	<1	<1	<1	<1
Toluene	1	1	1,000	<1	NA	NA	<1	2.5B	2.2	2.3	2.3	<1	<1
SVOC 8270	10	20-22		<10	NA	NA	<22	<20	NA	<25-75	<11	NA	<10

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
J Result is an estimate.
R Result has been rejected.
U Compound is not present above the concentration listed.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE D-3. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Landfill (LF01)

Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks				Lab Blanks
					SW01	SW02	SW03	SW04	AB02	EB04	EB05	TB04	
Laboratory Sample ID Numbers					1372 1374	1368 1370	1362 1364 4285-2	1348 1354 4285-1	315 4303-1	311 4302-10	332 392 4303-5	1346 4302-9	4285 4302 4303
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
PCBs	0.2	2	0.5	<1	<2R	<2J	<2	<2J	NA	NA	<10	NA	NA
TOC	5,000	5,000		<5,000-12,000	NA	NA	53,900J	98,000	NA	<5,000	<5,000J	NA	<5,000
TSS	100	100		<30,000-8,000	NA	NA	8,200	200,000	NA	NA	NA	NA	<100
TDS	10,000	10,000		<352,000-328,000	NA	NA	1,226,000J	2,416,000	NA	NA	NA	NA	<10,000

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
R Result has been rejected.

TABLE D-3. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Landfill (LF01)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank			Lab Blanks
					SW03	SW04						EB04		
Laboratory Sample ID Numbers					4285-2	4285-1						4302-10		4285 4302
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L		µg/L
Aluminum	17.4	100		<100-350 (<100-340)	180 (<100)	<100 (<100)						<100		<100 (<100)
Antimony	N/A	50	6	<100 (<100)	<100 (<100)	<100 (<100)						<100		<100 (<100)
Arsenic	5.3	50	50	<100 (<100)	<100 (<100)	<100 (<100)						<100		<100 (<100)
Barium	1.2	50	2,000	<50-93 (<50-91)	120 (89)	120 (110)						<50		<50 (<50)
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)	<50 (<50)						<50		<50 (<50)
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)	<50 (<50)						<50		<50 (<50)
Calcium	34.5	200		4,500-88,000 (4,100-86,000)	130,000 (130,000)	190,000 (180,000)						<200		<200-378 (378)
Chromium	3.29	50	100	<50 (<50)	<50 (<50)	<50 (<50)						<50		<50 (<50)
Cobalt	N/A	100		<100 (<100)	<100 (<100)	<100 (<100)						<100		<100 (<100)
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)	<50 (<50)						<50		<50 (<50)
Iron	25	200		180-2,800 (<100-1,600)	15,000 (240)	3,200 (340)						<100		<100 (<100)
Lead	6.6	100	15	<100 (<100)	<100 (<100)	<100 (<100)						<100		<100 (<100)

☐ CT&E Data.
N/A Not analyzed.

TABLE D-3. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Landfill (LF01)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank			Lab Blanks
					SW03	SW04						EB04		
Laboratory Sample ID Numbers					4285-2	4285-1						4302-10		4285 4302
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L		µg/L
Magnesium	47.8	50		<5,000-53,000 (2,600-54,000)	55,000 (54,000)	78,000 (76,000)						<200		<200 (<200)
Manganese	1.24	50		<50-510 (<50-120)	1,500 (1,400)	560 (480)						<50		<50 (<50)
Molybdenum	N/A	50		<50 (<50)	<50 (<50)	<50 (<50)						<50		<50 (<50)
Nickel	5.5	50	100	<50 (<50)	<50 (<50)	<50 (<50)						<50		<50 (<50)
Potassium	1,154	5,000		<5,000 (<5,000)	9,400 (9,100)	110,000 (101,000)						<5,000		<5,000 (<5,000)
Selenium	62.4	100	50	<100 (<100)	<100 (<100)	<100 (<100)						<100		<100 (<100)
Silver	2.6	50	50	<50 (<50)	<50 (<50)	<50 (<50)						<50		<50 (<50)
Sodium	27.7	250		8,400-410,000 (8,200-450,000)	160,000 (150,000)	440,000 (410,000)						<250		<250-267 (<250)
Thallium	0.57	5	2	<5 (<5)	<5 (<5)	<5 (<5)						<5		<5 (<5)
Vanadium	1.8	50		<50 (<50)	<50 (<50)	<50 (<50)						<50		<50 (<50)
Zinc	8.2	50		<50-160 (<50)	<50 (<50)	<50 (<50)						<50		<50 (<50)

☐ CT&E Data.
N/A Not analyzed.

TABLE D-3. OLD LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Surface Water
Site: Old Landfill (LF01)   Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples							Field Blank			Lab Blank
					2SW01	2SW02	2SW03	2SW04					EB06		
Laboratory Sample ID Numbers					1663	1664	1665	1666					1688 1690		#5-9693
ANALYSES	µg/L	µg/L		µg/L	µg/L	µg/L	µg/L	µg/L					µg/L		µg/L
DRPH	100	1,000		<200	<1,000[b]	<1,000[b]	<1,000[b]	<1,000[b]					<1,000J[b]		<1,000J
RRPH (Approx.)	200	2,000		NA	<2,000	<2,000	<2,000	<2,000					<2,000		<2,000

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
b DRPH concentrations reported for these samples are equivalent to diesel range organics (DRO) as defined by ADEC.

TABLE D-4. POL CATCHMENT ANALYTICAL DATA SUMMARY

Installation: Barter Island Matrix: Soil
Site: POL Catchment (LF03) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks						Lab Blanks	
					S01	S01-0.75	S02-0.75	S03-0.75	AB01	AB02	EB03	EB04	TB03	TB04		
Laboratory Sample ID Numbers					1290 4302-1	4216-7	4216-8	4216-9	4173-9 4197-6	315 4303-1	4213-4 4215-6	311 4302-10	4211-2	1346 4302-9	#3&4-92493 #3&4-83193 4302 4215/4213 4212/4211 4197/4173	#6-83193 #1&2-83193 4302 4216
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	9.55-1,150	5,200[b]	8.84[d]	6.95[d]	4.76[d]	NA	NA	<100	NA	NA	NA	<100	<4.00-<70J
GRPH	0.400	0.400	100	<0.4-<9.0	19.J[b]	<0.400	<0.400	<0.400	NA	<100J[b]	<20	<100J[b]	NA	<100J[b]	<20-<100J	<0.400-<2J
RRPH (Approx.)	10-30	100-300	2,000[a]	<480	180	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	1.23J	<0.100	<0.100	<0.100								
Benzene	0.020	0.020	0.5	<0.020-<0.300	<0.02	<0.020	<0.020	<0.020	<1	<1	<1	<1	<1[c]	<1	<1	<0.020
Toluene	0.020	0.020		<0.020-<0.300	0.08	<0.020	<0.020	<0.020	1.2	<1	3.2	<1	<1[c]	<1	<1	<0.020
Ethylbenzene	0.020	0.020		<0.020-<0.300	0.05	<0.020	<0.020	<0.020	<1	<1	<1	<1	<1[c]	<1	<1	<0.020
Xylenes (Total)	0.040	0.040		<0.040-<0.600	1.1J	<0.040	<0.040	<0.040	<2	<2	<2	<2	<2[c]	<2	<2	<0.040
VOC 8010	0.020	0.020		<0.020-<0.300	NA	<0.020	<0.020	<0.020	<1-9.8	NA	NA	NA	NA	NA	<1	<0.020
VOC 8260																
n-Butylbenzene	0.020	0.200		<0.025-<0.500	3.70	NA	NA	NA	NA	<1	NA	<1	NA	<1	<0.020	<1
sec-Butylbenzene	0.020	0.200		<0.025-<0.500	1.62	NA	NA	NA	NA	<1	NA	<1	NA	<1	<0.020	<1
Ethylbenzene	0.020	0.200		<0.025-<0.500	0.313	NA	NA	NA	NA	<1	NA	<1	NA	<1	<0.020	<1
Isopropylbenzene	0.020	0.200		<0.025-<0.500	0.409	NA	NA	NA	NA	<1	NA	<1	NA	<1	<0.020	<1
p-Isopropyltoluene	0.020	0.200		<0.025-<0.500	1.69	NA	NA	NA	NA	<1	NA	<1	NA	<1	<0.020	<1
n-Propylbenzene	0.020	0.200		<0.025-<0.500	0.920	NA	NA	NA	NA	<1	NA	<1	NA	<1	<0.020	<1

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with an unweathered middle distillate fuel.

TABLE D-4. POL CATCHMENT ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: POL Catchment (LF03)
Matrix: Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples								Field Blanks			Lab Blanks	
					SD01	SD02 & SD08 (Replicates)		SD03-1	SD04-1	SD05	SD06	SD07	AB01	EB03	TB03		
Laboratory Sample ID Numbers					4216-11 4212-3	4219-13	4219-12	4215-5	4215-1	4215-4	4219-11	4213-3 4219-10	4173-9 4197-6	4213-4 4215-6	4211-2	4215 4213 4211	4219 4216 4215 4213 4212
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	8.55-1,150	2,250	1,940	2,460	2,610	28,600	10,700	268[e]	15.2J[d]	NA	<100	NA	<100	<4.00
GRPH	0.400	0.400-0.600	100	<0.4-<9.0	12.7	<0.500	0.429	6.30	78.5	67.9	<0.600	<0.400	NA	<20	NA	<20	<0.400
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	1.15	<0.100	<0.100	0.161	4.309	6.282	<0.150	<0.100					
Benzene	0.020	0.020-0.070	0.5	<0.020-<0.300	<0.070	<0.020	<0.020	<0.02	<0.035	<0.04	<0.030	<0.020	<2	<1	<1	<1	<0.020
Toluene	0.020	0.020-0.070		<0.020-<0.300	<0.070	<0.020	<0.020	<0.02	0.116B	0.108B	<0.030	<0.020	1.2	3.2	<1[c]	<1	<0.020
Ethylbenzene	0.020	0.020-0.070		<0.020-<0.300	0.323	<0.020	<0.020	0.034	0.739	0.982	<0.030	<0.020	<1	<1	<1[c]	<1	<0.020
Xylenes (Total)	0.040	0.040-0.140		<0.040-<0.600	0.827	<0.040	<0.040	0.127	3.57	5.30	<0.060	<0.040	<2	<2	<2[c]	<2	<0.040
VOC 8010	0.020	0.020-0.070		<0.020-<0.300	<0.070	<0.020	<0.020	NA	NA	NA	<0.030	<0.020	<1-9.8	NA	NA	<1	<0.020
VOC 8260																	
n-Butylbenzene	0.020	0.120-0.400		<0.025-<0.500	0.635	NA	NA	NA	NA	NA	NA	<0.120 J	<1	<1	<1	<1	<0.020
Methylene Chloride	0.020	0.120-0.400	90	<0.025-<0.500	<0.400	NA	NA	NA	NA	NA	NA	0.255JB	1.1	2.4	<1	<1	<0.020
Tetrachloroethene	0.020	0.120-0.400		<0.025-<0.500	<0.400	NA	NA	NA	NA	NA	NA	5.42J	<1	<1	<1	<1	<0.020
1,2,4-Trimethylbenzene	0.020	0.120-0.400		<0.025-<0.500	0.638	NA	NA	NA	NA	NA	NA	<0.120 J	<1	<1	<1	<1	<0.020
1,3,5-Trimethylbenzene	0.020	0.120-0.400		<0.025-<0.500	0.536	NA	NA	NA	NA	NA	NA	0.379J	<1	<1	<1	<1	<0.020

☐ CT&E Data.
NA Not analyzed.
B The analyte was detected in the associated blank samples.
J Result is an estimate.
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.
e The laboratory reported that 183 mg/kg of the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE D-4. POL CATCHMENT ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Sediment
Site: POL Catchment (LF03)   Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples								Field Blanks			Lab Blanks	
					SD01	SD02 & SD08 (Replicates)		SD03-1	SD04-1	SD05	SD06	SD07	AB01	EB03	TB03		
Laboratory Sample ID Numbers					4216-11 4212-3	4219-13	4219-12	4215-5	4215-1	4215-4	4219-11	4213-3 4219-10	4173-9 4197-6	4213-4 4215-6	4211-2	4215 4213 4211	4219 4216 4215 4213 4212
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
SVOC 8270																	
2-Methylnaphthalene	0.200	0.460-1.00		<0.23<3.5	3.44 J	NA	NA	NA	NA	NA	NA	<0.460					
TOC				32,000-199,000	NA	NA	NA	NA	NA	NA	NA	19,500	NA	<5,000	NA	<5,000	NA

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.

TABLE D-4. POL CATCHMENT ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Sediment
Site: POL Catchment (LF03) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks		Lab Blanks	
					2SD09	2SD10			AB02	EB06		
Laboratory Sample ID Numbers					1678	1680			315 4303-1	1688/1690	#5-9693 #3&4-82493 #1&2-9493	#3&4-9693
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg			µg/L	µg/L	µg/L	mg/kg
DRPH	5-20	50-200	500[a]	9.55-1,150	<200J[b]	<50J[b]			NA	<1,000J[b]	<1,000J	NA
GRPH	0.2-0.8	2-8	100	<0.400-<9.0	<8J[b]	<2J[b]			<100J[b]	<50J[b]	<50J	<2J
RRPH (Approx.)	10-40	100-400	2,000[a]	<480	<400	<100			NA	<1,000	<2,000	NA
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.44	<0.10						
Benzene	0.002-0.008	0.02-0.08	0.5	<0.020-<0.300	<0.08	<0.02			<1	<1	<1	<0.02
Toluene	0.002-0.008	0.02-0.08		<0.020-<0.300	<0.08	<0.02			<1	<4J	<1	<0.02
Ethylbenzene	0.002-0.008	0.02-0.08		<0.020-<0.300	<0.08	<0.02			<1	<2J	<1	<0.02
Xylenes (Total)	0.004-0.02	0.04-0.2		<0.040-<0.600	<0.2	<0.04			<2	<5J	<2	<0.04

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE D-4. POL CATCHMENT ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island — Matrix: Surface Water
Site: POL Catchment (LF03) — Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks
					SW01	SW02	SW03		AB01	EB03	TB03	
Laboratory Sample ID Numbers					4216-6 4212-4	4219-8	4213-2 4219-9		4173-9 4197-6	4213-4 4215-6	4211-2	4219/4216 4215/4213 4212/4211
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L		µg/L	µg/L	µg/L	µg/L
DRPH	100	100		<200	612[ad]	1,770[ad]	1,200[ad]		NA	<100	NA	<100
GRPH	20	20		<20	367[a]	<20	<20		NA	<20	NA	<20
BTEX (8020/8020 Mod.)												
Benzene	1	1	5	<1	2.7	<1	<1		<1	<1	<1[c]	<1
Toluene	1	1	1,000	<1	<1	<1	<1		1.2	3.2	<1[c]	<1
Ethylbenzene	1	1	700	<1	19	<1	<1		<1	<1	<1[c]	<1
Xylenes (Total)	1	1	10,000	<2	38.4	<2	<2		<2	<2	<2[c]	<2
VOC 8010												
1,2-Dichloroethane	1	1	5	1.3B-2.8B	4.6B	NA	NA		1.2	NA	NA	<1
VOC 8260												
Benzene	1	1	5	<1	2.5	NA	<1		<1	<1	<1	<1
n-Butylbenzene	1	1		<1	2.4	NA	<1		<1	<1	<1	<1
sec-Butylbenzene	1	1		<1	1.0	NA	<1		<1	<1	<1	<1
1,2-Dichloroethane	1	1	5	3U-3.2B	3.9B	NA	4.4B		1.6	2.2	<1	<1
Ethylbenzene	1	1	700	<1	18	NA	<1		<1	<1	<1	<1

☐ CT&E Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
U Compound is not present above the concentration listed.
a Total petroleum hydrocarbons in these water samples exceed the 15 µg/L stated for fresh water in ADEC's Water Quality Criteria 18 AAC 70 (ADEC 1989).
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with an unweathered middle distillate fuel.

TABLE D-4. POL CATCHMENT ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Surface Water
Site: POL Catchment (LF03) Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks
					SW01	SW02	SW03		AB01	EB03	TB03	
Laboratory Sample ID Numbers					4216-6 4212-4	4219-8	4213-2 4219-9		4173-9 4197-6	4213-4 4215-6	4211-2	4219/4216 4215/4213 4212/4211
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L		µg/L	µg/L	µg/L	µg/L
Isopropylbenzene	1	1		<1	2.9	NA	<1		<1	<1	<1	<1
p-Isopropyltoluene	1	1		<1	2.1	NA	<1		<1	<1	<1	<1
Naphthalene	1	1		<1	35	NA	<1		<1	<1	<1	<1
n-Propylbenzene	1	1		<1	3.6	NA	<1		<1	<1	<1	<1
1,2,4-Trimethylbenzene	1	1		<1	19	NA	<1		<1	<1	<1	<1
1,3,5-Trimethylbenzene	1	1		<1	13	NA	<1		<1	<1	<1	<1
Xylenes (Total)	2	2	10,000	<2	33.3	NA	<2		<2	<2	<2	<2
SVOC 8270	10	10-11		<10	<10.6-<11	NA	<10		NA	<10	NA	<10
TOC	5,000	5,000		<5,000-12,700	48,100	NA	21,000		NA	<5,000	NA	<5,000
TSS	100	100		<30,000-8,000	71,000	NA	12,000		NA	NA	NA	<100-<200
TDS	10,000	10,000		<352,000-328,000	847,000	NA	637,000		NA	NA	NA	<10,000

☐ CT&E Data.
NA Not analyzed.

TABLE D-5. CURRENT LANDFILL ANALYTICAL DATA SUMMARY

Installation: Barter Island
Site: Current Landfill (LF04)
Matrix: Soil/Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks	
					S01	S02	SD01	SD02	AB02	EB04	TB04		
Laboratory Sample ID Numbers					326	1334	1336 4286-3	1338 4286-4	315 4303-1	311 4302-10	1346 4302-9	#3&4-82493 #3&4-83193 4303 4302	#6-83193 #5-82493 #3&4-82493 #1&2-83193 428
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	6-55	60-550	500[a]	9.55-1,150	<70J[b]	<340[b]	<550[b]	60[b]	NA	NA	NA	NA	<50-<70J
GRPH	0.2-1	2-10	100	<0.4-<9	<2J[b]	<10J[b]	<6J[b]	<2J[b]	<100J[b]	<100J[b]	<100J[b]	<100J	<2J
RRPH (Approx.)	12-56	120-560	2,000[a]	<480	<140	<560	<340	<120	NA	NA	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<1.5	<0.5	<0.28	<0.15					
Benzene	0.003-0.01	0.03-0.1	0.5	<0.020-<0.300	<0.03	<0.1	<0.06	<0.03	<1	<1	<1	<1	<0.02
Toluene	0.003-0.01	0.03-0.1		<0.020-<0.300	<0.03	<0.1	<0.06	<0.03	<1	<1	<1	<1	<0.02
Ethylbenzene	0.003-0.01	0.03-0.1		<0.020-<0.300	<0.03	<0.1	<0.06	<0.03	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.006-0.02	0.06-0.2		<0.040-<0.600	<0.06	<0.2	<0.1	<0.06	<2	<2	<2	<2	<0.04
HVOC 8010	0.003-0.01	0.03-0.1		<0.5J	<0.03J	<0.1J	<0.06J	<0.03J	<1	<1	<1J	<1	NA
VOC 8260													
Toluene	0.020	0.200		<0.025-<0.500	NA	NA	<0.200	0.026	<1	<1	<1	<1	<0.020
SVOC 8270	0.200	0.200		<0.230-<3.50	NA	NA	<0.200	<0.200	NA	<25-75	NA	<10	<0.200
PCBs	0.01-0.07	0.1-0.7	10	<0.020-<0.100	<0.5-<0.7	<0.1	<0.1	<0.1	NA	NA	NA	NA	<0.1-<0.5
TOC				32,000-199,000	NA	NA	198,000	2,860	NA	<5,000	NA	<5,000	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE D-5. CURRENT LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island — Matrix: Soil/Sediment
Site: Current Landfill (LF04) — Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples 2SD03	Environmental Samples 2SD04	Field Blanks AB03	Field Blanks EB08	Lab Blanks	
Laboratory Sample ID Numbers					1742 4616-15	1744 4616-16	1712	1719/1720 4616-13	#5-9693 #1&2-9693 #1&2-9493 4616	#6-9593 #1&2-9693 #1&2-9793 4616
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00-6	18.3-60	500	9.55-1,150	<18.3[cd]	<60[b]	NA	<1,000J[b]	<1,000J	<50
GRPH	0.400-0.2	0.400-2	100	<0.400-<9.0	<0.400[c]	8J[b]	<50J[b]	<50J[b]	NA	<0.400-<1J
RRPH (Approx.)	12-64	120-640	2,000[a]	<480	<640	<120	NA	<2,000	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	0.2J	<0.10				
Benzene	0.002-0.01	0.02-0.1	0.5	<0.020-<0.300	<0.1	<0.02	<1	<1	NA	<0.02
Toluene	0.002-0.01	0.02-0.1		<0.020-<0.300	<0.1	<0.02	<3J	<1J	NA	<0.02
Ethylbenzene	0.002-0.01	0.02-0.1		<0.020-<0.300	<0.1	<0.02	<2J	<1	NA	<0.02
Xylenes (Total)	0.004-0.02	0.04-0.2		<0.040-<0.600	0.2J	<0.04	<5J	<2	NA	<0.04
HVOC 8010	0.01-0.05	0.1-0.5		<0.5J	<0.5J	<0.1J	<9J	<5J	NA	<0.1J-<10J
VOC 8260	0.020	0.020		<0.025-<0.500	<0.020	<0.020	NA	<1-6.6	<1	<0.020

- ☐ CT&E Data.
- ▩ F&B Data.
- NA Not analyzed.
- J Result is an estimate.
- a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
- b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
- c Sample was analyzed by F&B also; DRPH and GRPH were detected at <310[b] and <5J[b] mg/kg, respectively.
- d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE D-5. CURRENT LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Current Landfill (LF04)
Matrix: Sediment
Units: mg/kg
METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples					Field Blank			Lab Blanks
					SD01	SD02					EB04		
Laboratory Sample ID Numbers					4286-3	4286-4					4302-10		4286 4302
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L		µg/L
Aluminum	0.35	2		1,500-25,000	7,500	1,900					<100		<100
Antimony	N/A	55-260		<7.8-<230	<260	<55					<100		<100
Arsenic	0.11	5.5-26		<4.9-8.5	<26	<5.5					<100		<100
Barium	0.024	1-30		27-390	120	<30					<50		<50
Beryllium	N/A	2.8-13		<2.6-6.4	<13	<2.8					<50		<50
Cadmium	0.33	2.8-13		<3.0-<36	<13	<2.8					<50		<50
Calcium	0.69	4		360-59,000	10,000	7,200					<200		<200
Chromium	0.066	1-13		<4.3-47	<13	3.4					<50		<50
Cobalt	N/A	5.5-26		<5.1-12	<26	<5.5					<100		<100
Copper	0.045	1		<2.7-45	18	9.9					<50		<50
Iron	0.50	2		5,400-35,000	17,000	4,700					<100		<100
Lead	0.13	2-26		<5.1-22	<26	6.1					<100		<100
Magnesium	0.96	4		360-7,400	2,800	3,800					<200		<200
Manganese	0.025	1		25-290	380	40					<50		<50
Molybdenum	N/A	2.8-13		<2.5-<11	<13	<2.8					<50		<50
Nickel	0.11	1		4.2-46	16	4.6					<50		<50
Potassium	23	280-1,300		<300-2,200	<1,300	<280					<5,000		<5,000
Selenium	1.2	5.6-26		<7.8-<170	<26	<5.6					<100		<100

☐ CT&E Data.
N/A Not available.

TABLE D-5. CURRENT LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Current Landfill (LF04)
Matrix: Sediment
Units: mg/kg
METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples					Field Blank			Lab Blanks
					SD01	SD02					EB04		
Laboratory Sample ID Numbers					4286-3	4286-4					4302-10		4286 4302
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L		µg/L
Silver	0.53	2.8-13		<3-<100	<13	<2.8					<50		<50
Sodium	0.55	5		<160-680	870	89					<250		<250-267
Thallium	0.11	0.26-1.3		<0.2-<1.2	<1.3	<0.26					<5		<5
Vanadium	0.036	1		6.3-59	21	6.3					<50		<50
Zinc	0.16	1		9.2-95	65	31					<50		<50

☐ CT&E Data.

TABLE D-5. CURRENT LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Surface Water
Site: Current Landfill (LF04) Units: μg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples		Field Blanks			Lab Blanks
					SW01	SW02	AB02	EB04	TB04	
Laboratory Sample ID Numbers					1324/1326 4286-1	1328/1330 4286-2	315 4303-1	332 4302-10	1346 4302-9	#5-83193 #5-9693 #3&4-83193 #3&4-82493 4303/4302 4286
ANALYSES	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L
DRPH	100	1,000		<200	<1,000[b]	<1,000[b]	NA	NA	NA	<1,000J
GRPH	10	100		<20	<100J[b]	<100J[b]	<100J[b]	<100J[b]	<100J[b]	<100J
RRPH (Approx.)	200	2,000		NA	<2,000	<2,000	NA	NA	NA	<2,000
BTEX (8020/8020 Mod.)										
Benzene	0.1	1	5	<1	<1	<1	<1	<1	<1	<1
Toluene	0.1	1	1,000	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	0.1	1	700	<1	<1	<1	<1	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<1	<2	<2	<2	<2	<2	<2
HVOC 8010										
Trichloroethene	0.1	1	5	NA	<1J	36J	<1	<1	<1J	<1J
VOC 8260										
1,2-Dichloroethane	1	1	5	3U-3.2B	2.6B	2.7B	6.3	1.5	<1	<1
Dichlorodifluoromethane	1	1		<1	<1	3.7	<1	<1	<1	<1

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
J Result is an estimate.
U Compound is not present above the concentration listed.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE D-5. CURRENT LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Surface Water
Site: Current Landfill (LF04)   Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples		Field Blanks			Lab Blanks
					SW01	SW02	AB02	EB04	TB04	
Laboratory Sample ID Numbers					1324/1326 4286-1	1328/1330 4286-2	315 4303-1	332 4302-10	1346 4302-9	#5-83193 4303/4302 4286
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
p-Isopropyltoluene	1	1		<1	<1	1.1	<1	<1	<1	<1
Toluene	1	1	1,000	<1	<1	1.3B	2.2	2.3	<1	<1
Trichloroethene	1	1	5	<1	<1	6	<1	<1	<1	<1
SVOC 8270	10	22		<10	<22	<22	NA	<25-75	NA	<10
PCBs	0.2	2	0.5	<1	<2	<2	NA	NA	NA	NA
TOC	5,000	5,000		<5,000-12,700	23,400	26,600	NA	<5,000	NA	<5,000
TSS	100	200		<30,000-8,000	156,000	22,000	NA	NA	NA	<200
TDS	10,000	10,000		<352,000-328,000	905,000	614,000	NA	NA	NA	<10,000

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
B The analyte was detected in the associated blank.

