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Feasibility Study

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St. Lawrence Island, Alaska

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ACRONYM LIST

AAC	Alaska Administrative Code
ACL	Alternate Cleanup Level
ACM	Asbestos-containing material
ADEC	Alaska Department of Environmental Conservation
AFS	Air Force Station
Alaska District	U.S. Army Corps of Engineers – Alaska District
ANCSA	Alaska Native Claims Settlement Act
ARAR	Applicable and relevant or appropriate requirements
ASL	Above sea level
AST	Above ground storage tank
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
BTEX	Benzene, toluene, ethylene, and xylenes
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COC	Contaminants of concern
COPCs	Contaminants of potential concern
CRSA	Coastal Resource Service Area
CSM	Conceptual Site Model
CWA	Clean Water Act
CY	cubic yard
DERP	Defense Environmental Restoration Program
DoD	Department of Defense
DRO	Diesel range organics
E-5	A number raised to the exponent, e.g., 1E-5 is 0.00001 or 1 in 100,000
ENRI	Environment and Natural Resources Institute
FS	Feasibility Study
FUDS	Formerly Used Defense Site
ft	feet
GRO	Gasoline range organics
HHERA	Human Health and Ecological Risk Assessment
HQ	Hazard Quotient
IC	Institutional controls
LTM	Long term monitoring
MCL	Maximum contaminant level (drinking water standard)
METS	Matrix enhanced treatment system
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
MW	Monitoring well or Montgomery Watson
MWH	Montgomery Watson Harza
NAPL	Non-aqueous phase liquid
NCP	National Contingency Plan
ND	Non-detect
NDAI	No Department of Defense Action Indicated
NFRAP	No further remedial action planned

NOAA	National Oceanic and Atmospheric Administration
NPL	National Priority List
O&M	Operations and maintenance
PAH	Polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PEC	Probable effects concentration
PEL	Probable effects level
PID	Photoionization detector
POL	Petroleum, oil, and lubricants
ppm	parts per million
PQL	Practical quantitation level
RAO	Remedial action objectives
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RI	Remedial investigation
RRO	Residual range organics
SARA	Superfund Amendments and Reauthorization Act
SB	Soil boring
SQG	Sediment quality guideline
SQuiRT	Screening Quick Reference Tables
SVE	Soil vapor extraction
SVOCs	Semi-volatile organic carbons
TAH	Total aromatic hydrocarbons
TAqH	Total aqueous hydrocarbons
TAL	Target Analyte List
TBC	To Be Considered
TCE	Trichloroethene
TEC	Threshold effects concentration
TEL	Threshold effects level
TEQ	Toxic equivalency quotient
TBC	To be considered
TOC	Total organic carbon
TRPH	Total recoverable petroleum hydrocarbons
TSCA	Toxic Substances Control Act
UCL	Upper confidence level
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USC	United States Code
USCS	Unified soil classification system
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	Underground storage tank
VOC	Volatile organic compound
WAC	Washington Administrative Code
WP	Well point

EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers Alaska District conducted a series of remedial investigations between 1994 and 2004 to identify and delineate contamination at the Northeast Cape Formerly Used Defense Site (F10AK0696) located on St. Lawrence Island, Alaska. In addition, several interim removal actions were conducted to address building demolition and miscellaneous debris, containerized wastes, and hotspots of contaminated soil. This feasibility study summarizes the historical sampling results for each site or area of concern at the Northeast Cape Air Force Station, summarizes previous removal activities applicable to particular sites, and evaluates a range of alternatives according to the criteria prescribed by the Comprehensive Environmental Response, Compensation, and Liability Act.

A total of 33 individual sites have been investigated and characterized at Northeast Cape, including background locations. Of these sites, seventeen are proposed for no further remedial action because they meet the identified remedial action objectives. The remaining sites have been grouped geographically into 8 areas for further evaluation of alternatives. The areas of concern include the Fuel Pumphouse and Pipeline (Sites 3 and 4), the Cargo Beach Road Former Drum Field (Site 6), the Landfills (Sites 7 and 9), the Pipeline Break (Site 8), and Main Operations Complex (Sites 10, 11, 13, 15, 19, 27), the Drainage Basin (Site 28), the Suqitughneq River and Estuary (Site 29), and the White Alice Complex (Sites 31 and 32).

Depending on the particular site characteristics and affected media, the alternatives evaluated include no action, institutional controls, natural attenuation, landfarming, phytoremediation, thermal treatment, off-site treatment and disposal, capping, reactive matting, reactive walls, constructed wetlands, and chemical oxidation. Cost estimates are provided for each alternative. The estimated costs range from $186,000 to implement institutional controls at one site to $84 million for complete removal of the landfills.

The information within this feasibility study will be used as the basis for proposing remedial alternatives for the Northeast Cape site in a future Proposed Plan document. A combination of alternatives may be used to achieve the remedial action objectives. Input from the community, regulatory agency, and other stakeholders will be considered during the development of the Proposed Plan.

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1.0 INTRODUCTION/OVERVIEW

This Feasibility Study (FS) report provides an evaluation of remedial alternatives for the Northeast Cape Air Force Station Site located on St. Lawrence Island, Alaska. The remedial alternatives presented in this report were developed based on the results of the four phases of remedial investigation (RI) conducted between 1994 and 2004 at the site. This FS report includes a qualitative conceptual site model (CSM) that identifies potentially complete exposure pathways, and focuses on identifying and evaluating appropriate technologies that have a reasonable chance of use at the site. The Northeast Cape site is a Formerly Used Defense Site (FUDS), and is not listed on the National Priorities List (NPL). This project was authorized by the Defense Environmental Restoration Program (DERP) of the United States Department of Defense (DoD), and was conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

1.1 Purpose and Organization of Report

The FS report is intended to provide information sufficient to support an informed risk management decision regarding which remedy appears to be most appropriate for the Northeast Cape site. The FS is based on data collected during previous investigations and will be used during preparation of the Proposed Plan and, following public comment on the Proposed Plan, a Decision Document for the site remedy. The development of the FS follows guidance for conducting a feasibility study under CERCLA (USEPA, 1988), and alternatives were developed and evaluated using standard criteria. Although petroleum is not defined as a hazardous substance, pollutant, or contaminant under CERCLA, for administrative convenience the same process was utilized to evaluate potential remedial alternatives. The state of Alaska defines (A.S 46.03.826) hazardous substance to mean (A) an element or compound which, when it enters into the atmosphere or in or upon the water or surface or subsurface land of the state, presents an imminent and substantial danger to the public health or welfare, including but not limited to fish, animals, vegetation, or any part of the natural habitat in which they are found; (B) oil; or (C) a substance defined as a hazardous substance under 42 U.S.C. 9601(14). Oil is defined by statute to mean a derivative of a liquid hydrocarbon and includes crude oil, lubricating oil, sludge, oil refuse or another petroleum-related product or by-product.

In accordance with Environmental Protection Agency (EPA) guidance, this FS is presented as a three-phase process to develop, screen, and analyze remedial actions for the site. The specific remediation requirements are based on the nature and extent of contamination determined during the RI, and the potential risk pathways identified by the CSM and Human Health and Ecological Risk Assessment. The overall objective of the FS is to develop and evaluate a range of remediation alternatives, based on site-specific findings and on current and future use scenarios.

The first phase of the FS consisted of identifying and screening a range of potentially applicable technologies. This initial technology screening is based on consideration of the potential for each technology to achieve site-specific remedial action objectives (RAOs) given the characteristics of the impacted media, the nature of contamination, and other site conditions. Those technologies were then assembled into a variety of alternatives representing a range of treatment options, and screened with respect to their effectiveness, implementability, and relative cost. Based on these criteria, the alternatives best suited for site remediation were then retained for a more detailed analysis during the study's third phase. This third phase consists of two primary elements: (1) definition of the waste management strategies to be employed in each alternative and further analysis of each alternative against an established set of evaluation criteria; and (2) a comparative analysis to evaluate the relative performance of each alternative in relation to those evaluation criteria.

To develop the framework for the assessment of appropriate technologies, this report is organized into several sections and appendices, as described below:

Section 1.0 describes the objectives and organization of the report. It also provides background information on the site.

Section 2.0 presents a qualitative CSM that describes potential exposure routes and receptors.

Section 3.0 identifies the applicable or relevant and appropriate requirements (ARARs), RAOs, and remedial action requirements to be addressed in any remediation strategy. Alternate cleanup levels are also proposed. Based on these requirements and considerations, potential remediation technologies are identified and screened for their applicability to RAOs at the site.

Section 4.0 identifies potential remediation technologies and provides an initial screening against RAOs at the site. Further development and screening of a range of alternatives assembled from the potential remediation technologies is discussed in the site-specific summary sections later in the document (see sections 6.0 through 13.0).

Section 5.0 presents a detailed description of the data at each site recommended for no further remedial action planned.

Sections 6.0 through 13.0 describe background information, historical sampling results, and results of previous removal actions for all remaining sites. A range of alternatives are presented and described. These descriptions are developed to address remediation at specific locations where site use scenarios demonstrate a potential risk. Each description is followed by an analysis and comparison of the relative performance of each alternative based on a series of criteria, including (1) overall protectiveness of human health and the environment; (2) compliance with ARARs; (3) short-term effectiveness; (4) long-term effectiveness and performance; (5) reduction of toxicity, mobility, or volume through treatment; (6) implementability; and (7) cost.

1.2 Background Information

A brief summary of the site history and environmental conditions is presented in this section. These topics are discussed in greater detail in the remedial investigation reports (see References).

1.2.1 Site Location

Northeast Cape is located on St. Lawrence Island in the Bering Sea, approximately 135 miles southwest of Nome, Alaska, as shown in Figure 1-1. The Village of Savoonga is the closest community, and is located approximately 60 miles northwest of Northeast Cape. The site is located near the northeast end of the island at around 63º19’ North, 168º58’ West, approximately 9 miles west of the northeastern cape of St. Lawrence Island. According to land acquisition records, the size of the Northeast Cape site, as a whole complex, is approximately 4,800 acres, or 7.5 square miles. The Northeast Cape site is bounded by Kitnagak Bay to the northeast, Kangighsak Point to the northwest, and the Kinipaghulghat Mountains to the south.

1.2.2 Site History and Ownership

The former military installation operated from about 1954 until 1972 as a surveillance station and a White Alice Communications station. In 1982, the Navy obtained the former White Alice property (26 acres), but did not utilize the site as a communications site. The land transfer was later deemed invalid and property ownership reverted to Sivuqaq, Inc. and Savoonga Native Corporation. Demolition of the buildings and the majority of other structures has been completed under multiple U.S. Army Corps of Engineers (USACE) contracts. The runway, improved gravel roads, and concrete slabs of some of the former structures remain intact.

1.2.3 History of Investigations

Remedial investigations have been performed at the Northeast Cape site since 1994. Phase I of the remedial investigation was conducted during the summer of 1994. Additional sampling was performed as part of Phase II during 1996 and 1998. Additional investigations were conducted during the 2001 and 2002 field seasons as part of Phase III. A final round of investigation was completed during 2004 as part of Phase IV remedial investigation. A brief summary of the nature and extent of contamination at each site within the Northeast Cape site is presented in Sections 5 through 13. The site descriptions are based on information presented in various phases of the remedial investigation. This information has been summarized and included herein to provide the framework to support the development of remedial alternatives. The reader is referred to the reports listed in Section 16 References for more detailed discussions of site characterization.

2.0 CONCEPTUAL SITE MODEL

In order to provide a framework for consideration of remediation alternatives a Conceptual Site Model (CSM) depicting potential sources of chemicals, release mechanisms, means of retention in or migration to exposure media, exposure routes, and receptors was developed. The CSM is intended to provide a background description of contaminant fate and transport mechanisms. A complete pathway from the source of chemicals to the human receptors is necessary for chemical exposure to occur.

Required elements for a complete exposure pathway include:

- A source of potentially toxic chemicals (e.g., primary sources, such as contents of drums or tanks, or a secondary source, such as contaminated soil).
- A mechanism of chemical release to the environment (e.g., spillage to the ground).
- A mechanism of retention in or transport to an exposure medium (e.g., adsorption to soil, or leaching from soil to shallow subsurface water and subsequent transport as a dissolved constituent to a nearby surface water body).
- A point of contact between receptor and exposure medium (e.g., a person digging in contaminated soil).
- An intake route for the receptor (e.g., ingestion of impacted soil or water).

Figure 3-1 from the Risk Assessment (MWH, 2004) shows a generalized visual representation of the Human Health CSM developed for the Northeast Cape site based on information gathered during the remedial investigation. The CSM depicts complete exposure pathways for a future permanent resident and soils, sediment, surface water, and groundwater. Groundwater exposure pathways are evaluated on a site-specific basis and discussed in more detail in Sections 3.6.3, and 6 through 14. The shallow groundwater within specific areas of the Northeast Cape installation is not a current or reasonably expected potential future drinking water source. These areas are characterized by low-lying tundra; including the vicinity of Cargo Beach (Sites 3, 4), and the landfills (Sites 6, 7, 9). The groundwater exposure pathway is only applicable to Areas of Concern E – Main Operations Complex and H – White Alice Complex. Figure 3-6 illustrates the ecological conceptual site model for Northeast Cape.

2.1 Sources and Release Mechanisms

The primary sources that may have released chemicals at the former Northeast Cape site are the petroleum fuel storage tanks and piping, Air Force Station (AFS) buildings, and landfills. The buildings, fuel storage tanks, drums, and miscellaneous debris have all been removed under prior removal actions.

Once a spill or release occurs, soil is expected to serve as the retention medium at the site. Soil that is impacted by chemicals released from the primary source is expected to serve as a secondary source from which chemicals may be migrating to other media such as air, shallow groundwater, surface water, or sediment.

2.2 Migration and Retention Mechanisms

The primary physical processes affecting contaminant concentrations and migration include dispersion, dilution, and sorption. Volatilization of contaminants may affect some organic contaminant concentrations. Soils at the site are characterized by silts near the surface, overlying more sand-dominated soils at depth. The silt contains varying quantities of clay/sand/gravel. In general, developed areas of the site consist of gravel fill from local sources and the outlying areas consist of native tundra or peat. Permafrost exists at the site, at varying depths. Groundwater has been observed as both suprapermafrost (shallow) and a deeper aquifer.

2.3 Exposure Routes and Receptors

The potential human and ecological receptors were evaluated in the Human Health and Ecological Risk Assessment (MWH, 2004). A summary of the exposure routes and intake pathways is presented in the following subsections.

2.3.1 Human Receptors

Human receptors are expected to include site visitors, seasonal subsistence users, and future permanent residents. Several potential exposure scenarios were identified in the conceptual site model:

- incidental ingestion of soil/sediment
- dermal contact with soil/sediment/surface water
- inhalation of dust from soil or volatile organic compounds in water
- ingestion of surface water or groundwater
- consumption of subsistence food items

2.3.2 Ecological Receptors

The potentially affected biological resources evaluated included vegetation, birds, fish, shellfish, terrestrial mammals, marine mammals, and special status species. The ecological risk evaluation focused on three selected indicator receptors, the tundra vole, cross fox, and glaucous-winged gull. These species were utilized in the risk characterization, which integrated exposure dose analysis and effect assessment and compared these values to ecological toxicity reference values to calculate a chemical-specific hazard quotient for each site.

Ecological hazard estimates were calculated for three ecological indicator receptors (i.e., the tundra vole, cross fox, and glaucous-winged gull) based on modeled exposure to chemicals in site soil, sediment, surface, or shallow subsurface water, as appropriate for a given site.

3.0 IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

A review of potential applicable or relevant and appropriate requirements (ARARs) was performed to facilitate selecting remedial alternatives. Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria or limitations promulgated under Federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than Federal requirements may be applicable. Relevant and appropriate requirements mean those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or state environmental or facility siting laws that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent that Federal requirements may be relevant and appropriate. ARARs can be divided into three categories: (1) chemical-specific, (2) location-specific, and (3) action-specific.

These requirements were used in developing the project remedial action objectives (RAOs). ARARs include environmental laws such as the State of Alaska soil and groundwater cleanup level determination methods set forth in the Oil and Hazardous Substances Pollution Control Regulations, Water Quality Standards, Drinking Water Standards, and the federal Resource Conservation and Recovery Act (RCRA), Safe Drinking Water Act (SDWA), Clean Air Act (CAA), Clean Water Act (CWA), and Solid Waste Disposal Act (SWDA).

Chemical-specific ARARs are media-specific laws and requirements that regulate the release to the environment of materials that possess certain chemical or physical characteristics. These requirements generally set health-and risk-based concentration limits for hazardous substances. If a chemical is subject to more than one discharge or exposure limit, the more stringent of the requirements is generally applied.

Chemical-Specific ARARs	Explanation
Water Quality Standards (18 AAC 70)	Standards applicable to surface water quality.
Oil and Hazardous Substances Pollution Control Regulations (18 AAC 75)	Soil and groundwater cleanup levels. Allows for alternative cleanup levels (ACLs) to be established based on site-specific data or a risk assessment.
Underground Storage Tanks (18 AAC 78)	Regulations pertaining to underground storage tanks.

Location-specific ARARs are related to the geographical or physical position of the site, including its location relative to wetlands, endangered species, floodplains, and any other regulated features. These physical features may limit the type of remedial actions that can be implemented and may pose additional constraints on a cleanup action.

Action-specific ARARs are requirements that define acceptable treatment and disposal procedures for hazardous substances. These ARARs set performance, design, or other action specific controls or restrictions on particular kinds of activities related to management of hazardous substances or pollutants. Action-specific ARARs are assessed for the particular remedial activities selected for a specific site.

Action-Specific ARARs	Explanation
Identification and Listing of Hazardous Wastes (40 CFR Part 261 and 18 AAC 62)	Standards applicable to the management, transportation, and disposal of hazardous waste.

A summary of ARARs and a discussion of their applicability to govern the potential site remediation activities are presented in the following sections.

3.1 Chemical-specific ARARs

Chemical-specific requirements are based on health or risk-based concentrations in environmental media (e.g., water or soil) for specific hazardous chemicals. These requirements may be used to set cleanup levels for the chemicals of concern in the designated media. Soil cleanup levels have been promulgated at the state of Alaska level as presented in the Oil and Other Hazardous Substances Pollution Control Regulations, 18 Alaska Administrative Code (AAC) 75, for a number of petroleum hydrocarbons, organic compounds, and inorganic compounds. These standards constitute an ARAR under CERCLA. Site-specific alternative cleanup levels (ACLs) may also be used, subject to approval by the Alaska Department of Environmental Conservation (ADEC), under ADEC Cleanup Methods Three and Four. Method Three allows a responsible person to propose ACLs that modify Method Two cleanup levels (18 AAC 75.341[c], Table B1, and 18 AAC 75.341 [d], Table B2) using site-specific soil data, fate and transport data, or exposure parameters. Method Four ACLs may be proposed based on the completion of a risk assessment showing the proposed ACLs are protective of human health, safety, and welfare, and of the environment. Groundwater cleanup levels have been promulgated by the State of Alaska in 18 AAC 75.345, Table C.

The Toxic Substances Control Act (TSCA) also provides chemical specific action levels. TSCA is the primary Federal statute regulating the use of certain chemicals and substances, including asbestos, PCBs, radon and lead.

Soil - The RAOs identified for site soils are to:

- Prevent current and future exposure to humans by ingestion, inhalation, and dermal contact with contaminated soils at levels above ARARs.
- Prevent infiltration/migration of contaminants that could result in groundwater contamination in excess of ARARs.

Groundwater - The RAOs identified for the remediation of site groundwater are to:

- Prevent ingestion of groundwater containing contaminants at levels above ARARs.

Table 3-1 summarizes the general remedial action objectives for environmental media at Northeast Cape.

Table 3-1. General Remedial Action Objectives for Northeast Cape, Alaska

Environmental Media	Exposure Route	Receptors	Remedial Action Objectives	
			For Human Health	For Environmental Protection
Soils	Dermal Contact Ingestion Inhalation	Recreational Use Subsistence Use Ecosystem	Prevent exposure to soils exceeding contaminant-specific cleanup levels or site-specific protection standards	Prevent migration of contaminants to the unconfined aquifer and to surrounding surface soils and surface waters. Minimize physical impacts to sensitive areas (e.g., wetlands) during remedial activities
Sediments	Dermal Contact Ingestion Inhalation	Recreational Use Subsistence Use Ecosystem	Prevent exposure to soils exceeding contaminant-specific cleanup levels or site-specific protection standards	Prevent migration of contaminants to the unconfined aquifer and to surrounding surface soils and surface waters.
Surface Water	Dermal Contact Ingestion Inhalation	Recreational Use Subsistence Use Ecosystem	Prevent exposure to soils exceeding contaminant-specific cleanup levels or site-specific protection standards	Prevent migration of contaminants to the unconfined aquifer and to surrounding surface soils and surface waters.
Groundwater	Ingestion Inhalation	Recreational Use Subsistence Use Ecosystem	Prevent exposure to soils exceeding contaminant-specific cleanup levels or site-specific protection standards	Prevent migration of groundwater contamination at levels that could negatively impact streams and other bodies of water.
Air	Ingestion (dust) Inhalation	Recreational Use Subsistence Use Ecosystem	Prevent exposure to dust and vapors exceeding contaminant-specific cleanup levels or site-specific protection standards	Prevent wind suspension of contaminated soil

3.2 Location-specific ARARs

The entirety of St. Lawrence Island is located within the Bering Straits Coastal Resource Service Area (CRSA) inland coastal zone boundary, thus activities at the Northeast Cape site are regulated by state and federal agencies. Legislation that applies to this project includes:

Fish and Wildlife Coordination Act (16 USC 661 et seq.); 40 CFR 6.302. Provides for the protection of fish and wildlife from adverse effects of water resources development projects. Remedial actions could affect coastal waters.

Coastal Zone Management Act (16 USC 1131 et seq.); 50 CFR 35.1 et seq. Provides for the protection of coastal areas.

3.3 Action-specific ARARs

Federal and state regulations govern the identification, management, transportation, and disposal of hazardous wastes and are applicable to remedial actions implemented at the site.

Identification and Listing of Hazardous Waste (40 CFR Part 261 and 18 AAC 62) regulates the generation, storage, transportation, and disposal of hazardous wastes.

3.4 Overview of Risk Assessment

The Final Human Health and Ecological Risk Assessment (HHERA) (MWH, 2004) for the Northeast Cape installation evaluated the potential risks associated with exposure to soil, sediment, shallow subsurface water, groundwater, and subsistence food consumption. The risk assessment evaluated incidental ingestion, dermal contact, and dust inhalation pathways as components of the human exposure scenarios for soil. The risk assessment also evaluated the subsistence consumption of fish and plants harvested from impacted areas of the Northeast Cape Installation and from locations within the vicinity of the Northeast Cape Installation that are believed unimpacted by site activities. Potential dermal exposures to petroleum hydrocarbons were not quantitatively evaluated in the risk assessment due to uncertainties in extrapolating oral reference doses (RfDs) to the dermal route of administration. The ingestion of groundwater was evaluated directly and not via the modeled migration to groundwater pathway for soils.

Under a future permanent resident scenario, complete exposure pathways include the incidental ingestion/contact with soils/sediment, dust inhalation, and ingestion/contact with surface or subsurface waters. Therefore, potential future human health risks will depend upon the specific site inhabited and the source of potable water. Potential sources of potable water include the fractured bedrock aquifer near the base of the Kinipulghat Mountains (e.g., between the White Alice complex and the Main Complex), groundwater beneath the Main Operations Complex or fresh surface water obtained from the Suqitughneq River or other fresh surface water sources. Shallow groundwater consisting of percolated rainfall and seasonally-thawed water in the active layer of tundra soils is not a potential drinking water source or complete exposure pathway. Areas of shallow groundwater have been observed perched on ice rich frozen ground in boggy, tundra areas. Subsistence food pathways for future seasonal or permanent residents could include consumption of plants and fish collected from impacted locations or ambient locations. The consumption of fish collected from the Suqitughneq River as well as ambient locations was further evaluated by the Agency for Toxic Substances and Disease Registry (ATSDR, 2005) and they concluded no adverse health effects are likely to result from ingestion of the subsistence-caught fish species, as explained further in the following section.

3.5 Cumulative Risk

Alternate cleanup levels must also be protective from a cumulative risk perspective. Cumulative risk is defined as the sum of risks resulting from multiple sources and pathways to which humans are exposed. Cancer and non-cancer cumulative risks are calculated separately. When more than one hazardous substance is present at a site or multiple exposure pathways exist, calculated cleanup levels may need to be adjusted downward. Lead contamination in soil or groundwater is not included in cumulative risk calculations, because cancer slope factor and non-cancer reference dose values are not applied to this chemical. Lead is evaluated separately using a model predicting integrated uptake of lead in children. For petroleum hydrocarbons, each fraction is a mixture of many different chemicals. Risks from individual petroleum constituents (i.e., indicator compounds) such as benzene, toluene, ethylbenzene, xylenes (BTEX) or polycyclic aromatic hydrocarbons (PAHs) are included in the cumulative risk calculations.

However, bulk petroleum hydrocarbons mixtures (e.g., diesel (DRO), gasoline (GRO) or residual range (RRO) organics) are assessed using toxicity and chemical parameters for the total petroleum range. The risk from bulk hydrocarbons is not included in the cumulative risk calculations because the risk from indicator compounds is considered protective of the cumulative risk to petroleum exposure.

Under EPA's *Guidelines for the Health Risk Assessment of Chemical Mixtures* (1986) the most preferred method for evaluating the risk to chemical mixtures is to use toxicological data for the mixture itself. Many mixtures have different toxicological properties than their constituents. At this time, there is not enough toxicological data available to calculate risk to the full petroleum fractions other than using a surrogate approach to determine toxicity.

The Alaska Department of Environmental Conservation regulations (18 AAC 75.325(g)) state that a responsible person proposing an alternative cleanup level for soil or groundwater based on a site-specific risk assessment under method four, or using cleanup levels developed under methods two or three, shall ensure that the risk from hazardous substances does not exceed the cumulative carcinogenic risk standard of 1 in 100,000 (e.g., 1E-5) across all exposure pathways and the cumulative noncarcinogenic risk standard at a hazard index of 1 for all exposure pathways. All completed pathways must be included in cumulative risk calculations including those pathways not addressed in 18 AAC 75.341 Table B1 and 18 AAC 75.345 Table C. Each contaminant detected above one-tenth of the Tables B1 inhalation or ingestion or Table C cleanup levels must be included in cumulative risk calculations.

However, according to 18 AAC 75.325(h), the state may also consider a risk standard consistent with the range acceptable under the National Contingency Plan (40 C.F.R. 300.430, revised as of July 1, 2002). This risk range applies to carcinogens only. The acceptable risk range is an excess cancer risk to an individual of 1 in 10,000 (1E-4) to 1 in 1,000,000 (1E-6). Consideration of the risk range is to be based on site-specific conditions, land use, hazardous substance characteristics, statutory compliance, protection of human health, safety, and welfare, and the environment, ability of cleanup to be implemented, long-term and short-term effectiveness, use of treatment technologies, public comment, and cost.

An evaluation of the subsistence pathway (e.g., fish or plant consumption) was also included in the Northeast Cape Risk Assessment (MWH, 2004). The cancer risk and noncancer hazard estimates[1] associated with future consumption of fish harvested from either the Suqitughneq River or a background location, the Tapisaghak River both exceeded the ADEC risk standards of 1E-5 for carcinogens and 1 for noncarcinogens. These results suggest that a significant portion of the human health risk attributable to subsistence food use is associated with regional ambient contamination. In addition, the estimated risks for both impacted and ambient areas include extremely conservative exposure assumptions which tend to overestimate the potential for risk. Arsenic was a primary risk driver for consumption of fish harvested from either impacted or ambient locations at the Northeast Cape Installation. The source of arsenic in fish tissue samples

[1] The carcinogenic risk and noncarcinogenic hazard estimates for consumption of fish from the Suqitughneq River were calculated as 9E-4 and 17, respectively. These risk estimates were attributable to the presence of arsenic, PAHs, and PCBs (Aroclor-1254 and Aroclor-1260) in fish fillet samples. Carcinogenic risk and noncarcinogenic hazard estimates associated with future consumption of fish harvested from a background location, the Tapisaghak River (Site 30), were calculated as 1E-3 and 19, respectively. These risk estimates were attributable to the presence of arsenic and PCBs (Aroclor-1254 and Aroclor-1260) in fish fillet samples collected from the Tapisaghak River.

collected from impacted and ambient locations is not certain, although high ambient levels of arsenic are observed throughout Alaska (USGS, 1988). Elevated levels of arsenic have not been documented in the sediments of the Suqitughneq River or Drainage Basin.

The risk assessment suggests that there is very little difference in risks associated with subsistence consumption of fish harvested from impacted areas versus ambient locations[2]. Furthermore, the potential risks associated with the subsistence pathway have been demonstrated to be not significant based on a separate evaluation of the fish tissue data by the U.S. Department of Health and Human Services, Agency for Toxic Substances Disease Registry (ATSDR) Health Consultation (ASTDR, 2005). An assessment of persistent organic pollutants in reindeer on St. Lawrence Island also concluded that that no health problems would be expected in individuals consuming a diet containing large quantities[3] of reindeer meat and fat (ATSDR, 2001). Thus, the subsistence pathway was not included in the cumulative risk calculations during the development of alternative cleanup levels.

The Suqitughneq River is the current source of potable water for seasonal residents and visitors to the Northeast Cape Installation. No carcinogenic chemicals of potential concern (COPCs) were identified for water samples collected from the Suqitughneq River, and noncarcinogenic hazard estimates were below ADEC's point of departure criterion.

3.6 Calculation of Cleanup Levels

Based on site-specific conditions, exposure parameters and assumptions, alternate soil cleanup levels (ACLs) were calculated for contaminants designated as chemicals of concern at various areas of concern for the Northeast Cape site. ACLs for soil were developed using two different scenarios. The State of Alaska considers all groundwater to be a potential future drinking water source, unless certain conditions[4] are met. At Northeast Cape, most of the site is characterized by native tundra vegetation, and the shallow groundwater found above the permafrost is unlikely to be accessed as a viable future drinking water source. However, alternate cleanup levels based on the migration to groundwater pathway were calculated to evaluate the feasibility of performing additional remedial actions assuming some areas of shallow groundwater could be consumed in the future. The community has expressed concerns that the most stringent cleanup levels be applied site-wide based on future residential use, assuming a worst-case scenario for potential drinking water sources. The feasibility study highlights the difference in volume of contaminated soils calculated using the alternate cleanup levels. Under Scenario A, cleanup levels were based on the completed exposure pathways from the human health risk assessment. Scenario A assumes a potential future permanent resident may be exposed over a lifetime through incidental ingestion of contaminated soil/sediment. Scenario A assumed drinking water is obtained from non-contaminated sources such as the Suqitughneq River or the deep aquifer near the Main Complex. Under Scenario B, soil cleanup levels were developed using site

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[2] However, concentrations of PCBs were (slightly) higher in fish tissue samples collected from the Suqitughneq River versus the Tapisaghak River, and PAHs were detected in fish tissue samples collected from the Suqitughneq River but not in samples collected from the Tapisaghak River.

[3] ATSDR Health Consultation assumed an individual would consume 1 kg (2.2 lbs) of reindeer meat each day for 4 months of the year.

[4] 18 AAC 75.350, (1) the groundwater is not used for a private or public drinking water system…, (2) the groundwater is not a reasonably expected potential future source of drinking water… (3) the groundwater affected by the hazardous substance will not be transported to groundwater that is a source of drinking water…

specific information for the migration to groundwater pathway only. Scenario B assumes a future permanent resident would consume groundwater impacted by contamination that has migrated from contaminated soils to the water table. The primary COCs are petroleum hydrocarbons (DRO and RRO) and polychlorinated biphenyls (PCBs). Other metals (lead) and volatile organic compounds (VOCs) were also present at isolated locations.

3.6.1 Scenario A – Alternate Cleanup Levels for Soil

Under Scenario A, site-specific soil cleanup levels for the COCs at the Northeast Cape site were calculated using the equations and assumptions for the future permanent resident exposure scenario of the human health risk assessment (MWH, 2004). The alternate cleanup levels are listed in Table 3-2. More detailed information on the input parameters, assumptions used, and example equations is found in Appendix B, Tables B1, B2 and B3. The proposed DRO and RRO alternate soil cleanup levels were calculated using the standard non-cancer risk assessment equations, future residential exposure assumptions, the recommended toxicity values for each petroleum fraction (e.g., C10-C25 aliphatics, C10-C25 aromatics, etc.). A total DRO or total RRO concentration was then calculated using the default percentages of aromatics and aliphatics. The lower concentration (e.g., aromatic) was divided by the corresponding aromatic default percentage (e.g., 0.4) to derive the total DRO or RRO cleanup level. DRO and RRO are both present at the site. The target hazard quotient was set at 1.0 for each fraction, per the Cumulative Risk Guidance (ADEC, 2002), which states: “The potential risk from each petroleum fraction must be calculated; however they are not included in a cumulative risk calculation with other petroleum fractions or with other chemicals in the tables of chemicals of potential concern.”

Table 3-2. Scenario A Alternate Cleanup Levels for Soil at Northeast Cape

Compound	Maximum Site Concentration[1] (mg/kg)	ACL (mg/kg)	Source of ACL	HQ	Cancer Risk
Benzene	0.73	2	C	---	1.0E-07
Ethylbenzene	3	21	C	---	1.0E-07
Naphthalene	191	120	NC	0.1	---
PCB-1260 (Aroclor 1260)	37	1	C, NC	0.5	3.0E-06
	Cumulative Risk			0.6	3E-06
Diesel Range Organics	150,000	9,200			--
Diesel Range Organics, Aliphatic	120,000	9,158		1.0	--
Diesel Range Organics, Aromatic	60,000	3,663		1.0	--
Residual Range Organics	14,000	9,200			--
Residual Range Organics, Aliphatic	12,600	183,154		1.0	--
Residual Range Organics, Aromatic	4,200	2,747		1.0	--

Notes:
[1] Maximum concentration from all samples collected by USACE at Northeast Cape
ACL Alternate Cleanup Level
BG Background, site-specific value for Northeast Cape
C Carcinogen, risk equations
EPA US Environmental Protection Agency
HQ Hazard Quotient
NC Non carcinogen, risk equations

3.6.2 Scenario B – ACLs based on the Migration to Groundwater Pathway

Alternate cleanup levels for petroleum hydrocarbons (e.g., diesel and residual range organics) can also be derived using site-specific soil data and a simplified, conservative fate and transport model. The model assumes contaminants within the soil column are transported to an underlying aquifer that is used as a drinking water source. According to the ADEC "migration to groundwater" means a potential exposure to hazardous substances in soil through direct ingestion of groundwater contaminated with concentrations of hazardous substances at levels listed in Table C at 18 AAC 75.345(b) (1) as a result of movement of hazardous substances through soil to the groundwater. However, in order for the migration to groundwater pathway to apply at a particular location, the groundwater must be a reasonably expected potential future source of drinking water. The State of Alaska considers groundwater at a site to be a drinking water source unless a demonstration is made that the groundwater is not a reasonably expected potential future source of drinking water, based on an evaluation of:

- the availability of the groundwater as a drinking water source, including depth to groundwater, the storativity and transmissivity of the aquifer, the presence of permafrost, and other relevant information;
- actual or potential quality of the groundwater, including organic and inorganic substances, and as affected by background, saltwater intrusion, and known or existing area-wide contamination;
- other factors listed in 18 AAC 75.350

The risk equations for the migration to groundwater pathway presented in the *Cleanup Levels Guidance* (ADEC, 2004) assume hydrocarbons are present in the soil environment in three phases, the dissolved phase (i.e., within the soil pore water), vapor phase (i.e., dissolved into the air in the soil pores), and adsorbed phase (i.e., sorbed onto soil particles). However, once the petroleum concentration in the soil is above the soil saturation limit (Csat), there is a fourth phase present. This fourth phase is liquid product or non-aqueous phase liquid (NAPL). The soil saturation limit or concentration, Csat, for petroleum is relatively low, meaning equilibrium will be reached in a relatively short period of time (e.g., months). Thus, most spills will have four phases present.

The 3-phase model works well for pure products such as benzene or toluene, but not for mixtures such as petroleum. The risk equations for the migration to groundwater pathway used by ADEC (adopted from the USEPA Soil Screening Guidance) assume only three phases of petroleum hydrocarbons are present. Since the equations ignore the presence of NAPL, the calculated cleanup levels for petroleum are conservative by one or two or more orders of magnitude.

For actual releases, especially old releases (over six months to a year) and small releases (half acre or less), the site migration to groundwater dynamics have essentially reached equilibrium (providing the original source, e.g., leaking tank, has been removed). In these situations, it is more accurate to simply measure any contamination in the groundwater or surface water instead of using equations to calculate predicted water concentrations. Thus, the model calculations can be improved by evaluating the actual groundwater concentrations. For those sites where groundwater data indicates contamination has not migrated to the groundwater, alternative cleanup levels calculated using the simplified model discussed herein are not appropriate.

Since the source of contamination was site operations and spills that occurred over 30 years ago, the system has likely reached a steady state or equilibrium. At the main complex, soil and groundwater data were collected, thus modeling the migration to groundwater pathway using the 3-phase assumptions should not be performed. Instead, a more practical approach can be employed, focusing on the current and future risk posed by the contaminants in each media, e.g., soil and groundwater ingestion.

The following default input parameters for the risk equations (3-phase model) may be modified using site-specific data, according to the Guidance for Cleanup of Petroleum Contaminated Sites (ADEC, 2000):

- dry soil bulk density;
- total soil porosity;
- water-filled porosity;
- air-filled porosity;
- average soil moisture content;
- fraction organic carbon of soil;
- dilution factor;
- aquifer hydraulic conductivity;
- hydraulic gradient;
- mixing zone gradient;
- source length parallel to groundwater flow;
- infiltration rate; and
- aquifer thickness

At the Northeast Cape site, the following data were collected to use as input parameters in the soil cleanup level equations:

- total organic carbon
- average soil moisture content (ASTM D2216)
- dry soil bulk density (ASTM D2167 TM)
- mean annual precipitation

The equations and input parameters are summarized in Table 3-3. The soil cleanup levels based on the migration to groundwater pathway are most sensitive to the parameters *fraction of organic carbon* (foc), *infiltration rate* (I), and *dilution factor* (DF). The soil characteristics at Northeast Cape vary widely based on site location (e.g., gravel versus tundra). Total organic carbon content (TOC) was measured at over 70 sampling locations. Table 3-4 summarizes the data used to calculate the average fraction organic carbon and average soil moisture content by site. A more detailed summary of all the site-specific and chemical-specific input parameters and the equations used to derive the alternate soil cleanup levels can be found in Appendix B (see Tables B4, B5 and B6).

The total organic carbon (TOC) data was segregated by site location (e.g., background, Site 7, Main Complex, Site 31, etc.). TOC data was rejected if the sum of DRO and RRO exceeded 1,000 mg/kg, or biogenic analysis indicated fuels were present, based on recommendations in an ADEC presentation Conducting Cleanups Under Methods Two and Three (May 2001). TOC data was further segregated based on the unified soil classification system (USCS) types. The background data were segregated into two categories based on the sample USCS classification, peat or tundra-like soil (PT, ML) and gravel or other soil (SM, GP, GM, GW, GP-GM). All tundra or peat (PT, ML) data had indications of DRO+RRO greater than 1000 ppm. Therefore, this data was not used in the calculations. However, laboratory interpretation of the sample chromatograms indicated that the results were predominantly biogenic materials, and not petroleum hydrocarbons. A total of 13 background samples were averaged to represent gravel soil conditions. Only TOC data collected by the methods E415.1, SGS Laboratories, Inc. standard operating procedure (based on E415.1), or SW9060 were included in the database. TOC data by ASTM 2974 and Walkley-Black (measures organic matter) were excluded from the dataset based on guidance from the ADEC.

Table 3-3. Soil/water partitioning equation for migration to groundwater

Soil cleanup level (mg/kg) = Cw {(Koc) + ((ϴw + ϴaH')/ ρb)}

Symbol	Parameter/Definition	Units	Default	Northeast Cape
Cw	target soil leachate concentration	mg/L	= (Groundwater Cleanup Level) * (10 + DF), 10 is attenuation factor	chemical-specific
Koc	soil organic carbon/water partition coefficient	L/kg	chemical-specific	chemical-specific
foc	fraction organic carbon in soil	g/g	0.001 (0.1%)	Varies- See Table 3-4
ρb	dry soil bulk density	kg/L	1.5	0.341 (tundra) 1.62 (gravel)
ρs	soil particle density	kg/L	2.65	2.65
N	total soil porosity =(1 – ρb/ρs)	Lpore/ Lsoil	0.434	varies based on ρb
ϴw	water-filled soil porosity =w*ρb	Lwater/ Lsoil	0.3 (30%)	varies based on w
ϴa	air-filled soil porosity =(n – (w*ρb))	Lair/Lsoil	0.13	varies based on w
W	average soil moisture content	kgwater/ kgsoil	0.2 (20%)	varies – See Table 3-4
H'	Henry's law constant	Unitless	chemical-specific	chemical-specific
DF	dilution factor =1+((K*i*D)/(Inf*L))	Unitless	3.3	4.2
K	Hydraulic conductivity	m/yr	876	876
i	Hydraulic gradient	m/m	0.002	0.002
D	mixing zone depth $=(0.0112L^2)^{0.5}$+ da {1 - exp[(-L*Inf)/(K*I*da)]}	m	5.50	4.77
Inf	Infiltration =1/5 * (mean + one standard deviation of yearly rainfall)	m/yr	0.13	0.08
L	source length parallel to groundwater flow	m	32	32
d_a	Aquifer thickness	m	10	10

Table 3-4. Site-specific values for Total Organic Carbon and Average Soil Moisture Content					
Site	**Average TOC (mg/kg)**	**Number of Samples**	**Average Moisture Content (%)**	**Number of Samples**	**Notes**
Background (gravel)	10,500	13	8	11	average SM,GP,GM,GW, GP-GM
Background (sediment)	164,000	6			average DRO+RRO<1000 ppm
Background (tundra)	185,200	8			average biogenic
Main Complex	3,200	7			0-10 ft average
Site 7	18,600	3			0-10 ft average
Site 31	5,900	9			Average, no diesel hits
Sediment (Site 28, 29)	54,800	6			Average, no diesel hits
All Sites	8,100	31			average all data, gravel pads, DRO+RRO<1000 mg/kg, minus max/min values, to 10 ft depth only

The site-specific soil alternate cleanup levels for total diesel range organics and total residual range organics are summarized in Table 3-5. The cleanup levels vary significantly based on the fraction organic carbon content of the soils. The aliphatic/aromatic fractional alternate cleanup levels were transformed into a total DRO and RRO level by dividing the aromatic or aliphatic cleanup level by a corresponding aromatic or aliphatic default percentage. For example, the DRO cleanup levels were calculated by dividing the corresponding DRO aliphatic level by 0.80 and also dividing the corresponding DRO aromatic level by 0.40. The lowest result of these two calculations is the alternate cleanup level for Total DRO. The nature of the soil matrix throughout Northeast Cape indicates RRO contamination will not significantly migrate based on the organic carbon content of the soils, and the calculated alternate cleanup levels would range from 37,000 to 584,000 mg/kg. However, the alternate cleanup levels for RRO were capped at the maximum allowable concentration of 22,000 mg/kg found in 18 AAC 75 Table B2.