TABLE D-5. CURRENT LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island — Matrix: Surface Water
Site: Current Landfill (LF04) — Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks
					2SW01	2SW02	2SW03	AB03	EB06	EB08	
Laboratory Sample ID Numbers					1669	1670	1747/1748 4616-14	1712	1688/1690	1719/1720 4616-13	#5-9693 #1&2-9793 #1&2-9493 4616
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
DRPH	100	1,000		<200	<1,000[b]	<1,000[b]	<1,000J[b]	NA	<1,000J[b]	<1,000J[b]	<1,000J
GRPH	5	50		<20	NA	NA	<50J[b]	<50J[b]	<100J[b]	<50J[b]	<2J-<50
RRPH (Approx.)	200	2,000		NA	<2,000	<2,000	<2,000	NA	<2,000	<2,000	<2,000
BTEX (8020/8020 Mod.)											
Benzene	0.1	1	5	<1	NA	NA	<1	<1	<1	<1	<1-<5
Toluene	0.1	1	1,000	<1	NA	NA	<1	<3J	<4J	<1J	<1
Ethylbenzene	0.1	1	700	<1	NA	NA	<1	<2J	<2J	<1	<1
Xylenes (Total)	0.2	2	10,000	<1	NA	NA	<2	<5J	<5J	<2	<2
HVOC 8010											
Trichloroethene	0.1	1	5	NA	NA	NA	8J	<1	<1	<1J	<1-<10J
VOC 8260	1	1		<1-3.2B	NA	NA	<1	NA	NA	<1-6.6	<1

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
J Result is an estimate.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE D-5. CURRENT LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Current Landfill (LF04)
Matrix: Surface Water
Units: µg/L
METAL ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples					Field Blank			Lab Blanks
					SW01	SW02					EB04		
Laboratory Sample ID Numbers					4286-1	4286-2					4302-10		4286 4302
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L		µg/L
Aluminum	17.4	100		<100-350 (<100-340)	<740J (<100)J	<100 (<100)					<100		<100 (<100)
Antimony	N/A	100	6	<100 (<100)	<100J (<100)J	<100 (<100)					<100		<100 (<100)
Arsenic	5.3	100	50	<100 (<100)	<100J (<100)J	<100 (<100)					<100		<100 (<100)
Barium	1.2	50	2,000	<50-93 (<50-91)	150J (61)J	<50 (<50)					<50		<50 (<50)
Beryllium	N/A	50	4	<50 (<50)	<50J (<50)J	<50 (<50)					<50		<50 (<50)
Cadmium	1.7	50	5	<50 (<50)	<50J (<50)J	<50 (<50)					<50		<50 (<50)
Calcium	34.5	200		4,500-88,000 (4,100-86,000)	120,000J (120,000)J	58,000 (59,000)					<200		<200 (<200)
Chromium	3.29	50	100	<50 (<50)	<50J (<50)J	<50 (<50)					<50		<50 (<50)
Cobalt	N/A	100		<100 (<100)	<100J (<100)J	<100 (<100)					<100		<100 (<100)
Copper	2.3	50	1,300	<50 (<50)	<50J (<50)J	<50 (<50)					<50		<50 (<50)
Iron	25	100		180-2,800 (<100-1,600)	21,000J (890)J	2,400 (2,200)					<100		<100 (<100)

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE D-5. CURRENT LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Current Landfill (LF04)

Matrix: Surface Water
Units: µg/L

METAL ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples					Field Blank			Lab Blanks
					SW01	SW02					EB04		
Laboratory Sample ID Numbers					4286-1	4286-2					4302-10		4286 4302
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L		µg/L
Lead	6.6	10-100	15	<100 (<100)	<10J (<100)J	<100 (<100)					<100		<100 (<100)
Magnesium	47.8	200		<5,000-53,000 (2,600-54,000)	41,000J (41,000)J	29,000 (28,000)					<200		<200 (<200)
Manganese	1.24	50		<50-510 (<50-120)	1,800J (260)J	150 (150)					<50		<50 (<50)
Molybdenum	N/A	50		<50 (<50)	<50J (<50)J	<50 (<50)					<50		<50 (<50)
Nickel	5.5	50	100	<50 (<50)	<50J (<50)J	<50 (<50)					<50		<50 (<50)
Potassium	1,154	500		<5,000 (<5,000)	5,200J (<5,000)J	12,000 (10,000)					<5,000		<5,000 (<5,000)
Selenium	62.4	100	50	<100 (<100)	<100J (<100)J	<100 (<100)					<100		<100 (<100)
Silver	2.6	50	50	<50 (<50)	<50J (<50)J	<500 (<50)					<50		<50 (<50)
Sodium	27.7	250		8,400-410,000 (8,200-450,000)	100,000J (100,000)J	100,000 (87,000)					<250		267
Thallium	0.57	5	2	<5 (<5)	<5J (<5)J	<5 (<5)					<5		<5 (<5)
Vanadium	1.8	50		<50 (<50)	<50J (<50)J	<50 (<50)					<50		<50 (<50)
Zinc	8.2	50		<50-160 (<50)	<50J (<50)J	<50 (<50)					<50		<50 (<50)

☐ CT&E Data.
N/A Not analyzed.
J Result is an estimate.

TABLE D-6. CONTAMINATED DITCH ANALYTICAL DATA SUMMARY

Installation: Barter Island Matrix: Soil
Site: Contaminated Ditch (SD08) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples								Field Blanks			Lab Blanks	
					S01-3 & S10-3 (Replicates)		S02-3	S03-3.5	S04-2.5	S05-3	S06-2	S07-3	AB01	EB01	TB02		
Laboratory Sample ID Numbers					4199-9	4199-8	4203-7	4199-10	4199-12	4199-11	4216-2	4216-1	4173-9	4175-3	4179-5	4203 4199 4197	4199 4203 4216
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	9.55-1,150	691	535	2,260	7.03	234	742[c]	743[e]	22.4[d]	NA	<200	NA	<200	<4.00
GRPH	0.400	0.400	100	<0.4-<9	134	171	133	<0.400	163	9.84	23.8	<0.400	NA	<20	NA	<20	<0.400
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	7.14	9.00	1.367	0.099	15.54	1.629	<0.852	<0.100					
Benzene	0.020	0.020-0.200	0.5	<0.020-<0.300	<0.100	<0.200	<0.020	<0.020	<0.100	<0.100	<0.080	<0.020	<1	<1	<1	<1	<0.020
Toluene	0.020	0.020-0.200		<0.020-<0.300	0.885B	0.182JB	0.210B	0.024B	0.874B	<0.100	0.532B	<0.020	1.2	<1	<1	<1	<0.020
Ethylbenzene	0.020	0.020-0.200		<0.020-<0.300	1.59	2.14	0.113	0.027	3.01	0.279	<0.080	<0.020	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.040-0.400		<0.040-<0.600	5.55	6.86	1.254	0.072	12.53	1.35	<0.160	<0.040	<2	<2	<2	<2	<0.040
VOC 8010	0.020	0.020-0.100		<0.020-<0.300	<0.075	<0.100	<0.020	<0.020	<0.020	<0.020	NA	NA	<1-9.8	<1-2.5	<1	<1	<0.020

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
B The analyte was detected in the associated blank.
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.
c The laboratory reported that 213 mg/kg of the EPH pattern in this sample was not consistent with a middle distillate fuel.
d The laboratory reported that 19.9 mg/kg of the EPH pattern in this sample was not consistent with a middle distillate fuel.
e The laboratory reported that the EPH pattern in this sample was not consistent with an unweathered middle distillate fuel.

TABLE D-6. CONTAMINATED DITCH ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Soil
Site: Contaminated Ditch (SD08) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples						Field Blanks		Lab Blanks	
					2S11-3.5	2S12-4.5	2S13-3.5 & 2S14-3.5 (Replicates)		2S15-4	2S16-1	AB03	EB07		
Laboratory Sample ID Numbers					1730	1732	1734	1736	1738	1740	1712	1715 1716 4616-9	#5-9693 4616	#6-9593 #1&2-9693
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	mg/kg
DRPH	6	60	500[a]	9.55-1,150	<60[b]	<60[b]	<60[b]	<60[b]	<60[b]	<60[b]	NA	<200[c]	<200	<50
GRPH	0.1	1	100	<0.400-<9.0	<1J[b]	<1J[b]	<1J[b]	<1J[b]	<1J[b]	<1J[b]	<50J[b]	<20[c]	<20	<1J
RRPH (Approx.)	12	120	2,000[a]	<480	<120	<120	<120	<120	<120	<120	NA	<1,000	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10				
Benzene	0.002	0.02	0.5	<0.020-<0.300	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<1	<1	NA	<0.02
Toluene	0.002	0.02		<0.020-<0.300	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<3J	<2J	NA	<0.02
Ethylbenzene	0.002	0.02		<0.020-<0.300	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<2J	<1	NA	<0.02
Xylenes (Total)	0.004	0.04		<0.040-<0.600	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<5J	<2	NA	<0.04

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c This sample was analyzed by F&B also; DRPH and GRPH were detected at <1,000J[b] and <50J[b] µg/L, respectively.

TABLE D-6. CONTAMINATED DITCH ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Sediment
Site: Contaminated Ditch (SD08)   Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples						Field Blanks			Lab Blanks	
					SD01	SD02	SD03	SD04	SD05 & SD09 (Replicates)		AB01	EB01	TB01		
Laboratory Sample ID Numbers					4198-8 4178-3	4198-9	4198-10	4198-11	4198-12 4173-6	4198-13 4178-4	4173-9 4197-6	4203-8 4175-3	4197-7 4173-10	4173 4175 4203	4173 4178 4198
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	9.55-1,150	<4.00	<4.00	<4.00	7.14[c]	4.27	7.46	NA	<200	NA	<200	<4.00
GRPH	0.400	0.400-2.00	100	<0.4-<9	2.97	<0.400	<0.400	<0.400	<2.00	4.05	NA	<20	NA	<20	<0.400
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100					
Benzene	0.020	0.020	0.5	<0.020-<0.300	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<1	<1	<1	<1	<0.020
Toluene	0.020	0.020		<0.020-<0.300	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	1.2	<1	<1	<1	<0.020
Ethylbenzene	0.020	0.020		<0.020-<0.300	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.040		<0.040-<0.600	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<2	<2	<2	<2	<0.040
VOC 8260	0.020	0.020-0.025		<0.025-<0.500	<0.020	NA	NA	NA	<0.025	<0.020	<1-1.9	<1J-4.4J	<1	<1	<0.025
SVOC 8270	0.200	0.200-1.00		<0.23-<3.5	NA	NA	NA	NA	<0.200-<1.00	<0.230	NA	<10	NA	<10	<0.200
TOC				32,000-199,000	2,780	NA	NA	NA	1,670	2,900	NA	7,800	NA	<5,000	NA

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.
c The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE D-6. CONTAMINATED DITCH ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Contaminated Ditch (SD08)
Matrix: Sediment
Units: mg/kg
METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank			Lab Blanks
					SD01	SD05 & SD09 (Replicates)						EB01		
Laboratory Sample ID Numbers					4178-3	4173-6	4178-4					4175-3		4178 4175 4173
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L		µg/L
Aluminum	0.35	2-2,800		1,500-25,000	<2,800	2,400	2,500					<100		<100
Antimony	N/A	54-57		<7.8-<230	<54	<57	<57					<100		<100
Arsenic	0.11	5.4-5.7		<4.9-8.5	<5.4	<5.7	<5.7					<100		<100
Barium	0.024	1		27-390	27	32	44					<50		<50
Beryllium	N/A	1-2.7		<2.6-6.4	<2.7	3.2	2.8					<50		<50
Cadmium	0.33	1-2.8		<3.0-<36	<2.7	<2.8	2.8					<50		<50
Calcium	0.69	4		360-59,000	12,300	5,000	6,900					<200		<200
Chromium	0.066	1		<4.3-<47	4.4	5.3	4.0					<50		<50
Cobalt	N/A	1-57		<5.1-12	<5.4	<57	5.7					<100		<100
Copper	0.045	1		<2.7-45	4.7	5.8	4.1					<50		<50
Iron	0.50	2		5,400-35,000	9,800	12,000	8,700					<100		<100
Lead	0.13	5.4-5.7		<5.1-22	<5.4	<5.7	<5.7					<100		<100
Magnesium	0.96	4		360-7,400	2,600J	1,400	2,300					<200		<200
Manganese	0.025	1		25-290	98J	250	160					<50		<50
Molybdenum	N/A	2.9-5.7		<2.5-<11	<5.4	<2.9	<5.7					<50		<50
Nickel	0.11	1		4.2-46	7.6	6.6	6.1					<50		<50
Potassium	23	100		<300-2,200	440	336	370					<5,000		<5,000

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE D-6. CONTAMINATED DITCH ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island　　Matrix: Sediment　　METALS ANALYSES
Site: Contaminated Ditch (SD08)　　Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank			Lab Blanks
					SD01	SD05 & SD09 (Replicates)						EB01		
Laboratory Sample ID Numbers					4178-3	4173-6	4178-4					4175-3		4178 4175 4173
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L		µg/L
Selenium	1.2	2-5.7		<7.8-<170	<5.4	57	<5.7					<100		<100
Silver	0.53	2.7-2.9		<3-<110	<2.7	<2.9	<2.8					<50		<50
Sodium	0.55	5		<160-680	80	72	65					<250		<250
Thallium	0.011	0.28		<0.2-<1.2	<0.28J	<0.28	<0.28					<5		<5
Vanadium	0.036	1		6.3-59	7.8	8.4	7.7					<50		<50
Zinc	0.16	1		9.2-95	20J	27	27					<50		<50

☐ CT&E Data.
J Result is an estimate.

TABLE D-6. CONTAMINATED DITCH ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Contaminated Ditch (SD08)

Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks
					SW01	SW02	SW03	SW04 & SW08 (Duplicates)		AB01	EB02	TB01	
Laboratory Sample ID Numbers					4178-2 4197-1	4197-2	4197-3	4175-1 4197-4	4173-1 4197-5	4173-9 4197-6	4179-1 4206-4	4197-7 4173-10	4206 4197 4178 4175 4173
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
DRPH	100	200		<200	<200	<200	<200	<200	<200	NA	<100	NA	<100
GRPH	20	20		<20	<20	<20	<20	<20	<20	NA	<20	NA	<20
BTEX (8020/8020 Mod.)													
Benzene	1	1-20	5	<1	<1	<1	<20	<1	<1	<1	<1	<1	<1
Toluene	1	1-20	1,000	<1	<1	<1	<20	<1	<1	1.2	<1	<1	<1
Ethylbenzene	1	1-20	700	<1	<1	<1	<20	<1	<1	<1	<1	<1	<1
Xylenes (Total)	2	2-40	10,000	<2	<2	<2	<40	<2	<2	<2	<2	<2	<2
VOC 8260													
1,2-Dichloroethane	1	1	5	3U-3.2B	5.4B	NA	NA	5.3B	4.4B	1.6	3.0	<1	<1
cis-1,2-Dichloroethene	1	1	70	<1	<1	NA	NA	1.4	1.5	<1	<1	<1	<1
SVOC 8270	10	10		<10	<10	NA	NA	<10	<10	NA	<11	NA	<10
TOC	5,000	5,000		<5,000-12,700	15,000	NA	NA	13,000	11,300	NA	NA	NA	<5,000
TSS	100	200		<30,000-8,000	57,000	NA	NA	6,000	8,000	NA	NA	NA	<200
TDS	10,000	10,000		<352,000-328,000	662,000	NA	NA	610,000	590,000	NA	NA	NA	12,000

☐ CT&E Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
U Compound is not present above the concentration listed.

TABLE D-6. CONTAMINATED DITCH ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Contaminated Ditch (SD08)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples							Field Blank		Lab Blanks
					SW01	SW04 & SW08 (Replicates)							EB01	
Laboratory Sample ID Numbers					4178-2	4175-1	4173-1						4179-1	4179 4178 4175 4173
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L	µg/L
Aluminum	17.4	100		<100-350 (<100-340)	1,900 (<100)	<100 (<100)	<100 (<100)						<100	<100 (<100)
Antimony	N/A	100	6	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)						<100	<100 (<100)
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)						<100	<100 (<100)
Barium	1.2	50	2,000	<50-93 (<50-91)	110 (82)	83 (79)	86 (78)						<50	<50 (<50)
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)						<50	<50 (<50)
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)						<50	<50 (<50)
Calcium	34.5	100		4,500-88,000 (4,100-86,000)	7,200 (71,000)	63,000 (65,000)	63,000 (61,000)						<200	<200 (<200)
Chromium	3.29	50	100	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)						<50	<50 (<50)
Cobalt	N/A	100		<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)						<100	<100 (<100)

☐ CT&E Data.
N/A Not available.

TABLE D-6. CONTAMINATED DITCH ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Surface Water METALS ANALYSES: TOTAL (DISSOLVED)
Site: Contaminated Ditch (SD08) Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples							Field Blank		Lab Blanks
					SW01	SW04 & SW08 (Replicates)							EB01	
Laboratory Sample ID Numbers					4178-2	4175-1	4173-1						4179-1	4179 4178 4175 4173
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L	µg/L
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)						<50	<50 (<50)
Iron	25	100		180-2,800 (<100-1,600)	4,200 (<100)	2,200 (180)	2,400 (<100)						<100	<100 (<100)
Lead	6.6	100	15	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)						<100	<100 (<100)
Magnesium	47.8	100		<5,000-53,000 (2,600-54,000)	31,000 (30,000)	27,000 (27,000)	27,000 (27,000)						<200	<200 (<200)
Manganese	1.24	100		<50-510 (50-120)	170 (100)	150 (130)	150 (120)						<50	<50 (<50)
Molybdenum	N/A	50		<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)						<50	<50 (<50)
Nickel	5.5	50	100	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)						<50	<50 (<50)
Potassium	1,154	5,000		<5,000 (<5,000)	<5,000 (<5,000)	<5,000 (<5,000)	<5,000 (<5,000)						<5,000	<5,000 (<5,000)
Selenium	62.4	100	50	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)						<100	<100 (<100)
Silver	2.6	50	50	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)						<50	<50 (<50)

☐ CT&E Data.
N/A Not available.

TABLE D-6. CONTAMINATED DITCH ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island — Matrix: Surface Water — METALS ANALYSES: TOTAL (DISSOLVED)
Site: Contaminated Ditch (SD08) — Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples							Field Blank		Lab Blanks
					SW01	SW04 & SW08 (Replicates)							EB01	
Laboratory Sample ID Numbers					4178-2	4175-1	4173-1						4179-1	4179 4178 4175 4173
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L	µg/L
Sodium	27.7	100		8,400-410,000 (8,200-450,000)	120,000 (96,000)	98,000 (91,000)	90,000 (85,000)						<250	<250 (<250)
Thallium	0.57	5	2	<5 (<5)	<5 (<5)	<5 (<5)	<5 (<5)						<5	<5 (<5)
Vanadium	1.8	50		<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)						<50	<50 (<50)
Zinc	8.2	50		<50-160 (<50)	<50 (<50)	<50 (<50)	<50 (<50)						<50	<50 (<50)

☐ CT&E Data.

TABLE D-7. OLD RUNWAY DUMP ANALYTICAL DATA SUMMARY

Installation: Barter Island Matrix: Soil
Site: Old Runway Dump (LF12) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples S01	Environmental Samples S02	Environmental Samples S03	Field Blanks AB02	Field Blanks EB05	Field Blanks TB05	Lab Blanks	Lab Blanks
Laboratory Sample ID Numbers					416 4305-10	412	414	315 4303-1	332 392 4303-5	375	#3&4-82493 #1&2-82493 4303	#6-82393 #1&2-82493 4305
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5	50	500[a]	9.55-1,150	<50J[b]	<50J[b]	<50J[b]	NA	<1000[b]	NA	NA	<50J
GRPH	0.2	2	100	<0.4-<9	<2J[b]	<2J[b]	<2J[b]	<100J[b]	<100J[b]	<50J[b]	<100J	<2J
RRPH (Approx.)	10	100	2,000[a]	<480	<100	<100	<100	NA	<1000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.10J	<0.10J	<0.10J					
Benzene	0.002	0.02	0.5	<0.020-<0.300	<0.02J	<0.02J	<0.02J	<1	<1	<1	<1	<0.02J
Toluene	0.002	0.02		<0.020-<0.300	<0.02	<0.02	<0.02	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002	0.02		<0.020-<0.300	<0.02	<0.02	<0.02	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004	0.04		<0.040-<0.600	<0.04	<0.04	<0.04	<2	<2	<2	<2	<0.04
HVOC (8010 Mod.)	0.002	0.02		<0.50J	<0.02J	<0.02J	<0.02J	<1	<1	<1	<1	<0.02J
VOC 8260	0.020	0.020		<0.025-<0.500	<0.02	NA	NA	<1-6.3	<1-3.2	NA	<1	<0.020
SVOC 8270	0.200	0.200-1.00		<0.230-<3.50	<0.200-<1.00	NA	NA	NA	<1	NA	<10	<0.200
PCBs	0.05	0.5	10	<0.020-<0.100	<0.5	<0.5	<0.5	NA	<10	NA	NA	<0.1-<0.5
Pesticides	0.001-0.05	0.01-0.5		<0.001-<0.100	<0.01J-<0.5J	NA	NA	NA	<0.2-<10	NA	NA	<0.01-<0.5
TOC				32,000-199,000	7,680	NA	NA	NA	<5,000J	NA	<5,000	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE D-7. OLD RUNWAY DUMP ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Site: Old Runway Dump (LF12)	Matrix: Soil Units: mg/kg			METALS ANALYSES											
Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installation	Environmental Samples							Field Blank			Lab Blanks
					S01								EB05		
Laboratory Sample ID Numbers					4305-10								4303-5		4305 4303
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg								µg/L		µg/L
Aluminum	0.35	2		1,500-25,000	1,700								<100		<100
Antimony	N/A	52		<7.8-<230	<52								<100		<100
Arsenic	0.11	5.2		<4.9-8.5	<5.2								<100		<100
Barium	0.024	1		27-390	16								<50		<50
Beryllium	N/A	2.6		<2.6-6.4	<2.6								<50		<50
Cadmium	0.33	2.6		<3.0-<36	<2.6								<50		<50
Calcium	0.69	4		360-59,000	2,200								<200		<200
Chromium	0.066	1		<4.3-4.7	4.5								<50		<50
Cobalt	N/A	5.2		<5.1-12	<5.2								<100		<100
Copper	0.045	1		<2.7-45	7.3								<50		<50
Iron	0.50	2		5,400-35,000	7,500								200		<100
Lead	0.13	5.2		<5.1-22	<5.2								<100		<100
Magnesium	0.96	4		360-7,400	1,100								<200		<200
Manganese	0.025	1		25-290	67								<50		<50
Molybdenum	N/A	2.6		<2.5-<11	<2.6								<50		<50
Nickel	0.11	1		4.2-46	5.3								<50		<50
Potassium	23	260		<300-2,200	<260								<5,000		<5,000

☐ CT&E Data.
N/A Not available.

TABLE D-7. OLD RUNWAY DUMP ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Runway Dump (LF12)

Matrix: Soil
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installation	Environmental Samples							Field Blank			Lab Blanks
					S01								EB05		
Laboratory Sample ID Numbers					4305-10								4303-5		4305 4303
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg								µg/L		µg/L
Selenium	1.2	52		<7.8-<170	<52								<100		<100
Silver	0.53	2.6		<3-<110	<2.6								<50		<50
Sodium	0.55	5		<160-680	410								<250		<250-267
Thallium	0.011	0.25		<0.2-<1.2	<0.25								<5		<5
Vanadium	0.036	1		6.3-59	5.1								<50		<50
Zinc	0.16	1		9.2-95	16								<50		<50

☐ CT&E Data.

TABLE D-8. HEATED STORAGE ANALYTICAL DATA SUMMARY

Installation: Barter Island
Site: Heated Storage (Building 87) (SS13)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blank	
					S01	S02	S03	S04	AB01	EB03A	TB03		
Laboratory Sample ID Numbers					4216-3	4212-5 4216-10	4219-5	4219-6	4173-9 4197-6	4211-1 4215-7	4211-2	4197/4173 4215/4211	4219/4216 4212
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	9.55-1,150	116[f]	3,580J[g]	1,290[d]	797[e]	NA	<100	NA	<100	<4.00
GRPH	0.400	0.400	100	<0.400-<9.0	<0.400	423	<0.400	3.65	NA	<20	NA	<20	<0.400
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	0.021	3.445N	<0.100	0.22					
Benzene	0.020	0.020	0.5	<0.020-<0.300	<0.020	<0.020	<0.020	<0.020	<1	<1	<1[c]	<1	<0.020
Toluene	0.020	0.020		<0.020-<0.300	<0.020	0.632N	<0.020	0.03	1.2	<1	<1[c]	<1	<0.020
Ethylbenzene	0.020	0.020		<0.020-<0.300	<0.020	0.283N	<0.020	0.03	<1	<1	<1[c]	<1	<0.020
Xylenes (Total)	0.040	0.040		<0.040-<0.600	0.021	2.53N	<0.040	0.16	<2	<2	<2[c]	<2	<0.040
VOC 8010	0.020	0.020		<0.020-<0.300	<0.020	<0.020	<0.020	<0.020	<1-9.8	NA	NA	<1	<0.020
VOC 8260													
1,3,5-Trimethylbenzene	0.020	0.020		<0.025-<0.500	NA	7.68	NA	NA	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.040		<0.050-<1.000	NA	0.124	NA	NA	<2	<2	<2	<2	<0.040
SVOC 8270	0.200	2.10		<0.230-<3.50	NA	<2.10	NA	NA	NA	<11	<1	<10	<0.200
PCBs													
Aroclor 1254	0.020	0.020	10	<0.020-<0.100	0.932	2.72	2.4	0.316	NA	<1	NA	<1	<0.010

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification".
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.
e The laboratory reported that 310 mg/kg of the EPH pattern in this sample was not consistent with a middle distillate fuel.
f The laboratory reported that the EPH pattern in this sample was not consistent with an unweathered middle distillate fuel.
g The laboratory reported that 1090 mg/kg of the EPH pattern in this sample was not consistent with an unweathered middle distillate fuel.