Table 3-5. Scenario B Alternate Cleanup Levels, Migration to Groundwater Pathway

	All Sites Gravel (mg/kg)	**Main Complex (0-10 ft) (mg/kg)**	**Site 28 Tundra Soil (mg/kg)**	**Site 31 (mg/kg)**
Fraction Organic Carbon (average TOC, %)	0.81%	0.32%	5%	0.59%
DRO aliphatics	61,800	24,200	382,000	45,300
DRO aromatics	870	340	5,300	640
Total DRO (mg/kg)	2,200	850	12,500*	1,600
RRO aliphatics	N/A	N/A	N/A	N/A
RRO aromatics	28,400	11,100	175,000	20,800
Total RRO (mg/kg)	22,000*	22,000*	22,000*	22,000*
*capped at Maximum Allowable Concentration (18 AAC 75, Table B2)				
Benzene		0.02		
Ethylbenzene		13		
Naphthalene		64		

The migration to groundwater alternate soil cleanup levels should only be applied at those locations where the groundwater is a reasonably expected potential future drinking water source, or sufficient data exists to indicate a 4-phase distribution of petroleum hydrocarbons is present. Since the source of contamination was site operations and spills that occurred over 30 years ago, the system has reached a steady state or equilibrium. At the main complex, soil and groundwater data were collected, thus modeling the migration to groundwater pathway using default assumptions should not be performed. Instead, a more practical approach can be employed, focusing on the current and future risk posed by the contaminants in each media.

3.6.3 Groundwater Cleanup Levels

The State of Alaska classifies all groundwater within the state as a potential drinking water source, unless specific requirements in 18 AAC 75.350 are met. The shallow groundwater at low-lying areas of the Northeast Cape Installation is not a current or reasonably expected potential future drinking water source. For example, the shallow groundwater in the tundra north of the Suqitughneq River and near the Bering Sea likely consists of percolated rainfall and seasonally-thawed water within the active layer of the shallow soils. The shallow groundwater in these areas is intermittent both spatially and temporally. Monitoring wells installed in tundra areas are extremely slow to recharge. Additionally, the anticipated depth of frost in soils in the winter is expected to be greater than 6 to 10 feet bgs. Areas of shallow groundwater near the Bering Sea could also be impacted by saltwater intrusion, which would affect its usability. The shallow groundwater is only available seasonally during the summer months, and the quantity of water is unreliable and insufficient to sustain a well. Therefore, accessing the shallow subsurface water above the permafrost zone as a potential future drinking water source is not reasonable.

Sources of groundwater at Northeast Cape in areas near the base of the Kinipaghulghat Mountains, at the Main Complex area, and within the suspected deeper aquifer are considered potential future drinking water. Groundwater at the Main Complex area contains elevated concentrations of petroleum hydrocarbons and other compounds such as benzene and metals. The groundwater cleanup levels for contaminants of concern at the Main Complex are based on 18 AAC 75.345(b)(1) Table C and summarized in Table 3-6a.

Using the assumption that shallow groundwater is not a reasonably expected potential future drinking water source, the applicable groundwater cleanup levels can be based on 18 AAC 75.345(b)(2) – “the 10 times rule”. Cleanup levels for contaminants of concern at Tundra Areas that are not considered a potential drinking water source are shown in Table 3-6b. Tundra areas include the vicinity of Sites 3 and 4 Fuel Pumphouse and Pipeline, Site 6 Cargo Beach Road Drum Field, Site 7 Cargo Beach Road Landfill, and Site 9 Housing and Operations Landfill.

Table 3-6a. Cleanup Levels for Groundwater at the Main Complex

Chemicals of Concern	Main Complex Cleanup Level [a] (mg/L)	Main Complex Hazard Quotient
NONCARCINOGENS		
Lead [b]	0.015	--
Benzene	0.005	0.1
Ethylbenzene	0.7	0.2
Cumulative Risk(all COCs)		0.3
PETROLEUM HYDROCARBONS		
Diesel Range Organics	1.5	
Diesel Range Organics, Aliphatic	3.7	1
Diesel Range Organics, Aromatic	1.5	1
Gasoline Range Organics	1.3	
Gasoline Range Organics, Aliphatic	1.3	0.01
Gasoline Range Organics, Aromatic	7.3	1
Residual Range Organics	1.1	
Residual Range Organics, Aliphatic	n/a	n/a
Residual Range Organics, Aromatic	1.1	1
CARCINOGENS		
Arsenic	0.05	8.80E-04
Benzene	0.005	3.20E-06
Cumulative Risk (all COCs)		8.8E-04
Cumulative Risk (all COCs, except arsenic)		3.2E-06

[a] ADEC 18 AAC 75.345 Table C Cleanup Level (as amended through December 30, 2006)
[b] Lead contamination in soil or groundwater is not included in cumulative risk calculations, per Cumulative Risk Guidance (ADEC, 2002).

Table 3-6b. Cleanup Levels for Groundwater, non drinking water source

Chemicals of Concern	Tundra Areas Cleanup Level [a] (mg/L)
NONCARCINOGENS	
Arsenic	0.5
Lead	0.15
Nickel	1.0
Zinc	110
PETROLEUM HYDROCARBONS	
Diesel Range Organics	15
Residual Range Organics	11

[a] Based on 18 AAC 75.345(b)(2) Note: Cumulative risk calculations not applicable to tundra areas, groundwater is not a reasonably expected potential drinking water source.

The lower of the aliphatic or aromatic fraction cleanup levels for DRO or RRO were selected as the total DRO or total RRO groundwater cleanup level. While selecting the lower value as the groundwater cleanup level is consistent with current ADEC practices, this approach conservatively assumes the water contains 100% of the DRO or RRO as aromatic compounds. The assumption is valid for RRO because the aliphatic constituents are essentially insoluble and would not be measured in water. The assumption is problematic for DRO because both aliphatics and aromatics can be detected in water, and if the less toxic aliphatics actually comprise a higher proportion of the mixture, the potential risks may be overestimated. For example, Diesel Fuel #2 has been measured to have 64% aliphatic constituents and 35% aromatic constituents (including PAHs).

Individual risks from each petroleum fraction must be calculated; however, they are not included in a cumulative risk calculation with other petroleum fractions or with other chemicals in the tables. Petroleum is a chemical mixture. Under EPA's *Guidelines for the Health Risk Assessment of Chemical Mixtures* (1986), the most preferred method for evaluating the risk to chemical mixtures is to use toxicological data for the mixture itself. Many mixtures have different toxicological properties than their constituents. At this time, there is not enough toxicological data available to calculate risk to the full petroleum fractions other than using a surrogate approach to determine toxicity. Based on recommendations of the TPH Working Group series (TPHCWG, 1998b), the ADEC selected reference doses and reference concentrations to estimate the potential noncarcinogenic toxicity of 6 petroleum fractions (e.g., GRO aromatic, GRO aliphatic, DRO aromatic, DRO aliphatic, RRO aromatic, and RRO aliphatic).

According to the Petroleum Cleanup Guidance (ADEC, 2000c), the critical effects for each of the six identified surrogate fractions (including aromatic/aliphatic groups) are not the same. The critical effects include hepatoxicity, nephrotoxicity, decreased body weight, and neurotoxicity. As stated in the Cumulative Risk Guidance (ADEC, 2002), noncancer effects can be segregated by target organ or system endpoint. Thus, the groundwater cleanup levels for total DRO and total RRO are protective of human health.

3.6.4 Surface Water Cleanup Levels

Surface water cleanup levels can be based on the groundwater cleanup levels shown above, assuming the water is used as a drinking water source. In addition, surface water must meet water quality standards as promulgated by the State of Alaska in 18 AAC 70.

The water quality criteria for petroleum hydrocarbons, oil, and grease are set out in a table in regulation at 18 AAC 70.020 (b). For petroleum the cleanup levels are 10 parts per billion total aromatic hydrocarbons (TAH) and 15 parts per billion total aqueous hydrocarbons (TAqH). TAH is the sum of concentrations of benzene, toluene, ethylbenzene, and xylene isomers, commonly called BTEX. TAqH is the sum of concentrations of TAH (BTEX) plus the polycyclic aromatic hydrocarbons (PAH) in the water column.

This code states in Chapter 1, Fresh Water, Section (C) Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife; "…individual substances may not exceed EPA Quality Criteria for water, or if those criteria do not exist, may not exceed the Primary Maximum

Contaminant Levels of the Alaska Drinking Water Standards. The department may, in its discretion, establish chronic and acute criteria to protect sensitive and biologically important life stages of resident Alaskan species, using methods approved by the USEPA or alternate methods approved by the department. In addition, there may be no concentrations of toxic substances in water or in shoreline or bottom sediments, that, singly or in combination, cause or reasonably can be expected to cause toxic effects on aquatic life, except as authorized by this chapter."

3.6.5 Sediment Cleanup Levels

Sediment cleanup levels have not been promulgated by the State of Alaska or the USEPA. The state of Alaska also does not have a defined framework for the screening, assessment, and remediation of contaminated sediments. However, the USEPA recently published a comprehensive guidance document on evaluation and remediation of contaminated sediment sites, Contaminated Sediment Remediation Guidance for Hazardous Waste Sites (USEPA, 2005). Petroleum is not a hazardous waste under CERCLA, but is regulated by the state of Alaska as a pollutant. Nationwide, screening and cleanup levels for petroleum hydrocarbon fractions in sediment are not available. Thus, the evaluation of petroleum hydrocarbons in sediments relies primarily on the concentration of PAHs and other constituents. Sediments naturally contain a high level of natural lipids (e.g., fats) that often contribute to false positive laboratory results when testing for petroleum hydrocarbons. The knowledge of non-impacted sediment levels of total organic carbon and other compounds is essential to evaluate potentially impacted areas.

In general, intermittently submerged sediments (i.e., ephemeral ponds, wet tundra) are treated as soil for the purpose of evaluating sites for potential contamination. However, several areas at Northeast Cape contain predominantly continuously submerged sediments, the Suqitughneq River and Estuary (Site 29), portions of the Drainage Basin (Site 28), and possibly the POL Spill Site (Site 8).

The ADEC Sediment Quality Guidelines Tech Memo (ADEC, 2004b) recommends the use of the threshold effects level (TEL) and probable effects level (PEL) Sediment Quality Guidelines (SQGs), as published in the National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQuiRTs) (NOAA, 1999). The TEL, threshold effects level, tends to be the most conservative screening value. Determination as to which value to utilize in sediment evaluation (TEL/PEL) should be made based upon site specific information, requirements and acceptable risk level.

In applying the NOAA SQuiRT values, the following must be considered for assessment:

1) The values are Sediment Quality Guidelines (SQGs) and as such, should be used for screening purposes only. They are not meant to be, nor should they be, viewed or utilized as sediment cleanup levels.
2) The values are based upon effects reported for benthic organisms; organisms that inhabit the bottom of an aquatic environment. They do not address or apply to bioaccumulation, adverse effects in higher trophic level organisms (biomagnification), and/or human health. As such, compounds that are known (or suspected) to bioaccumulate and biomagnify may warrant further investigation.

3) If TEL/PEL values are not listed for a contaminant, alternative, published screening levels may be proposed and reviewed on a site specific basis.
4) Background concentrations should be evaluated when metal(s) are the contaminants of concern (COC).

Site specific sediment determinations must be based upon all available data and a weight of evidence approach is recommended for final, site specific decisions in regards to sediment contamination.

The USEPA recognizes that the derivation of ecologically based cleanup levels is a complex and interactive process incorporating contaminant fate and transport processes, toxicological considerations and potential habitat impacts of the remediation alternatives (USEPA, 2005). Cleanup levels should consider a range of factors including:

- The magnitude of the observed or expected effects of site releases and the level of biological organization affected (e.g., individual, local population, or community);
- The likelihood that these effects will occur or continue;
- The ecological relationship of the affected area to the surrounding habitat;
- Whether the affected area is a highly sensitive or ecologically unique environment; and
- The recovery potential of the affected ecological receptors and expected persistence of the chemicals of concern under present site conditions.

The Human Health and Ecological Risk Assessment (MWH, 2004) included an evaluation of ecological effects in the Drainage Basin and Suqitughneq River. Based on the conceptual site model and available chemical data, there were no predicted adverse ecological effects in the Suqitughneq River. Low trophic level adverse effects were possible for the Drainage Basin, but have not been confirmed. A previous study by the Environmental and Natural Resources Institute at the University of Alaska (ENRI) (MWH, 2000) titled Tier 2 Ecological Assessment included an evaluation of sediment toxicity at several Northeast Cape locations using the Microtox bioassay, and an assessment of the macroinvertebrate and fish communities.

The proposed cleanup levels for continuously submerged sediments are shown in Table 3-7. The sediment cleanup levels are based on a combination of sediment standards from several sources. The State of Washington, Department of Ecology, has promulgated criteria to identify, screen, and cleanup contaminated surface sediment sites, in Washington Administrative Code (WAC) Chapter 173-204-500, Table III. The chemical criteria in Table III establish minor adverse effects as the Puget Sound marine sediment minimum cleanup level to be used in the evaluation of cleanup alternatives. Although the Washington standards are for marine sediments, they may be useful to evaluate site conditions at Northeast Cape. Additional screening level values besides those included in the NOAA SQuiRT tables are also available in the literature. In particular, consensus-based Threshold and Probable Effects Concentrations (TEC/PEC) were developed by MacDonald et al. for the USEPA, Great Lakes National Program Office (USEPA, 2002). Probable effects concentrations represent levels above which harmful effects are likely to be observed, whereas threshold effects concentrations represent levels below which harmful effects are unlikely to be observed. TEC levels are useful for screening sites for the presence of contamination, and PEC levels may be useful in determining cleanup goals.

The proposed cleanup level for PCBs is shown on a dry-weight basis, normalized for organic carbon content. The cleanup level conservatively assumes the sediments contain 1% total organic carbon. The organic carbon content of sediment is an important factor influencing the movement and bioavailability of nonpolar organic compounds such as PCBs or PAHs. Actual total organic carbon concentrations in sediments of Northeast Cape vary considerably, and range from 2.5% - 5.5% in the Suqitughneq River, to 14% in the Drainage Basin. The proposed cleanup levels for petroleum hydrocarbons (DRO/RRO) in sediment are based on potential human health exposure via the incidental ingestion/dermal contact routes. The proposed cleanup levels were calculated using a future residential scenario, with 90 days exposure/year, and a target HQ of 0.1. A target HQ of 0.1 was selected to account for uncertainties related to potential adverse ecological effects.

Table 3-7. Sediment cleanup levels

	Cleanup Level **mg/kg DW**
PAHs	
2 –methylnaphthalene [a]	0.6
Acenaphthene [a]	0.5
Benzo(g,h,i)perylene [b]	1.7
Fluoranthene [b]	2.0
Fluorene [a]	0.8
Indeno(1,2,3-cd)pyrene [b]	3.2
Naphthalene [a]	1.7
Phenanthrene [a]	4.8
Total LPAH [a]	7.8
Total HPAH [a]	9.6
PCBs [a,b]	0.7
METALS	
Chromium [a]	270
Lead [a]	530
Zinc [a]	960
DRO [c]	3,500
RRO [c]	3,500

Notes:
[a] based on Washington State Administrative Code WAC 173-204-520, Table III, Sediment Minimum Cleanup Level (WAC, 1995)
[b] based on MacDonald et al, Consensus-based Probable Effects Concentration (PEC) (USEPA, 2002)
[c] based on potential human health exposure via the incidental ingestion/dermal contact routes, calculated using a future residential scenario, exposure frequency 90 days/year, and a target HQ of 0.1
DRO – diesel range organics
DW – dry weight
HPAH – high molecular weight PAHs
LPAH – low molecular weight PAHs
mg/kg – milligrams per kilogram
PAHs – polynuclear aromatic hydrocarbons
PCBs – polychlorinated biphenyls
PEC – probable effects concentration
RRO – residual range organics

4.0 IDENTIFICATION AND SCREENING OF RESPONSE ACTIONS

4.1 General Response Actions

General response actions describe those actions that will satisfy the remedial action objectives. This section discusses general response actions for applicable environmental media and contamination at the site. Table 4-1 presents the general response actions and associated remedial technologies. Technologies were identified within several general response action categories including: Limited Action, Containment, In-Situ Treatment, and Ex-Situ Treatment.

General Response Actions for Soil/Sediment

General response actions potentially capable of meeting the remedial action objectives for contaminated soils at Northeast Cape include: no action, limited action, containment, in-situ treatment, and ex-situ treatment. The no action alternative is required for consideration by the National Contingency Plan (NCP). Limited action can range from restricting site access to long-term monitoring to detect changes in site conditions. Monitoring actions themselves do not achieve a specific cleanup goal, but can provide assurance that existing site conditions do not change substantially, and may be a component of natural attenuation. Containment actions represent a variety of approaches to separate or place a barrier between contaminated soil and potential human or environmental receptors. Responses involving active treatment can be in-situ (in place) or ex-situ, which requires the physical removal of contaminated material. Ex-situ technologies can be performed on-site or off-site, for example, soil could be transported off-site for thermal treatment or a thermal treatment unit could be transported to the site. The mobilization costs, volume of soil and contaminants of concern to be treated are important elements in deciding whether to perform onsite or offsite treatment.

General Response Actions for Groundwater and Surface Water

The general response actions that may be capable of meeting the remedial action objectives for groundwater and surface water include no action, limited action, containment, in-situ treatment and ex-situ treatment. Active remediation methods for groundwater may simultaneously address soil contamination as well. The mobilization costs, volume of water, contaminants of concern to be treated and operation costs are important elements in deciding whether to perform active or passive treatment or even limited action and containment options.

General Response Actions for Air

Potential general response actions for the air pathway are not included in Table 4-1. Because of the limited evidence of harmful airborne contaminants that exist at the site, response actions for this media are limited to air monitoring or controlling fugitive emissions of dust during any remedial action activities.

Table 4-1. General Response Actions and Associated Remedial Technologies, Northeast Cape, Alaska

General Response Action	Remedial Technologies for Soil and Sediment	Remedial Technologies for Groundwater/Surface Water
No Action	Consideration is required by the National Contingency Plan (NCP)	Consideration is required by the NCP
Limited Action	• Access restrictions • Natural attenuation • Long-term monitoring • Institutional controls	• Access restrictions • Natural attenuation • Long-term monitoring • Institutional controls
Containment	• Capping • Surface controls	• Hydraulic Containment
In-situ Treatment	<u>Physical/Chemical Treatment</u> • Soil vapor extraction (SVE) • Soil Flushing • Chemical reduction/oxidation • Solidification/Stabilization • Thermally enhanced SVE <u>Biological Treatment</u> • Bioventing • Enhanced Biodegradation • Phytoremediation	<u>Physical/Chemical Treatment</u> • Air Sparging • Bioslurping • Chemical Oxidation • Dual phase extraction • Thermal treatment • Air stripping • Passive treatment walls <u>Biological Treatment</u> • Enhanced Biodegradation • Phytoremediation
Ex-situ Treatment	<u>Physical/Chemical Treatment</u> • Soil washing • Chemical reduction/oxidation • Solidification/Stabilization • Thermal desorption/ destruction/Incineration • Beneficial reuse (paving) • Matrix Enhanced Treatment System <u>Biological Treatment</u> • Landfarming/composting • Enhanced Biodegradation • Phytoremediation • Slurry phase biodegradation <u>Off – Site Treatment/Disposal</u> • Landfill • Incineration • Beneficial Reuse	<u>Physical/Chemical Treatment</u> • Oxidation • Granulated Activated Carbon • Sprinkler Irrigation • Ion Exchange • Air Stripping <u>Biological Treatment</u> • Bioreactors • Constructed wetlands <u>Containment</u> • Physical Barriers • Deep Well Injection

4.2 Screening of Remedial Action Technologies

This section identifies a broad range of remedial action technologies and process options applicable to potential environmental problems associated with Northeast Cape FUDS. In accordance with EPA guidelines (USEPA, 1988), the initial identification and screening of technologies and process options has been performed separately for each of the potentially contaminated media under consideration at Northeast Cape FUDS. Air media has been eliminated from further consideration as not requiring a response action. Any air monitoring or dust/vapor control will be addressed separately during the remedial action phase under the applicable work plan.

Due to the remote location of Northeast Cape FUDS, the screening of technologies will incorporate the consideration of logistical, environmental and climatic limitations. Extreme climate conditions eliminate many potential remedial actions and limit the effectiveness of others to an approximate three to four month period each year. The average length of the frost-free season for the Northeast Cape area is approximately 80 days

The initial screening of the technologies and process options was limited to an assessment of the applicability of particular options with respect to the COCs. Further evaluation was made of the effectiveness, implementability, and relative cost, as described below:

- Effectiveness - the focus for this criterion was on the potential effectiveness of the process option to mitigate risk levels
- Implementability - implementability issues include both the technical and administrative feasibility of a process option
- Cost - relative costs presented in this section are estimated for comparative purposes

Each potentially applicable technology/process option was evaluated with regard to the general screening criteria. More detailed discussions of the technologies are presented in later sections. This section summarizes the remedial technologies and process options that will be considered for further evaluation. Technologies were retained from the Table 4-1 General Response Actions, based on the usability of the technology for a particular site, and the general feasibility of implementing this technology given the remote location of Northeast Cape, lack of a dedicated power source and short field season. A summary of the process options considered is provided below. Table 4-2 presents the process options that were retained for further consideration.

Table 4-2. Screening of Remedial Action Alternatives

SITES	NFRAP	No Action	Institutional Controls	Nat. Attenuation	LTM	Capping	Landfarming	Phytoremediation	Thermal Treatment	Off-site Treatment/Disposal	Reactive Matting	Chemical Oxidation	Reactive Walls	Constructed Wetlands
No Further Action 1, 2, 5, 12, 14, 16, 17, 18, 20, 21, 22, 23, 24, 25, 26, 33, 34	X													
Fuel Pumphouse and Pipeline Sites 3, 4		S, W	S, W	S, W	S, W		S	S	S	S		W		
Drum Dump Site 6		S, W	S, W	S, W	S, W		S, W	S, W	S, W	S, W				
POL Spill Site 8		S, W	S, W	S, W	S, W		S	S			S/M			
Landfills Sites 7, 9		S, W, M	S, W, M		S, W, M	S, M				S, M				
Main Complex 10, 11, 13, 15, 19, 27		S, W	S, W	S, W	S, W		S	S	S	S	S	S, W	W	
Drainage Basin Site 28		W, M	W, M	W, M	W, M		M	M		M	M			W, M
White Alice and Tram Sites 31, 32		S	S	S	S		S	S	S	S		S		
PCBs Site wide		S	S			S				S				

MEDIA:
S = soil, M = sediment, W = water

No Further Remedial Action Planned (NFRAP). Under NFRAP and No Department of Defense Action Indicated (NDAI) status; no further investigations or cleanup actions are necessary. This status may be reviewed and modified in the future if new information becomes available which indicates the presence of contamination or exposure routes that may cause a risk to human health or the environment.

No Action. A no action alternative is included as a baseline reflecting the current conditions of the site without any cleanup or monitoring effort. This alternative is used for comparison to each of the other alternatives and does not include any monitoring or institutional controls. No cost is associated with this alternative. Consideration of the no action alternative is required by the National Contingency Plan (NCP).

Institutional Controls (ICs). Institutional controls include any type of physical, legal, or administrative mechanism that restricts the use of, or limits access to, real property to prevent or reduce risks to human health, safety, and the environment. ICs are considered response actions under CERCLA, and, as such, must be coordinated with the current landowner, regulatory agencies, and appropriate local authorities. The objective of ICs is to ensure that future land use remains compatible with the land use that was the basis for the evaluation, selection, and implementation of the response action. Some examples of land use controls include deed notices, land use restriction (e.g., construction of houses), limits on soil excavation, drinking water consumption advisories, fencing around contaminated areas, and placement of warning signs. The need for, and likelihood of, landowner acceptance and compliance with ICs is an additional consideration.

Natural Attenuation. Natural subsurface processes are allowed to continue to reduce contaminant concentration to acceptable levels. Natural attenuation can significantly limit the migration of contaminants resulting from releases of petroleum hydrocarbons. Biodegradation by indigenous subsurface microorganisms appears to be one of the primary mechanisms for natural attenuation.

Long Term Monitoring. Soil and/or water samples are collected from impacted sites and analyzed for the contaminants of concern on an established time schedule. Analytical results are used to evaluate the contaminant degradation or check on the mobility.

Capping. Capping provides containment by minimizing vertical movement of contamination and reducing the likelihood of human and animal contact with contamination. Capping consists of covering the contaminated area with a low-permeability cover to prevent the infiltration of surface water, a drain layer above the cap to direct precipitation, and a vegetative covering that prevents erosion and restores the area’s native vegetation.

Bioventing. With bioventing, oxygen is delivered to contaminated unsaturated soils by forced air movement (either extraction or injection of air) to increase oxygen concentrations and stimulate biodegradation. Bioventing stimulates the natural in situ biodegradation of any aerobically degradable compounds in soil by providing oxygen to existing soil microorganisms. In contrast to soil vapor vacuum extraction, bioventing uses low air flow rates to provide only enough oxygen to sustain microbial activity. Oxygen is most commonly supplied through direct air injection into residual contamination in soil. In addition to degradation of adsorbed fuel residuals, volatile compounds are biodegraded as vapors move slowly through biologically active soil. Bioventing techniques have been successfully used to remediate soils contaminated by petroleum hydrocarbons, pesticides, wood preservatives, and other organic chemicals. Bioventing was not retained for further consideration for a number of logistical reasons. The lack of a sustainable electric source is a major consideration combined with the arctic region temperatures. The very short field season, the isolation of the site, and the number of years that it would take for bioventing to achieve the RAO's given these conditions may be cost prohibitive and therefore was eliminated from further consideration.

Landfarming/Composting. Landfarming aerates contaminated soil, sediment, or sludge by placing the excavated soil into lined beds, and periodically turning or tilling the soil. Soil conditions are often controlled to optimize the rate of contaminant degradation. Conditions normally controlled include:

- Moisture content (usually by irrigation or spraying).
- Aeration (by tilling and mixing).
- pH (buffered near neutral pH by adding crushed limestone or agricultural lime).
- Other amendments (e.g., soil bulking agents, nutrients, etc.)

Contaminated media is usually treated in lifts that are up to 18 inches thick. When the desired level of treatment is achieved, the lift is removed and a new lift is constructed. The site would be managed properly to prevent both on-site and off-site problems with ground water, surface water, air, or food chain contamination. Adequate monitoring and environmental safeguards would be required.

Composting is a controlled biological process by which organic contaminants are converted by microorganisms (under aerobic and anaerobic conditions) to innocuous, stabilized byproducts. Contaminated soil is excavated and mixed with bulking agents and organic amendments such as wood chips, hay, manure, and/or vegetative wastes. Proper amendment selection ensures adequate porosity and provides a balance of carbon and nitrogen to promote microbial activity. Maximum degradation efficiency is achieved through maintaining oxygenation (e.g., daily windrow turning), irrigation as necessary, and closely monitoring moisture content, and temperature.

There are three process designs used in composting: aerated static pile composting (compost is formed into piles and aerated with blowers or vacuum pumps), mechanically agitated in-vessel composting (compost is placed in a reactor vessel where it is mixed and aerated), and windrow composting (compost is placed in long piles known as windrows and periodically mixed with mobile equipment). Windrow composting is usually considered to be the most cost-effective composting alternative.

Phytoremediation. Phytoremediation is a process that uses plants to remove, transfer, stabilize, and destroy contaminants in soil, sludge, sediment, and groundwater. Growing and, in some cases, harvesting plants grown on contaminated soil is a remediation method that can be used to clean sites with shallow contamination. Phytoremediation of deeper soils may be performed by excavation and building phytoremediation cells. Phytoremediation may be applicable for the remediation of metals, pesticides, solvents, petroleum products, PAHs, and landfill leachates. The effectiveness of phytoremediation depends on the chemical nature of the contaminants.

Microbial communities in the rhizosphere (e.g., plant root system) can biodegrade a wide variety of organic contaminants. Arctared fescue and annual ryegrass planted together in soil containing crude oil or diesel fuels have been shown to reduce the concentration of petroleum hydrocarbons in soils. Benefits of phytoremediation include limited environmental disturbance and lower costs. Phytoremediation is particularly well-suited to treatment of large areas of surface contamination. Phytoremediation is slower than *ex situ* methods, typically requiring several seasons for site clean-up. The time required to achieve clean-up standards may be particularly long for hydrophobic pollutants that are tightly bound to soil particles.

Chemical Oxidation. Chemical oxidation is an in-situ treatment option for either soil and/or groundwater. This option chemically converts hazardous contaminants to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. The oxidizing agents most commonly used are ozone, hydrogen peroxide, hypochlorites, chlorine, and chlorine dioxide. The chemical oxidants most commonly employed to date include peroxide, ozone, and permanganate. These oxidants have been able to cause the rapid and complete chemical destruction of many toxic organic chemicals; other organics are amenable to partial degradation as an aid to subsequent bioremediation. Field applications have clearly affirmed that matching the oxidant and *in situ* delivery system to the contaminants of concern (COCs) and the site conditions is the key to successful implementation and achieving performance goals.

Thermal Treatment. Thermal processes use heat to increase the volatility (separation); burn, decompose, destruct; or melt the contaminants. Separation technologies include thermal desorption and hot gas decontamination. Destruction technologies include incineration, and pyrolysis. Vitrification immobilizes inorganics and destroys some organics. Thermal treatments offer quick cleanup times but are typically the most costly treatment group. This difference, however, is less in ex situ applications than in in-situ applications. Cost is driven by energy and equipment costs and is both capital and operations and maintenance (O&M) intensive.

The main advantage of ex situ treatments is that they generally require shorter time periods, and there is more certainty about the uniformity of treatment because of the ability to screen, homogenize, and continuously mix the soils. Ex situ processes, however, require excavation of soils leading to increased costs and engineering for equipment, possible permitting, and materials handling worker safety issues.

Separation technologies will have an off-gas stream requiring treatment. Destruction techniques typically have a solid residue (ash) and possibly a liquid residue (from the air pollution control equipment) that will require treatment or disposal. If the treatment is conducted on-site, the ash may be suitable for use as clean fill, or may be placed in an on-site monofill. If the material is shipped off-site for treatment, it will typically be disposed of in a landfill that may require pretreatment prior to disposal. It should be noted that for separation and destruction techniques, the residual that requires treatment or disposal is a much smaller volume than the original. Vitrification processes usually produce a slag of decreased volume compared to untreated soil because they drive off moisture and eliminate air spaces. A possible exception can occur if large quantities of fluxing agent are required to reduce the melting point of the contaminated soil.

Off-site treatment and disposal. Excavation using conventional earthmoving equipment is the common method of extracting contaminated soil at and below the ground surface. Excavation methods are typically not affected by waste types or technical requirements at sites.

Reactive Matting. A reactive core mat is an aqueous permeable composite of geotextiles and reactive core materials that reliably adsorb oils and similar organics, heavy metals, and other inorganic materials from water and contaminated sediment.

Reactive Walls. A permeable reaction wall is installed across the flow path of a contaminant plume, allowing the water portion of the plume to passively move through the wall. These barriers allow the passage of water while prohibiting the movement of contaminants by employing such agents as zero-valent metals, chelators (ligands selected for their specificity for a given metal), sorbents, microbes, and others.

The contaminants will either be degraded or retained in a concentrated form by the barrier material. The wall could provide permanent containment for relatively benign residues or provide a decreased volume of the more toxic contaminants for subsequent treatment. Passive treatment walls are generally intended for long-term operation to control migration of contaminants in ground water. Target contaminant groups for passive treatment walls are VOCs, semi-volatile organic carbons (SVOCs), and inorganics. The technology can be used, but may be less effective, in treating some fuel hydrocarbons.

Matrix Enhanced Treatment System. The Matrix Enhanced Treatment System (METS) is a remediation process that uses mobile and self-propelled equipment. Very large debris, such as rock, concrete or asphalt, is screened off at the hopper opening. From the hopper, the soil is transferred in a regulated flow to a custom designed processing mill. The mill impacts and shreds the soil, while blending a treatment solution (chemical, biological, or both), along with air and moisture, into the soil. METS is designed to work with any soluble decontamination reagent or microbial culture that has been suitably prepared and mixed according to proprietary methods. In the METS process, the contaminants are either destroyed or rendered environmentally inert by chemical bonding or degradation.

The METS process is designed to eliminate soil variability while introducing one or more chemical or biological reagent(s) known to degrade and/or neutralize the specific contaminants in that soil. The process reduces the soil to a fine particle state in order to maximize access to the contaminant molecules. This process ensures the even distribution of the reagent(s) throughout this soil matrix, and the degradation/neutralization is completed before the soil loses its homogenous and fine particulate composition. The METS process also creates a relatively high level of air entrainment in the soil, along with the proper moisture content. METS was not retained for further consideration due to the short field season and the isolated location of the contamination.

Constructed Wetlands. The constructed wetlands-based treatment technology uses natural geochemical and biological processes inherent in an artificial wetland ecosystem to accumulate and remove metals, explosives, and other contaminants from influent waters. The process can use a filtration or degradation process. Although the technology incorporates principal components of wetland ecosystems; including organic soils, microbial fauna, algae, and vascular plants; microbial activity is responsible for most of the remediation.

Influent waters with high metal concentrations and low pH flow through the aerobic and anaerobic zones of the wetland ecosystem. Metals are removed through ion exchange, adsorption, absorption, and precipitation with geochemical and microbial oxidation and reduction. Ion exchange occurs as metals in the water contact humic or other organic substances in the wetland. Wetlands constructed for this purpose often have little or no soil instead they have straw, manure or compost. Oxidation and reduction reactions catalyzed by bacteria that occur in the aerobic and anaerobic zones, respectively, play a major role in precipitating metals as hydroxides and sulfides. Precipitated and adsorbed metals settle in quiescent ponds or are filtered out as water percolates through the medium or the plants.

Influent water with explosive residues or other contaminants flows through and beneath the gravel surface of a gravel-based wetland. The wetland, using emergent plants, is a coupled anaerobic-aerobic system. The anaerobic cell uses plants in concert with natural microbes to degrade the contaminant. The aerobic, also known as the reciprocating cell, further improves water quality through continued exposure to the plants and the movement of water between cell compartments. Wetland treatment is a long-term technology intended to operate continuously for years.

4.3 Detailed Analysis of Alternatives

The criteria used to assess each remedial action alternative, as established in USEPA guidance (USEPA, 1988). The first two criteria are threshold factors that establish levels of effectiveness that all alternatives must meet in order to be considered responsive to the RAOs. The remaining five criteria are balancing factors by which each alternative is evaluated relative to the other alternatives.

1. **Overall protectiveness of human health and the environment** - Evaluation of this criterion focuses on how site risks are eliminated, reduced, or controlled through engineering or institutional controls. This overall assessment of protectiveness reflects the assessment of long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

2. **Compliance with ARARs** - This criterion addresses whether each alternative meets chemical-specific, location-specific, and action-specific ARARs identified for the site.

3. **Short-term effectiveness** - The potential health effects and environmental impacts of each alternative action during construction and implementation are evaluated by this criterion. The factors assessed in this evaluation include protection of the community during implementation and construction, environmental impacts during implementation, and the estimated time required to meet RAOs.

4. **Long-term effectiveness and permanence** - This criterion addresses the results of each alternative with respect to the risk remaining at the site after the conclusion of the remedial action. Evaluation of this criterion includes an assessment of the magnitude of

the residual risk from untreated waste. It also includes an assessment of the adequacy, reliability, and useful life of any controls that are to be used to manage hazardous wastes that remain on site after the remediation.

5. **Reduction in the toxicity, mobility, or volume through treatment** - Evaluation of this criterion includes an assessment of the treatment processes to be employed by each remedial action and the types of wastes they would treat; the amount of waste that would be destroyed or treated; the projected amount of reduction in toxicity, mobility, or volume; the degree to which the treatment is irreversible; and the types and quantities of residuals that would remain after treatment. Also considered in this assessment is whether the alternative would satisfy the expresses preference of the Superfund Amendments and Reauthorization Act (SARA), Section 121, for remedial actions that reduce the toxicity, mobility, or volume of hazardous waste.

6. **Implementability** - This criterion is evaluated in terms of technical and administrative feasibility and the availability of services and materials to accomplish the remediation. Technical feasibility includes relative ease of installation or constructability; the ease of additional remediation, if necessary; and the ease of monitoring the effectiveness of the remediation. Administrative feasibility addresses the degree of procedural difficulty anticipated for each alternative in permitting and institutional requirements.

7. **Cost** - The major cost elements for each alternative are presented in Appendix C. A tabular summary of the cost breakdown by phase for each alternative and Area of Concern is also shown in Table 4-3 (see attachments). The estimates were developed using RACER 2006, a parametric cost estimating program specifically developed for environmental cleanup. Using a commercially available program such as RACER allows the input of standardized assumptions, and maintains consistency in estimating the costs across the alternatives to the extent practical. The cost estimates are rough order-of-magnitude, and should not be used as Government estimates for procurement purposes because they do not reflect a fully designed contract nor do they include the level of detail appropriate for that use. The estimates are intended as a guide in evaluating the alternatives relative to one another, and are based on information available at the time of the estimate. The cost estimates assume each Area of Concern will be addressed separately. If multiple sites are remediated concurrently, cost savings related to mobilization/demobilization costs and efficiency of scale may be realized. Hypothetical “combined” costs for grouped Areas of Concerns are shown in Table 4-3, to illustrate the magnitude of cost if the same technology was utilized for multiple sites. Several alternatives may be combined for the selected remedy, such as institutional controls and a removal action. Actual costs would depend on the final scope, schedule, site conditions, and true labor, equipment, and material costs.

In addition to these seven criteria, there are two other criteria to be evaluated as part of the FS process:

8. **State Agency Acceptance -** The acceptability of each remediation alternative to the state is considered in the Decision Document after comments on the FS and Proposed Plan have been received. The criterion for state acceptance addresses the technical and

administrative issues that the State of Alaska may have regarding each of the remediation alternatives.

9. **Community Acceptance** - The acceptability of each alternative to the community is also considered in the Decision Document after public comments on the FS and Proposed Plan have been received. The criterion for community acceptance addresses issues and concerns that the public may have regarding the various alternatives.

A detailed analysis of each proposed alternative is contained within each applicable subsection of the Site Summaries. During the next phase of planning, the Proposed Plan, specific alternatives will be selected for each Area of Concern. Multiple technologies may be selected and sites further grouped for remediation. Hypothetical costs can be calculated using Table 4-3. A combination approach may also be selected for a particular Area of Concern from the alternatives evaluated. For example: limited excavation of soil, with continued monitored natural attenuation and institutional controls.

5.0 SITE SUMMARIES – NO FURTHER REMEDIAL ACTION PLANNED

A number of individual sites at the Northeast Cape installation have been investigated and do not require further actions to address potential hazardous or toxic wastes. Areas proposed for NFRAP include Sites 1, 2, 5, 12, 14, 16, 17, 18, 20, 21, 22, 23, 24, 25, 26, 33, and 34. Additional details on each specific site are summarized in the following subsections. The locations of areas proposed for no further action are shown on Figure 5-1.

5.1 Site 1 – Burn Site Southeast of Airstrip

5.1.1 Background

An area near the airstrip was reportedly used as a burn pit or perhaps for fire training. Field observations and sampling in the vicinity have not revealed any evidence of these activities. The airstrip is located on a low, relatively flat northeast/southwest trending ridge parallel to the lower Suqitughneq River drainage. The topography around the airstrip is depositional, with permafrost within a few feet of ground surface, and is suggestive of a lateral moraine from a former piedmont glacier. No bedrock outcrops were observed in the vicinity. The airstrip appears to have been constructed by plowing back the active layer of peaty soil to frozen ground, placing rocky fill on the frozen ground, and grading the surface with gravel and sand.

5.1.2 Previous Removal/Remedial Actions

Miscellaneous debris consisting of wires/cables between the airstrip and main complex were removed from the tundra by Bristol Environmental Engineering and Construction Services, Inc. during the 2005 field season.

5.1.3 Nature and Extent of Contamination

Soil samples were collected during the 2004 Phase IV remedial investigation and analyzed for fuel constituents (DRO/GRO/RRO, SVOCs) and RCRA metals. SVOCs were not detected and metals were below background levels[5]. The contaminants of potential concern are DRO and RRO. The measured DRO concentrations ranged from 387 to an estimated 1,870 mg/kg. The measured RRO concentrations ranged from 4,550 to an estimated 19,300 mg/kg. Sampling classifications based on field observations indicate all samples were collected from peat soils, ranging from brown to dark brown, silt to slightly silty, moist to wet. No sheen was observed when the samples were collected. An analysis of potential contributions from biogenic compounds was not made. At one sampling location, soil was collected and analyzed by the primary laboratory and a second laboratory for quality assurance purposes. The measured RRO concentrations were 13,800 J mg/kg (primary), 19,300 J mg/kg (duplicate/QC), and 4,500 mg/kg (triplicate/QA). The average RRO concentration at this location was 12,550 mg/kg, which does not exceed the maximum allowable concentration of 22,000 mg/kg in 18 AAC 75 Table B2.