TABLE D-8. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island; Site: Heated Storage (Building 87) (SS13); Matrix: Soil; Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks		Lab Blanks	
					2S05-1	2S06-1	2S07-1	AB03	EB07		
Laboratory Sample ID Numbers					1724 4616-10	1726 4616-12	1728 4616-11	1712	1715 1716 4616-9	#3&4-82493 #1&2-9693 #5-9693 4616	#1&2-9693 #6-9593 4616
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00-60	500[a]	9.55-1,150	<60[b]	<4.00[c]	110J[b]	NA	<200[d]	<200	<50
GRPH	0.400	0.400-1	100	<0.4-<9	<1J[b]	<0.400[c]	6J[b]	<50J[b]	<20[d]	<20-<50J	<0.400-<1J
RRPH (Approx.)	12	120	2,000[a]	<480	2,400	<120	<120	NA	<1,000	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.10	<0.10	0.57J				
Benzene	0.002	0.02	0.5	<0.020-<0.300	<0.02	<0.02	<0.02	<1	<1	<1	<0.02
Toluene	0.002	0.02		<0.020-<0.300	<0.02	<0.02	<0.02	<3J	<2J	<1	<0.02
Ethylbenzene	0.002	0.02		<0.020-<0.300	<0.02	<0.02	0.07	<2J	<1	<1	<0.02
Xylenes (Total)	0.004	0.04		<0.040-<0.600	<0.04	<0.04	0.5J	<5J	<2	<2	<0.04
VOC 8260	0.020	0.020-0.070		<0.025-<0.500	<0.070	<0.020	<0.020	NA	<1-8.3	<1	<0.020

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c This sample was analyzed by F&B also; DRPH and GRPH were detected at <60[b] and <1J[b] mg/kg, respectively.
d This sample was analyzed by F&B also; DRPH and GRPH were detected at <1,000J[b] and <50[b] µg/L, respectively.

TABLE D-8. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island — Matrix: Sediment
Site: Heated Storage (Building 87) (SS13) — Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks	
					SD01	SD02	SD03	AB01	EB03A	TB03		
Laboratory Sample ID Numbers					4212-2 4216-5	4219-1	4219-4	4173-9 4197-6	4211-1 4215-7	4211-2	4197 4173 4215 4211	4219 4216 4212
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	9.55-1,150	770J[f]	36.5[d]	51.4[e]	NA	<100	NA	<100	<4.00
GRPH	0.400	0.400	100	<0.400-<9.0	0.653	<0.400	1.17	NA	<20	NA	<20	<0.400
BTEX (8020/8020 Mod.)			15 Total BTEX	<0.250-<1.500	0.321N	<0.100	0.48					
Benzene	0.020	0.020-0.025	0.5	<0.020-<0.300	<0.025	<0.020	<0.020	<1	<1	<1[c]	<1	<0.020
Toluene	0.020	0.020-0.025		<0.020-<0.300	<0.025	<0.020	0.23	1.2	<1	<1[c]	<1	<0.020
Ethylbenzene	0.020	0.020-0.025		<0.020-<0.300	0.028N	<0.020	<0.020	<1	<1	<1[c]	<1	<0.020
Xylenes (Total)	0.040	0.040-0.050		<0.040-<0.600	0.293N	<0.040	0.25	<2	<2	<2[c]	<2	<0.040
VOC 8010	0.020	0.020		<0.020-<0.300	NA	<0.020	<0.020	<1-9.8	NA	NA	<1	<0.020
VOC 8260												
Toluene	0.020	0.020		<0.025-<0.500	0.029	NA	NA	1.9	3.3	<1	<1	<0.020
Xylenes (Total)	0.040	0.040		<0.050-<1.000	0.052	NA	NA	<2	<2	<2	<2	<0.040

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification".
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.
e The laboratory reported that 40.2 mg/kg of the EPH pattern in this sample was not consistent with a middle distillate fuel.
f The laboratory reported that the EPH pattern in this sample was not consistent with an unweathered middle distillate fuel.

TABLE D-8. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Sediment
Site: Heated Storage (Building 87) (SS13) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks	
					SD01	SD02	SD03	AB01	EB03A	TB03		
Laboratory Sample ID Numbers					4212-2 4216-5	4219-1	4219-4	4173-9 4197-6	4211-1 4215-7	4211-2	4215 4211	4216 4212
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
SVOC 8270	0.200	1.00		<0.23-<3.5	<1.00	NA	NA	NA	<11	NA	<10	<0.200
PCBs												
Aroclor 1254	0.020	0.02-0.1	10	<0.020-<0.100	0.112	<0.1	<0.02	NA	<1	NA	<10	<0.020

☐ CT&E Data.
NA Not analyzed.

TABLE D-8. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Sediment
Site: Heated Storage (Building 87) (SS13) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks	
					SD06	SD07	SD08	AB01	EB01	TB02		
Laboratory Sample ID Numbers					4203-2	4203-3	4203-1	4173-9 4197-6	4203-8 4175-3	4179-5 4199-13	4203	4203
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	9.55-1,150	37.3	32.5	115	NA	<200	NA	<200	<4.00
GRPH	0.400	0.400	100	<0.400-<9.0	4.45	2.7	8.94	NA	<20	NA	<20	<0.400
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	0.043	<0.125	0.224					
Benzene	0.020	0.020-0.025	0.5	<0.020-<0.300	<0.020	<0.025	<0.020	<1	<1	<1	<1	<0.020
Toluene	0.020	0.020-0.025		<0.020-<0.300	<0.020	<0.025	<0.020	1.2	<1	<1	<1	<0.020
Ethylbenzene	0.020	0.020-0.025		<0.020-<0.300	<0.020	<0.025	0.045	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.040-0.050		<0.040-<0.600	0.043	<0.050	0.179	<2	<2	<2	<2	<0.040
VOC 8010	0.020	0.020-0.025		<0.020-<0.300	<0.020	<0.025	<0.020	<1-9.8	<1-2.5	<1	<1	<0.020
Pesticides (8080)	0.001	0.020		<0.001-<0.100	NA	NA	<0.02	NA	<1J	NA	<0.1-<1	<0.001

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.

TABLE D-8. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Heated Storage (Building 87) (SS13)
Matrix: Soil/Sediment
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank			Lab Blanks
					S02	SD01						EB03A		
Laboratory Sample ID Numbers					4212-5	4212-2						4211-1		4212 4211
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg						µg/L		µg/L
Aluminum	0.35	2		1,500-25,000	3,000	2,900						<100		<100
Antimony	N/A	53-54		<7.8-<230	<54	<53						<100		<100
Arsenic	0.11	5.3-5.4		<4.9-8.5	<5.4	<5.3						<100		<100
Barium	0.024	1		27-390	43	23						<50		<50
Beryllium	N/A	2.7		<2.6-6.4	<2.7	<2.7						<50		<50
Cadmium	0.33	1-2.7		<3.0-<36	<2.7	2.7						<50		<50
Calcium	0.69	4		360-59,000	14,000	5,100						<200		<200
Chromium	0.066	1		<4.3-47	17	11						<50		<50
Cobalt	N/A	5.3-5.4		<5.1-12	<5.4	<5.3						<100		<100
Copper	0.045	1		<2.7-45	12	7.5						<50		<50
Iron	0.50	2		5,400-35,000	9,600	8,000						<100		<100
Lead	0.13	2		<5.1-22	33	33						<100		<100
Magnesium	0.96	4		360-7,400	4,900	2,400						<200		<200
Manganese	0.025	1		25-290	96	56						<50		<50
Molybdenum	N/A	2.7		<2.5-<11	<2.7	<2.7						<50		<50
Nickel	0.11	1		4.2-46	7.9	6.6						<50		<50
Potassium	23	100		<300-2,200	580	360						<5,000		<5,000
Selenium	1.2	53-54		<7.8-<170	<54	<53						<100		<100

☐ CT&E Data.
N/A Not available.

TABLE D-8. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Heated Storage (Building 87) (SS13)
Matrix: Soil/Sediment
Units: mg/kg
METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank			Lab Blanks
					S02	SD01						EB03A		
Laboratory Sample ID Numbers					4212-5	4212-2						4211-1		4212 4211
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg						µg/L		µg/L
Silver	0.53	2.7		<3-<110	<2.7	<2.7						<50		<50
Sodium	0.55	5		<160-680	60	38						<250		<250
Thallium	0.011	<0.27		<0.2-<1.2	<0.27	<0.27						<5		<5
Vanadium	0.036	1		6.3-59	9.1	14						<50		<50
Zinc	0.16	1		9.2-95	180	500						<50		<50

☐ CT&E Data.

TABLE D-8. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island — Matrix: Surface Water
Site: Heated Storage (Building 87) (SS13) — Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks
					SW01	SW02			AB01	EB03A	TB03	
Laboratory Sample ID Numbers					4212-1 4216-4	4213-1 4219-7			4173-9 4197-6	4211-1 4215-7	4211-2	4219 4216/4213 4212/4211 4197/4173
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L			µg/L	µg/L	µg/L	µg/L
DRPH	100	100		<200	5,760[a]	1,300[ad]			NA	<100	NA	<100
GRPH	20	20		<20	<20	6.9[a]			NA	<20	NA	<20
BTEX (8020/8020 Mod.)												
Benzene	1	1	5	<1	<1	6.9			<1	<1	<1[c]	<1
Toluene	1	1	1,000	<1	<1	<1			1.2	<1	<1[c]	<1
Ethylbenzene	1	1	700	<1	<1	3.1			<1	<1	<1[c]	<1
Xylenes (Total)	2	2	10,000	<2	<2	12.8			<2	<2	<2[c]	<2
VOC 8260												
Benzene	1	1	5	<1	<1	6.4			<1	<1	<1	<1
Chloromethane	1	1		<1	<1	4.2			<1	<1	<1	<1
1,2-Dichloroethane	1	1	5	3U-3.2B	6.1B	9.1B			1.6	<1	<1	<1
Ethylbenzene	1	1	700	<1	<1	2.5			<1	<1	<1	<1
Naphthalene	1	1		<1	<1	1.6			<1	<1	<1	<1

☐ CT&E Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
U Compound is not present above the concentration listed.
a Total petroleum hydrocarbons in these water samples exceed the 15 µg/L stated for fresh water in ADEC's Water Quality Criteria 18 AAC 70 (ADEC 1989).
c BTEX determined by 8260 method analysis.
d The laboratory reported that the EPH pattern in this sample was not consistent with an unweathered middle distillate fuel.

TABLE D-8. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Surface Water
Site: Heated Storage (Building 87) (SS13)   Units: μg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks
					SW01	SW02			AB01	EB03A	TB03	
Laboratory Sample ID Numbers					4212-1 4216-4	4213-1 4219-7			4173-9 4197-6	4211-1 4215-7	4211-2	4215 4212/4211 4197/4173
ANALYSES	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L			μg/L	μg/L	μg/L	μg/L
Tetrachloroethene	1	1	5	<1	<1	12			<1	<1	<1	<1
1,2,4-Trimethylbenzene	1	1		<1	<1	1.4			<1	<1	<1	<1
1,3,5-Trimethylbenzene	1	1		<1	<1	1.3			<1	<1	<1	<1
Xylenes (Total)	2	2	10,000	<2	<2	10.4			<2	<2	<2	<2
SVOC	10	10		<10	<10	<10			NA	<11	NA	<10

☐ CT&E Data.
NA Not analyzed.

TABLE D-8. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Surface Water
Site: Heated Storage (Building 87) (SS13)   Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks
					SW05	SW06	SW07			AB01	EB02	TB02	
Laboratory Sample ID Numbers					4206-2	4206-3	4206-1			4197-6	4206-4	4199-13	4206 4199 4197
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L			µg/L	µg/L	µg/L	µg/L
DRPH	100	100		<200	334[a]	196[a]	349[a]			NA	<100	NA	<100
GRPH	20	20		<20	<20	<20	<20			NA	<20	NA	<20
BTEX (8020/8020 Mod.)													
Benzene	1	1	5	<1	<1	<1	<1			<1	<1	<1	<1
Toluene	1	1	1,000	<1	<1	<1	<1			1.2	<1	<1	<1
Ethylbenzene	1	1	700	<1	<1	<1	3.2			<1	<1	<1	<1
Xylenes (Total)	2	2	10,000	<2	<2	3.8	12.5			<2	<2	<2	<2
VOC 8010													
1,2-Dichloroethane	1	1	5	3U-3.2B	3.3B	3.8B	<1			1.2	2.9	<1	<1

☐ CT&E Data.
N/A Not analyzed.
B The analyte was detected in the associated blank.
U Compound is not present above the concentration listed.
a Total hydrocarbons in these water samples exceed the 15 µg/L stated for fresh water in ADEC's Water Quality Criteria 18 AAC 70 (ADEC 1989).

TABLE D-8. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Heated Storage (Building 87) (SS13)
Matrix: Surface Water
Units: µg/L
METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples							Field Blank			Lab Blanks
					SW01	SW02							EB03A		
Laboratory Sample ID Numbers					4212-1	4213-1							4211-1		4213 4212 4211
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L							µg/L		µg/L
Aluminum	17.4	100		<100-350 (<100-340)	160 (<100)	210 (<100)							<100 (<100)		<100 (<100)
Antimony	N/A	100	6	<100 (<100)	<100 (<100)	<100 (<100)							<100 (<100)		<100 (<100)
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)	<100 (<100)							<100 (<100)		<100 (<100)
Barium	1.2	50	2,000	<50-93 (<50-91)	82 (68)	82 (65)							<50 (<50)		<50 (<50)
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)	<50 (<50)							<50 (<50)		<50 (<50)
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)	<50 (<50)							<50 (<50)		<50 (<50)
Calcium	34.5	200		4,500-88,000 (4,100-86,000)	75,000 (71,000)	130,000 (130,000)							<200 (<200)		<200 (<200)
Chromium	3.29	100	100	<50 (<50)	<50 (<50)	<50 (<50)							<50 (<50)		<50 (<50)
Cobalt	N/A	100		<100 (<100)	<100 (<100)	<100 (<100)							<100 (<100)		<100 (<100)
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)	<50 (<50)							<50 (<50)		<50 (<50)

☐ CT&E Data.
N/A Not available.

TABLE D-8. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Heated Storage (Building 87) (SS13)
Matrix: Surface Water
Units: µg/L
METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples							Field Blank			Lab Blanks
					SW01	SW02							EB03A		
Laboratory Sample ID Numbers					4212-1	4213-1							4211-1		4213 4212 4211
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L							µg/L		µg/L
Iron	25	100		180-2,800 (<100-1,600)	1,600 (280)	12,000 (4,000)							<100 (<100)		<100-792 (792)
Lead	6.6	100	15	<100 (<100)	<100 (<100)	<100 (<100)							<100 (<100)		<100 (<100)
Magnesium	47.8	200		<5,000-53,000 (2,600-54,000)	26,000 (25,000)	46,000 (46,000)							<200 (<200)		<200 (<200)
Manganese	1.24	50		<50-510 (<50-120)	310 (240)	540 (500)							<50 (<50)		<50 (<50)
Molybdenum	N/A	50		<50 (<50)	<50 (<50)	<50 (<50)							<50 (<50)		<50 (<50)
Nickel	5.5	50	100	<50 (<50)	<50 (<50)	<50 (<50)							<50 (<50)		<50-82 (82)
Potassium	1,154	5,000		<5,000 (<5,000)	5,100 (<5,000)	17,000 (17,000)							<5,000 (<5,000)		<5,000 (<5,000)
Selenium	62.4	100	50	<100 (<100)	<100 (<100)	<100 (<100)							<100 (<100)		<100 (<100)
Silver	2.6	50	50	<50 (<50)	<50 (<50)	<50 (<50)							<50 (<50)		<50 (<50)
Sodium	27.7	250		8,400-410,000 (8,200-450,000)	100,000 (110,000)	92,000 (98,000)							<250 (<250)		<250 (<250)
Thallium	0.57	5	2	<5 (<5)	<5 (<5)	<5 (<5)							<5 (<5)		<5 (<5)

☐ CT&E Data.
N/A Not available.

TABLE D-8. HEATED STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Heated Storage (Building 87) (SS13)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples							Field Blank			Lab Blanks
					SW01	SW02							EB03A		
Laboratory Sample ID Numbers					4212-1	4213-1							4211-1		4213 4212 4211
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L							µg/L		µg/L
Vanadium	1.8	50		<50 (<50)	<50 (<50)	<50 (<50)							<50 (<50)		<50 (<50)
Zinc	8.2	50		<50-160 (<50)	<50 (<50)	<50 (<50)							<50 (<50)		<50 (<50)

☐ CT&E Data.

TABLE D-9. GARAGE ANALYTICAL DATA SUMMARY

Installation: Barter Island   Matrix: Soil
Site: Garage (SS14)   Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples S01	S02-2.5	S03-3 & S06-3 (Replicates)		S04-2	Field Blanks AB02	EB05	TB05	Lab Blanks	
Laboratory Sample ID Numbers					339	341	343	347	345 4301-7	315 4303-1	332 392 4303-5	375	#5-8249 #3&4-82493 #1&2-82493 4303	#6-82393 #1&2-82493 4301
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5	50	500[a]	9.55-1,150	<50J[b]	12,400J[b]	5,800J[b]	3,100J[b]	5,500J[b]	NA	<1,000[b]	NA	NA	<50J
GRPH	0.2	2	100	<0.400-<9.0	<2J[b]	208J[b]	190J[b]	190J[b]	118J[b]	<100J[b]	<100J[b]	<50J[b]	<50J-<100J	<2J
RRPH (Approx.)	10	100	2,000[a]	<480	<100	27,000	2,300	<100	410	NA	<1,000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.10	25R	48.2R	0.24R	<0.10R					
Benzene	0.002	0.02	0.5	<0.020-<0.300	<0.02	0.4R	<0.02R	<0.02R	<0.02R	<1	<1	<1	<1	<0.02J
Toluene	0.002	0.02		<0.020-<0.300	<0.02	0.6R	<0.02R	0.06R	<0.02R	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002	0.02		<0.020-<0.300	<0.02	14R	8.2R	0.09R	<0.02R	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004	0.04		<0.040-<0.600	<0.04	10R	40R	0.09R	<0.04R	<2	<2	<2	<2	<0.04
HVOC (8010 Mod.)														
Tetrachloroethene	0.002-0.01	0.02-0.1		<0.5J	<0.02	0.06R	0.06R	<0.1R	<0.02R	<1	<1	<1	<1	<0.02J
VOC 8260														
Naphthalene	0.020	0.200		<0.025-<0.500	NA	NA	NA	NA	2.78	<1	<1	NA	<1	<0.020
1,3,5-Trimethyl-benzene	0.020	0.200		<0.025-<0.500	NA	NA	NA	NA	6.32	<1	<1	NA	<1	<0.020
Xylenes (Total)	0.040	0.400		<0.050-<1.000	NA	NA	NA	NA	0.293[c]	<2	<2	NA	<2	<0.040
SVOC 8270														
2-Methylnaphthalene	0.200	2.10		<0.23-<3.5	NA	NA	NA	NA	5.84	NA	<11	NA	<10	<0.200

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
R Result has been rejected.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c Result is indicative of o-xylenes only.

TABLE D-9. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Garage (SS14)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks	
					S01	S02-2.5	S03-3 & S06-3 (Replicates)		S04-2	AB02	EB05	TB05		
Laboratory Sample ID Numbers					339	341	343	347	345 4301-7	315 4303-1	332 392 4303-5	375	#5-8249 #3&4-82493 #1&2-82493 4303	#6-82393 #1&2-82493 4301
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
Pesticides	0.002	0.02-0.5		<0.001-<0.100	<0.02J-<0.5J	NA	NA	NA	NA	NA	<0.2-<10	NA	NA	<0.01-<0.5
PCBs	0.05-0.06	0.5-0.6	10	<0.020-<0.100	<0.5	<5	<0.6	<0.5	<0.5	NA	<10	NA	NA	<0.1-<0.5

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.

TABLE D-9. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island | Matrix: Soil/Sediment | METALS ANALYSES
Site: Garage (SS14) | Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank			Lab Blanks
					S04-2	SD01						EB05		
Laboratory Sample ID Numbers					4301-7	4301-4						4303-5		4301 4303
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg						µg/L		µg/L
Aluminum	0.35	2		1,500-25,000	2,100	2,000						<100		<100
Antimony	N/A	52-53		<7.8-<230	<52	<53						<100		<100
Arsenic	0.11	5.2-5.3		<4.9-8.5	<5.2	<53						<100		<100
Barium	0.024	1		27-390	20	29						<50		<50
Beryllium	N/A	2.6-2.7		<2.6-6.4	<2.6	<2.7						<50		<50
Cadmium	0.33	2.6-2.7		<3.0-<36	<2.6	<2.7						<50		<50
Calcium	0.69	4		360-59,000	9,300J	4,400J						<200		<200
Chromium	0.066	1		<4.3-47	5.1	53						<50		<50
Cobalt	N/A	5.2-5.3		<5.1-12	<5.2	<5.3						<100		<100
Copper	0.045	1		<2.7-45	4.9	16						<50		<50
Iron	0.50	2		5,400-35,000	6,500	6,400						200		<100
Lead	0.13	2		<5.1-22	16J	231J						<100		<100
Magnesium	0.96	4		360-7,400	4,500J	1,900J						<200		<200
Manganese	0.025	1		25-290	63	50						<50		<50
Molybdenum	N/A	2.6-2.7		<2.5-<11	<2.6	<2.7						<50		<50
Nickel	0.11	1		4.2-46	5.1	5.6						<50		<50
Potassium	23	100		<300-2,200	300	310						<5,000		<5,000

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE D-9. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Site: Garage (SS14)			Matrix: Soil/Sediment Units: mg/kg		METALS ANALYSES									
Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank			Lab Blanks
					S04-2	SD01						EB05		
Laboratory Sample ID Numbers					4301-7	4301-4						4303-5		4301 4303
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg						µg/L		µg/L
Selenium	1.2	5.3-52		<7.8-<170	<52	<5.3						<100		<100
Silver	0.53	2.6-2.7		<3-<110	<2.6J	<2.7J						<50		<50
Sodium	0.55	5		<160-680	66	110						<250		<250-267
Thallium	0.011	0.25-1.4		<0.2-<1.2	<0.25	<1.4						<5		<5
Vanadium	0.036	1		6.3-59	7.5	6.6						<50		<50
Zinc	0.16	1		9.2-95	35	200						<50		<50

☐ CT&E Data.
J Result is an estimate.

TABLE D-9. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Soil
Site: Garage (SS14)   Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks		Lab Blanks	
					2S05-2	2S07-4	2S08-3	AB03	EB07		
Laboratory Sample ID Numbers					1706 4616-1	1710 4616-3	1708 4616-2	1712	1715 1716 4616-9	#5-9693 #1&2-9693 #1&2-9493 4616	#5-9593 #3&4-9693 4616
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00-20	50-200	500[a]	9.55-1,150	<200J[b]	4,820[c]	<50J[b]	NA	<200[d]	<1,000J	<4.0
GRPH	0.2-0.400	0.400-4	100	<0.4-<9	<4J[b]	358[c]	<2J[b]	<50J[b]	<20[d]	NA	<0.400-<2J
RRPH (Approx.)	10-40	100-400	2,000[a]	<480	<400	<120	<100	NA	<2,000	<2,000	NA
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.15	5.8JN	<0.10				
Benzene	0.002-0.003	0.02-0.03	0.5	<0.020-<0.300	<0.03	1.4N	<0.02	<1	<1	NA	<0.02
Toluene	0.002-0.003	0.02-0.03		<0.020-<0.300	<0.03	2.3J	<0.02	<3J	<2J	NA	<0.02
Ethylbenzene	0.002-0.003	0.02-0.03		<0.020-<0.300	<0.03	0.4J	<0.02	<2J	<1	NA	<0.02
Xylenes (Total)	0.004-0.006	0.04-0.06		<0.040-<0.600	<0.06	1.7J	<0.04	<5J	<2	NA	<0.04
VOC 8260											
Benzene	0.020	0.020-0.400	0.5	<0.025-<0.500	0.072	<0.400	<0.020	NA	<1	<1	<0.020
n-Butylbenzene	0.020	0.020-0.400		<0.025-<0.500	<0.040	3.10	<0.02	NA	<1	<1	<0.020
sec-Butylbenzene	0.020	0.020-0.400		<0.025-<0.500	<0.040	1.28	<0.02	NA	<1	<1	<0.020

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification."
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c This sample was analyzed by F&B also; DRPH and GRPH were detected at 8,460J[b] and 700J[b] mg/kg, respectively.
d This sample was analyzed by F&B also; DRPH and GRPH were detected at <1,000J[b] and <50J[b] µg/L, respectively.

TABLE D-9. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Garage (SS14)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks		Lab Blanks	
					2S05-2	2S07-4	2S08-3	AB03	EB07		
Laboratory Sample ID Numbers					1706 4616-1	1710 4616-3	1708 4616-2	1712	1715 1716 4616-9	4616	4616
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	mg/kg
cis-1,2-Dichloroethene	0.020	0.020-0.400		<0.025-<0.500	0.069	<0.400	<0.020	NA	<1	<1	<0.020
Ethylbenzene	0.020	0.020-0.0400		<0.025-<0.500	<0.040	0.550	<0.020	NA	<1	<1	<0.020
Isopropylbenzene	0.020	0.020-0.400		<0.025-<0.500	<0.040	0.637	<0.020	NA	<1	<1	<0.020
p-Isopropyltoluene	0.020	0.020-0.400		<0.025-<0.500	<0.040	2.03	<0.02	NA	<1	<1	<0.020
Methylene Chloride	0.020	0.020-0.400	90	<0.025-<0.500	<0.040	<0.400	0.031B	NA	8.3	<1	<0.020
Naphthalene	0.020	0.020-0.400		<0.025-<0.500	<0.040	46.0	<0.02	NA	<1	<1	<0.020
n-Propylbenzene	0.020	0.020-0.400		<0.025-<0.500	<0.040	1.17	<0.02	NA	<1	<1	<0.020
Tetrachloroethene	0.020	0.020-0.400		<0.025-<0.500	<0.040	<0.400	0.023	NA	<1	<1	<0.020
Toluene	0.020	0.020-0.400		<0.025-<0.500	0.134	<0.400	<0.02	NA	1.7	<1	<0.020
1,2,4-Trimethylbenzene	0.020	0.020-0.400		<0.025-<0.500	<0.040	13.3	<0.02	NA	<1	<1	<0.020
1,3,5-Trimethylbenzene	0.020	0.020-0.400		<0.025-<0.500	<0.040	2.93	<0.02	NA	<1	<1	<0.020
Xylenes (Total)	0.040	0.040-0.800		<0.500-<1.000	<0.080	4.98	<0.04	NA	<2	<2	<0.040
Total BTEX			10	<0.125-<2.500	0.206	5.53	<0.10				

☐ CT&E Data.
NA Not analyzed.
B The analyte was found in the associated blank.