[5] Background levels were calculated in Technical Memorandum - Background Determination for Risk Assessment (MWH, 2003), the summary tables are provided in the Appendix.

5.1.4 Conceptual Site Model

The primary media potentially affected is tundra soil. Potential exposure pathways include incidental ingestion of soils by recreational site users or subsistence gatherers. Ecological receptors may also be affected through the food chain.

5.1.5 Remedial Action Objectives

Prevent exposure to soils exceeding contaminant-specific cleanup levels or site-specific protection standards. Prevent migration of contaminants to surrounding surface soils and surface waters. Minimize physical impacts to sensitive areas (e.g., wetlands) during remedial activities.

Site-specific cleanup levels appropriate for this area of concern are based on a risk-based approach, Scenario A, which assumes the primary exposure point is the incidental ingestion of contaminated soil. The migration to groundwater pathway, Scenario B, is not applicable because the shallow groundwater at this location is not a reasonably expected potential drinking water source.

Risk-based cleanup levels (soil ingestion)

- 9,200 mg/kg DRO and 9,200 mg/kg RRO

Using a risk-based approach, RRO would be the only COC. The area affected is limited in extent, and it is highly unlikely a human receptor would be exposed for long enough duration to pose a potential risk. In addition, RRO does not exceed the ADEC Table B2 maximum allowable concentration of 22,000 mg/kg.

No further remedial action is recommended.

5.2 Site 2 – Airport Terminal and Landing Strip

5.2.1 Background

The airport terminal area consisted of two buildings, an operations/control tower and transformer shed, and the gravel apron pad located on the southeast side of the airstrip. An above ground storage tank (AST) was also located at the southeast corner of the tower building.

5.2.2 Previous Removal/Remedial Actions

The terminal building structures and other miscellaneous debris were removed in 2003; including 44 tons of inert waste, 3 tons of scrap metal, and 2 tons of asbestos-containing materiel (ACM). The AST (1,000-gallon) was removed under a prior removal action in 2000. The transformers were removed during a prior removal action by Northwest Enviroservices (NEC, 1995).

5.2.3 Nature and Extent of Contamination

Soil samples were collected during the 1994 and 1998 remedial investigation and analyzed for BTEX, fuels (DRO/GRO/RRO or total recoverable petroleum hydrocarbons (TRPH)), metals, PAHs, or PCBs. DRO ranged from 8.2 to 376 mg/kg, whereas RRO ranged from 45 to 120 mg/kg. No other compounds were detected above cleanup levels.

5.2.4 Conceptual Site Model

The primary media potentially affected is gravel pad soil. Potential exposure pathways include incidental ingestion of soils by recreational site users or subsistence gatherers. Ecological receptors may also be affected through the food chain.

5.2.5 Remedial Action Objectives

Prevent exposure to soils exceeding contaminant-specific cleanup levels or site-specific protection standards. Prevent migration of contaminants to the shallow groundwater and to surrounding surface soils and surface waters. Minimize physical impacts to sensitive areas (e.g., wetlands) during remedial activities.

Site-specific cleanup levels appropriate for this area can be based on two scenarios. Scenario A assumes a risk-based approach with the primary exposure point being the incidental ingestion of contaminated soil. Scenario B assumes contaminants in soils may leach into groundwater and models this possibility using conservative modeling equations. Site-specific characteristics of the soil matrix are used to derive cleanup levels.

Risk-based cleanup levels (soil ingestion)

- 9,200 mg/kg DRO and 9,200 mg/kg RRO

Migration to groundwater cleanup levels (TOC of 0.008 g/g in gravel)

- 2,200 mg/kg DRO and 22,000 mg/kg RRO

Using either the risk-based approach or the migration to groundwater scenario, all COPCs would be eliminated. Therefore, no further action is recommended for Site 2.

5.3 Site 5 – Cargo Beach

5.3.1 Background

The Cargo Beach area is immediately north of the hunting and fishing camp and extends west and east from the Cargo Beach Road. The area was used for barge off loading operations.

5.3.2 Previous Removal/Remedial Actions

Bristol Environmental removed exposed debris at the Cargo Beach site during the 2003 and 2005 field seasons. A total of 26 tons of inert waste were transported off-island for disposal in 2003. Additional piles of miscellaneous debris and scrap metal were removed in 2005.

5.3.3 Nature and Extent of Contamination

Chemical contamination has not been detected at this site. No further action is recommended for Site 5.

5.4 Site 12 – Gasoline Tank Area

5.4.1 Background

This site contained two ASTs with leaded gasoline and a fuel pump inside a shed immediately east of the two tanks.

5.4.2 Previous Removal/Remedial Actions

The tanks were removed under prior removal actions.

5.4.3 Nature and Extent of Contamination

No evidence of leaks or spills was observed around these tanks. Soil sampling confirmed that the site meets the cleanup goals. GRO concentrations ranged from ND to 22 mg/kg, DRO ranged from 29 to 140 mg/kg, RRO ranged from 230 to 560 mg/kg, and benzene was not detected.

No further action is recommended for Site 12.

5.5 Site 14 – Emergency Power Building

5.5.1 Background

This site includes Building 98 and the immediately adjacent area. A 5,000-gallon AST and transformer pad were located on the south side of the building.

Photo: Emergency Power Building concrete pad post-demolition

5.5.2 Previous Removal/Remedial Actions

The building and tank were removed under prior removal actions. PCB-contaminated soils, approximately 7.2 tons, were also excavated and disposed offsite during the 2005 field season.

5.5.3 Nature and Extent of Contamination

The primary contaminant of concern is PCBs in soil. Historical soil sampling (1998 and 2001) indicated PCBs were present near a former concrete transformer pad area at concentrations ranging from 0.2 to 19 mg/kg. Two discrete areas of contaminated soil were identified and excavated during the 2005 field season to a depth of 1.5 and 3.0 feet below ground surface. Soil confirmation samples were collected from the bottom of each excavation and verified that no PCBs remain above 1 ppm. The concentration of PCBs at the bottom of each excavation was 0.206 and 0.0526 mg/kg, respectively.

No further action is recommended for Site 14.

5.6 Site 16 – Paint and Dope Storage Building

5.6.1 Background

This site consisted of a wood-framed building located on the north side of the perimeter access road surrounding the main operations complex. The site was originally a flammable liquids storage facility.

5.6.2 Previous Removal/Remedial Actions

The building, miscellaneous debris, 3 tons of visually stained soils, and an AST were removed during prior removal actions.

5.6.3 Nature and Extent of Contamination

Environmental sampling activities for Site 16 included the collection of soil and shallow groundwater samples. All chemicals detected in site media were evaluated in the human health and ecological risk assessment. The primary contaminants of potential concern in soil were arsenic, antimony, lead, and PCBs. Arsenic was detected in soils at concentrations ranging from 3.4 to 12 mg/kg and was the primary risk driver in the human health risk estimates. However, the arsenic is attributable to naturally occurring background levels. Antimony concentrations ranged from non-detect (ND) to 21 mg/kg, (average 95% upper confidence level (UCL) of 9.6 mg/kg). PCBs were detected at 1.4 mg/kg in one surface soil sampling location adjacent to building foundation in 1994; all 7 other sampling results were less than 1 ppm. The average concentration (95%UCL) for PCBs is 0.78, which is less than the cleanup level. Lead was also detected above 400 mg/kg at several locations. However, further sampling in 2001 demonstrated that concentrations were below the residential cleanup level of 400 mg/kg. The average concentration (95%UCL) for lead is 400 mg/kg.

The primary contaminants of potential concern in shallow groundwater were cadmium and trichloroethene (TCE). The shallow groundwater at Site 16 was evaluated in the risk assessment as a potential future source of potable water, including the ingestion, dermal contact, or inhalation of volatile organics pathways. The exposure concentrations used in the risk evaluation were based on the maximum concentrations detected. Thus, a single detection of TCE (0.0033 mg/L) in shallow groundwater from the 1994 remedial investigation contributed to a potential cancer risk of $1.2x10^{-4}$, whereas the USEPA drinking water maximum contaminant level (MCL) of 0.005 mg/L results in a cancer risk of $2.1x10^{-4}$. The concentration of TCE does not exceed the MCL and was an isolated occurrence. TCE was only detected in 1 out of 3 wells during the 1994 investigation. Follow up groundwater sampling was conducted in 1998 and the results were all non-detect for TCE. Furthermore, the calculated risk from ingestion of shallow groundwater for future permanent residents is within the range set by the USEPA for risk management consideration (1E-04 to 1E-06). The exposure point concentration for cadmium in shallow groundwater was 0.06 mg/L, which exceeds the Table C cleanup level of 0.005 mg/L. Cadmium was detected in 1 of the 3 wells (1994), and dissolved cadmium was not detected in the same water sample (filtered). The detected concentration of total cadmium is likely attributable to suspended sediment particles in the water column. Lead was also detected in shallow groundwater (1994 and 1998), at levels ranging from 0.0029 to 0.67 mg/L. However, dissolved lead in groundwater did not exceed Table C levels. The presence of groundwater at Site 16 has been limited. Additional groundwater sampling was attempted in 2004, but not completed due to insufficient water in the monitoring wells. Given the intermittent nature of the shallow groundwater at Site 16, it is very unlikely a future potable water supply could be established and utilized over an entire year.

No further action is recommended for Site 16. The risk assessment results are within the risk management range set by the USEPA. The concentration of TCE in shallow groundwater is below MCLs, and the detections of cadmium and lead were isolated and associated with suspended sediments in the water column (e.g., not the dissolved phase).

5.7 Site 17 – General Supply Warehouse and Mess Hall Warehouse

5.7.1 Background

This site included Buildings 107 and 111 at the main operations complex. The warehouses were used to store miscellaneous materials required for general base operations.

5.7.2 Previous Removal/Remedial Actions

The buildings were demolished and removed during prior removal actions.

5.7.3 Nature and Extent of Contamination

No sources of contamination were identified during the remedial investigation. No further action is recommended for Site 17.

5.8 Site 18 – Housing Facilities and Squad Headquarters

5.8.1 Background

This site included Building 99, 100, 101, 102, 104, 105, 106, 12 and 130, as well as the connecting utilidors and immediately surrounding area. The buildings were investigated for the presence of hazardous substances such as lead-based paint and asbestos-containing materials (ACM).

5.8.2 Previous Removal/Remedial Actions

All structures were demolished and disposed off-site during prior removal actions.

5.8.3 Nature and Extent of Contamination

No contamination was identified during the remedial investigation. No further action is recommended for Site 18.

5.9 Site 20 – Aircraft Control and Warning Building

5.9.1 Background

Site 20 included Building 103 at the main operations complex.

5.9.2 Previous Removal/Remedial Actions

The building was inspected for ACM, demolished, and disposed offsite during the 2003 removal action.

5.9.3 Nature and Extent of Contamination

No contamination was identified in the immediate vicinity of this structure. No further action is recommended for Site 20.

5.10 Site 21 – Wastewater Treatment Facility

5.10.1 Background

Site 21 consists of the wastewater treatment system for the main housing and operations complex. The facility is located west of the perimeter road and consisted of a concrete septic settling tank which discharged via an 8" insulated cast iron pipe to the wetland area approximately 450 feet to the west.

5.10.2 Previous Removal/Remedial Actions

Photo (2001) Site 21 wastewater tank prior to demolition

The septic tank compartments were cleaned and decommissioned during the 2003 removal action. The utilidor corridor from the main complex to the septic tank and the wooden utilidor outfall line were also removed in 2003. Soil confirmation samples were collected from underneath the inlet and outfall lines, and adjacent to and below the lowest level of the septic tank. Soil samples were also collected from beneath the wooden utilidor corridor. The concrete tank was broken up and buried in place.

5.10.3 Nature and Extent of Contamination

Soil, sediment, surface water, and shallow groundwater samples have been collected from Site 21 throughout the various phases of remedial investigation. Historical sampling locations are shown on Figure 5-2. Arsenic and PCBs were identified as primary COPCs during the investigations. During the initial investigation (1994), PCBs were detected above 1 ppm at one location (94NE21SS1168, 1.9 mg/kg[6]) in soil due west of the tank; downgradient samples and additional samples collected during the 2001 investigation indicated the detection was an isolated occurrence. Sludge from within the septic tank was sampled in 1999 and contained PCBs at a concentration of 120 mg/kg, thus the tank was thoroughly cleaned and sampled during the 2003 removal action. Confirmation samples collected after decontamination and decommissioning of the septic tank further demonstrated that PCBs had not migrated through the concrete at significant levels. One sample, collected immediately beneath the outfall piping adjacent to the septic tank contained detectable PCBs at 1.7 mg/kg. PCBs were not detected in all 17 other samples collected from beneath the concrete tank and the wooden utilidor at Site 21. Sampling results are summarized on Figure 5-2.

Arsenic was detected at a single location (94NE21SS167) at an anomalous concentration of 170 mg/kg in surface soil downgradient of the septic tank outfall during the 1994 investigation. Other surface soil and subsurface soil samples collected in 1994 at Site 21 contained arsenic at levels ranging from 2.8 to 39 mg/kg. Additional surface soil samples were collected from the surrounding tundra near the septic tank outfall in 2001 and arsenic concentrations ranged from 4.5 to 11.5 mg/kg and were within the range of ambient levels for the Northeast Cape site. Sediment samples were also collected in 2001 from downgradient locations and contained arsenic at concentrations ranging from 12.1 to 14.7 mg/kg. During the 2004 removal action, arsenic was detected in tundra soil samples collected from immediately beneath the demolished utilidor corridor and concentrations ranged from 11.4 to 35.2 mg/kg. The arsenic detections are most likely attributable to naturally occurring minerals in the tundra soils, or associated with treated wood comprising the framing of the utilidor system. There is no other known source[7] for the detected arsenic.

Chromium was also identified as a potential COPC during the remedial investigation, but did not exceed ambient levels established for Northeast Cape of 48 – 50 mg/kg in soil/gravel. Soil samples collected from Site 21 contained chromium at concentrations ranging from 4 to 42 mg/kg; chromium in sediment samples ranged from 36 to 93 mg/kg. Soil confirmation samples collected in 2003 along the utilidor corridor and adjacent to the septic tank bottom contained chromium at concentrations ranging from 21.3 to 109 mg/kg. Furthermore, it is unlikely the chromium is in the hexavalent state, and will not pose a risk to residents. Arsenic and PCBs were the only identified COPCs which contributed to potential future risks at Site 21.

Shallow groundwater had one detection of arsenic above the ADEC Table C cleanup level of 0.05 mg/L during the 1994 investigation (MW21-1, 0.072 mg/L). A second shallow groundwater sample (MW21-3) contained 0.041 mg/L arsenic. The average concentration in shallow groundwater was 0.0565 mg/L, compared to the cleanup level of 0.05 mg/L. The groundwater samples were also analyzed for dissolved arsenic, and the concentrations did not exceed drinking water standards, ranging from non-detect to 0.01 mg/L. The difference between total and dissolved arsenic in the water is attributable to suspended sediments in the water column. Four surface water samples collected in 1994 and 2001 downgradient of the monitoring well locations did not contain arsenic above action levels, arsenic concentrations ranged from

[6] In addition to the primary sample result, QC and QA samples were collected and analyzed. PCBs were measured at 4.2 mg/kg in the duplicate sample, and 0.93 mg/kg in the triplicate sample.
[7] Arsenic leaching from treated timbers is not considered a CERCLA release since the wood was being used for its intended purpose.

ND (0.005) to 0.002 mg/L. The source of the detected arsenic is likely ambient soil concentrations at the site.

No further action is recommended for the Site 21 wastewater treatment tank area. The extent of PCBs and arsenic detected at concentrations above the cleanup levels is spatially limited and does not pose a threat to human health or the environment. The extent of potential impacts is insignificant and the evidence suggests the arsenic detections are not related to a military source. The primary source of potential PCB contamination has been remediated, the sludge from the septic tank was removed, and the entire concrete structure was cleaned, sampled, and demolished in place.

5.11 Site 22 - Water Wells and Water Supply Building

5.11.1 Background

This site includes the water storage building, the pumphouse, and four water wells. The water storage building held four 20-foot diameter and 26-foot high water storage tanks. An underground storage tank (UST) was located adjacent to the pumphouse.

5.11.2 Previous Removal/Remedial Actions

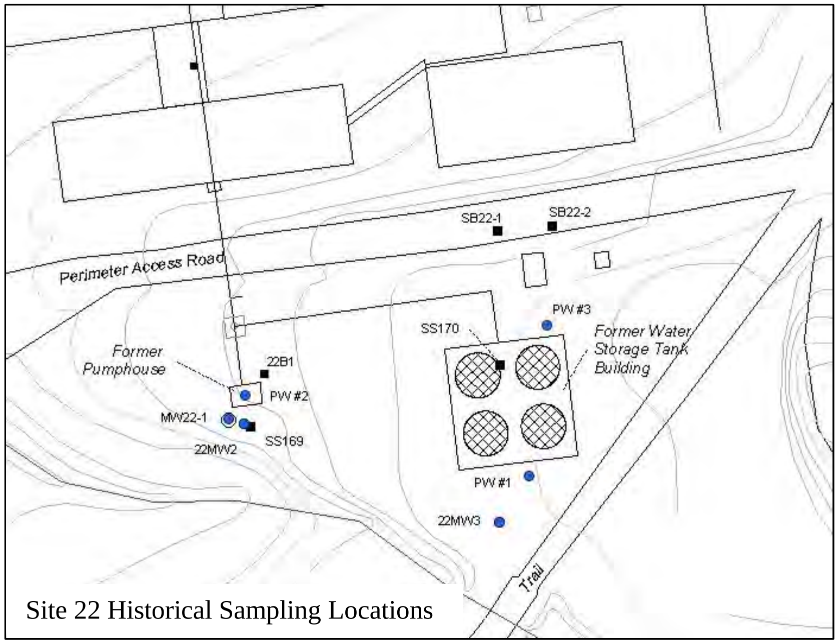
The buildings were demolished, and the UST was removed and decommissioned during the 2001 field season. Approximately 18 cubic yards of soil were removed from the excavation during tank decommissioning. A small area of stained soil from within the Water Storage Tank building was also excavated. All containerized wastes were removed from the buildings prior to demolition.

5.11.3 Nature and Extent of Contamination

During the 1994 investigation, one soil sample from within the water storage building contained DRO, antimony, and lead above screening levels. Soil and debris from inside the building were cleaned up during the 2000 field season. Another small excavation in this area was completed during the 2001 removal action. Two deeper soil borings were advanced due north of the water storage building in 2002 to evaluate the possible migration of contamination from the utilidor corridor. No analytes were detected above screening levels. The soil borings encountered refusal and/or bedrock at 32 and 36 feet below ground surface (bgs), without encountering any groundwater.

In 1994, a groundwater monitoring well (MW 22-1) was installed southwest of the pumphouse and sampled to determine if contamination was migrating from the adjacent UST. MW 22-1 was installed to a depth of 33 feet, with groundwater encountered at 28.2 ft bgs. DRO was detected at 0.28 mg/L but was below the Table C cleanup level. No other COPCs, including BTEX, GRO or TRPH were detected in the groundwater sample. Soil samples were also collected from the boring, at 24.5-26.5 feet and 26-28 ft below ground surface, and did not contain any COPCs above screening levels.

After the UST was excavated and decommissioned in 2001, soil confirmation samples were collected and analyzed for petroleum hydrocarbons (DRO/GRO/RRO), BTEX, and PAHs. The sampling results indicated DRO remained in subsurface soils (6 feet bgs) at concentrations ranging from 1,770 to 6,370 mg/kg. No other COPCs were detected in the soil confirmation samples above cleanup levels. The excavation was backfilled with clean soil.



Site 22 Historical Sampling Locations

In 2001, the three potable water supply wells were sampled before being decommissioned. In potable well (PW) #2, RRO was detected above the Table C cleanup level at a concentration of 2.8 mg/L. PW-2 had a measured well depth of 44.2 feet, and a water level of 22.45 feet. Field observations hypothesized that oils from pulling out the diesel-operated pump were left in the well casing. DRO was also detected in the well, but slightly below the cleanup level.

In 2004, two additional monitoring wells were installed at Site 22 to further evaluate the groundwater aquifer and all results were non-detect for petroleum hydrocarbons. At 22MW2, located south of the former pumphouse and downgradient of the former PW #2, a low-yield water bearing zone was encountered at 22 to 23 ft bgs. A high-yield water bearing zone was present at about 28 ft bgs. Frozen ground was suspected at 30 ft bgs and confirmed at 35 ft bgs where the boring was terminated. A second monitoring well, 22MW3, was installed south of the water storage building and southeast of 22MW2. Frozen ground was suspected at 28 ft bgs, and confirmed at 42 ft bgs. The total depth of the well was 38 ft bgs. Water was encountered at 33 ft bgs. There were no detections of COPCs above screening levels in the soil or groundwater samples from either monitoring well. Furthermore, a soil boring advanced to 26 ft bgs northeast of the pumphouse did not encounter groundwater, and soil samples from 6, 13, and 17 ft depths did not contain any COPCs above screening levels.

The most recent sampling data demonstrates that the source removal of the UST successfully reduced the potential for migration of contamination to the aquifer. The two monitoring wells installed downgradient of the former pumphouse and water storage building confirmed that fuel contamination in the shallow groundwater aquifer is not present. Thus, the single detection of residual range organics from the now-decommissioned PW#2 was an isolated occurrence. Furthermore, the concentrations of DRO in the subsurface soils do not exceed the risk-based alternate cleanup levels for human health and thus will not pose a risk to future residents. Soil borings surrounding the UST excavation also demonstrate that contamination has not migrated laterally or to depths of 28 feet below ground surface. No further action is recommended for Site 22.

5.12 Site 23 – Power and Communications Line Corridors

5.12.1 Background

The power and communications line corridors extend from the main operations complex to the outlying facilities west along the access road.

5.12.2 Previous Removal/Remedial Actions

During the 2003 and 2005 field seasons, debris was removed from the corridors in conjunction with the removal action at Sites 24 and 25.

5.12.3 Nature and Extent of Contamination

Two discrete areas along the corridor were investigated during 1994 based on field observations of potential contaminant sources. Soil samples were collected and analyzed for fuels and PCBs. Some DRO and low level PCBs were detected, but the concentrations were below cleanup levels.

No further action is recommended for Site 23. All potential sources of contamination have been removed.

5.13 Site 24 – Receiver Building Area

5.13.1 Background

The receiver building area is located approximately 1.5 miles west of the main operations complex. It consisted of a reinforced concrete building on concrete pillars. The equipment associated with the building was removed during deactivation of the installation. The gravel pad is suspected to consist of empty drums covered with gravel.

5.13.2 Previous Removal/Remedial Actions

The concrete building was demolished (49 tons) and used as backfill in low areas at the main operations complex during the 2003 removal action activities. Miscellaneous debris (i.e., inert waste and scrap metal) was also removed from Site 24 and the connecting corridor extending back to the main operations complex and Site 25 during the 2003 field season. A total of 15 tons of solid waste and 4 tons of scrap metal debris were removed near Site 24.

5.13.3 Nature and Extent of Contamination

During the 1994 remedial investigation, soil, water, and sediment samples were collected and analyzed for petroleum compounds. DRO concentrations ranged from 17 mg/kg to 4,250 mg/kg in soils/tundra. Total recoverable petroleum hydrocarbons (TRPH) was also measured, but this analytical method does not compare directly with ADEC cleanup levels and cannot be used for determining potential risk. Groundwater/surface water samples did not exceed 1.5 mg/L DRO.

In 2001, two sediment samples and one surface water sample were collected. The surface water sample did not contain any COPCs. One sediment sample contained DRO (4,600 mg/kg) above a soil screening level, but the concentration did not exceed the alternate soil cleanup level of 9,600 mg/kg. However, it is unknown if the reported DRO concentration may be artificially high and include some proportion of naturally occurring biogenic compounds. Biogenic compounds are naturally-occurring organic compounds found in organic matter and plant and animal oils. When analyzing for petroleum, the resulting DRO and RRO concentrations can include naturally occurring biogenic compounds. If sufficient biogenic material is in the soil, it can cause artificially high analytical results. Antimony also exceeded screening levels at this location. There is no site-specific ambient level of antimony calculated for soil or sediment. Antimony was detected in the two sediment samples at a concentrations ranging from 11 to 70 mg/kg versus the ADEC Table B2 ingestion level of 41 mg/kg in soil. Soil, sediment, and water samples were also collected in 1994 and analyzed for antimony; all results were non detect at a method reporting limit of 10 mg/kg. Since the 2001 detection was isolated, and potential sources of contamination (e.g., debris) have been removed, the antimony does not pose a significant risk to human health and the environment.

Since DRO concentrations in water did not exceed the Table C cleanup levels, migration to groundwater cleanup levels do not apply. The concentrations of petroleum hydrocarbons in soil/sediment also do not exceed ingestion cleanup levels.

No further action is recommended for Site 24.

5.14 Site 25 – Direction Finder Area

5.14.1 Background

The direction finder site is located about 1.8 miles west of the main operations complex. This site originally contained a small building with radio equipment. The building had been burned and the debris pushed to the sides of the gravel pad when the installation was deactivated.

5.14.2 Previous Removal/Remedial Actions

Scattered drums on or near the gravel pad, as well as an estimated 5 tons of incidental stained soils were removed during the 2000 removal action. Miscellaneous debris (13 tons) was also removed from Site 25 and the connecting corridor extending back to the main operations complex during the 2003 field season by Bristol.

5.14.3 Nature and Extent of Contamination

Soil, sediment, surface, and groundwater were sampled during the Phase 1 remedial investigation. DRO concentrations ranged from 190 to 1,100 mg/kg. The surface soil staining associated with sample SS176 was excavated and removed during the 2001 field season. Groundwater and surface water samples did not contain DRO above 1.5 mg/L.

This site does not pose a risk to human health and the environment, no further action is recommended.

5.15 Site 26 – Former Construction Camp

5.15.1 Background

The former Construction Camp area is located adjacent to and upgradient of the main operations complex, southeast of the perimeter access road. The site consists of a flat gravel pad area and a pumphouse shed. There were no other existing structures or debris at this location.

5.15.2 Previous Removal/Remedial Actions

The pumphouse shed was demolished and removed in 2001. One former water supply well (No.4) was also decommissioned in 2001.

5.15.3 Nature and Extent of Contamination

The former water supply well was sampled in 2001 before being decommissioned. Water was encountered at 25.65 feet below the top of casing. The total well depth was noted as 57.85 ft below top of casing. The groundwater sample was analyzed for fuels, metals, and VOCs. No contaminants of potential concern (COPCs) were detected. In 2004, a new monitoring well was installed at Site 26 to further evaluate the groundwater aquifer and provide an upgradient monitoring well for the Main Operations Complex. The well was installed to a depth of 42 feet bgs. Water was observed at 36.84 ft below the well measuring point (casing). The water level elevation was calculated at 70.53 ft. A second monitoring well was installed downgradient of the site, northeast of the main complex along the beach access road south of the Suqitughneq River bridge. The downgradient monitoring well was originally planned to intercept a deeper aquifer, but deep well completion was not possible. The total depth of this well was 24.22 ft, and water was encountered at 5.32 ft below the measuring point, or an elevation of 51.17 ft. No COPCs were identified in the groundwater samples.

No further action is recommended for Site 26. There are no contaminants of concern in the groundwater aquifer at this location. The existing well may serve as an upgradient monitoring well for the Main Operations Complex.

5.16 Site 33 – Upper Tram Terminal

5.16.1 Background

A tramway linked the lower tram terminal buildings with the upper tram building, located on top of Mt. Kangukhsam. The site consisted of a tram terminal building connected to the Upper Camp by an enclosed track man-lift.

5.16.2 Previous Removal/Remedial Actions

The structures and tram towers were demolished and removed during the 2003 and 2005 field seasons.

5.16.3 Nature and Extent of Contamination

During the 2001 remedial investigation, surface soil samples were collected from stained soil areas outside the tram bay. DRO concentration ranged from ND to 660 mg/kg. RRO was below screening levels and PCBs were not detected. No further action is recommended.

5.17 Site 34 – Upper Camp

5.17.1 Background

The Upper Camp is located at the top of Mt. Kangukhsam and consisted of a substation transformer pad, two ASTs, a radome building, and the upper quarters building.

5.17.2 Previous Removal/Remedial Actions

Scattered drums were removed during a previous removal action. The site structures and ASTs were demolished and removed during the 2003 field season.

5.17.3 Nature and Extent of Contamination

Historical soil sampling indicated the presence of PCBs (1.4 mg/kg) in soil adjacent to the concrete transformer pad. During the 2001 investigation, additional surface soil samples were collected from a grid around the former pad. PCBs were detected at 1.06 mg/kg, which does not exceed the ADEC cleanup level.

Soil samples were also collected and analyzed for fuels and/or PCBs and PAHs from various locations near the ASTs, an outfall pipe, the former drum field, and background locations. DRO was detected at concentrations ranging from ND to 1,100 mg/kg. RRO was not detected above screening levels. PCBs and PAHs were not detected. The DRO levels do not pose a potential risk to human health or the environment. No further action is recommended.

6.0 AREA OF CONCERN A – FUEL PUMPHOUSE AND PIPELINE

6.1 Site 3 – Fuel Line Corridor and Pumphouse

6.1.1 Background

The site is located just south of Cargo Beach on Kitnagak Bay. A 4-inch welded pipeline was used to transfer diesel fuel from the pumphouse to the bulk storage facilities at the housing and operations areas (Main Complex). The pumphouse is roughly 1.5 miles north of the main operations complex, and was situated on a gravel pad estimated to be approximately 2 feet thick. Three seasonal dwellings with associated fuel containers, all-terrain vehicles, and scrap machinery are located within 100 feet of the former pumphouse location. The site topography generally slopes north-northeast towards the beach. The area between the pumphouse and the beach consists of former dunes covered with tundra. The area south of the gravel pad appears to contain unconsolidated deposits, likely of glacial origin, with a thick tundra mat cover. Permafrost and ice-rich soil underlie the tundra.

6.1.2 Previous Removal/Remedial Actions

The fuel pumphouse, two ASTs, batteries, drums, miscellaneous debris, stained soils, and the fuel pipeline were removed during prior removal actions. A portion of the gravel pad was also excavated and stockpiled at the site. Approximately 12.67 tons of petroleum-contaminated soils were excavated and disposed off-site in 2001.

6.1.3 Nature and Extent of Contamination

Soil, sediment and shallow groundwater sampling was conducted as part of the remedial investigations between 1994 and 2004. Petroleum hydrocarbons have been detected in soils near the former pumphouse, outlying sediments, and in shallow groundwater downgradient of the pumphouse along the former fuel pipeline (see Figure 6-1). During the 2004 investigation, laboratory evaluation attributed a portion of the hydrocarbon detections in soil and sediment to biogenic compounds, not petroleum. In 2004, concentrations of DRO in soil and sediment ranged from 168 to an estimated 20,500 mg/kg; RRO ranged from 1,150 to an estimated 28,500 mg/kg. Historical soil sampling results from the gravel pad in 1994 showed DRO levels from 314 to 3,760 mg/kg and RRO levels from 393 to 6,550 mg/kg. Stained soils were excavated

Photos. Excavated soil at Site 3 Former Pumphouse observed in 2004 (left) and 2005 (right). Debris pile in foreground has since been removed.

from the gravel pad area and soil confirmation samples collected from the bottom of the excavation showed residual DRO levels ranging from non-detect to 2,280 mg/kg and RRO levels from 245 to 393 mg/kg.

One monitoring well was installed within the gravel pad of the pumphouse site in 1998. DRO was measured at 14 mg/L (WP3-1) in a water sample from this location. The field notes indicated that WP3-1 was slow to recharge, and the water was silty with a fuel odor, appeared dark brown, and had a sheen. Turbidity and contamination also caused interference with the dissolved oxygen meter, and was not readable. Additional well points were installed downgradient of the gravel pad during the 2001 investigation. DRO concentrations in shallow groundwater ranged from 1.8 to 3.3 mg/L; whereas RRO levels in these well points ranged from 1.3 to 8.1 mg/L. The field log books from the 2001 investigation noted that water samples from WP 3-2, WP 3-3, and WP 3-4 were “silty”.

Further investigation was conducted during the 2004 field season and DRO concentrations ranged from 0.433 mg/L to 3.4 mg/L. RRO in shallow groundwater ranged from 0.641 mg/L to 3.4 mg/L. The higher concentrations of RRO were detected in well points placed in tundra, not the gravel pad. The water samples collected in 2004 were also evaluated for potential biogenic influences and the highest detections (03WP102) were indicative of diesel range organics.

6.1.4 Risk Assessment

Shallow groundwater concentrations of petroleum hydrocarbons consistently exceed the ADEC Table C cleanup levels, even at distances from the pumphouse into the surrounding tundra. The Final Human Health and Ecological Risk Assessment (MWH, 2004) evaluated the consumption of shallow groundwater as a permanent future drinking water source and the non-cancer hazard index was 12. The risk assessment used the historical maximum concentration of DRO and RRO, 14 mg/L and 8.1 mg/L, respectively. However, the laboratory data may not accurately reflect actual presence of fuels as opposed to naturally occurring biogenic compounds. The laboratory results also reflect concentrations in unfiltered samples and may include petroleum hydrocarbons associated with suspended solids in the water column.

Using the most recent shallow groundwater monitoring data, the non-cancer risk from future consumption of drinking water on a year-round basis equals a hazard index of 3. The hazard index is the summation of individual hazard quotients for each contaminant of concern (i.e., DRO aliphatics, DRO aromatics, RRO aliphatics, and RRO aromatics). ADEC guidance states that individual risks from each petroleum fraction must be calculated; however, these hazard quotients are *not* included in a cumulative risk calculation with other petroleum fractions or with other chemicals in the site cleanup tables. Thus, the hazard index of 3 can be evaluated using the hazard quotients for each individual constituent. The risk associated with each individual petroleum fraction does not exceed a hazard quotient of 1.

Furthermore, cumulative risk guidance (ADEC, 2002) recommends summing only those chemicals that affect the same target organ or system endpoint. For non-carcinogens, the health threats resulting from exposure to two or more hazardous substances with similar types of toxic responses are assumed to be additive. However, many non-carcinogens have varying toxic effects and therefore assuming that these effects are additive may not be valid. To accurately assess the possible effects of non-carcinogenic compounds, a hazard index can be segregated by target organ or system endpoint and mechanism of toxicity. DRO and RRO aliphatics and aromatics affect different endpoints. The risk associated with each individual petroleum fraction does not exceed a hazard quotient of 1.

6.2 Site 4 – Native Fishing and Hunting Camp

6.2.1 Background

A native fishing and hunting camp is located southwest of the Cargo Beach barge landing area. The site includes wood frame structures originally constructed as housing for the native civilian employees of the base. Three structures are currently used by local residents for part of the year; the other structures are in disrepair due to inclement weather. Former sources of contamination at the site include abandoned vehicles, drums, and two ASTs used for water storage.

6.2.2 Previous Removal/Remedial Actions

The debris, drums, ASTs, and stained soils were removed under a previous removal action in 2000-2001. Approximately 1.21 tons of petroleum contaminated soils were excavated and disposed off-site.

6.2.3 Nature and Extent of Contamination

Soil and shallow groundwater sampling was conducted as part of the remedial investigation. Petroleum hydrocarbons (diesel and residual range organics) were detected in soils and shallow groundwater.

One surface soil sample (1994) contained DRO at 5,300 mg/kg. The contaminated soil was an isolated occurrence and covered a small area. This area of stained soil is presumed to correspond to the soil excavation performed in 2001. A soil confirmation sample analyzed in triplicate (primary, QC, QA) from the removal action demonstrated that DRO in remaining soils ranged from 388 to 1,400 mg/kg from the bottom of the excavation; RRO concentrations ranged from 2,380 to 14,000 mg/kg from the same location. The average concentrations of DRO and RRO in the post-excavation sample were 773 and 6,950 mg/kg, respectively. The residual soil contamination does not exceed the identified cleanup levels.

Shallow groundwater samples were collected in 1998 and 2001. During the 1998 field investigation, DRO and RRO were detected at concentrations of 3.7 and 6.5 mg/L, respectively. In 2001, an additional 3 well points were installed downgradient of the original well point. The 2001 sampling results indicated levels of DRO ranging from 0.96 to 2.0 mg/L; RRO levels ranged from 2.6 to 6.5 mg/L. Only one location, 01NE04WP103, exceeded the ADEC Table C groundwater cleanup level for DRO of 1.5 mg/L. However, all the 2001 DRO results were qualified as "VB - analyte detected in sample and associated blank indicating a possible false-positive result". The concentrations of DRO and RRO detected in water during the 1998 sampling event may also have been affected by suspended sediments in the water column or contributions from naturally occurring biogenic compounds in the tundra peat. The 1998 field notes indicated the water sample from WP 4-1 appeared very turbid, reddish brown. The high turbidity also caused interference and the field sampler was unable to record the redox potential.

The 2001 field notes indicated that the water samples were "silty" from WP 4-2, and "very silty" from WP 4-3 and 4-4. The well points were installed to the maximum depth feasible, 3 to 6 feet below ground surface during the 2001 investigation, in saturated ground.

6.2.4 Risk Assessment

The petroleum hydrocarbons detected in soil do not pose a risk to future permanent residents via the incidental ingestion or dermal pathways. The petroleum hydrocarbons detected in the shallow groundwater were evaluated in the risk assessment using the maximum detected concentrations of DRO and RRO from the 1998 field investigation, 3.7 and 6.5 mg/L, respectively. The risk assessment evaluated the consumption of shallow groundwater as a permanent future drinking water source, assuming daily use of this water. This assumption represents a worst-case scenario. The non-cancer risk was calculated to have a hazard index of 3, which exceeds the threshold of 1. The more recent 2001 sampling results should be considered representative of current groundwater conditions[8].

6.3 Sites 3 and 4 Combined - Fuel Pumphouse and Pipeline

6.3.1 Conceptual Site Model

The site topography generally slopes toward the beach to the north-northeast. The area between the former fuel pumphouse and the beach consists of what appear to be former dunes covered with tundra. The area south of the pumphouse appears to contain unconsolidated deposits, likely of glacial origin, with a thick tundra mat cover. Permafrost and ice-rich soil underlie the tundra. The pumphouse gravel pad is less than 2 feet thick at the boring locations, and frozen ground was encountered between 3 and 4 feet below ground surface (bgs).

The primary media potentially affected is gravel pad soil and shallow groundwater. Potential completed exposure pathways include incidental ingestion of soils by recreational site users or subsistence gatherers. The shallow groundwater in the immediate vicinity of Sites 3 and 4 is not a reasonably expected potential drinking water source. Ecological receptors may also be affected through the food chain.

Site 3 is located within 350 feet of the Bering Sea, and the depth to deep groundwater is unknown. Frozen soils have been encountered at depths of 5 feet or less. During the 2004 investigation, well points 03WP103 (WP 3-3) and 03WP05 (WP 5) had very low water yields, and required several days to purge and sample. Given the shallow depth to groundwater, the peaty nature of the soils, and the presence of permafrost, it is reasonable to assume the shallow groundwater would only be available seasonally, and it would be highly unlikely this water could reliably produce drinking water for an entire year to support a future permanent residence. The water's salinity content may also preclude its use as a permanent drinking water source. Tidal influences have also been noted in well points located closest to the beach. For example, during the 2004 field investigation, groundwater level measurements over several days at well point 03WP06, located closest to Cargo Beach, varied from 2.5 to 3.6 feet below the top of the well.

[8] From ADEC Risk Assessment Procedures Manual, 2005: "groundwater samples from a single well should be used to calculate the 95% upper confidence level (UCL) average concentration for each sample point. If adequate groundwater data are available, trends in groundwater concentrations may be considered in establishing the exposure point concentration.

Furthermore, higher salinity levels reduce the amount of oxygen that can dissolve in water. During the 2004 fieldwork, 03WP06 had the lowest dissolved oxygen content, 0.93 mg/L, compared to 2.2 to 5.7 mg/L in the other well points. The oxygen reduction potential of well point 03WP06 was negative (-102 mV) compared to the other locations which ranged from 40 to 80 mV. An alternate water source would likely be necessary, such as the Suqitughneq River or groundwater obtained elsewhere in the vicinity.

6.3.2 Remedial Action Objectives

The remedial objectives for the fuel pumphouse and pipeline are to prevent exposure to soils exceeding site-specific alternate cleanup levels for DRO and RRO. Secondary objectives are to prevent migration of groundwater contamination at levels that could negatively impact surface waters, and minimize physical impacts to sensitive areas (e.g., wetlands) during remedial activities.

Site-specific cleanup levels appropriate for this area of concern are based on a risk-based approach, Scenario A, which assumes the primary exposure point is the incidental ingestion of contaminated soil. The migration to groundwater pathway, Scenario B, is not applicable to Sites 3 and 4 because the shallow groundwater at this location is not a reasonably expected potential drinking water source.

Scenario A – Soil Alternate Cleanup Levels (risk-based, soil ingestion)

- 9,200 mg/kg DRO and 9,200 mg/kg RRO

One area of DRO contamination exists in the Site 3 gravel pad area above the Scenario A risk-based alternate cleanup level for DRO, based on the 2004 sampling results. The estimated area affected is 400 square feet, to a depth of 4 feet. No other areas of soil contamination remain at the gravel pad/road area with petroleum concentrations above the alternate cleanup levels.