TABLE D-9. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Sediment
Site: Garage (SS14) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Sample SD01				Field Blanks AB02	Field Blanks EB05	Field Blanks TB05	Lab Blanks	
Laboratory Sample ID Numbers					349 4301-4				315 4303-1	332 392 4303-5	375	#3&4-82493 #1&2-82493 4303	#6-82393 #1&2-82493 4301
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg				µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	70	700	500[a]	9.55-1,150	5,100J[b]				NA	<1,000[b]	NA	NA	<50J
GRPH	0.2	2	100	<0.400-<9.0	390J[b]				<100J[b]	<100J[b]	<50J[b]	<50J-<100J	<2J
RRPH (Approx.)	70	700	2,000[a]	<480	13,000				NA	<1,000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	59J								
Benzene	0.03	0.3	0.5	<0.020-<0.300	<0.3				<1	<1	<1	<1	<0.02J
Toluene	0.03	0.3		<0.020-<0.300	1				<1	<1	<1	<1	<0.02
Ethylbenzene	0.03	0.3		<0.020-<0.300	11				<1	<1	<1	<1	<0.02
Xylenes (Total)	0.06	0.6		<0.040-<0.600	47J				<2	<2	<2	<2	<0.04
HVOC (8010 Mod.)	0.03	0.3		<0.5J	<0.3				<1	<1	<1	<1	<0.02J
VOC 8260													
n-Butylbenzene	0.020	0.200		<0.025-<0.500	4.22				<1	<1	NA	<1	<0.020
sec-Butylbenzene	0.020	0.200		<0.025-<0.500	1.24				<1	<1	NA	<1	<0.020
tert-Butylbenzene	0.020	0.200		<0.025-<0.500	0.256				<1	<1	NA	<1	<0.020
Ethylbenzene	0.020	0.200		<0.025-<0.500	0.728				<1	<1	NA	<1	<0.020
Isopropylbenzene	0.020	0.200		<0.025-<0.500	0.681				<1	<1	NA	<1	<0.020

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE D-9. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Garage (SS14)

Matrix: Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Sample				Field Blanks			Lab Blanks	
					SD01				AB02	EB05	TB05		
Laboratory Sample ID Numbers					349 4301-4				315 4303-1	332 392 4303-5	375	4303	4301
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg				µg/L	µg/L	µg/L	µg/L	mg/kg
p-Isopropyltoluene	0.020	0.200		<0.025-<0.500	2.47				<1	<1	NA	<1	<0.020
Naphthalene	0.020	0.200		<0.025-<0.500	14.9				<1	<1	NA	<1	<0.020
n-Propylbenzene	0.020	0.200		<0.025-<0.500	0.918				<1	<1	NA	<1	<0.020
1,2,4-Trimethylbenzene	0.020	0.200		<0.025-<0.500	14.7				<1	<1	NA	<1	<0.020
1,3,5-Trimethylbenzene	0.020	0.200		<0.025-<0.500	9.32				<1	<1	NA	<1	<0.020
Xylenes (Total)	0.040	0.400		<0.050-<1.000	10.3				<2	<2	NA	<2	<0.040
SVOC 8270													
2-Methylnaphthalene	0.200	2.20		<0.230-<3.50	14.5				NA	<11	NA	<10	<0.200
Phenanthrene	0.200	2.20		<0.230-<3.50	4.79				NA	<11	NA	<10	<0.200
bis(2-Ethylhexyl) Phthalate	0.200	2.20	50	<0.230-<3.50	4.6				NA	<11	NA	<10	<0.200
Fluoranthene	0.200	2.20		<0.230-<3.50	2.28				NA	<11	NA	<10	<0.200
Isophorone	0.200	2.20		<0.230-<3.50	1.49J				NA	<11	NA	<10	<0.200
Naphthalene	0.200	2.20		<0.230-<3.50	7.73				NA	<11	NA	<10	<0.200

☐ CT&E Data.
NA Not analyzed.
J Results in an estimate.

TABLE D-9. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Garage (SS14)
Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Sample						Field Blanks			Lab Blanks
					SW01						AB02	EB05	TB05	
Laboratory Sample ID Numbers					336/333 4301-1						315 4303-1	332 392 4303-5	375	#6-82393 #5-82493 #3&4-82493 #1&2-82493 4303 4301
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L						µg/L	µg/L	µg/L	µg/L
DRPH	100	1,000		<200	<1,000J[b]						NA	<1,000[b]	NA	NA
GRPH	10	100		<20	<100J[b]						<100J[b]	<100J[b]	<50J[b]	<50J-<100J
RRPH (Approx.)	200	2,000		NA	<2,000						NA	<1,000	NA	NA
BTEX (8020/8020 Mod.)														
Benzene	0.1	1	5	<1	<1						<1	<1	<1	<1
Toluene	0.1	1	1,000	<1	<1						<1	<1	<1	<1
Ethylbenzene	0.1	1	700	<1	<1						<1	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<2	8J						<2	<2	<2	<2
HVOC (8010 Mod.)	0.1	1		NA	<1						<1	<1	<1	<1
SVOC 8270	10	25		<10	<25						NA	<11	NA	<10
Pesticides	0.2	2		<1	<2J-<50J						NA	<0.2-<10	NA	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE D-9. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Garage (SS14)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample								Field Blank			Lab Blanks
					SW01									EB05		
Laboratory Sample ID Numbers					4301-1									4303-5		4301 4305
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L									µg/L		µg/L
Aluminum	17.4	100		<100-350 (<100-340)	<100 (<100)									<100		<100 (<100)
Antimony	N/A	100	6	<100 (<100)	<100 (<100)									<100		<100 (<100)
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)									<100		<100 (<100)
Barium	1.2	50	2,000	<50-93 (<50-91)	74 (62)									<50		<50 (<50)
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)									<50		<50 (<50)
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)									<50		<50 (<50)
Calcium	34.5	100		4,500-88,000 (4,100-86,000)	105,000 (110,000)									<200		<200-378 (378)
Chromium	3.29	50	100	<50 (<50)	<50 (<50)									<50		<50 (<50)
Cobalt	N/A	100		<100 (<100)	<100 (<100)									<100		<100 (<100)
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)									<50		<50 (<50)
Iron	25	100		180-2,800 (<100-1,600)	6,000 (5,500)									200		<100 (<100)

☐ CT&E Data.
N/A Not available.

TABLE D-9. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Surface Water   METALS ANALYSES: TOTAL
Site: Garage (SS14)   Units: µg/L   (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample								Field Blank			Lab Blanks
					SW01									EB05		
Laboratory Sample ID Numbers					4301-1									4303-5		4301 4305
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L									µg/L		µg/L
Lead	6.6	100	15	<100 (<100)	<100J (<100)J									<100		<100 (<100)
Magnesium	47.8	100		<5,000-53,000 (2,600-54,000)	34,000 (32,000)									<200		<200 (<200)
Manganese	1.24	50		<50-210 (<50-120)	490 (460)									<50		<50 (<50)
Molybdenum	N/A	50		<50 (<50)	<50 (<50)									<50		<50 (<50)
Nickel	5.5	50	100	<50 (<50)	<50 (<50)									<50		<50 (<50)
Potassium	1,154	100		<5,000 (<5,000)	9,100 (8,200)									<5,000		<5,000 (<5,000)
Selenium	62.4	100	50	<100 (<100)	<100 (<100)									<100		<100 (<100)
Silver	2.6	50	50	<50 (<50)	<50 (<50)									<50		<50 (<50)
Sodium	27.7	100		8,400-410,000 (8,200-450,000)	130,000 (140,000)									<250		<250-267 (<250)
Thallium	0.57	5	2	<5 (<5)	<5 (<5)									<5		<5 (<5)

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE D-9. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Garage (SS14)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample								Field Blank			Lab Blanks
					SW01									EB05		
Laboratory Sample ID Numbers					4301-1									4303-5		4301 4305
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L									µg/L		µg/L
Vanadium	1.8	50		<50 (<50)	<50 (<50)									<50		<50 (<50)
Zinc	8.2	50		<50-160 (<50)	<50 (<50)									<50		<50 (<50)

☐ CT&E Data.

TABLE D-10. WEATHER STATION BUILDING ANALYTICAL DATA SUMMARY

Installation: Barter Island
Site: Weather Station Building (SS15)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks	
					S01	S02-2	S03	S04	S05	AB01	EB01	TB01		
Laboratory Sample ID Numbers					4198-1	4198-4	4178-1 4198-5	4198-6	4198-7	4173-9 4197-6	4175-3 4203-8	4173-10 4179-7	#5-9693 #1&2-9493 4203 4175	4198 4178
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	4.00	4.00	500[a]	9.55-1,150	6,100	8,420	2,090	214	107[c]	NA	<200	NA	<200-<1,000J	<4.00
GRPH	0.400	0.400	100	<0.400-<9.0	216	1,020	11.1	1.46	5.3	NA	<20	NA	<20-<50J	<0.400
BTEX (8020/ 8020 Mod.)			10 Total BTEX	<0.250-<1.500	0.459	3.567	0.154	0.023	0.547					
Benzene	0.020	0.020	0.5	<0.020-<0.300	<0.020	<0.020	<0.020	<0.020	<0.020	<1	<1	<1	<1	<0.020
Toluene	0.020	0.020		<0.020-<0.300	<0.020	0.137	<0.020	<0.020	<0.020	1.2	<1	<1	<1	<0.020
Ethylbenzene	0.020	0.020		<0.020-<0.300	0.196	1.09	0.056	<0.020	0.071	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.040		<0.040-<0.600	0.263	2.34	0.098	0.023[d]	0.476	<2	<2	<2	<2	<0.040
VOC 8260														
Naphthalene	0.020	0.020		<0.025-<0.500	NA	NA	0.083	NA	NA	<1	<1J	<1	<1	<0.020
1,3,5-Trimethylbenzene	0.020	0.020		<0.025-<0.500	NA	NA	0.084	NA	NA	<1	<1J	<1	<1	<0.020
Xylenes (Total)	0.020	0.020		<0.050-<1.000	NA	NA	0.079	NA	NA	<2	<2J	<2	<2	<0.040

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.
a The action level for DRPH is based on conversations with ADEC; a final action level has not yet been determined.
c The laboratory reported that 6.39 mg/kg of the EPH pattern in this sample was not consistent with a middle distillate fuel.
d Result is indicative of p & m xylenes only.

TABLE D-10. WEATHER STATION ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Weather Station Building (SS15)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks	
					2S06	2S07-2	2S08-2	AB01	EB06	TB01		
Laboratory Sample ID Numbers					1682	1684	1686	4173-9 4197-6	1688 1690	4173-10 4179-7	#5-9693 #1&2-9493 4203 4175	#3&4-9693 4198
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-6	50-60	500[a]	9.55-1,150	<50J[b]	<50J[b]	<60J[b]	NA	<1,000J[b]	NA	<200-<1,000J	<4.00
GRPH	0.2	2	100	<0.400-<9.0	<2J[b]	4J[b]	<2J[b]	NA	<50J[b]	NA	<20-<50J	<0.400-<2J
RRPH (Approx.)	10-12	100-120	2,000[a]	<480	<100	<100	<120	NA	<2,000	NA	<2,000	NA
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.10	0.3J	<0.10					
Benzene	0.002-0.020	0.02	0.5	<0.020-<0.300	<0.02	<0.02	<0.02	<1	<1	<1	<1	<0.020
Toluene	0.002-0.020	0.02		<0.020-<0.300	<0.02	<0.02	<0.02	1.2	<4J	<1	<1	<0.020
Ethylbenzene	0.002-0.020	0.02		<0.020-<0.300	<0.02	0.1J	<0.02	<1	<2J	<1	<1	<0.020
Xylenes (Total)	0.004-0.040	0.04		<0.040-<0.600	<0.04	0.2J	<0.04	<2	<5J	<2	<2	<0.040

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE D-11. WHITE ALICE FACILITY ANALYTICAL DATA SUMMARY

Installation: Barter Island
Site: White Alice Facility (SS16)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples							Field Blanks			Lab Blanks	
					S01	S02 Composite	S03 Composite	S04 Composite	S05 Composite	S06 & S07 (Replicates)		AB02	EB05	TB05		
Laboratory Sample ID Numbers					320	321	370	371	372	373	374	315	392 332	375	#5-82493	#6-82393
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5	50	500[a]	9.55-1,150	NA	NA	<50J[b]	<50J[b]	<50J[b]	<50J[b]	<50J[b]	NA	<1,000[b]	NA	NA	<50J
RRPH (Approx.)	10-20	100-200	2,000[a]	<480	NA	NA	<100	<100	<100	<200	<200	NA	<1,000	NA	NA	<100
PCBs																
Aroclor 1254	0.01-0.05	0.1-0.5	10	<0.020-<0.100	52J	<0.5	<0.1	<0.1	<0.1	20J	30J	NA	<10	NA	NA	<0.1-<0.5

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH concentrations reported for these samples are equivalent to diesel range organics (DRO) as defined by ADEC.

TABLE D-11. WHITE ALICE FACILITY ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Soil
Site: White Alice Facility (SS16)   Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples							Field Blank	Lab Blank
					2S08-1.5	2S09	2S10 & 2S11 (Replicates)		2S12	2S13-1.5		EB06	
Laboratory Sample ID Numbers					1671	1672	1673	1674	1675	1676		1688 1690	#5-9493
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		µg/L	mg/kg
PCBs													
Aroclor 1254	0.05	0.5	10	<0.020-<0.100	<0.5	8.7J	<0.5	<0.5	<0.5	<0.5		<2	<0.1-<2

☐ CT&E Data.
▩ F&B Data.
J Result is an estimate.

TABLE D-12. POL TANKS ANALYTICAL DATA SUMMARY

Installation: Barter Island
Site: POL Tanks (ST17)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks	
					S02	S03	S04 & (Replicates)	S06	S05-1.5	AB02	EB04	TB04		
Laboratory Sample ID Numbers					1292	1294	1296 4302-4	1300 4302-5	1298	315 4303-1	311 4302-10	1346 4302-9	#3&4-82493 #3&4-83193 4303 4302	#6-83193 #1&2-83193 4302
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	8	80	500[a]	9.55-1,150	<80[b]	540[b]	730[b]	1,670[b]	<80[b]	NA	NA	NA	NA	<70J
GRPH	0.2-0.4	2-4	100	<0.400-<9.0	<2J[b]	295J[b]	52J[b]	65J[b]	<4J[b]	<100J[b]	<100J[b]	<100J[b]	<100J	<2J
RRPH (Approx.)	10-30	100-300	2,000[a]	<480	<100	<300	<100	<140	<120	NA	NA	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.10	1.0	0.4J	1.0J	<0.35					
Benzene	0.002-0.006	0.02-0.06	0.5	<0.020-<0.300	<0.02	<0.06	<0.03	<0.02	<0.03	<1	<1	<1	<1	<0.02
Toluene	0.002-0.006	0.02-0.06		<0.020-<0.300	<0.02	1.0	<0.03	<0.02	<0.06	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002-0.006	0.02-0.06		<0.020-<0.300	<0.02	<0.02	0.1	0.4	<0.06	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004-0.020	0.04-0.2		<0.040-<0.600	<0.04	<0.04	0.3J	0.6J	<0.2	<2	<2	<2	<2	<0.04
VOC 8260														
1,2,4-Trimethylbenzene	0.020	0.240-0.250		<0.025-<0.500	NA	NA	0.511	0.344	NA	<1	<1	<1	<1	<0.020
SVOC 8270	0.200	2.30-2.50		<0.23-<3.5	NA	NA	<2.50	<2.30	NA	NA	<25-75	NA	<10	<0.200

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE D-13. FUEL TANKS ANALYTICAL DATA SUMMARY

Installation: Barter Island Site: Fuel Tanks (ST18)				Matrix: Soil Units: mg/kg													
Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples								Field Blanks			Lab Blanks	
					S01	S02	S03 & (Replicates)	S10	S04	S05	S06	S07	AB02	EB04	TB04		
Laboratory Sample ID Numbers					1302	1304 4302-7	1306	1308	1310	1312	1314	1322	315 4303-1	311 4302-10	1346 4301-9	#3&4-82493 #3&4-83192 4303 4302 4301	#1&2-83193 #6-83193 4302
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-10	50-100	500[a]	9.55-1,150	<80[b]	<70[b]	<80[b]	<80[b]	<100[b]	<80[b]	<50[b]	<70[b]	NA	NA	NA	NA	<70J
GRPH	0.2	2	100	<0.400-<9.0	<2J[b]	<2J[b]	<2J[b]	<2J[b]	<2J[b]	<2J[b]	<2J[b]	<2J[b]	<100J[b]	<100J[b]	<100J[b]	<50J-<100J	<2J
RRPH (Approx.)	10-11	100-110	2,000[a]	<480	<100	<100	<100	<100	<100	<100	190	<110	NA	NA	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10					
Benzene	0.002	0.02	0.5	<0.020-<0.300	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<1	<1	<1	<1	<0.02
Toluene	0.002	0.02		<0.020-<0.300	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002	0.02		<0.020-<0.300	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004	0.04		<0.040-<0.600	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<2	<2	<2	<2	<0.04
VOC 8260																	
Ethylbenzene	0.020	0.020		<0.025-<0.500	NA	0.020	NA	NA	NA	NA	NA	NA	<1	<1	<1	<1	<0.020
1,2,4-Trimethylbenzene	0.020	0.020		<0.025-<0.500	NA	0.128	NA	NA	NA	NA	NA	NA	<1	<1	<1	<1	<0.020
1,3,5-Trimethylbenzene	0.020	0.020		<0.025-<0.500	NA	0.048	NA	NA	NA	NA	NA	NA	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.040	10	<0.500-<1.00	NA	0.191	NA	NA	NA	NA	NA	NA	<2	<2	<2	<2	<0.040
SVOC	0.200	0.220		<0.230-<3.50	NA	<0.220	NA	NA	NA	NA	NA	NA	NA	<25-75	NA	<10	<0.200
TOC				32,000-199,000	NA	1,330	NA	NA	NA	NA	NA	NA	NA	<5,000	NA	<5,000	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE D-13. FUEL TANKS ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island — Matrix: Soil/Sediment
Site: Fuel Tanks (ST18) — Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks				Lab Blanks	
					S08-0.75	S09-1.5	2S11-2	2S12-2	SD01	AB02	EB04	EB08	TB04		
Laboratory Sample ID Numbers					1316	1318	1754 4616-6	1752	1320 4302-6	315 4303-1	311 4302-10	1719 1720 4616-13	1346 4302-9	#3&4-83193 #3&4-82493 #1&2-9693 #5-9693 4616 4303 4302	#1&2-83193 #6-83193 4616 4302
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-10	50-100	500[a]	9.55-1,150	<100[b]	<60[b]	490[b]	<50[b]	<70[b]	NA	NA	<1,000J[b]	NA	<1,000J	<70J
GRPH	0.1-0.2	1-2	100	<0.400-<9.0	NA	<2J[b]	6J[b]	<1J[b]	<2J[b]	<100J[b]	<100J[b]	<50J[b]	<100J[b]	<50J-<100J	<2J
RRPH (Approx.)	10-15	100-150	2,000[a]	<480	<150	<100	<100	<100	<110	NA	NA	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	NA	<0.10	0.8J	<0.10	<0.10						
Benzene	0.002	0.02	0.5	<0.020-<0.300	NA	<0.02	0.1J	<0.02	<0.02	<1	<1	<1	<1	<1	<0.02
Toluene	0.002	0.02		<0.020-<0.300	NA	<0.02	0.1	<0.02	<0.02	<1	<1	<1J	<1	<1	<0.02
Ethylbenzene	0.002	0.02		<0.020-<0.300	NA	<0.02	0.2	<0.02	<0.02	<1	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004	0.04		<0.040-<0.600	NA	<0.04	0.4J	<0.04	<0.04	<2	<2	<2	<2	<2	<0.04
VOC 8260															
Benzene	0.020	0.020	0.5	<0.025-<0.500	NA	NA	0.091	NA	<0.020	<1	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.020	0.040		<0.050-<1.000	NA	NA	0.063	NA	<0.040	<2	<2	<2	<2	<2	<0.040
SVOC 8270	0.20	<0.210-0.214		<0.230-<3.50	NA	NA	<0.214-<1.67	NA	<0.210	NA	<25-75	NA	NA	<10	<0.200
TOC				32,000-199,000	NA	NA	NA	NA	3,400	NA	<5,000	NA	NA	<5,000	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE D-13. FUEL TANKS ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Surface Water
Site: Fuel Tanks (ST18)   Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Sample					Field Blanks			Lab Blanks
					SW01					AB02	EB04	TB04	
Laboratory Sample ID Numbers					317 4302-8					315 4303-1	311 4302-10	1346 4302-9	#3&4-83193 #3&4-82493 4303 4302
ANALYSES	µg/L	µg.L	µg/L	µg/L	µg/L					µg/L	µg/L	µg/L	µg/L
GRPH	10	100		<20	<100J[b]					<100J[b]	<100J[b]	<100J[b]	<100J
BTEX (8020/8020 Mod.)													
Benzene	0.1	1	5	<1	<1					<1	<1	<1	<1
Toluene	0.1	1	1,000	<1	<1					<1	<1	<1	<1
Ethylbenzene	0.1	1	700	<1	<1					<1	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<2	<2					<2	<2	<2	<2
VOC 8260	1	1		<1-3.2B	<1-3U					<1-6.3	<1-6.0	<1	<1
SVOC 8270	10	10		<10	<10					NA	<25-75	NA	<10
TOC	5,000	5,000		<5,000-12,700	36,300					NA	<5,000	NA	<5,000
TSS	100	200		<30,000-8,000	8,000J					NA	NA	NA	<200
TDS	10,000	10,000		<352,000-328,000	711,000J					NA	NA	NA	12,000

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
J Result is an estimate.
U Compound is not present above the concentration listed.
b GRPH concentrations reported for these samples are equivalent to gasoline range organics (GRO) as defined by ADEC.

TABLE D-14. OLD DUMP SITE ANALYTICAL DATA SUMMARY

Installation: Barter Island
Site: Old Dump Site (LF19)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks	
					S01-1.5	S02-2	S03	AB02	EB05	TB05		
Laboratory Sample ID Numbers					353 4301-9	355	357	315 4303-1	392/332 4303-5	375	#3&4-82493 #1&2-82493 4303	#6-82393 #1&2-82493 4301
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5.0-12	50-120	500[a]	9.55-1,150	<50J[b]	<50J[b]	<50J[b]	NA	<1,000[b]	NA	NA	<50J
GRPH	0.2-4.6	2-4.6	100	<0.400-<9.0	<46J[b]	<8J[b]	<5J[b]	<100J[b]	<100J[b]	<50J[b]	<100J	<2J
RRPH (Approx.)	10	100	2,000[a]	<480	<100	<100	<100	NA	<1,000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	0.06R	<2.14	<1.54					
Benzene	0.002-0.005	0.02-0.05	0.5	<0.020-<0.300	<0.02R	<0.02	<0.02	<1	<1	<1	<1	<0.02J
Toluene	0.002-0.005	0.02-0.05		<0.020-<0.300	<0.02R	<0.02	<0.02	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002-0.005	0.02-0.05		<0.020-<0.300	0.06R	<0.8	<0.2	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004-0.010	0.04-0.1		<0.040-<0.600	<0.04R	<1.3	<1.3	<2	<2	<2	<1	<0.04
HVOC (8010 Mod.)	0.002-0.005	0.02-0.05		<0.5J	<0.02R	<0.02	<0.02	<1	<1	<1	<2	<0.02J
VOC 8260	0.020	0.020		<0.025-<0.050	<0.020	NA	NA	<1-6.3	<1-3.2	NA	<1	<0.020
SVOC 8270	0.200	0.200-1.00		<0.230-<3.50	<0.200-<1.00	NA	NA	NA	<11	NA	<10	<0.200
Pesticides	0.002-0.05	0.02-0.5		<0.001-<0.100	<0.02J-<0.5J	NA	NA	NA	<0.2-<10	NA	NA	<0.01-<0.5
PCBs	0.05-0.12	0.5-1.2	10	<0.020-<0.100	<0.5	<0.5	<0.5	NA	<10	NA	NA	<0.1-<0.5

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
R Result has been rejected.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE D-14. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Dump Site (LF19)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples: S04-2.5 & S06-2.5 (Replicates)		Environmental Samples: S05-2	Field Blanks: AB02	Field Blanks: EB05	Field Blanks: TB05	Lab Blanks	
Laboratory Sample ID Numbers					359 4301-8	363 4301-10	361	315 4303-1	392/332 4303-5	375	#3&4-82493 #1&2-82493 4303	#6-82393 #1&2-82493 4301
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5.0-12	50-120	500[a]	9.55-1,150	<50J[b]	<50J[b]	<120J[b]	NA	<1,000[b]	NA	NA	<50J
GRPH	0.2-0.5	2-5	100	<0.4-<9	<3J[b]	<2J[b]	<5J[b]	<100J[b]	<100J[b]	<50J[b]	<100J	<2J
RRPH (Approx.)	10	100	2,000[a]	<480	<100	<100	1,800	NA	<1,000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<1.24	<0.81	<0.80					
Benzene	0.002-0.005	0.02-0.05	0.5	<0.020-<0.300	<0.02	<0.02	<0.05	<1	<1	<1	<1	<0.02J
Toluene	0.002-0.005	0.02-0.05		<0.020-<0.300	<0.02	<0.02	<0.05	<1	<1	<1	<1	<0.02
Ethylbenzene	0.007-0.05	0.07-0.5		<0.020-<0.300	<0.5	<0.07	<0.2	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.05-0.07	0.5-0.7		<0.040-<0.600	<0.7	<0.5	<0.5	<2	<2	<2	<1	<0.04
HVOC (8010 Mod.)	0.002-0.005	0.02-0.05		<0.5J	<0.02	<0.02	<0.05	<1	<1	<1	<2	<0.020J
VOC 8260	0.020	0.020		<0.025-<0.050	<0.020	<0.020	NA	<1-6.3	<1-3.2	NA	<1	<0.020
SVOC 8270	0.200	0.20-0.710		<0.23-<3.5	<0.210-<0.710	<0.210-<1.00	NA	NA	<11	NA	<10	<0.200
Pesticides	0.002-0.05	0.02-0.5		<0.001-<0.100	<0.02J-<0.5J	NA	NA	NA	<0.2-<10	NA	NA	<0.01-<0.5
PCBs	0.05-0.12	0.5-1.2	10	<0.020-<0.100	<0.5	<0.5	<1.20	NA	<10	NA	NA	<0.1-<0.5
TOC				32,900-199,000	4,950	NA	NA	NA	5,000J	NA	<5,000	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE D-14. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Soil
Site: Old Dump Site (LF19) Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank			Lab Blanks
					S01-1.5	S04-2.5 & S06-2.5 (Replicates)						EB05		
Laboratory Sample ID Numbers					4301-9	4301-8	4301-10					4303-5		4303 4301
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L		µg/L
Aluminum	0.35	2		1,500-25,000	2,500	2,900	3,500					<100		<100
Antimony	N/A	49-52		<7.8-<230	<51	<52	<49					<100		<100
Arsenic	0.11	4.9-5.2		<4.9-8.5	<5.1	<5.2	<4.9					<100		<100
Barium	0.024	1		27-390	16	23	31					<50		<50
Beryllium	N/A	2.5-2.6		<2.6-6.4	<2.6	<2.6	<2.5					<50		<50
Cadmium	0.33	2.5-2.6		<3.0-<36	<2.6	<2.6	<2.5					<50		<50
Calcium	0.69	4		360-59,000	8,400	9,800J	12,000					<200		<200
Chromium	0.066	1		<4.3-47	5.0	5.4	7.4					<50		<50
Cobalt	N/A	4.9-5.2		<5.1-12	<5.1	<5.2	<4.9					<100		<100
Copper	0.045	1		<2.7-45	7.9	5.4	4.8					<50		<50
Iron	0.50	2		5,400-35,000	7,500	8,000	8,800					200		<100
Lead	0.13	4.9-5.2		<5.1-22	<51	<5.2J	<4.9					<100		<100
Magnesium	0.96	4		360-7,400	1,500	1,700J	1,900					<200		<200
Manganese	0.025	1		25-290	160	120	130					<50		<50
Molybdenum	N/A	2.5-2.6		<2.5-<11	<2.6	<2.6	<2.5					<50		<50
Nickel	0.11	1		4.2-46	6.9	6.8	7.8					<50		<50
Potassium	23	100		<300-2,200	340	390	410					<5,000		<5,000

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE D-14. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Soil
Site: Old Dump Site (LF19) Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples						Field Blank			Lab Blanks
					S01-1.5	S04-2.5 & S06-2.5 (Replicates)						EB05		
Laboratory Sample ID Numbers					4301-9	4301-8	4301-10					4303-5		4303 4301
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L		µg/L
Selenium	1.2	49-52		<7.8-<170	<51	<52	<49					<100		<100
Silver	0.53	2.5-2.6		<3-<110	<2.6	<2.6J	<2.5					<50		<50
Sodium	0.55	5		<160-680	53	60	70					<250		<250-267
Thallium	0.011	2.5-2.7		<0.2-<1.2	<0.25	<0.27	<0.26					<5		<5
Vanadium	0.036	1		6.3-59	5.8	6.6	9.3					<50		<50
Zinc	0.16	1		9.2-95	20	20	21					<50		<50

☐ CT&E Data.
J Result is an estimate.

TABLE D-14. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Soil
Site: Old Dump Site (LF19)   Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples 2S06-1.5	2S07	2S08-1 & 2S09-1 (Replicates)		Field Blanks AB02	EB06	Lab Blanks	
Laboratory Sample ID Numbers					1698	1700	1702	1704	315	1688	#5-9693 #3&4-82493 #1&2-9493	#3&4-9693
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	mg/kg
DRPH	5-10	50-100	500[a]	9.55-1,150	<100J[b]	<60J[b]	<50J[b]	<50J[b]	NA	<1,000J[b]	<1,000J	NA
GRPH	0.2	2	100	<0.400-<9.0	22J[b]	<2J[b]	<2J[b]	<2J[b]	<100J[b]	<50J[b]	<50J-<100J	<2
RRPH (Approx.)	10-20	100-200	2,000[a]	<480	<200	<120	<100	<100	NA	<1,000	<2,000	NA
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.20	<0.10	<0.10	<0.10				
Benzene	0.002-0.004	0.020-0.04	0.5	<0.020-<0.300	<0.04	<0.02	<0.02	<0.02	<1	<1	<1	<0.02
Toluene	0.002-0.004	0.020-0.04		<0.020-<0.300	<0.04	<0.02	<0.02	<0.02	<1	<4J	<1	<0.02
Ethylbenzene	0.002-0.004	0.020-0.04		<0.020-<0.300	<0.04	<0.02	<0.02	<0.02	<1	<2J	<1	<0.02
Xylenes (Total)	0.004-0.008	0.04-0.08		<0.040-<0.600	<0.08	<0.04	<0.04	<0.04	<2	<5J	<2	<0.04
HVOCs	0.01-0.02	0.1-0.2		<0.5J	<0.2	<0.1	<0.1	<0.1	<1	<1-<5J	<1	<0.1

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE D-14. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Sediment
Site: Old Dump Site (LF19) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples		Field Blanks			Lab Blanks	
					SD01	2SD02	AB02	EB05	TB05		
Laboratory Sample ID Numbers					351	1696	315 4303-1	392/332 4303-5	375	#3&4-82493 #1&2-82493	#6-82393 #5-9593 #3&4-9693 #1&2-82493
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	6	60	500[a]	9.55-1,150	580J[b]	<60J[b]	NA	<1,000[b]	NA	NA	<50J
GRPH	0.2-2.7	2-27	100	<0.400-<9.0	<27J[b]	2J[b]	<100J[b]	<100J[b]	<50J[b]	<50J-<100J	<2J
RRPH (Approx.)	12	120	2,000[a]	<480	5,800	<120	NA	<1,000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	0.03R	<0.10					
Benzene	0.002	0.02	0.5	<0.020-<0.300	<0.02R	<0.02	<1	<1	<1	<1	<0.02J
Toluene	0.002	0.02		<0.020-<0.300	<0.02R	<0.02	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002	0.02		<0.020-<0.300	0.03R	<0.02	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004	0.04		<0.040-<0.600	<0.04R	<0.04	<2	<2	<2	<2	<0.04
HVOC (8010 Mod.)	0.002-0.001	0.02-0.1		<0.5J	<0.02R	<0.1	<1	<1	<1	<1	<0.1

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
R Result has been rejected.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE D-14. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Surface Water
Site: Old Dump Site (LF19) Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Sample			Field Blanks			Lab Blanks
					SW01			AB02	EB05	TB05	
Laboratory Sample ID Numbers					307 4303-6			315 4303-1	392/332 4303-5	375	#3&4-82493 #1&2-82493 4303
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L			µg/L	µg/L	µg/L	µg/L
GRPH	10	100		<20	<100J[b]			<100J[b]	<100J[b]	<50J[b]	<50J-<100J
BTEX (8020/8020 Mod.)											
Benzene	0.1	1	5	<1	<1			<1	<1	<1	<1
Toluene	0.1	1	1,000	<1	<1			<1	<1	<1	<1
Ethylbenzene	0.1	1	700	<1	<1			<1	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<2	<2			<2	<2	<2	<2
HVOC 8010	0.1	1		NA	<1			<1	<1	<1	<1
VOC 8260	1	1		<1	<1-7.5U			5.1	<1	NA	<1
SVOC 8270	10	33		<10	<33			NA	<11	NA	<10
TOC	5,000	5,000		<5,000-12,700	34,600J			NA	<5,000J	NA	<5,000
TSS	100	200		<30,000-8,000	51,000J			NA	NA	NA	<200
TDS	10,000	10,000		<352,000-328,000	1,800,000J			NA	NA	NA	12,000

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
J Result is an estimate.
U Compound is not present above the concentration listed.
b GRPH concentrations reported for these samples are equivalent to gasoline range organics (GRO) as defined by ADEC.

TABLE D-14. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Dump Site (LF19)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample							Field Blank			Lab Blank
					SW01								EB05		
Laboratory Sample ID Numbers					4303-6								4303-5		4303
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L								µg/L		µg/L
Aluminum	17.4	100		<100-350 (<100-340)	160 (<100)								<100		<100 (<100)
Antimony	N/A	100	6	<100 (<100)	<100 (<100)								<100		<100 (<100)
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)								<100		<100 (<100)
Barium	1.2	100	2,000	<50-93 (<50-91)	90 (140)								<50		<50 (<50)
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)								<50		<50 (<50)
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)								<50		<50 (<50)
Calcium	34.5	100		4,500-88,000 (4,100-86,000)	170,000 (160,000)								<200		<200 (<200)
Chromium	3.29	50	100	<50 (<50)	<50 (<50)								<50		<50 (<50)
Cobalt	N/A	100		<100 (<100)	<100 (<100)								<100		<100 (<100)
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)								<50		<50 (<50)
Iron	25	100		180-2,800 (<100-1,600)	18,000 (1,800)								200		<100 (<100)
Lead	6.6	100	15	<100 (<100)	<100 (<100)								<100		<100 (<100)

☐ CT&E Data.
N/A Not available.

TABLE D-14. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Old Dump Site (LF19)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample							Field Blank			Lab Blank
					SW01								EB05		
Laboratory Sample ID Numbers					4303-6								4303-5		4303
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L								µg/L		µg/L
Magnesium	47.8	100		<5,000-53,000 (2,600-54,000)	72,000 (75,000)								<200		<200 (<200)
Manganese	1.24	50		<50-510 (<50-120)	70 (56)								<50		<50 (<50)
Molybdenum	N/A	50		<50 (<50)	<50 (<50)								<50		<50 (<50)
Nickel	5.5	50	100	<50 (<50)	<50 (<50)								<50		<50 (<50)
Potassium	1,154	100		<5,000 (<5,000)	7,600 (8,700)								<500		<5,000 (<5,000)
Selenium	62.4	100	50	<100 (<100)	<100 (<100)								<100		<100 (<100)
Silver	2.6	50	50	<50 (<50)	<50 (50)								<50		<50 (<50)
Sodium	27.7	100		8,400-410,000 (8,200-450,000)	250,000 (320,000)								<250		267 (267)
Thallium	0.57	5	2	<5 (<5)	<5 (<5)								<5		<5 (<5)
Vanadium	1.8	50		<50 (<50)	<50 (<50)								<50		<50 (<50)
Zinc	8.2	50		<50-160 (<50)	<50 (<50)								<50		<50 (<50)

☐ CT&E Data.
N/A Not available.

TABLE D-15. BLADDER DIESEL SPILL ANALYTICAL DATA SUMMARY

Installation: Barter Island
Site: Bladder Diesel Spill (SS20)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks	
					S01-0.75	S02-0.75	S03-1 & S04-1 (Replicates)		AB02	EB05	TB05		
Laboratory Sample ID Numbers					402	400 4305-6	385 4305-5	380 4305-4	315 4303-1	392/332 4303-5	375	#3&4-82493 #1&2-82493 4303	#6-82393 #1&2-82493 4305
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5	50	500[a]	9.55-1,150	<50J[b]	<50J[b]	<50J[b]	<50J[b]	NA	<1,000[b]	NA	NA	<50J
GRPH	0.2-20	2-200	100	<0.400-<9.0	<2J[b]	<2J[b]	<50J[b]	<200J[b]	<100J[b]	<100J[b]	<50J[b]	<50J-<100J	<2J
RRPH (Approx.)	10	100	2,000[a]	<480	<100	<100	<100	<100	NA	<1,000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.10J	<0.10J	<0.10R	<0.10R					
Benzene	0.002	0.02	0.5	<0.020-<0.300	<0.02J	<0.02J	<0.02R	<0.02R	<1	<1	<1	<1	<0.02J
Toluene	0.002	0.02		<0.020-<0.300	<0.02	<0.02	<0.02R	<0.02R	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002	0.02		<0.020-<0.300	<0.02	<0.02	<0.02R	<0.02R	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004	0.04		<0.040-<0.600	<0.04	<0.04	<0.04R	<0.04R	<2	<2	<2	<2	<0.04
VOC 8260	0.020	0.020		<0.025-<0.500	NA	<0.020	<0.020	<0.020	<1-6.3	<1-3.2	NA	<1	<0.020
SVOC 8270	0.200	0.210-1.00		<0.230-<3.50	NA	<0.210-<1.00	<0.220-<1.00	<0.220-<1.00	NA	<11	NA	<10	<0.200
TOC				32,000-199,000	NA	1,150	3,750	2,970	NA	<5,000J	NA	<5,000	NA

- ☐ CT&E Data.
- ▩ F&B Data.
- NA Not analyzed.
- J Result is an estimate.
- R Result has been rejected.
- a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
- b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE D-15. BLADDER DIESEL SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Bladder Diesel Spill (SS20)
Matrix: Soil/Sediment
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples							Field Blank			Lab Blanks
					S02-0.75	S03-1 & S04-1 (Replicates)		SD01					EB05		
Laboratory Sample ID Numbers					4305-6	4305-5	4305-4	4305-1					4303-5		4305 4303
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L		µg/L
Aluminum	0.35	2		1,500-25,000	1,600	2,100	2,000	2,000					<100		<100
Antimony	N/A	2-58		<7.8-<230	<52	<53	<53	<58					<100		<100
Arsenic	0.11	5.2-5.8		<4.9-8.5	<5.2	<5.3	<5.3	<5.8					<100		<100
Barium	0.024	1		27-390	13	18	18	20					<50		<50
Beryllium	N/A	2.6-2.9		<2.6-6.4	<2.6	<2.7	<2.7	<2.9					<50		<50
Cadmium	0.33	2.6-2.9		<3.0-<36	<2.6	<2.7	<2.7	<2.9					<50		<50
Calcium	0.69	4		360-59,000	13,000	3,700	33,000	5,600					<200		<200
Chromium	0.066	1		<4.3-47	3.0	4.7	4.0	9.3					<50		<50
Cobalt	N/A	5.2-5.8		<5.1-12	<5.2	<5.3	<5.3	<5.8					<100		<100
Copper	0.045	1		<2.7-45	4.8	4.7	4.9	6.6					<50		<50
Iron	0.50	2		5,400-35,000	6,000	5,800	6,200	5,700					200		<100
Lead	0.13	2-5.2		<5.1-22	<5.2	11	8.5	9.2					<100		<100
Magnesium	0.96	4		360-7,400	5,600J	1,800	17,000	2,900J					<200		<200
Manganese	0.025	1		25-290	69	69	77	69					<50		<50
Molybdenum	N/A	2.6-2.9		<2.5-<11	<2.6	<2.7	<2.7	<2.9					<50		<50
Nickel	0.11	1		4.2-46	5.6	5.3	4.6	7.7					<50		<50
Potassium	23	260-290		<300-2,200	<260	<270	<270	<290					<5,000		<5,000

☐ CT&E Data.
N/A Not available
J Result is an estimate.

TABLE D-15. BLADDER DIESEL SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Bladder Diesel Spill (SS20)
Matrix: Soil/Sediment
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples							Field Blank			Lab Blanks
					S02-0.75	S03-1 & S04-1 (Replicates)		SD01					EB05		
Laboratory Sample ID Numbers					4305-6	4305-5	4305-4	4305-1					4303-5		4305 4303
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L		µg/L
Selenium	1.2	5.2-5.8		<7.8-<170	<5.2	<5.3	<5.3	<5.8					<100		<100
Silver	0.53	2.6-2.9		<3-<110	<2.6	<2.7	<2.7	<2.9					<50		<50
Sodium	0.55	5		<160-680	52	61	58	80					<250		<250-267
Thallium	0.011	0.25-0.3		<0.2-<1.2	<0.25	<0.27	<0.28	<0.30					<5		<5
Vanadium	0.036	1		6.3-59	4.9	6.0	6.3	6.7					<50		<50
Zinc	0.16	1		9.2-95	13	2.7	21	30					<50		<50

☐ CT&E Data.

TABLE D-15. BLADDER DIESEL SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island — Matrix: Sediment
Site: Bladder Diesel Spill (SS20) — Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples		Field Blanks			Lab Blanks	
					SD01	SD02	AB02	EB05	TB05		
Laboratory Sample ID Numbers					378 4305-1	381/382	315 4303-1	392/332 4303-5	375	#3&4-82493 #1&2-82493 4303	#6-82393 #1&2-82493 4305
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5	50	500[a]	9.55-1,150	<50J[b]	<50J[b]	NA	<1,000[b]	NA	NA	<50J
GRPH	0.2-9	2-90	100	<0.400-<9.0	<90J[b]	<2R[b]	<100J[b]	<100J[b]	<50J[b]	<50J-<100J	<2J
RRPH (Approx.)	10	100	2,000[a]	<480	<100	<100	NA	<1,000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.13	<0.10R					
Benzene	0.002	0.02	0.5	<0.020-<0.300	<0.02	<0.02R	<1	<1	<1	<1	<0.02J
Toluene	0.002	0.02		<0.020-<0.300	<0.02	<0.02R	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002-0.003	0.02-0.03		<0.020-<0.300	<0.03	<0.02R	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004-0.006	0.04-0.06		<0.040-<0.600	<0.06	<0.04R	<2	<2	<2	<2	<0.04
VOC 8260											
Naphthalene	0.020	0.020		<0.025-<0.500	0.280	NA	<1	<1	NA	<1	<0.020
Toluene	0.020	0.020		<0.025-<0.500	0.097	NA	2.2	2.3	NA	<1	<0.020

- ☐ CT&E Data.
- ▩ F&B Data.
- NA Not analyzed.
- J Result is an estimate.
- R Result has been rejected.
- a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have yet to be determined.
- b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE D-15. BLADDER DIESEL SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: Bladder Diesel Spill (SS20)

Matrix: Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples		Field Blanks			Lab Blanks	
					SD01	SD02	AB02	EB05	TB05		
Laboratory Sample ID Numbers					378 4305-1	381/382	315 4303-1	392/332 4303-5	375	#3&4-82493 #1&2-82493 4303	#6-82393 #1&2-82493 4305
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
SVOC 8270											
Fluoranthene	0.200	2.40		<0.230-<3.50	1.70J	NA	NA	<11	NA	<10	<0.200
Phenanthrene	0.200	2.40		<0.230-<3.50	1.96J	NA	NA	<11	NA	<10	<0.200
Pyrene	0.200	2.40		<0.230-<3.50	1.26J	NA	NA	<11	NA	<10	<0.200
TOC				32,000-199,000	3,360	NA	NA	<5,000J	NA	<5,000	NA

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.

TABLE D-15. BLADDER DIESEL SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island Matrix: Surface Water
Site: Bladder Diesel Spill (SS20) Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks
					SW01	SW02 & SW03 (Duplicates)			AB02	EB05	TB05	
Laboratory Sample ID Numbers					398/388 4305-7	403/406	407/410		315 4303-1	392/332 4303-5	375	#3&4-82493 #1&2-82493 4305 4303
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L		µg/L	µg/L	µg/L	µg/L
DRPH	100	1,000		<200	<1,000J[b]	<1,000J[b]	<1,000J[b]		NA	<1,000[b]	NA	NA
GRPH	10	100		<20	<100J[b]	<100J[b]	<100J[b]		<100J[b]	<100J[b]	<50J[b]	<50J-<100J
RRPH (Approx.)	200	2,000		NA	<2,000	<2,000	<2,000		NA	<1,000	NA	NA
BTEX (8020/8020 Mod.)												
Benzene	0.1	1	5	<1	<1	<1	<1		<1	<1	<1	<1
Toluene	0.1	1	1,000	<1	<1	<1	<1		<1	<1	<1	<1
Ethylbenzene	0.1	1	700	<1	<1	<1	<1		<1	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<2	<2	<2	<2		<2	<2	<2	<2
VOC 8260												
1,2-Dichloroethane	1	1	5	3U-3.2B	2.8B	NA	NA		6.3	3.2	NA	<1
Naphthalene	1	1		<1	2.7	NA	NA		<1	<1	NA	<1

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
J Result is an estimate.
U Compound is not present above the concentration listed.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE D-15. BLADDER DIESEL SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island   Matrix: Surface Water
Site: Bladder Diesel Spill (SS20)   Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks
					SW01	SW02 & SW03 (Duplicates)			AB02	EB05	TB05	
Laboratory Sample ID Numbers					398/388 4305-7	403/406	407/410		315 4303-1	392/332 4303-5	375	4305 4303
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L		µg/L	µg/L	µg/L	µg/L
SVOCs	10	10		<10	<10	NA	NA		NA	<11	NA	<10
TOC	5,000	5,000		<5,000-12,700	31,400	NA	NA		NA	<5,000J	NA	<5,000
TSS	100	200		<30,000-8,000	84,000J	NA	NA		NA	NA	NA	<200
TDS	10,000	10,000		<352,000-328,000	903,000J	NA	NA		NA	NA	NA	<10,000

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.

TABLE D-16. JP-4 SPILL ANALYTICAL DATA SUMMARY

Installation: Barter Island
Site: JP-4 Spill (SS21)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks	
					S01 Composite	S02	S03	2S04	2S05	AB02	EB05	TB05		
Laboratory Sample ID Numbers					364	366 4301-11	369	1692	1694	315 4303-1	392/332 4303-5	375	#3&4-82493 #1&2-82493 4303	#6-82393 #5-9593 #3&4-9693 #1&2-82493 4301
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-10	50-100	500[a]	9.55-1,150	<50J[b]	1,000J[b]	1,300J[b]	<100J[b]	<100J[b]	NA	<1,000[b]	NA	NA	<50J
GRPH	0.2-0.4	2-4	100	<0.400-<9.0	<2R[b]	300J[b]	280J[b]	<4J[b]	<2J[b]	<100J[b]	<100J[b]	<50J[b]	<50J-<100J	<2J
RRPH (Approx.)	10-20	100-200	2,000[a]	<480	<110	<100	<100	<200	<200	NA	<1,000	NA	NA	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<0.250-<1.500	<0.10R	48.2JN	38J	<0.20	<0.15					
Benzene	0.002-0.004	0.02-0.04	0.5	<0.200-<0.300	<0.02R	3.9JN	<0.04	<0.04	<0.03	<1	<1	<1	<1	<0.02J
Toluene	0.002-0.004	0.02-0.04		<0.200-<0.300	<0.02R	7.3JN	4	<0.04	<0.03	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002-0.004	0.02-0.04		<0.200-<0.300	<0.02R	10JN	10J	<0.04	<0.03	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004-0.008	0.04-0.08		<0.400-<0.600	<0.04R	27JN	24J	<0.08	<0.06	<2	<2	<2	<2	<0.04
HVOC 8010	0.004-0.02	0.04-0.2		<0.5J	<0.2R	<0.2	<0.04	<0.2	<0.1	<1	<1	<1	<1	<0.02J-<0.1
VOC 8260														
n-Butylbenzene	0.020	0.200		<0.025-<0.500	NA	4.20	NA	NA	NA	<1	<1	NA	<1	<0.020
sec-Butylbenzene	0.020	0.200		<0.025-<0.500	NA	1.94	NA	NA	NA	<1	<1	NA	<1	<0.020
tert-Butylbenzene	0.020	0.200		<0.025-<0.500	NA	0.345	NA	NA	NA	<1	<1	NA	<1	<0.020

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification."
R Result has been rejected.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE D-16. JP-4 SPILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Barter Island
Site: JP-4 Spill (SS21)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks	
					S01 Composite	S02	S03	2S04	2S05	AB02	EB05	TB05		
Laboratory Sample ID Numbers					364	366 4301-11	369	1692	1694	315 4303-1	392/332 4303-5	375	4303	#6-82393 #5-9593 4301
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
Ethylbenzene	0.020	0.200		<0.025-<0.500	NA	11.8	NA	NA	NA	<1	<1	NA	<1	<0.020
Isopropylbenzene	0.020	0.200		<0.025-<0.500	NA	2.25	NA	NA	NA	<1	<1	NA	<1	<0.020
p-Isopropyltoluene	0.020	0.200		<0.025-<0.500	NA	2.56	NA	NA	NA	<1	<1	NA	<1	<0.020
Naphthalene	0.020	0.200		<0.025-<0.500	NA	5.54	NA	NA	NA	<1	<1	NA	<1	<0.020
n-Propylbenzene	0.020	0.200		<0.025-<0.500	NA	3.26	NA	NA	NA	<1	<1	NA	<1	<0.020
Toluene	0.020	0.200		<0.025-<0.500	NA	24.0	NA	NA	NA	2.2	2.3	NA	<1	<0.020
1,2,4-Trimethylbenzene	0.020	0.200		<0.025-<0.500	NA	18.1	NA	NA	NA	<1	<1	NA	<1	<0.020
1,3,5-Trimethylbenzene	0.020	0.200		<0.025-<0.500	NA	9.16	NA	NA	NA	<1	<1	NA	<1	<0.020
Xylenes (Total)	0.040	0.400		<0.050-<1.000	NA	69.0	NA	NA	NA	<2	<2	NA	<2	<0.040
Total BTEX			15	<0.125-<2.500	NA	104.8	NA	NA	NA					
SVOC 8270														
2-Methylnaphthalene	0.200	0.200		<0.230-<3.50	NA	1.42	NA	NA	NA	NA	<11	NA	<10	<0.200
Naphthalene	0.200	0.200		<0.230-<3.50	NA	0.274	NA	NA	NA	NA	<11	NA	<10	<0.200
Pesticides	0.001-0.05	0.01-0.5		<0.001-<0.100	<0.01J-<0.5J	NA	NA	NA	NA	NA	<0.2-<10	NA	NA	<0.01-<0.5
TOC					NA	2,200	NA	NA	NA	NA	<5,000J	NA	<5,000	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.

TABLE 4-2. IDENTIFICATION OF CHEMICALS OF CONCERN AT THE JP-4 SPILL (SS21)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a] CANCER	RBSL[a] NON-CANCER	ARAR[b]	CHEMICAL OF CONCERN
JP-4 Spill (SS21)	Soil	DRPH	1,300	mg/kg	9.55-1,150	--	--	500[c]	**YES**
		GRPH	300	mg/kg	<0.400-<9	--	--	100[c]	**YES**
		Benzene	3.9	mg/kg	<0.020-<0.500	2.2	--	0.5[c]	**YES**
		n-Butylbenzene	4.20	mg/kg	<0.025-<0.500	--	--	--	NO
		sec-Butylbenzene	1.94	mg/kg	<0.025-<0.500	--	--	--	NO
		tert-Butylbenzene	0.345	mg/kg	<0.025-<0.500	--	--	--	NO
		Ethylbenzene	11.8	mg/kg	<0.020-<0.500	--	2,700	--	NO
		Isopropylbenzene	2.25	mg/kg	<0.025-<0.500	--	--	--	NO
		p-Isopropyltoluene	2.56	mg/kg	<0.025-<0.500	--	--	--	NO
		Naphthalene	5.54	mg/kg	<0.025-<3.50	--	100	--	NO
		n-Propylbenzene	3.26	mg/kg	<0.025-<0.500	--	--	--	NO
		Toluene	24.0	mg/kg	<0.020-<0.500	--	5,400	--	NO
		1,2,4-Trimethylbenzene	18.1	mg/kg	<0.025-<0.500	--	--	--	NO
		1,3,5-Trimethylbenzene	9.16	mg/kg	<0.025-<0.500	--	--	--	NO
		Xylenes	69.0	mg/kg	<0.040-<1.000	--	54,000	--	NO
		2-Methylnaphthalene	1.42	mg/kg	<0.230-<3.50	--	--	--	NO

a Risk-Based Screening Level.
b Applicable or Relevant and Appropriate Requirement.
c ADEC 1991.