Two sediment samples east of the gravel pad and former pumphouse location contained RRO only above the Scenario A risk-based cleanup level. The RRO concentrations ranged from 17,300 to 28,500 mg/kg. The level of RRO remaining at one of these two isolated locations also exceeds the maximum allowable concentration[9] of 22,000 mg/kg RRO listed in 18 AAC 75 Table B2. However, the contamination is not expected to significantly migrate due to the thick vegetative layer and peat matrix of the soil. Tundra/sediment soils contain naturally higher levels of organic carbon. Organic carbon typically binds contaminants such as petroleum and reduces its ability to migrate to shallow groundwater. Potential human receptors are unlikely to be exposed to this sediment at the same frequency and magnitude as gravel soils. The tundra soil/sediment matrix is covered by vegetation and thus less likely to be incidentally ingested or contacted by future residents for long enough duration to pose a potential risk. Based on a seasonal use scenario, the maximum concentration of RRO does not exceed a hazard index of 1. Thus, the concentrations do not pose a risk to human health.

[9] According to Note 14 of Table B2: the maximum allowable concentration is the concentration of C6-C10, C10-C25, or C25-C36 petroleum hydrocarbon range in surface and subsurface soil that, if exceeded, indicates an increased potential for hazardous substance migration or for risk to human health, safety, or welfare, or to the environment; the level of a petroleum hydrocarbon may not remain at a concentration above the maximum allowable concentration unless a responsible person demonstrates that the petroleum hydrocarbon will not migrate and will not pose a significant risk to human health, safety, or welfare, or to the environment. Free product must be recovered as required by 18 AAC 75.325(f).

Shallow groundwater at Sites 3 and 4 exceeds ADEC Table C cleanup standards for DRO and RRO. The future consumption of shallow groundwater from Sites 3 or 4 as a permanent drinking water source is not a reasonably anticipated future scenario. The shallow groundwater is difficult to access based on the peaty nature of the soils and the presence of permafrost and could be limited seasonally. Given the site's proximity to the Bering Sea, it is reasonable to assume the water table is tidally influenced. The salinity content of the groundwater will likely preclude its suitability as a permanent drinking water source. It is highly unlikely this water could reliably produce drinking water for an entire year to support a future permanent residence. Tidal influences have been noted in well points located closest to the beach. Under a risk-based scenario, if future consumption of groundwater from Sites 3 and 4 is limited to 180 days/year, and utilizing the maximum concentrations of petroleum hydrocarbons detected in the most recent sampling events, the potential noncancer hazard risk would not exceed the threshold of 1. Year-round consumption, if possible, would increase the hazard quotient to 2.

However, the community has expressed concern that changing permafrost conditions could influence the groundwater dynamics across Northeast Cape. The community has also expressed deep concerns about the ability to utilize the area as a future permanent settlement. Since the fuel pumphouse site is adjacent to an existing seasonal subsistence camp, alternatives to remediate the shallow groundwater are considered further. It appears the petroleum hydrocarbon plume extends approximately 200 feet from the gravel pad area.

Shallow groundwater cleanup levels,

- 1.5 mg/L DRO and 1.1 mg/L RRO (drinking water source)
- 15 mg/L DRO and 11 mg/L RRO (non-drinking water source)

6.4 Sites 3 and 4 Fuel Pumphouse and Pipeline Screening of Alternatives

The response actions identified in Section 4 were evaluated for the site-specific contaminants of concern and affected media at Sites 3 and 4.

No Action is retained for further evaluation per the requirements of the NCP. There are no costs associated with this alternative.

Institutional controls are applicable to Site 3 and 4 and could involve could involve physical, legal, or administrative mechanisms to restrict the use of or access to the site to prevent future risks to human health, safety, or the environment. Such controls could include a deed notice to provide information about the presence of contaminated soils at the site and that the shallow groundwater is not a reasonably expected potential future drinking water source. ICs are an effective tool to prevent exposure to the contaminants, can be implemented and typically have minimal costs. ICs are retained for further evaluation.

Natural attenuation and *long term monitoring* allow natural surface and sub-surface processes to reduce contaminant concentrations to acceptable levels over time. This alternative is applicable to Sites 3 and 4 because the primary contaminant of concern is petroleum hydrocarbons, which are known to naturally break down in the environment. The potential for significant impacts to human or ecological receptors is limited due to the nature of the contamination. Natural attenuation would not cause damage to the surrounding tundra/wetland environment. The costs associated with long term monitoring are relatively low.

The *capping* of petroleum-contaminated soils at Sites 3 and 4 was eliminated from further consideration. The size of the surface area affected at Sites 3 and 4 is small. Capping would not eliminate the potential source area for shallow groundwater contamination.

Landfarming was retained for further evaluation. The volume of soil contaminated above cleanup levels is not large. Several areas exist at Northeast Cape where soils could be spread out for landfarming. Costs will be relatively moderate.

Phytoremediation was retained for further evaluation. The short growing season is enhanced by the long days. Phytoremediation has been demonstrated effective at treating petroleum hydrocarbons. The costs are relatively moderate.

Thermal treatment was retained for further evaluation. Soil burning is a proven technology to remediate diesel-contaminated soils. Costs are moderate to high. Implementability may be more difficult given the remote location, lack of power, and no permanent residents nearby. All materials must be flown in or transported by barge. The small volume of contaminated soil at this site may preclude cost effectiveness to perform treatment on-site, unless other areas of the site are remediated concurrently.

Off-site treatment/disposal was retained for further evaluation. Soil excavation, containerization, transport and disposal are straightforward methods to remediate the site. Adverse environmental impacts could include damaging the tundra by heavy equipment.

Reactive matting was also eliminated from further consideration at Sites 3 and 4. The primary media affected is gravel fill soils near the former pumphouse. The sediments are not continuously submerged, thus placing matting over the tundra would not be effective.

Chemical oxidation was retained for further evaluation. The shallow groundwater at Sites 3 and 4 contains elevated levels of petroleum hydrocarbons. Introducing chemical oxidation into the shallow groundwater may enhance achieving the remedial action objectives in a shortened time period. This technology could also reduce the toxicity of the contaminants. Costs are relatively high due to the logistics and support needed to implement the chemical oxidation. Chemical oxidation would be effective for enhancing the degradation process of the petroleum hydrocarbon contaminated groundwater. Implementability may be more difficult at a remote site such as St. Lawrence Island, with a field season of 90-120 days. Due to the short field season, the treatment process may exceed one field season application.

Reactive walls were eliminated from consideration at Sites 3 and 4, based on the limited extent of contamination, proximity to the Bering Sea, the shallow depth of contamination, low flow of water, intermittent nature of the shallow groundwater, and presence of permafrost at 5 to 10 feet.

Constructed wetlands were eliminated from consideration. The area surrounding the gravel pad is native tundra, and enhancing this natural system would achieve limited benefits. Costs are unknown.

6.5 Fuel Pumphouse and Pipeline Detailed Evaluation of Alternatives

Based on the initial screening of remedial technologies and alternatives discussed above, a range of remedial alternatives were considered to address the soil and shallow groundwater contamination identified at Sites 3 and 4. The primary exposure routes are ingestion/dermal contact/dust inhalation of soil. The shallow groundwater is not a reasonably expected potential future drinking water source, but was evaluated further based on the possibility of its use as a temporary drinking water source given the proximity to the native subsistence camp.

- Alternative 1 is the no action response.
- Alternative 2 utilizes institutional controls to restrict the consumption of shallow groundwater and limit future construction of buildings on the existing gravel pad.
- Alternative 3 allows the petroleum hydrocarbons to naturally attenuate over time under existing biological conditions and involves future monitoring (5 years) of the shallow groundwater and soils to measure the rate of natural degradation at the site. In addition, an evaluation of the contribution of biogenic compounds to the petroleum hydrocarbon content of the soils and shallow groundwater should also be performed under this scenario to determine to proportion of fuel-related compounds versus naturally occurring biogenic compounds.
- Alternative 4 involves the use of landfarming technology to remediate the contaminated soils from this site. Petroleum-contaminated soils from an estimated 400 square foot area at the former pumphouse gravel pad would be excavated and staged onsite for incorporation of amendments to break down the contaminants.
- Alternative 5 utilizes phytoremediation to attenuate the petroleum-contaminated soils.
- Alternative 6 utilizes onsite thermal treatment to remediate the contaminated soils.
- Alternative 7 is excavation and off-site transport of DRO-contaminated soils. The contaminated soils would be treated and/or disposed at a permitted facility.
- Alternative 8 addresses the shallow groundwater contamination using chemical oxidation techniques. Temporary well points are utilized to inject oxygen into the subsurface, promoting increased degradation of the petroleum hydrocarbons.

6.5.1 Fuel Pumphouse and Pipeline Alternative 1 – No Action

Description
Under the no action alternative, the site would be left in its current state, with no activities to control or mitigate exposure to site contaminants. The no action alternative provides a baseline for comparing other remedial alternatives and is required for consideration by the NCP. There are no costs associated with Alternative 1.

Overall protection of human health and the environment
The existing levels in soil do not pose a potential risk to current seasonal residents or site visitors. The former pumphouse and pipeline site is located immediately adjacent to the native fishing and hunting camp which increases the likelihood that residents could be exposed to the

contamination. The no action alternative would not be protective of future permanent residents with long term exposure to the contaminated soil. The shallow groundwater contamination could potentially migrate downgradient to surface waters, but there is no current evidence of surface water impacts. The no action alternative is protective of future residents consuming the shallow groundwater for 6 months/year. The use of shallow groundwater at Site 3 and 4 as a permanent year-round drinking water source is not a reasonably anticipated scenario.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons will continue to occur even if no actions are taken. It would likely take many years to reach the site-specific soil ACLs under this approach. However, a limited area of gravel soil is affected at levels that could pose a future threat to human health. It would take many years for the shallow groundwater to meet cleanup standards, if considered a potential future drinking water source. The shallow groundwater meets the cleanup levels if considered a non-drinking water source.

Short-term effectiveness
The risk assessment determined there are no current risks to human health or the environment.

Long-term effectiveness and permanence
The no action alternative would not be protective of future permanent residents exposed to the contaminated soil on a daily basis for many years.

Reduction in toxicity, mobility, or volume through treatment
No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
The no action alternative is easily implemented.

Cost
The estimated cost of Alternative 1 is $ 0.

6.5.2 Fuel Pumphouse and Pipeline Alternative 2 – Institutional Controls

Description
Institutional controls at the Former Pumphouse and Pipeline could involve physical, legal, or administrative mechanisms to restrict the use of or access to the site to prevent future risks to human health, safety, or the environment. Such controls could include a deed notice to provide information to current or future landowners about the presence of diesel-contaminated soil at the site and the need for proper management of the soil if excavated. Institutional controls may also include a deed notice to inform current and future landowners that the shallow groundwater is not a reasonably expected potential future drinking water source. Other measures could involve restrictions on future construction of buildings or controls to prevent excavation of contaminated soils. Note that only one small area of the gravel pad has DRO levels which could pose a potential risk to human health.

Overall protection of human health and the environment
Institutional controls would prevent exposure of current and future residents to contaminated soils and shallow groundwater through a drinking water consumption advisory and restrictions on soil excavations. The existing levels in soil do not pose a potential risk to current seasonal residents or site visitors, but could pose a risk to future permanent residents with long term exposure. The former pumphouse and pipeline site is located immediately adjacent to the native fishing and hunting camp which increases the likelihood that residents could be exposed to the contamination. The shallow groundwater contamination could migrate downgradient to surface waters.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons will continue to occur if institutional controls are implemented. It would likely take many years to reach the site-specific soil ACLs under this approach. However, a limited area of gravel soil is affected at levels that could pose a future threat to human health. It would take many years for the shallow groundwater to meet cleanup standards, if considered a potential future drinking water source. The shallow groundwater meets the cleanup levels if considered a non-drinking water source.

Short-term effectiveness
Since the site is adjacent to the seasonal native fishing/hunting camp, there is a higher potential for exposure to site contaminants over a short period of time. The risk assessment determined no current risks to human health.

Long-term effectiveness and permanence
Institutional controls can be effective in the long term. Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Reduction in toxicity, mobility, or volume through treatment
No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
Institutional controls are typically easily implemented. The need for, and likelihood of, landowner acceptance and compliance with ICs is a consideration for alternatives requiring them. The land at Northeast Cape is owned jointly by two local Native Corporations, Savoonga Native Corporation and Sivuqaq, Inc. The ability of the Corporations to accept and maintain land use controls is unknown.

Cost
The estimated cost of Alternative 2 is $ 186,000.

6.5.3 Fuel Pumphouse and Pipeline Alternative 3 – Natural Attenuation and LTM

Description

Under this alternative, natural attenuation would be combined with long term monitoring (LTM) of the shallow groundwater and surrounding soils. The rate of petroleum hydrocarbon degradation has not been established and the extreme climate conditions on St. Lawrence Island could slow natural attenuation processes. Monitoring activities would establish a baseline, evaluate the reduction of contaminant concentrations over time, and determine if off-site migration is occurring. This alternative could also further evaluate the contribution from biogenic compounds to total petroleum hydrocarbon sampling results.

Natural attenuation processes would be evaluated through an initial baseline sampling of the soil/groundwater. Long term monitoring would involve the collection of additional soil/groundwater samples every 5 years for 25 years.

Overall protection of human health and the environment

Natural attenuation processes would reduce risks to human health and the environment over the long term. Since no permanent residents currently reside at Northeast Cape, there is no current risk to human health.

Compliance with ARARs

Natural attenuation of the petroleum hydrocarbons will continue to occur under implementation of this alternative. It would likely take many years to reach the site-specific soil ACLs under this approach. However, a limited area of gravel soil is affected at levels that could pose a future threat to human health. It would take many years for the shallow groundwater to meet cleanup standards, if considered a potential future drinking water source. The shallow groundwater meets the cleanup levels if considered a non-drinking water source.

Short-term effectiveness

Since the site is adjacent to the seasonal native fishing/hunting camp, there is a higher potential for exposure to site contaminants over a short period of time. The risk assessment determined no current risks to human health.

Long-term effectiveness and permanence

Natural attenuation and monitoring can be effective in the long term. Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions, implemented controls, and monitoring results would be required as part of this alternative.

Reduction in toxicity, mobility, or volume through treatment

No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
Natural attenuation with long term monitoring is easily implemented. Long term monitoring would involve an initial site visit to establish baseline conditions and periodic monitoring of the water and soil.

Cost
The estimated cost for Alternative 3 is $ 619,000.

6.5.4 Fuel Pumphouse and Pipeline Alternative 4 - Landfarming

Description
An estimated 60 cubic yards of petroleum-contaminated soils at the Former Pumphouse and Pipeline would be excavated and spread out in a designated area at Northeast Cape. Simply excavating and mixing the soils, as well as incorporating amendments (e.g., fertilizer, compost) will promote biological activity and the natural breakdown of the petroleum hydrocarbons. Soils exceeding the Scenario A alternate cleanup level (ACL) of 9,200 mg/kg DRO would be excavated and landfarmed. Historical sampling results indicate the remainder of the gravel pad already meets this ACL. The tundra sediments identified south and north of the gravel pad which exceed 9,200 mg/kg RRO would not be excavated because the existing soil matrix promotes binding of the organic compounds and transport to surface waters is not likely. The shallow groundwater would not be actively treated and the petroleum hydrocarbons would be allowed to naturally attenuate. Excavation of the major source of contamination would prevent potential transport of contaminants to the shallow groundwater.

Overall protection of human health and the environment
Landfarming would reduce risks to human health and the environment over the long term. The contaminated soils would be removed and treated to meet the Scenario A ACLs. Institutional controls (e.g., a deed notice) may be necessary to inform current and future landowners that the shallow groundwater is not a reasonably expected potential future drinking water source. Since no permanent residents currently reside at Northeast Cape, there is no current risk to human health.

Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Compliance with ARARs
Landfarming should meet cleanup levels within one or two field seasons for the petroleum-contaminated soils. It would take many years for the shallow groundwater to meet cleanup standards, if considered a potential future drinking water source. The shallow groundwater meets the cleanup levels if considered a non-drinking water source.

Short-term effectiveness

Since the site is adjacent to the seasonal native fishing/hunting camp, there is a higher potential for exposure to site contaminants over a short period of time. The risk assessment determined no current risks.

Long-term effectiveness and permanence
Landfarming is a proven technique to break down petroleum hydrocarbons.

Reduction in toxicity, mobility, or volume through treatment
Landfarming would significantly decrease the petroleum hydrocarbon concentrations. For the shallow groundwater, natural processes are assumed to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
Landfarming is relatively easy to implement. A flat area, such as the main operations complex, would be necessary to conduct the remedial activity. The progress of the soil treatment would need to be monitored, and the soils periodically turned over or tilled with a machine.

Cost
The estimated cost of Alternative 4 is $ 1,310,000.

6.5.5 Fuel Pumphouse and Pipeline Alternative 5 – Phytoremediation

Description
An estimated 60 cubic yards of petroleum-contaminated soils at the Former Pumphouse and Pipeline would be excavated and spread out in a designated area at Northeast Cape. The excavated soils would be planted with a mixture of plants such as arctic red fescue or other grasses. Amendments such as fertilizer or compost may also be added to promote increased biological activity and the natural breakdown of the petroleum hydrocarbons. Soil exceeding the Scenario A ACL of 9,200 mg/kg DRO would be excavated. Historical sampling results indicate the remainder of the gravel pad already meets the alternate cleanup level for DRO. The tundra sediment identified south and north of the gravel pad which exceeds 9,200 mg/kg of RRO would not be excavated because the existing soil matrix promotes binding of the organic compounds and transport to surface waters is not likely. The shallow groundwater would not be actively treated and the petroleum hydrocarbons would be allowed to naturally attenuate. Excavation of the major source of contamination would prevent additional transport of contaminants to the shallow groundwater.

Overall protectiveness of human health and the environment
Phytoremediation would reduce risks to human health and the environment over the long term. The contaminated soils would be removed and treated to meet Scenario A ACLs. Institutional controls (e.g., a deed notice) may be necessary inform current and future landowners that the shallow groundwater is not a reasonably expected potential future drinking water source. Since no permanent residents currently reside at Northeast Cape, there is no current risk to human health.

Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Compliance with ARARs
Phytoremediation should meet cleanup levels within several years for the petroleum-contaminated soils. It would likely take many years for the shallow groundwater to meet cleanup standards, if considered a potential future drinking water source. The shallow groundwater meets the cleanup levels if considered a non-drinking water source.

Short-term effectiveness
Excavation of the contaminated soils would be effective at reducing potential exposures in the short term.

Long-term effectiveness
Phytoremediation is a proven technique to remediate petroleum hydrocarbons.

Reduction in toxicity, mobility, or volume through treatment
Phytoremediation would significantly decrease the petroleum hydrocarbon concentrations. For the shallow groundwater, natural processes are assumed to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
Excavating soils, spreading onsite and seeding with plants and grasses are relatively simple processes. Plant growth could be adversely affected by short growing season, but the abundant daylight compensates for the cold temperatures. The alternative would have less maintenance requirements than landfarming. No long term maintenance such as periodic tilling of the soil, adding amendments, etc. However, there are more uncertainties associated with achieving good rates of plant growth.

Cost
The estimated cost of Alternative 5 is $ 1,190,000.

6.5.6 Fuel Pumphouse and Pipeline Alternative 6 – Thermal Treatment

Description
An estimated 60 cubic yards of petroleum-contaminated soils at the Former Pumphouse and Pipeline would be excavated and treated onsite using a soil burner to destroy the petroleum hydrocarbons using high temperatures. Contaminated soils exceeding the Scenario A risk-based ACL of 9,200 mg/kg DRO would be excavated. After treatment, the soil would be returned to the site or used as fill material elsewhere at Northeast Cape. A power source (e.g., generator) would be necessary to run the equipment. Historical sampling results indicate the remainder of the gravel pad already meets the alternate cleanup levels for DRO. The tundra sediment identified south and north of the gravel pad which exceeds 9,200 mg/kg of RRO would not be excavated because the existing soil matrix promotes binding of the organic compounds and transport to surface waters is not likely. The shallow groundwater would not be actively treated and the petroleum hydrocarbons would be allowed to naturally attenuate. Excavation of the

major source of contamination would prevent potential transport of contaminants to the shallow groundwater.

Overall protectiveness of human health and the environment
Excavation and thermal treatment would reduce risks to human health and the environment over the short and long term. The contaminated soils would be removed and treated to meet the Scenario A risk-based ACLs. Institutional controls (e.g., a deed notice) may be necessary to inform current and future landowners that the shallow groundwater is not a reasonably expected potential future drinking water source. Since no permanent residents currently reside at Northeast Cape, there is no current risk to human health.

Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Compliance with ARARs
Thermal treatment would meet the risk-based cleanup levels for the petroleum-contaminated soils. However, it would likely take many years for the shallow groundwater to meet cleanup standards, if considered a potential future drinking water source. The shallow groundwater meets the cleanup levels if considered a non-drinking water source.

Short-term effectiveness
Excavation and treatment of the contaminated soils would be effective at reducing potential exposures in the short term.

Long-term effectiveness
Thermal treatment such as soil burning is a proven technique to remediate petroleum hydrocarbons.

Reduction in toxicity, mobility, or volume through treatment
Thermal treatment destroys the petroleum hydrocarbons thus reducing the toxicity, mobility and volume of the contaminants in the soil.