APPENDIX E

SITE HABITAT MAPS

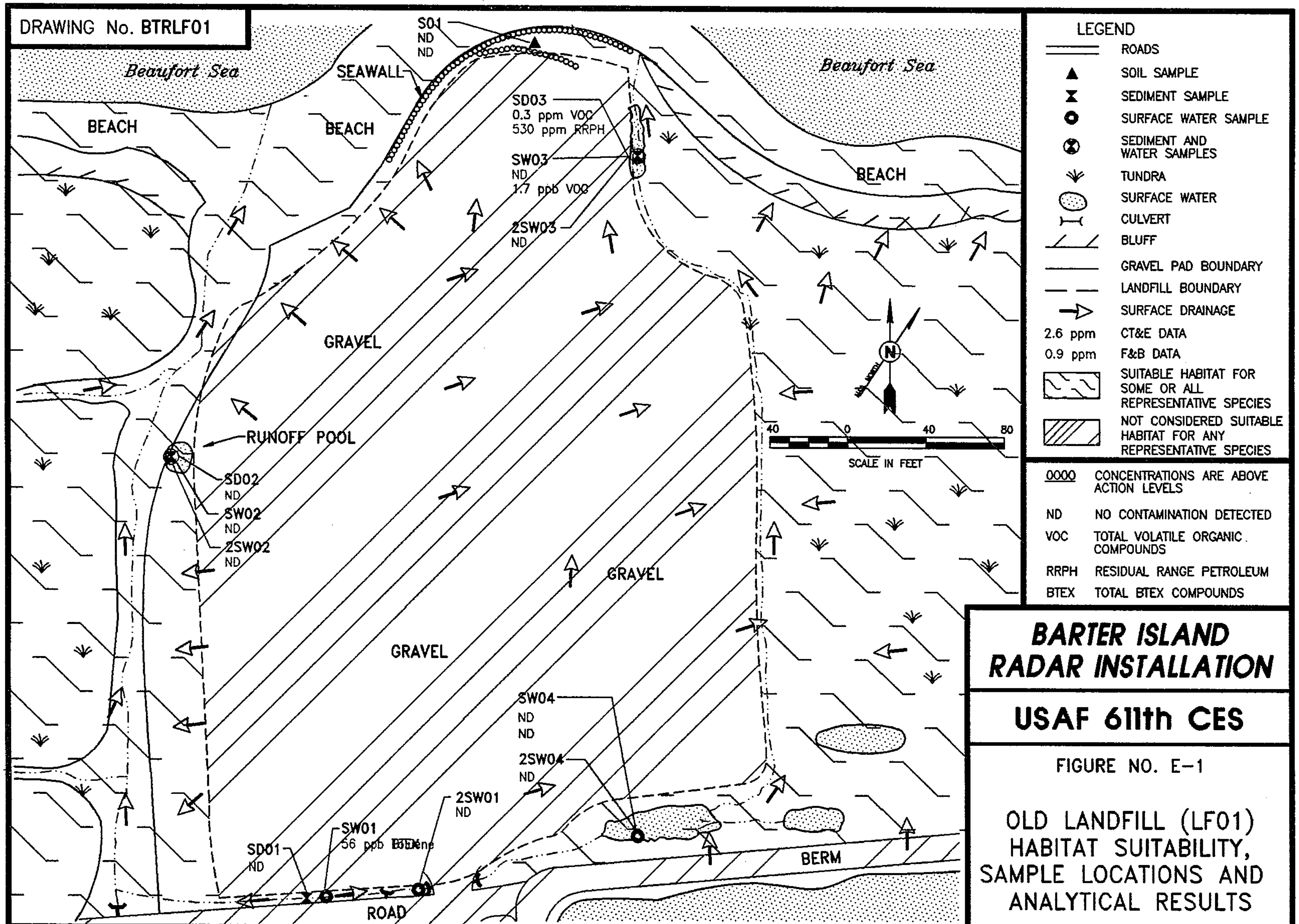
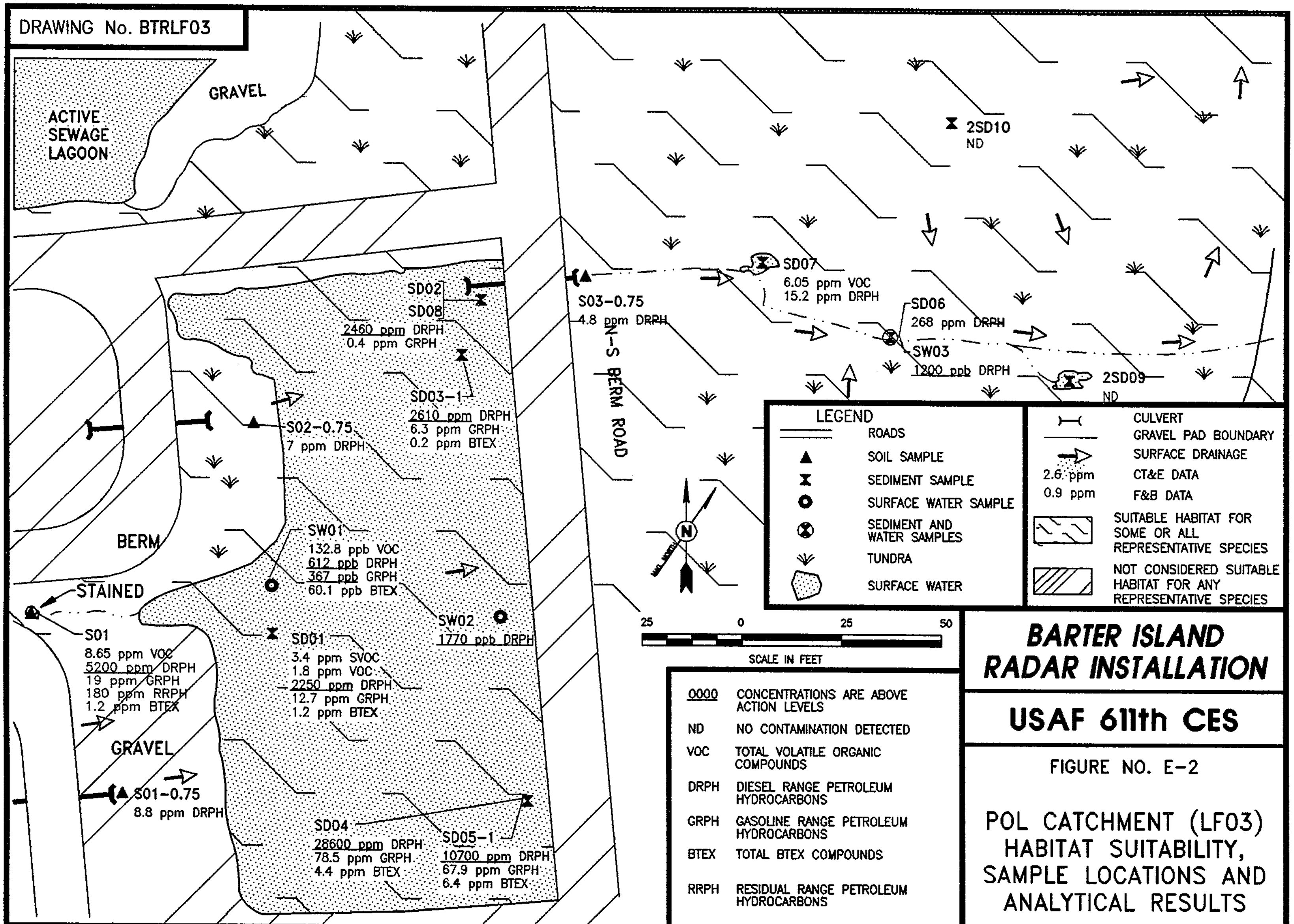
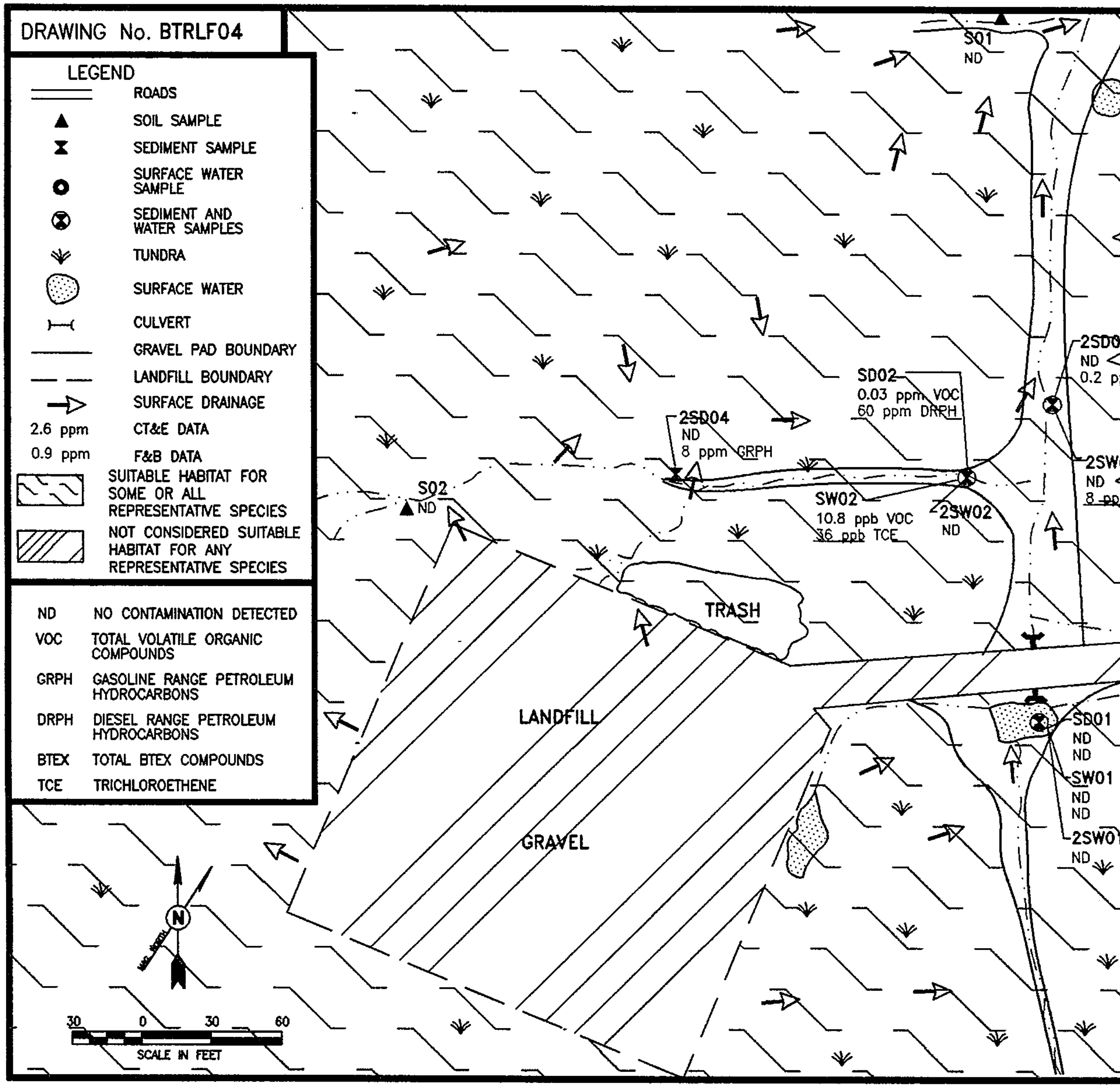


FIGURE NO. E-1

OLD LANDFILL (LF01) HABITAT SUITABILITY, SAMPLE LOCATIONS AND ANALYTICAL RESULTS


DRAWING No. BTRLF03
ACTIVE SEWAGE LAGOON
GRAVEL
BERM
STAINED
GRAVEL
N-S BERM ROAD
S01
8.65 ppm VOC
5200 ppm DRPH
19 ppm GRPH
180 ppm RRPH
1.2 ppm BTEX
S01-0.75
8.8 ppm DRPH
S02-0.75
7 ppm DRPH
SD02
SD08
2460 ppm DRPH
0.4 ppm GRPH
SD03-1
2610 ppm DRPH
6.3 ppm GRPH
0.2 ppm BTEX
SW01
132.8 ppb VOC
612 ppb DRPH
367 ppb GRPH
60.1 ppb BTEX
SW02
1770 ppb DRPH
SD01
3.4 ppm SVOC
1.8 ppm VOC
2250 ppm DRPH
12.7 ppm GRPH
1.2 ppm BTEX
SD04
28600 ppm DRPH
78.5 ppm GRPH
4.4 ppm BTEX
SD05-1
10700 ppm DRPH
67.9 ppm GRPH
6.4 ppm BTEX
S03-0.75
4.8 ppm DRPH
SD07
6.05 ppm VOC
15.2 ppm DRPH
SD06
268 ppm DRPH
SW03
1200 ppb DRPH
2SD09
ND
2SD10
ND
N
LEGEND
ROADS
SOIL SAMPLE
SEDIMENT SAMPLE
SURFACE WATER SAMPLE
SEDIMENT AND WATER SAMPLES
TUNDRA
SURFACE WATER
CULVERT
GRAVEL PAD BOUNDARY
SURFACE DRAINAGE
2.6 ppm CT&E DATA
0.9 ppm F&B DATA
SUITABLE HABITAT FOR SOME OR ALL REPRESENTATIVE SPECIES
NOT CONSIDERED SUITABLE HABITAT FOR ANY REPRESENTATIVE SPECIES
25 0 25 50
SCALE IN FEET
0000 CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND NO CONTAMINATION DETECTED
VOC TOTAL VOLATILE ORGANIC COMPOUNDS
DRPH DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH GASOLINE RANGE PETROLEUM HYDROCARBONS
BTEX TOTAL BTEX COMPOUNDS
RRPH RESIDUAL RANGE PETROLEUM HYDROCARBONS
BARTER ISLAND RADAR INSTALLATION
USAF 611th CES
FIGURE NO. E-2
POL CATCHMENT (LF03) HABITAT SUITABILITY, SAMPLE LOCATIONS AND ANALYTICAL RESULTS

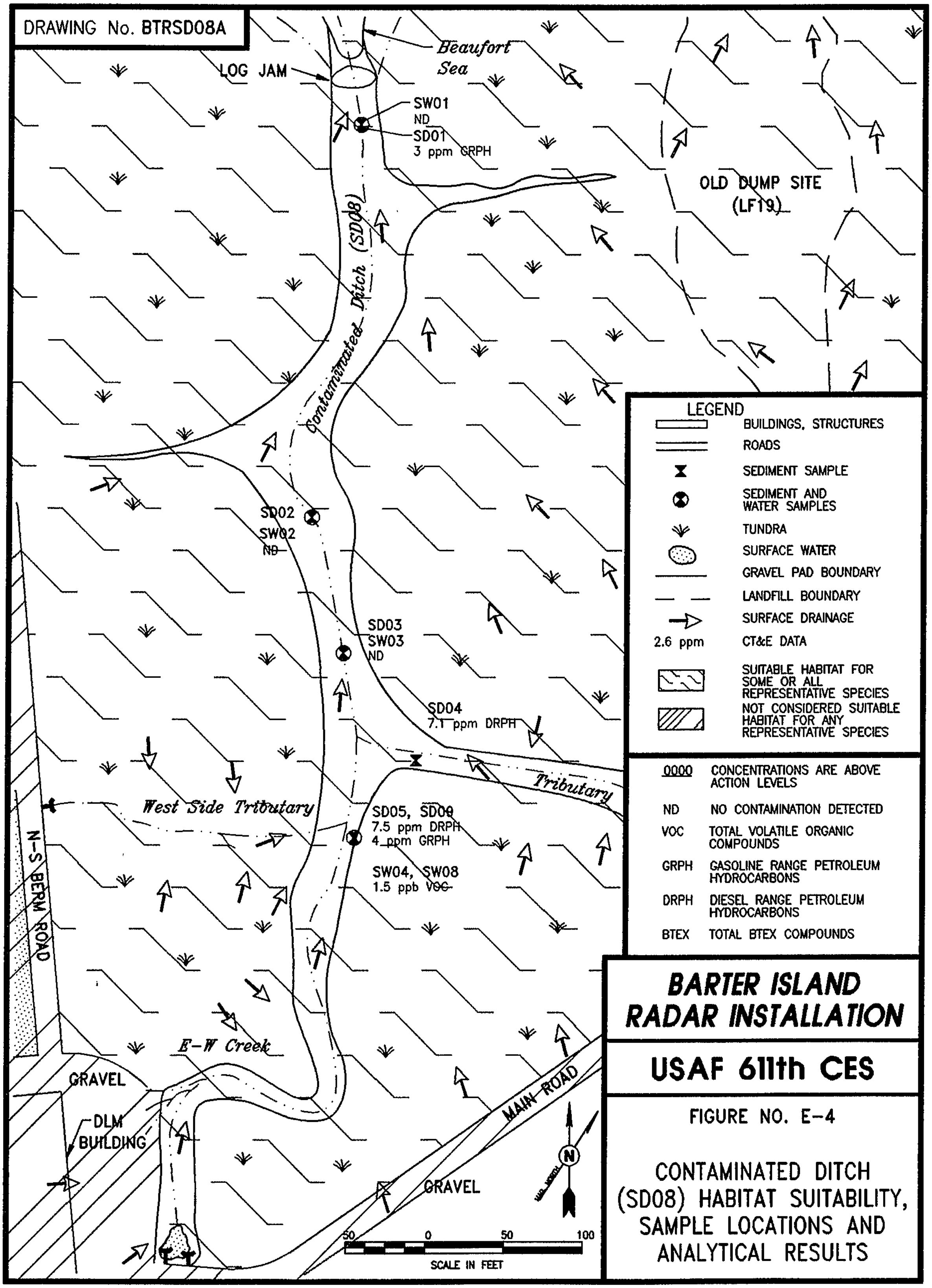


BARTER ISLAND RADAR INSTALLATION

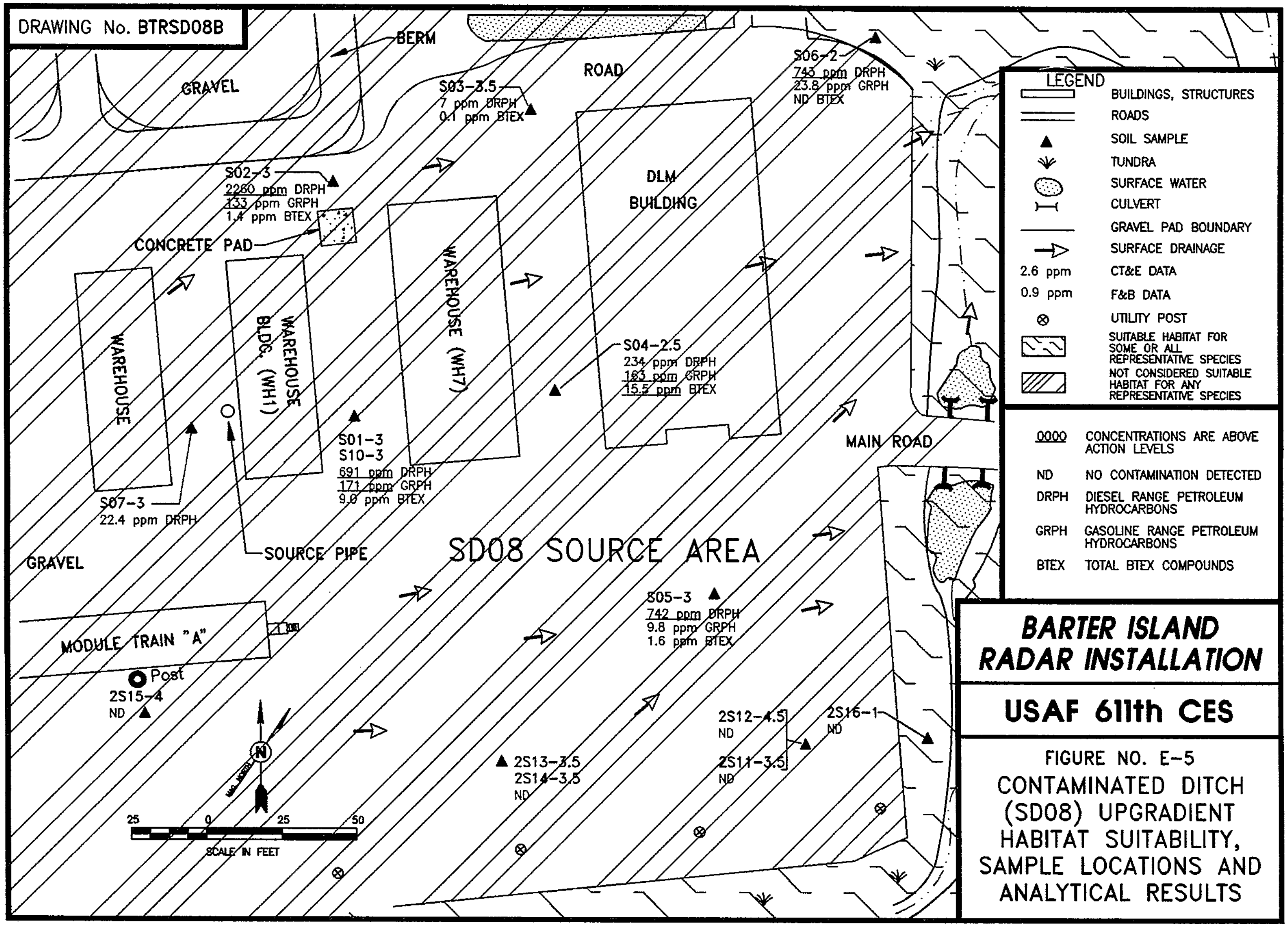
USAF 611th CES

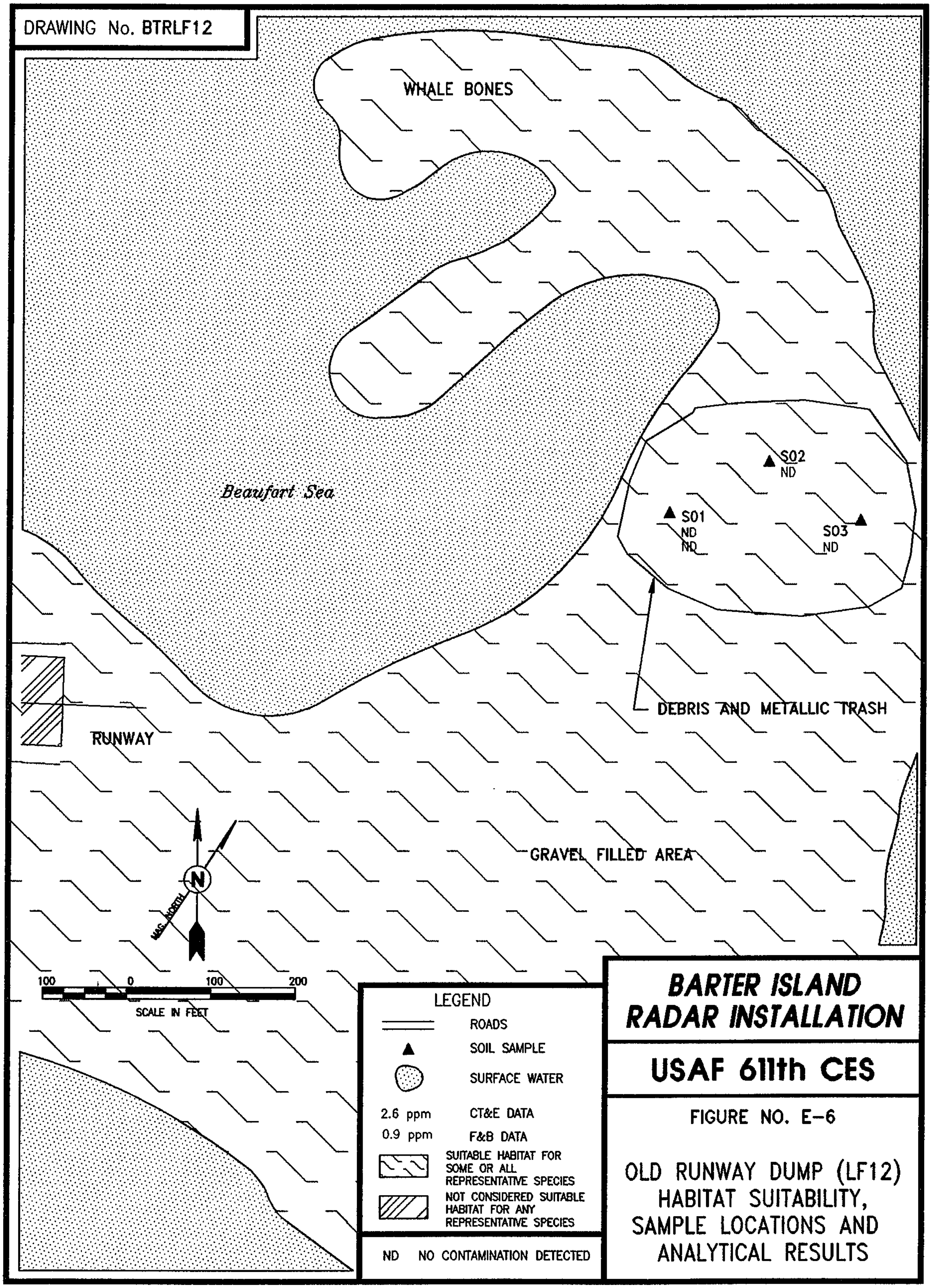
FIGURE NO. E-3

CURRENT LANDFILL (LF04)
HABITAT SUITABILITY,
SAMPLE LOCATIONS
ANALYTICAL RESULTS



DRAWING No. BTRSD08A
LOG JAM
Beaufort Sea
SW01
ND
SD01
3 ppm GRPH
OLD DUMP SITE (LF19)
Contaminated Ditch (SD08)
SD02
SW02
ND
SD03
SW03
ND
SD04
7.1 ppm DRPH
Tributary
West Side Tributary
SD05, SD09
7.5 ppm DRPH
4 ppm GRPH
SW04, SW08
1.5 ppb VOC
N-S BERM ROAD
E-W Creek
GRAVEL
DLM BUILDING
MAIN ROAD
GRAVEL
N
50 0 50 100
SCALE IN FEET
LEGEND
BUILDINGS, STRUCTURES
ROADS
SEDIMENT SAMPLE
SEDIMENT AND WATER SAMPLES
TUNDRA
SURFACE WATER
GRAVEL PAD BOUNDARY
LANDFILL BOUNDARY
SURFACE DRAINAGE
2.6 ppm CT&E DATA
SUITABLE HABITAT FOR SOME OR ALL REPRESENTATIVE SPECIES
NOT CONSIDERED SUITABLE HABITAT FOR ANY REPRESENTATIVE SPECIES
0000 CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND NO CONTAMINATION DETECTED
VOC TOTAL VOLATILE ORGANIC COMPOUNDS
GRPH GASOLINE RANGE PETROLEUM HYDROCARBONS
DRPH DIESEL RANGE PETROLEUM HYDROCARBONS
BTEX TOTAL BTEX COMPOUNDS
BARTER ISLAND RADAR INSTALLATION
USAF 611th CES
FIGURE NO. E-4
CONTAMINATED DITCH (SD08) HABITAT SUITABILITY, SAMPLE LOCATIONS AND ANALYTICAL RESULTS


DRAWING No. BTRSD08B
BERM
GRAVEL
ROAD
S03-3.5
7 ppm DRPH
0.1 ppm BTEX
S06-2
743 ppm DRPH
23.8 ppm GRPH
ND BTEX
S02-3
2280 ppm DRPH
133 ppm GRPH
1.4 ppm BTEX
CONCRETE PAD
DLM BUILDING
WAREHOUSE
WAREHOUSE BLDG. (WH1)
WAREHOUSE (WH7)
S04-2.5
234 ppm DRPH
163 ppm GRPH
15.5 ppm BTEX
S01-3
S10-3
691 ppm DRPH
171 ppm GRPH
9.0 ppm BTEX
S07-3
22.4 ppm DRPH
SOURCE PIPE
MAIN ROAD
SD08 SOURCE AREA
GRAVEL
S05-3
742 ppm DRPH
9.8 ppm GRPH
1.6 ppm BTEX
MODULE TRAIN "A"
Post
2S15-4
ND
2S12-4.5
ND
2S16-1
ND
2S11-3.5
ND
2S13-3.5
2S14-3.5
ND
MAG NORTH
25 0 25 50
SCALE IN FEET
LEGEND
BUILDINGS, STRUCTURES
ROADS
SOIL SAMPLE
TUNDRA
SURFACE WATER
CULVERT
GRAVEL PAD BOUNDARY
SURFACE DRAINAGE
2.6 ppm CT&E DATA
0.9 ppm F&B DATA
UTILITY POST
SUITABLE HABITAT FOR SOME OR ALL REPRESENTATIVE SPECIES
NOT CONSIDERED SUITABLE HABITAT FOR ANY REPRESENTATIVE SPECIES
0000 CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND NO CONTAMINATION DETECTED
DRPH DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH GASOLINE RANGE PETROLEUM HYDROCARBONS
BTEX TOTAL BTEX COMPOUNDS
BARTER ISLAND RADAR INSTALLATION
USAF 611th CES
FIGURE NO. E-5
CONTAMINATED DITCH (SD08) UPGRADIENT HABITAT SUITABILITY, SAMPLE LOCATIONS AND ANALYTICAL RESULTS

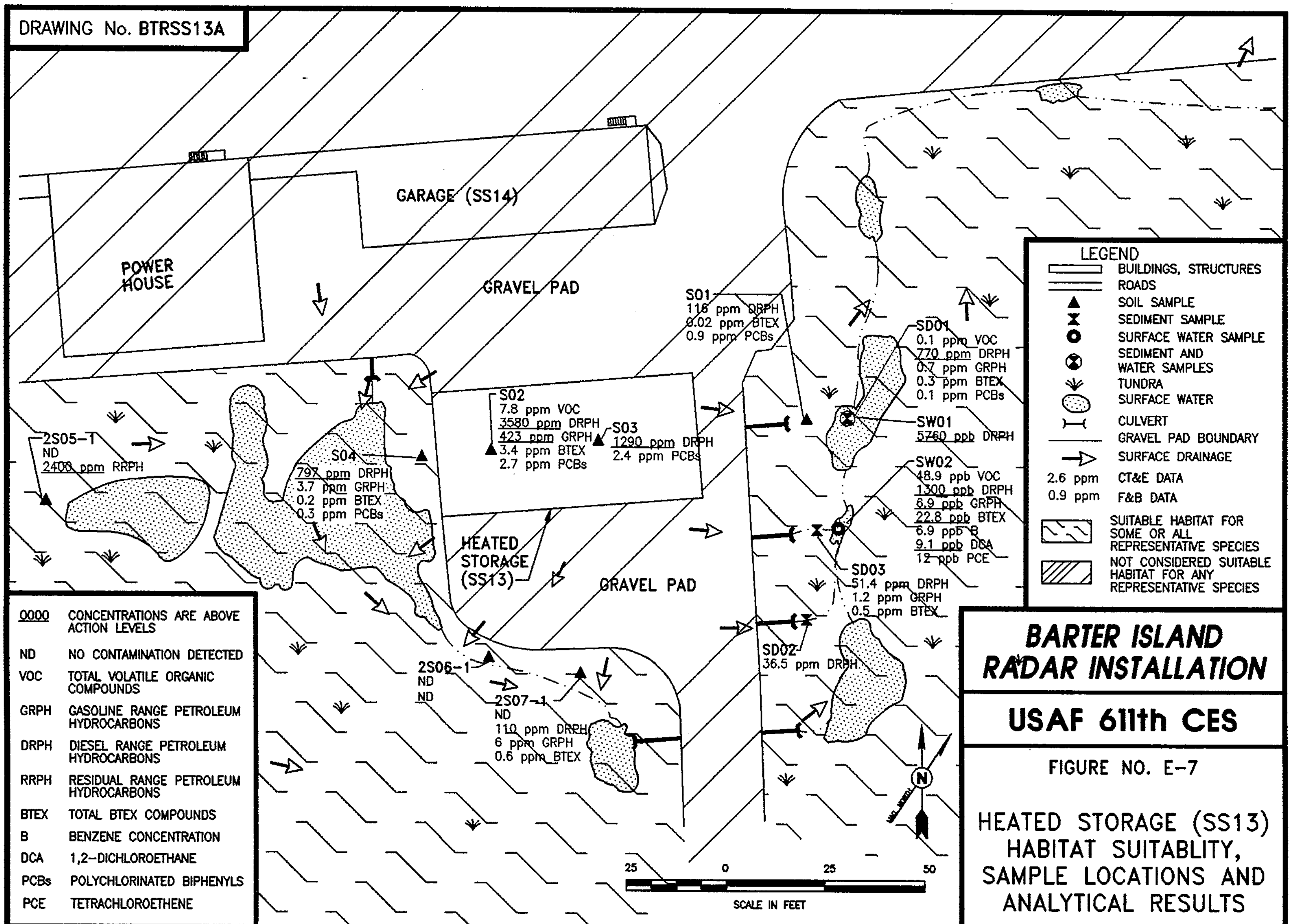


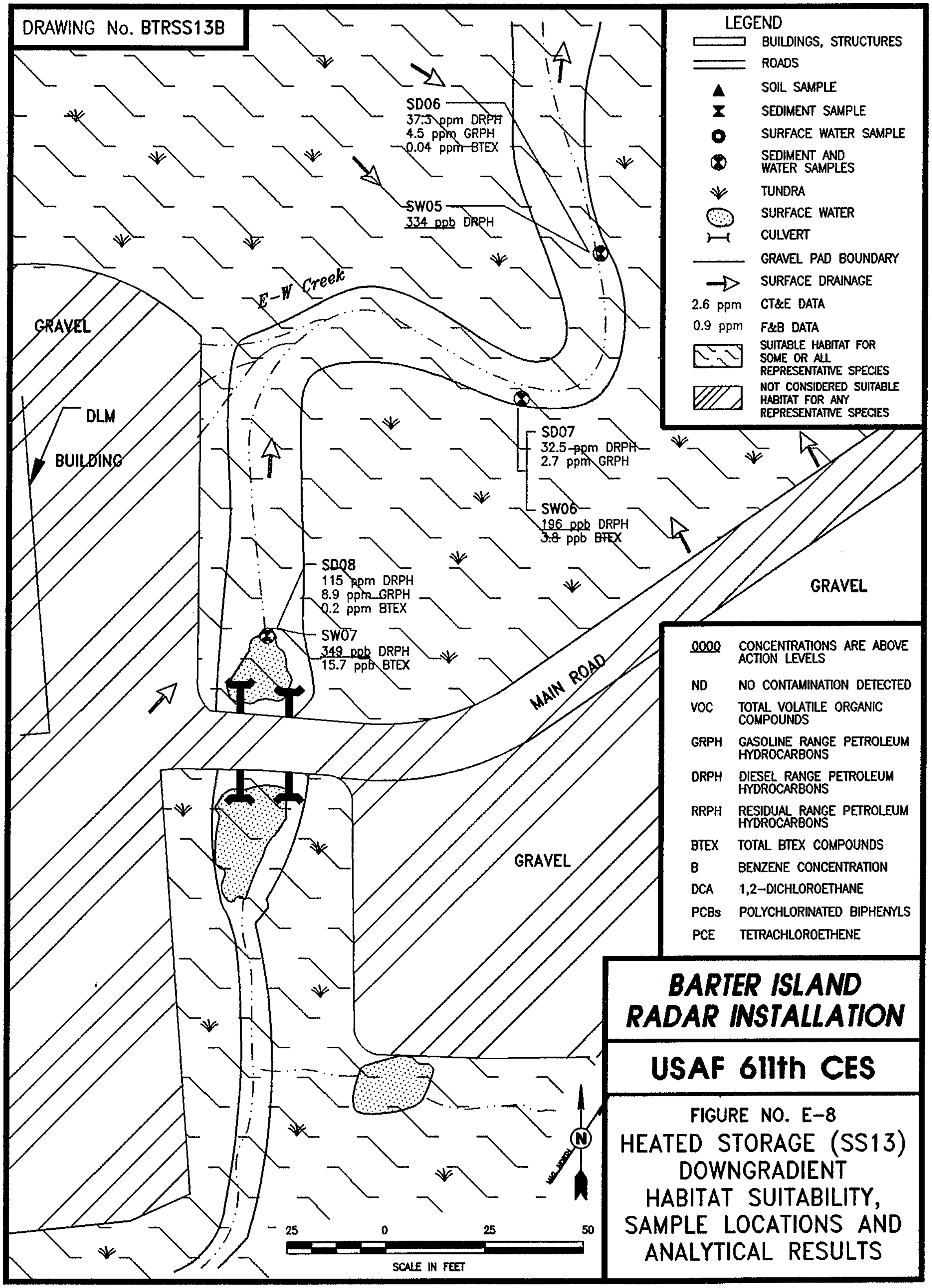
BARTER ISLAND RADAR INSTALLATION

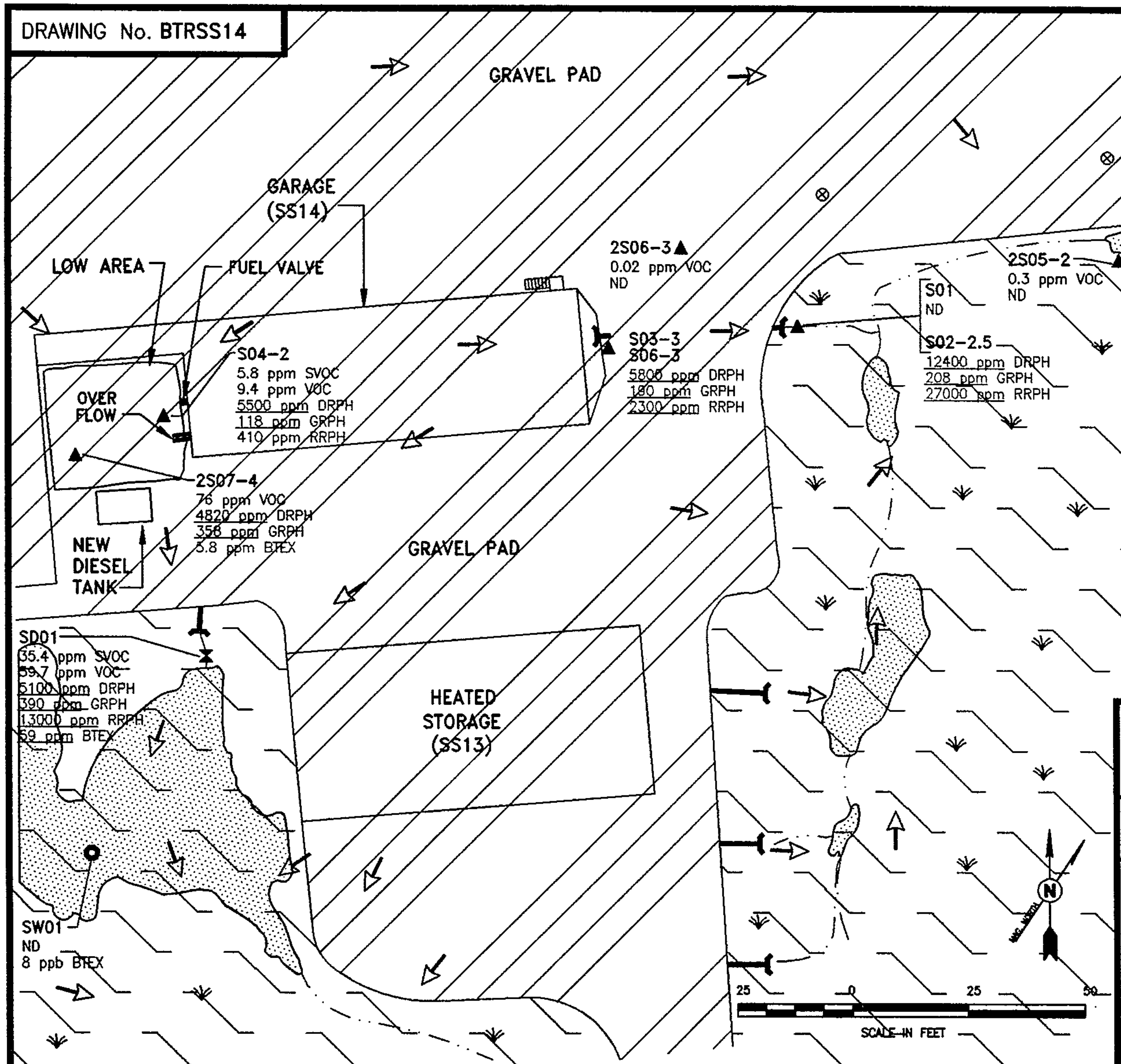
USAF 611th CES

FIGURE NO. E-6

OLD RUNWAY DUMP (LF12) HABITAT SUITABILITY, SAMPLE LOCATIONS AND ANALYTICAL RESULTS


DRAWING No. BTRSS13A
POWER HOUSE
GARAGE (SS14)
GRAVEL PAD
S01
116 ppm DRPH
0.02 ppm BTEX
0.9 ppm PCBs
S02
7.8 ppm VOC
3580 ppm DRPH
423 ppm GRPH
3.4 ppm BTEX
2.7 ppm PCBs
S03
1290 ppm DRPH
2.4 ppm PCBs
S04
797 ppm DRPH
3.7 ppm GRPH
0.2 ppm BTEX
0.3 ppm PCBs
2S05-1
ND
2400 ppm RRPH
HEATED STORAGE (SS13)
GRAVEL PAD
2S06-1
ND
ND
2S07-1
ND
110 ppm DRPH
6 ppm GRPH
0.6 ppm BTEX
SD01
0.1 ppm VOC
770 ppm DRPH
0.7 ppm GRPH
0.3 ppm BTEX
0.1 ppm PCBs
SW01
5760 ppb DRPH
SW02
48.9 ppb VOC
1300 ppb DRPH
6.9 ppb GRPH
22.8 ppb BTEX
6.9 ppb B
9.1 ppb DCA
12 ppb PCE
SD03
51.4 ppm DRPH
1.2 ppm GRPH
0.5 ppm BTEX
SD02
36.5 ppm DRPH
N
25 0 25 50
SCALE IN FEET
LEGEND
BUILDINGS, STRUCTURES
ROADS
SOIL SAMPLE
SEDIMENT SAMPLE
SURFACE WATER SAMPLE
SEDIMENT AND WATER SAMPLES
TUNDRA
SURFACE WATER
CULVERT
GRAVEL PAD BOUNDARY
SURFACE DRAINAGE
2.6 ppm CT&E DATA
0.9 ppm F&B DATA
SUITABLE HABITAT FOR SOME OR ALL REPRESENTATIVE SPECIES
NOT CONSIDERED SUITABLE HABITAT FOR ANY REPRESENTATIVE SPECIES
0000 CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND NO CONTAMINATION DETECTED
VOC TOTAL VOLATILE ORGANIC COMPOUNDS
GRPH GASOLINE RANGE PETROLEUM HYDROCARBONS
DRPH DIESEL RANGE PETROLEUM HYDROCARBONS
RRPH RESIDUAL RANGE PETROLEUM HYDROCARBONS
BTEX TOTAL BTEX COMPOUNDS
B BENZENE CONCENTRATION
DCA 1,2-DICHLOROETHANE
PCBs POLYCHLORINATED BIPHENYLS
PCE TETRACHLOROETHENE
BARTER ISLAND RADAR INSTALLATION
USAF 611th CES
FIGURE NO. E-7
HEATED STORAGE (SS13) HABITAT SUITABLITY, SAMPLE LOCATIONS AND ANALYTICAL RESULTS


DRAWING No. BTRSS13B
LEGEND
BUILDINGS, STRUCTURES
ROADS
SOIL SAMPLE
SEDIMENT SAMPLE
SURFACE WATER SAMPLE
SEDIMENT AND WATER SAMPLES
TUNDRA
SURFACE WATER
CULVERT
GRAVEL PAD BOUNDARY
SURFACE DRAINAGE
2.6 ppm CT&E DATA
0.9 ppm F&B DATA
SUITABLE HABITAT FOR SOME OR ALL REPRESENTATIVE SPECIES
NOT CONSIDERED SUITABLE HABITAT FOR ANY REPRESENTATIVE SPECIES
SD06
37.3 ppm DRPH
4.5 ppm GRPH
0.04 ppm BTEX
SW05
334 ppb DRPH
E-W Creek
GRAVEL
DLM
BUILDING
SD07
32.5 ppm DRPH
2.7 ppm GRPH
SW06
196 ppb DRPH
3.8 ppb BTEX
SD08
115 ppm DRPH
8.9 ppm GRPH
0.2 ppm BTEX
SW07
349 ppb DRPH
15.7 ppb BTEX
MAIN ROAD
GRAVEL
GRAVEL
0000 CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND NO CONTAMINATION DETECTED
VOC TOTAL VOLATILE ORGANIC COMPOUNDS
GRPH GASOLINE RANGE PETROLEUM HYDROCARBONS
DRPH DIESEL RANGE PETROLEUM HYDROCARBONS
RRPH RESIDUAL RANGE PETROLEUM HYDROCARBONS
BTEX TOTAL BTEX COMPOUNDS
B BENZENE CONCENTRATION
DCA 1,2-DICHLOROETHANE
PCBs POLYCHLORINATED BIPHENYLS
PCE TETRACHLOROETHENE
N
25 0 25 50
SCALE IN FEET
BARTER ISLAND RADAR INSTALLATION
USAF 611th CES
FIGURE NO. E-8
HEATED STORAGE (SS13) DOWNGRADIENT HABITAT SUITABILITY, SAMPLE LOCATIONS AND ANALYTICAL RESULTS



LEGEND

	BUILDINGS, STRUCTURES
	ROADS
	SOIL SAMPLE
	SEDIMENT SAMPLE
	SURFACE WATER SAMPLE
	TUNDRA
	SURFACE WATER
	CULVERT
	GRAVEL PAD BOUNDARY
	SURFACE DRAINAGE
2.6 ppm	CT&E DATA
0.9 ppm	F&B DATA
	UTILITY POST
	SUITABLE HABITAT FOR SOME OR ALL REPRESENTATIVE SPECIES
	NOT CONSIDERED SUITABLE HABITAT FOR ANY REPRESENTATIVE SPECIES

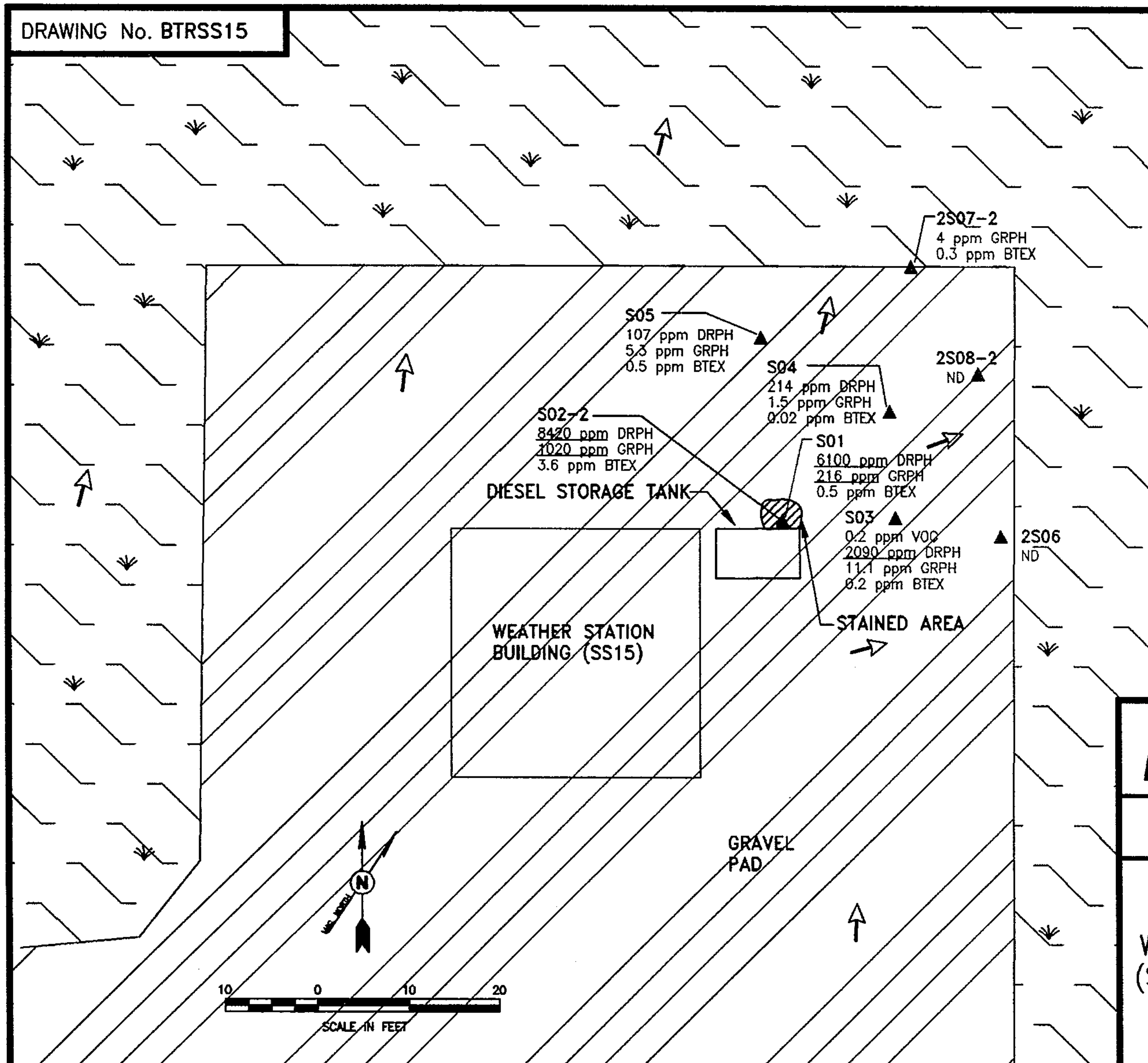
0000	CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND	NO CONTAMINATION DETECTED
SVOC	TOTAL SEMI-VOLATILE ORGANIC COMPOUNDS
VOC	TOTAL VOLATILE ORGANIC COMPOUNDS
DRPH	DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH	GASOLINE RANGE PETROLEUM HYDROCARBONS
RRPH	RESIDUAL RANGE PETROLEUM HYDROCARBONS
BTEX	TOTAL BTEX COMPOUNDS

BARTER ISLAND RADAR INSTALLATION

USAF 611th CES

FIGURE NO. E-9

GARAGE (SS14) HABITAT SUITABILITY, SAMPLE LOCATIONS AND ANALYTICAL RESULTS

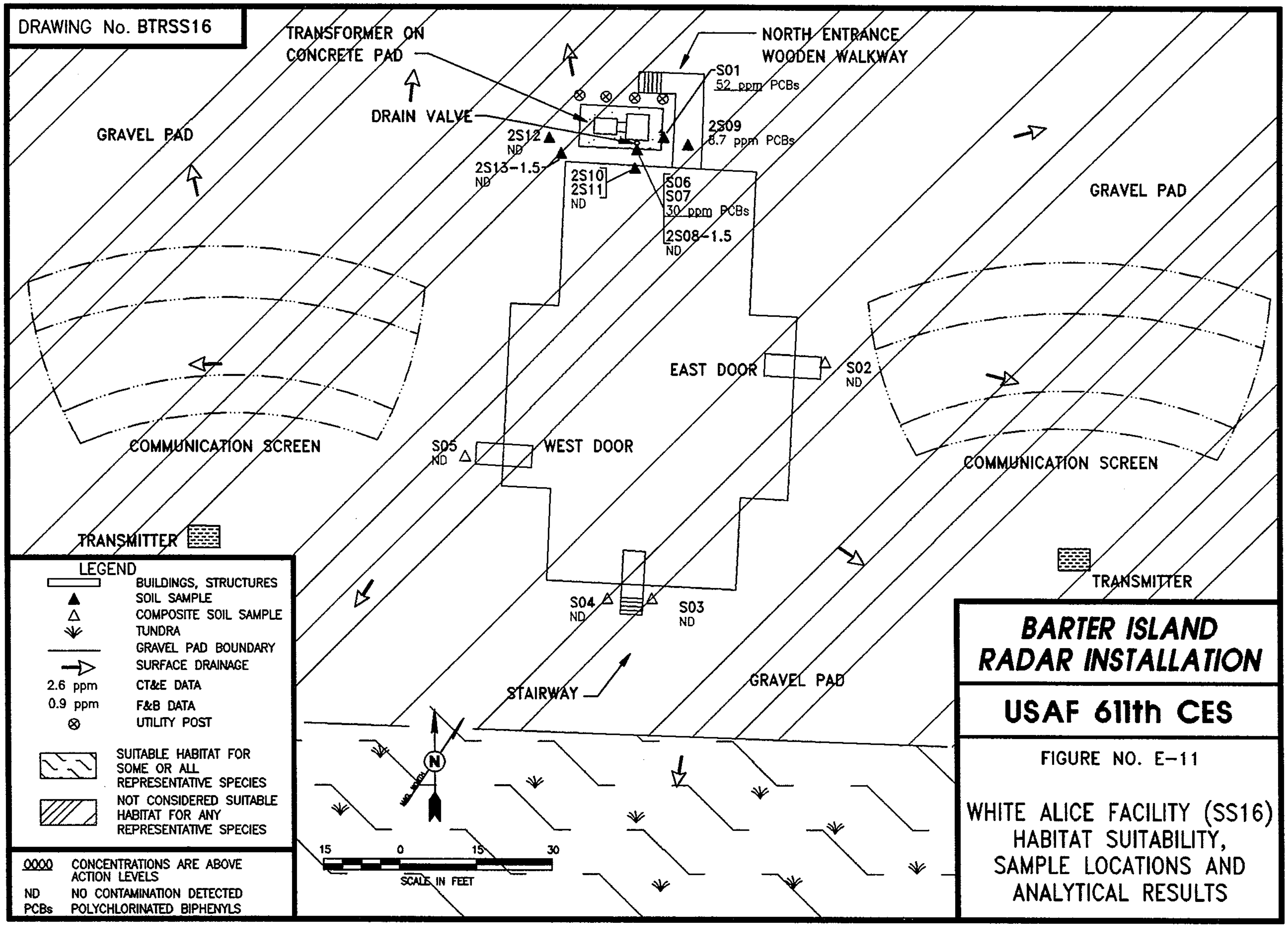


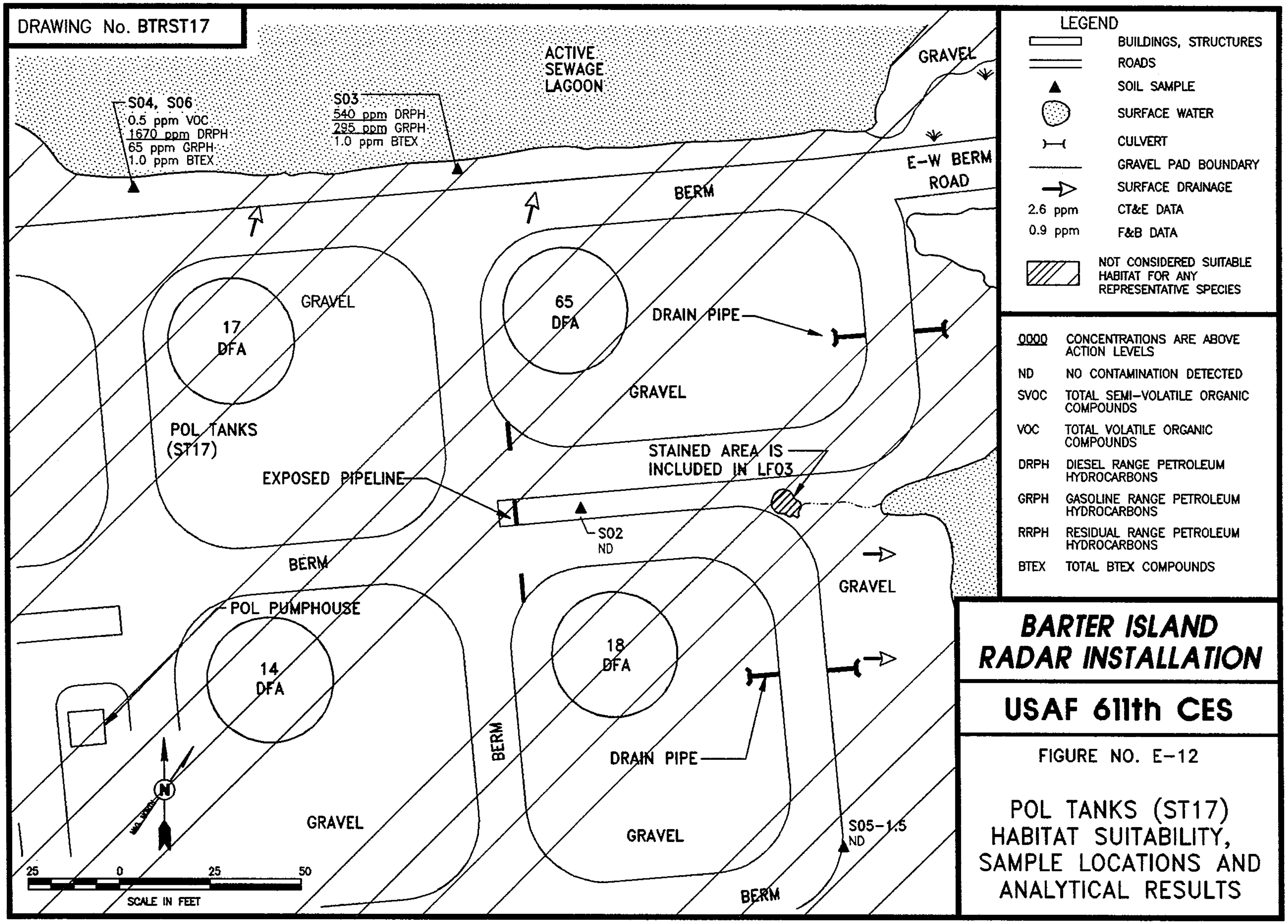
BARTER ISLAND RADAR INSTALLATION

USAF 611th CES

FIGURE NO. E-10

WEATHER STATION BUILDING (SS15) HABITAT SUITABILITY, SAMPLE LOCATIONS AND ANALYTICAL RESULTS


DRAWING No. BTRSS16
TRANSFORMER ON CONCRETE PAD
DRAIN VALVE
NORTH ENTRANCE WOODEN WALKWAY
S01
52 ppm PCBs
2S09
8.7 ppm PCBs
2S12
ND
2S13-1.5
ND
2S10
2S11
ND
S06
S07
30 ppm PCBs
2S08-1.5
ND
GRAVEL PAD
GRAVEL PAD
GRAVEL PAD
EAST DOOR
S02
ND
WEST DOOR
S05
ND
COMMUNICATION SCREEN
COMMUNICATION SCREEN
TRANSMITTER
TRANSMITTER
S04
ND
S03
ND
STAIRWAY
15 0 15 30
SCALE IN FEET
LEGEND
BUILDINGS, STRUCTURES
SOIL SAMPLE
COMPOSITE SOIL SAMPLE
TUNDRA
GRAVEL PAD BOUNDARY
SURFACE DRAINAGE
2.6 ppm CT&E DATA
0.9 ppm F&B DATA
UTILITY POST
SUITABLE HABITAT FOR SOME OR ALL REPRESENTATIVE SPECIES
NOT CONSIDERED SUITABLE HABITAT FOR ANY REPRESENTATIVE SPECIES
0000 CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND NO CONTAMINATION DETECTED
PCBs POLYCHLORINATED BIPHENYLS
BARTER ISLAND RADAR INSTALLATION
USAF 611th CES
FIGURE NO. E-11
WHITE ALICE FACILITY (SS16) HABITAT SUITABILITY, SAMPLE LOCATIONS AND ANALYTICAL RESULTS



BARTER ISLAND RADAR INSTALLATION

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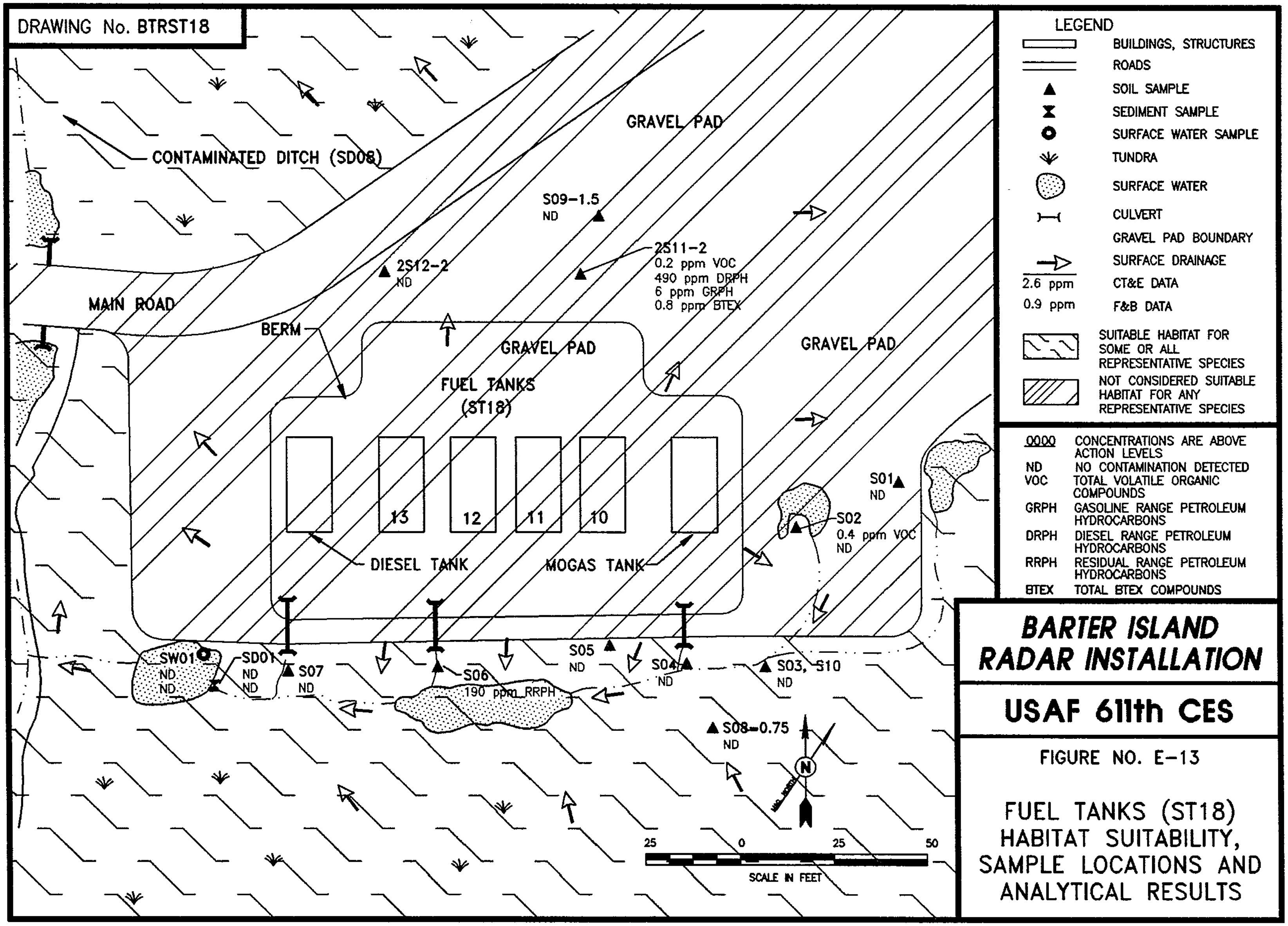
FIGURE NO. E-12

POL TANKS (ST17) HABITAT SUITABILITY, SAMPLE LOCATIONS AND ANALYTICAL RESULTS

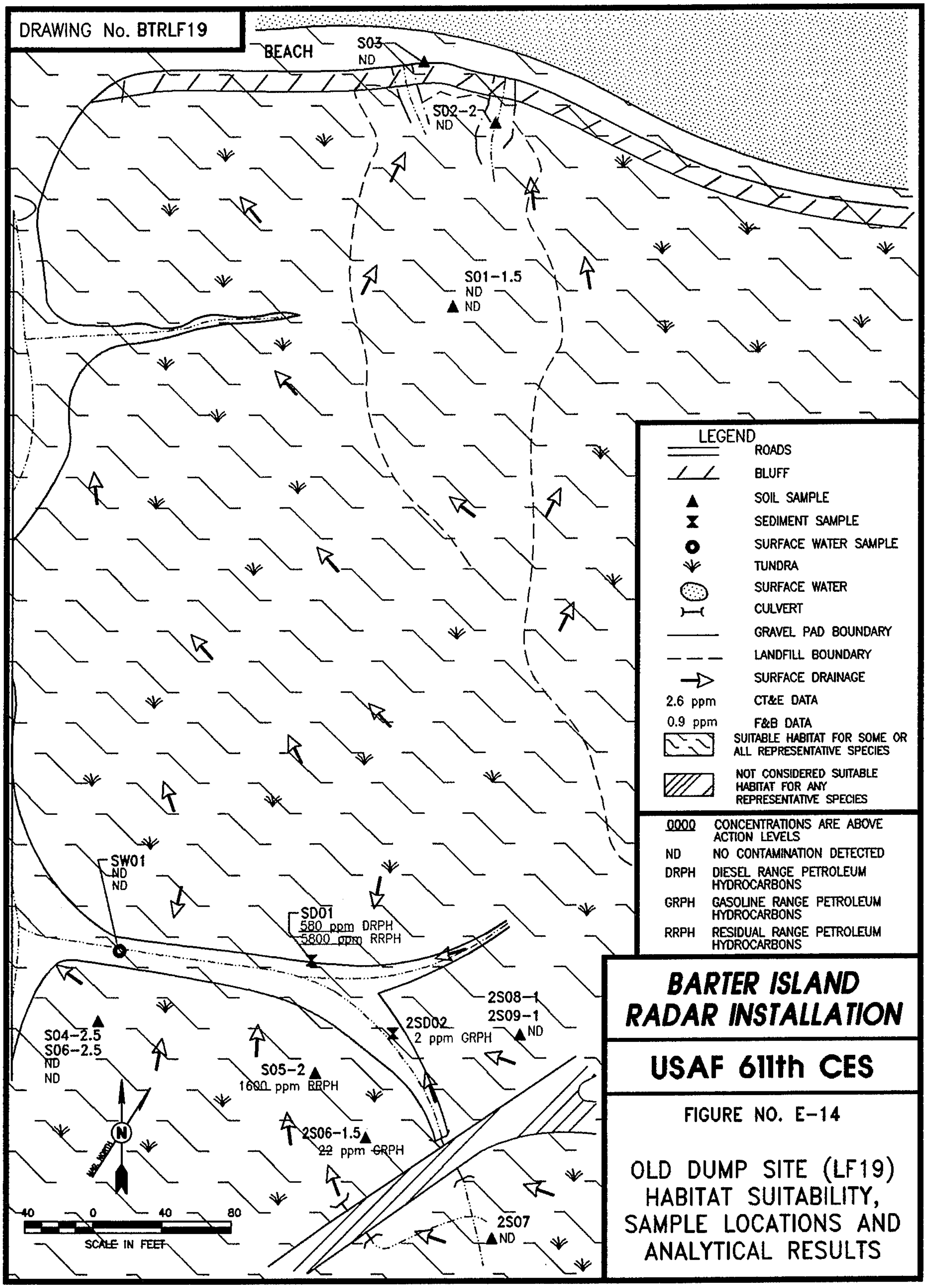


BARTER ISLAND RADAR INSTALLATION

USAF 611th CES

FIGURE NO. E-13

FUEL TANKS (ST18) HABITAT SUITABILITY, SAMPLE LOCATIONS AND ANALYTICAL RESULTS


DRAWING No. BTRLF19
BEACH
S03
ND
S02-2
ND
S01-1.5
ND
ND
SW01
ND
ND
SD01
580 ppm DRPH
5800 ppm RRPH
2S08-1
2S09-1
ND
2SD02
2 ppm GRPH
S04-2.5
S06-2.5
ND
ND
S05-2
1600 ppm RRPH
2S06-1.5
22 ppm GRPH
2S07
ND
N
MAG. NORTH
40
0
40
80
SCALE IN FEET
LEGEND
ROADS
BLUFF
SOIL SAMPLE
SEDIMENT SAMPLE
SURFACE WATER SAMPLE
TUNDRA
SURFACE WATER
CULVERT
GRAVEL PAD BOUNDARY
LANDFILL BOUNDARY
SURFACE DRAINAGE
2.6 ppm CT&E DATA
0.9 ppm F&B DATA
SUITABLE HABITAT FOR SOME OR ALL REPRESENTATIVE SPECIES
NOT CONSIDERED SUITABLE HABITAT FOR ANY REPRESENTATIVE SPECIES
0000 CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND NO CONTAMINATION DETECTED
DRPH DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH GASOLINE RANGE PETROLEUM HYDROCARBONS
RRPH RESIDUAL RANGE PETROLEUM HYDROCARBONS
BARTER ISLAND RADAR INSTALLATION
USAF 611th CES
FIGURE NO. E-14
OLD DUMP SITE (LF19) HABITAT SUITABILITY, SAMPLE LOCATIONS AND ANALYTICAL RESULTS

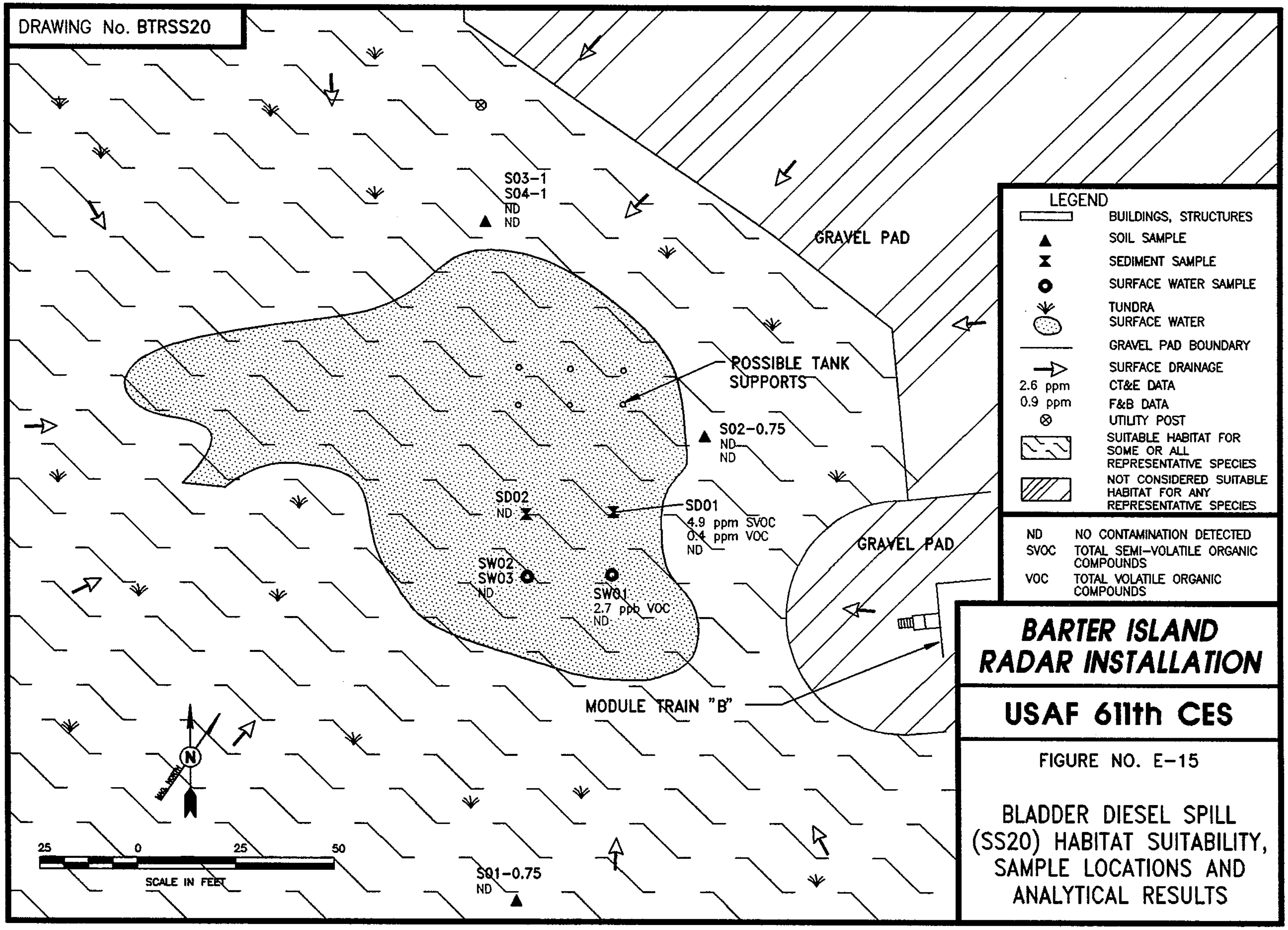
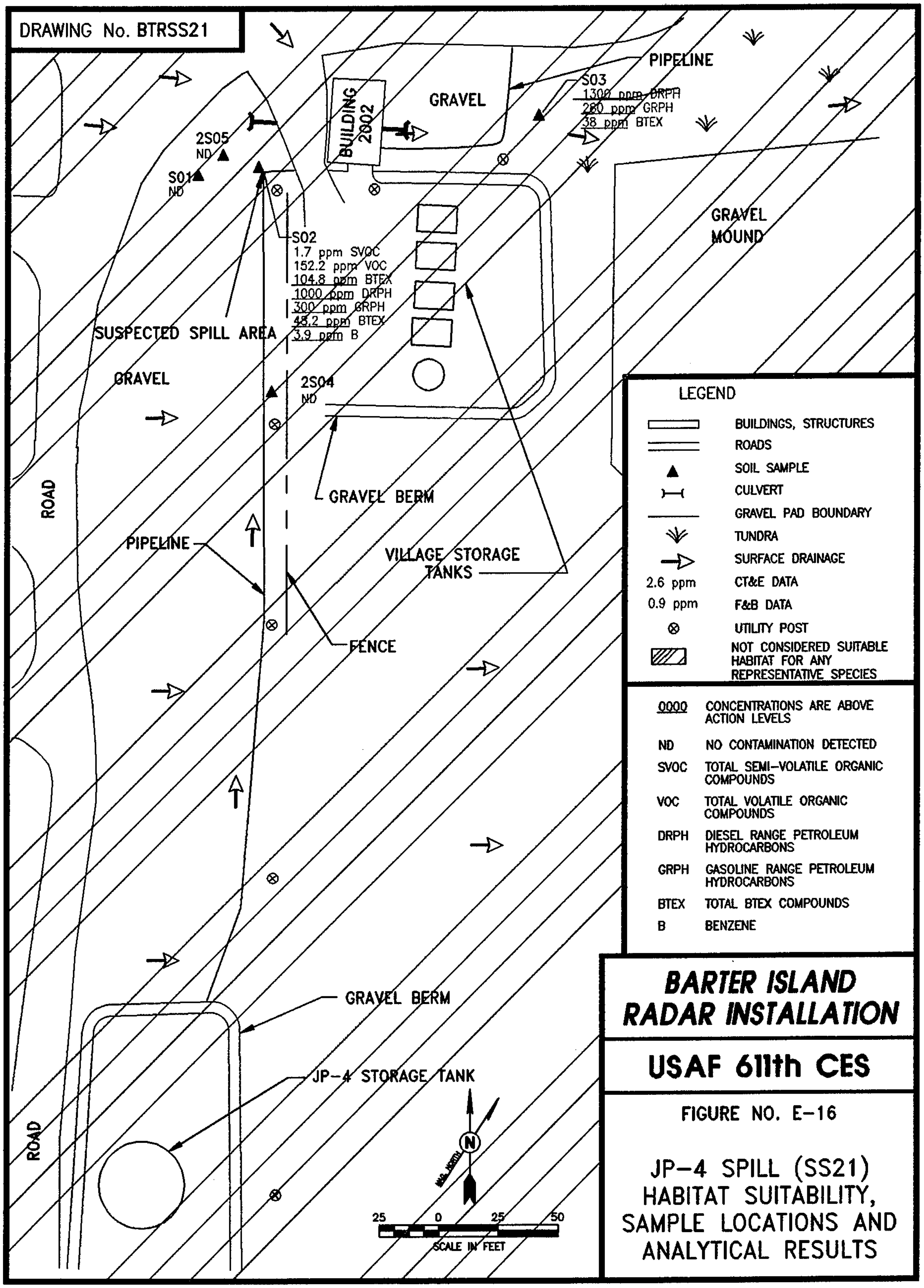


FIGURE NO. E-15

BLADDER DIESEL SPILL (SS20) HABITAT SUITABILITY, SAMPLE LOCATIONS AND ANALYTICAL RESULTS



DRAWING No. BTRSS21
PIPELINE
GRAVEL
BUILDING 2002
S03
1300 ppm DRPH
280 ppm GRPH
38 ppm BTEX
2S05
ND
S01
ND
S02
1.7 ppm SVOC
152.2 ppm VOC
104.8 ppm BTEX
1000 ppm DRPH
300 ppm GRPH
45.2 ppm BTEX
3.9 ppm B
GRAVEL MOUND
SUSPECTED SPILL AREA
GRAVEL
2S04
ND
GRAVEL BERM
ROAD
PIPELINE
VILLAGE STORAGE TANKS
FENCE
GRAVEL BERM
JP-4 STORAGE TANK
ROAD
N
MAG. NORTH
25
0
25
50
SCALE IN FEET
LEGEND
BUILDINGS, STRUCTURES
ROADS
SOIL SAMPLE
CULVERT
GRAVEL PAD BOUNDARY
TUNDRA
SURFACE DRAINAGE
2.6 ppm CT&E DATA
0.9 ppm F&B DATA
UTILITY POST
NOT CONSIDERED SUITABLE HABITAT FOR ANY REPRESENTATIVE SPECIES
0000 CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND NO CONTAMINATION DETECTED
SVOC TOTAL SEMI-VOLATILE ORGANIC COMPOUNDS
VOC TOTAL VOLATILE ORGANIC COMPOUNDS
DRPH DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH GASOLINE RANGE PETROLEUM HYDROCARBONS
BTEX TOTAL BTEX COMPOUNDS
B BENZENE
BARTER ISLAND RADAR INSTALLATION
USAF 611th CES
FIGURE NO. E-16
JP-4 SPILL (SS21) HABITAT SUITABILITY, SAMPLE LOCATIONS AND ANALYTICAL RESULTS