Implementability
Thermal treatment is slightly more complex than excavating the soils under the landfarming or phytoremediation alternatives. In addition to heavy equipment needed for soil excavation, a soil burner would need to be transported to Island. A suitable power source is also necessary. The cold temperatures and harsh climate will limit operating timeframe of the soil burner.

Cost
The estimated cost of Alternative 6 is $ 1,190,000.

6.5.7 Fuel Pumphouse and Pipeline Alternative 7 – Off-site Treatment and Disposal

Description
An estimated 60 cubic yards of petroleum-contaminated soils at the Former Pumphouse and Pipeline would be excavated and transported off-site for treatment and/or disposal at a permitted landfill facility. Soils would be excavated to meet the Scenario A risk-based ACL of 9,200 mg/kg DRO. Historical sampling results indicate the remainder of the gravel pad already meets the alternate cleanup levels for DRO. The tundra sediment identified south and north of the gravel pad which exceeds 9,200 mg/kg of RRO would not be excavated because the existing soil matrix promotes binding of the organic compounds and transport to surface waters is not likely. The shallow groundwater would not be actively treated and the petroleum hydrocarbons would be allowed to naturally attenuate. Excavation of the major source of contamination would prevent additional transport of contaminants to the shallow groundwater.

Overall protectiveness of human health and the environment
Excavation and offsite treatment/disposal of soils would reduce risks to human health and the environment. The contaminated soils would be removed and treated to meet the Scenario A risk-based ACLs. Institutional controls (e.g., a deed notice) may be necessary to inform current and future landowners that the shallow groundwater is not a reasonably expected potential future drinking water source. Since no permanent residents currently reside at Northeast Cape, there is no current risk to human health.

Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Compliance with ARARs
Excavation and off-site treatment/disposal would meet the Scenario A risk-based alternate cleanup levels for the petroleum-contaminated soils. However, it would likely take many years for the shallow groundwater to meet cleanup standards, if considered a potential future drinking water source. The shallow groundwater meets the cleanup levels if considered a non-drinking water source.

Short-term effectiveness
Excavation and offsite treatment/disposal of the soils would meet the alternate cleanup levels in one field season. Tundra soil/sediment would not disturbed or require additional restoration. The shallow groundwater would not meet cleanup levels in the short term, but institutional controls could be implemented to restrict use as a future permanent water supply.

Long-term effectiveness
Excavation and off-site treatment/disposal permanently removes the source of contaminated soils. The shallow groundwater will eventually meet the drinking water standards via natural attenuation of the petroleum hydrocarbons.

Reduction in toxicity, mobility, or volume through treatment
Excavation and off-site treatment or disposal permanent removes the petroleum hydrocarbons thus reducing the toxicity, mobility and volume of the contaminants in the soil. The shallow groundwater is allowed to naturally attenuate.

Implementability
Excavation and offsite transport is a straightforward remedial alternative that is commonly implemented at contaminated sites. The remote location will add complexity to this alternative and barge services will be required. This alternative can be completed in 1 field season.

Cost
The estimated cost of Alternative 7 is $ 1,030,000.

6.5.8 Fuel Pumphouse and Pipeline Alternative 8 – Chemical Oxidation

Description
The shallow groundwater contamination would be actively addressed under this alternative. The area surrounding both the former pumphouse and the former AST would be targeted for treatment. Temporary well points are typically installed throughout the plume to inject oxidizing compounds (e.g., ozone, hydrogen peroxide, etc.) into the subsurface. Chemical oxidation will promote the increased degradation of the petroleum hydrocarbons. The introduction of chemical oxidation into the shallow groundwater may enhance achieving the remedial action objectives in a shortened time period. This technology could also reduce the toxicity of the contaminants. The soil contamination is not addressed under this alternative.

Overall protectiveness of human health and the environment
The alternative would be protective of human health and the environment. Treatment of the petroleum-contaminated groundwater would require design of the quality, placement, and monitoring of the chemical oxidation process. The shallow groundwater would be treated to meet the drinking water standards over time. The contaminated soil is evaluated under the other alternatives. The contaminated soil does not pose a current risk to human health and the environment, but may pose a potential future risk to permanent residents.

Compliance with ARARs
This alternative would likely comply with ARARs over time, and the shallow groundwater would meet the drinking water standards in a shortened period of time. The contaminated soils would be allowed to naturally attenuate and may reach cleanup levels in many years.

Short-term effectiveness
Under this alternative, drilling and implementation of the chemical oxidation process poses potential adverse impacts to the construction personnel on site. However, these impacts are easily controlled with proper construction safety, equipment, and chemical handling techniques. The short-term effectiveness of this alternative for treating petroleum-contaminated groundwater is still considered low.

Long-term effectiveness

The long-term effectiveness and permanence of the alternative would likely achieve the remedial action objectives for groundwater in a reasonable time frame. The treatment would increase the oxidation process of the petroleum hydrocarbons and allow the shallow groundwater to meet the drinking water standards in a shortened period of time.

Reduction in toxicity, mobility, or volume through treatment
This alternative would greatly reduce the toxicity, mobility and volume of the shallow groundwater contamination. The chemical oxidation would be effective for enhancing the degradation process of the petroleum hydrocarbon contaminated groundwater. The contaminated soils would not be addressed by this alternative.

Implementability
Chemical oxidation would be more complex than the other remedial alternatives. This alternative would require greater logistics planning and chemical handling due to the remoteness of the St. Lawrence Island site and with a limited field season of 90-120 days. Depending on the design study and short application period, several applications of the chemical oxidants may be required to achieve the remedial action objective for the shallow groundwater.

Cost
The estimated cost of Alternative 8 is $ 1,240,000.

6.6 Fuel Pumphouse and Pipeline - Comparative Analysis of Alternatives

Alternative 1 No Action is least expensive and protective under current conditions, assuming the shallow groundwater is not used for drinking water purposes. Alternative 2 Institutional Controls is protective of future conditions and has a relatively low cost.

Additional characterization of the shallow groundwater (i.e., filtered samples, dissolved phase concentrations, evaluation of biogenic interference), could be considered to support the determination that the shallow groundwater is not a reasonably expected potential future drinking water source and to support the selection of a preferred alternative.

Sites 3 and 4	Cost
1 - No Action	$ 0
2- Institutional Controls	$186,000
3 - Nat. Attenuation and LTM	$619,000
4 – Landfarming	$1,310,000
5 - Phytoremediation	$1,190,000
6 - Thermal Treatment	$1,190,000
7 - Off-site Treatment/Disposal	$1,030,000
8 - Chemical Oxidation	$1,240,000

7.0 AREA OF CONCERN B – CARGO BEACH ROAD DRUM FIELD

7.1 Site 6 – Cargo Beach Road Drum Field

7.1.1 Background

The Cargo Beach Road Drum Field is located west of Cargo Beach Road, approximately 0.6 mile south of the former fuel pumphouse, and north of the Cargo Beach Road landfill. The drum field was used primarily for the disposal of empty drums containing petroleum, oil, or lubricants (POL) generated during the operation of the former installation. The surface deposits at the site resemble lodgment till, with relatively fine soils with cobbles exposed in the center of the site. The areas to the west-northwest and south contain only boulders and large cobbles.

Field observations indicated the area is subject to frost segregation, resulting in areas of uplifted fines and areas of rock. Soil staining has been observed in an area with fines and smaller particles, and most likely migrates with runoff to the west.

7.1.2 Previous Removal/Remedial Actions

Over 1,500 drums, an empty 500-gallon water storage tank, battery, and miscellaneous metal debris were removed during prior removal actions (2000 and 2001).

7.1.3 Nature and Extent of Contamination

During the remedial investigations, soil and shallow groundwater samples were collected and analyzed for petroleum hydrocarbons and other constituents.

A small surface soil stain with a DRO concentration of 14,300 mg/kg was documented during the 1994 remedial investigation at the eastern edge of the pad near the road. More recent soil sampling within 20 feet of the original location did not detect fuels at depth (10-15 ft bgs). Surface soil samples collected in 1994 from the edges of the gravel pad ranged from 17,900 (SS117) to 102,000 mg/kg DRO. In 1998, a surface soil sample from the stained gravel pad area contained 9,200 mg/kg. Two test pits were dug in the middle of the gravel area during the 2001 remedial investigation, to a depth of 5 feet; DRO ranged from 2,000 to 3,000 mg/kg, and RRO

1992 Photo. Drum field looking southwest.

2001 Photo. Drum field after removal action, looking southeast.

ranged from 3,400 to 8,500 mg/kg. The average concentration of DRO at Site 6 is 28,000 mg/kg. Soil is contaminated to an estimated depth of 2 to 7 feet below ground surface.

The shallow groundwater surrounding Site 6 also contained elevated concentration of various metals at several locations (west and northwest of the gravel pad). Low water yields were observed while sampling temporary well points and shallow groundwater is not consistently encountered across the site as evidenced by test pits dug 5 to 6 feet below the ground surface at Site 6. Furthermore, the quality of the shallow groundwater at this location is not within standard water quality parameters specified by the ADEC. Table 7-1 summarizes water quality data collected at Site 6. For example, the pH of the water ranged from 5.6 to 6.9 during the 2004 investigation, and two well points failed to meet the drinking water standard of a minimum of 6.0 pH. The COPCs in detected shallow groundwater and concentrations over time adjacent to Site 6 are shown in Table 7-2. Historical sampling locations are shown on Figure 7-1.

Table 7-1. Site 6 Water Quality Parameters

			PH	Conduct-ivity	Dissolved Oxygen	Temp.	Turbidity	specific conductance	ORP
		Units:		umhos/cm	mg/L	C	NTUs	mS/cm	mV
		Water quality criteria:	6.0 < 8.5		> 4	< 15	< 5		
MW 6-1	S of pad	1994	6.82	37.6	--	3.9	--	--	--
MW 6-2	W on pad	1994	6.87 (6.89)	250 (66.2)	--	7.7 (4.5)	--	--	--
WP 6-2	N of pad	2001	6.6	125	8.2	5.5	1000+	--	--
WP 6-3	SW of pad	2001	6.2	131	10.2	5.9	190	--	--
SW 116	W of pad	2001	--	--	--	--	--	--	--
06WP103	is WP 6-3	2004	5.6	--	8.5	6.4	--	0.13	181
06WP5	NW of pad	2004	6.9	--	5.0	5.0	--	0.32	-99
06WP6	W of pad and MW 6-2	2004	6.5	--	0.7	5.4	--	0.41	-258
06WP7	SW of pad	2004	5.9	--	9.0	4.2	--	0.07	102

Table 7-2. Site 6 Groundwater Data and Alternate Cleanup Levels

Contaminants of Potential Concern	SW115 1994 (mg/L)	MW 6-1 1994 (mg/L)	MW 6-2 1994 (mg/L)	WP 6-3 2001 (mg/L)	WP 6-3 2004 (mg/L)	06WP5 2004 (mg/L)	06WP6 2004 (mg/L)	06WP7 2004 (mg/L)	Max (mg/L)	HQ at max conc. (unitless)	ADEC Table C Level [a] (mg/L)	Cleanup Level [b] (mg/L)	HQ (unitless)
NON-CARCINOGENS													
Aluminum	NA	NA	NA	78.3	NA	NA	NA	NA	78.3	2.7	--	N/A	
Arsenic	NA	NA	NA	0.022	ND (0.01)	0.0127	0.068	ND (0.01)	0.068	7.8	0.05	N/A	
Barium	NA	NA	NA	0.406	0.015	0.588	2.98	0.0125	2.98	0.5	2	N/A	
Beryllium	ND (0.02)	0.02	NA	0.004	NA	NA	NA	NA	0.004	0.07	0.004	N/A	
Cadmium	ND (0.02)	ND (0.02)	NA	0.006	ND (0.002)	ND (0.002)	0.002	ND (0.002)	0.006	0.2	0.005	N/A	
Chromium	ND (0.02)	0.37	NA	1.22	0.00188	0.091	0.792	ND (0.004)	1.22	0.03	0.1, 55	N/A	
Copper	ND (0.02)	0.27	NA	0.26	NA	NA	NA	NA	0.27		1.3	N/A	--
Lead	0.005	**0.23**	NA	**0.16**	ND (0.001)	**0.0198**	**0.144**	0.0018	**0.23**	--	0.015	0.15	--
Lead, dissolved	ND (0.002)	0.002	NA	NA	NA	NA	NA	NA	0.002	--	--	--	--
Manganese	NA	NA	NA	1.58	NA	NA	NA	NA	1.58	0.4	--	N/A	
Nickel	ND (0.05)	0.23	NA	**1.68**	NA	NA	NA	NA	**1.68**	2.8	0.1	0.7	1
Thallium	ND (0.2)	ND (0.2)	NA	0.002	NA	NA	NA	NA	0.002	1.0	0.002	N/A	
Vanadium	NA	NA	NA	0.153	NA	NA	NA	NA	0.153	0.8	0.26	N/A	
Zinc	0.1	0.8	NA	**17.7**	NA	NA	NA	NA	**17.7**	2.0	11	110	1
Zinc, dissolved	0.06	ND (0.05)	NA	NA	NA	NA	NA	NA	0.06	--	--	--	--
PETROLEUM HYDROCARBONS													
Diesel Range Organics	**1.8**	0.27	**1.7**	0.29	0.164 J	0.385	0.213	0.189 J	**1.8**			15	
Residual Range Organics	NA	NA	NA	ND (0.5)	0.217 J	0.728	0.268	0.204 J	0.728		1.1	11	

Notes:

1.5

Data included for contaminants detected above 1/10th 18 AAC 75.345 Table C cleanup levels. **Bold** values exceed ADEC Table C Groundwater Cleanup Levels (e.g., drinking water source).

[a] 18 AAC 75.345 Table C (as amended through December 30, 2006)

[b] based on 18 AAC 75.345 (b)(2) assuming not a potential future drinking water source

ACL - alternate cleanup level
J - estimated value
MW- monitoring well
WP - well point
HQ - hazard quotient
NA - not analyzed for
ND - non detect
mg/L - milligrams per liter
N/A - not applicable
SW- surface water

The most likely source of the detected metals in shallow groundwater is natural background. Historic disposal of materials at the drum field may have also contributed to the 2001 detections of several metals such as lead, nickel, and zinc in the shallow groundwater. The elevated metals detected in shallow groundwater at Site 6 were isolated occurrences. The anomalous detections of metals (e.g. chromium and lead) in WP 6-3 (2001) were not replicated in the water sample collected in 2004. Furthermore, metals have not been detected in upgradient shallow groundwater monitoring wells at the adjacent Site 7 (WP 7-1 and WP 7-2). Metals were detected, but not at high concentrations, in sediment samples collected north and south of the Site 6 gravel pad.

Additional investigation was conducted in 2004 and elevated concentrations of several metals (barium and lead) were detected in 06WP6. However, soil samples collected during various phases of the remedial investigations did not contain elevated levels of metals. The only compound above soil screening levels (e.g., migration to groundwater, Table B1), detected in the soil boring closest to 06WP6 (06B5 on the western edge of the gravel pad, 2004), was arsenic at levels ranging from 2.0 to 9.9 mg/kg, which is within the normal background concentrations for the Northeast Cape site. Barium, cadmium, chromium, lead, mercury, selenium, and silver were either not detected or below screening levels in soil. Thus, the source of the anomalous metals in shallow groundwater could be extremely localized, or due to suspended sediments in the water column containing naturally occurring metals in the mineral soils. A surface water sample collected in 1994 from the ephemeral pond due west of the gravel area did not contain metals above screening levels, although DRO was detected at a concentration of 1.8 mg/L and 4,660 mg/kg in co-located sediment.

Sampling of the shallow groundwater is problematic at Site 6 due to the tundra/wetland environment. Installing good well points for sampling is not practical. Three well points were installed during the 2001 investigation, but one well point did not yield water.

7.1.4 Conceptual Site Model

The primary media potentially affected is gravel pad soil and shallow groundwater. Potential exposure pathways include incidental ingestion of soils by recreational site users or subsistence gatherers. Ecological receptors may also be affected through the food chain. The groundwater exposure pathway is not complete because the shallow groundwater is not a reasonably expected potential future drinking water source.

7.1.5 Risk Assessment

The primary contaminant of concern in soil is DRO. The maximum detected concentration of DRO in soil (102,000 mg/kg) resulted in a noncancer risk estimate which exceeds the ADEC point of departure of 1. The risk assessment did not consider shallow groundwater at Site 6 to be a complete exposure pathway. The groundwater exposure pathway was eliminated because shallow groundwater is not a reasonably expected potential future drinking water source.

7.1.6 Remedial Action Objectives

The remedial objectives for Site 6 are to prevent exposure to contaminated soils which may pose a risk to human health and the environment. Site-specific soil cleanup levels appropriate for this area can be based on two scenarios. Under Scenario A, cleanup levels were based on the completed exposure pathways from the human health risk assessment (i.e., incidental ingestion of or contact with contaminated soil). Under Scenario B, cleanup levels were developed using site specific information for the migration to groundwater pathway only. Site-specific characteristics of the soil matrix are used to derive cleanup levels. Note that concentrations of petroleum hydrocarbons and other compounds have been measured directly in shallow groundwater, thus the migration to groundwater cleanup levels should be applied with caution. Cleanup levels for shallow groundwater are shown below. Lead, nickel, zinc, DRO, and RRO were retained as contaminants of concern in shallow groundwater. The feasibility of using the shallow groundwater surrounding Site 6 as a permanent future water supply is low. The shallow groundwater is not a reasonably expected potential future drinking water source, therefore the applicable cleanup levels are based on 18 AAC 75.345(b)(2).

Scenario A - Soil Alternate Cleanup Levels (risk-based, soil ingestion)
- 9,200 mg/kg DRO and 9,200 mg/kg RRO

Scenario B - Soil Alternate Cleanup Levels (migration to groundwater pathway, TOC 0.8%)
- 2,200 mg/kg DRO and 22,000 mg/kg RRO

Shallow groundwater cleanup levels (non-drinking water source):
- Lead 0.15 mg/L
- Nickel 1.0 mg/L
- Zinc 110 mg/L
- DRO 15 mg/L
- RRO 11 mg/L

7.1.7 Site Parameters

The exact volume of soil contaminated above the target cleanup levels is unknown. Within the gravel pad area, however, estimates of the soil volume can be made. Under Scenario A, using the risk-based Alternate Cleanup Level of 9,200 mg/kg DRO, two areas of contaminated soil are present. A small area of stained soil was documented in 1994 at the eastern edge of the pad near the road. More recent soil sampling within 20 feet of the original location did not detect fuels at depth (10-15 ft bgs). Therefore, it was assumed the stained area was limited to approximately 20 feet horizontally and did not exceed 2 feet in depth. A larger area of stained soils is also present on the western portion of the pad, but sampling results have shown varying levels of DRO contamination. The estimated total volume to be addressed is approximately 1,050 cubic yards, assuming contamination to a depth of 2 feet at each area.

Under Scenario B, using the migration to groundwater Alternate Cleanup Level of 2,200 mg/kg DRO, the entire gravel pad is assumed to be contaminated. The estimated volume to be addressed is approximately 7,600 cubic yards, assuming contamination to an average depth of 5 feet. The gravel pad and surrounding area are a mix of fines and large cobbles. The surrounding topography is characterized by intermittent ponds, tundra, and large boulder fields.

The shallow groundwater at Site 6 is not currently used as a drinking water source, and is not a reasonably expected potential future source of drinking water. This shallow groundwater is intermittent, has low flow, and permafrost is present at 5 to 10 feet below ground surface. The community has expressed a desire to use the area for future residential purposes. Anomalous elevated concentrations of metals and DRO were detected to the west and northwest of the gravel pad area. The observed metal concentrations are likely due to naturally occurring sources in the soil and not the result of military impacts.

7.2 Cargo Beach Road Drum Field - Screening of Alternatives

The general response actions identified in Section 4 were evaluated for the site-specific contaminants of concern and affected media at Site 6.

No Action is retained for further evaluation per the requirements of the NCP. There are no costs associated with this alternative.

Institutional controls are applicable to Site 6 and could involve restrictions on placing buildings or excavating soils, deed notices informing landowners about the presence of contaminated soils, or a deed notice informing landowners the shallow groundwater is not a reasonable potential future drinking water source. ICs are an effective tool to prevent exposure to the contaminants, can be implemented and typically have minimal costs. ICs are retained for further evaluation.

Natural attenuation and *long term monitoring* allow natural surface and sub-surface processes to reduce contaminant concentrations to acceptable levels over time. This alternative is applicable to Site 6 because the primary contaminant of concern is petroleum hydrocarbons, which are known to naturally break down in the environment. The potential for significant impacts to human or ecological receptors is limited due to the nature of the contamination. Natural attenuation would not cause damage to the surrounding tundra/wetland environment. The costs associated with long term monitoring are relatively low.

Capping provides containment by minimizing vertical movement of contamination and reducing the likelihood of human and animal contact with contamination. Capping consists of covering the contaminated area with a low-permeability cover to prevent the infiltration of surface water, a drain layer above the cap to direct precipitation, and a vegetative covering that prevents erosion and restores the area's native vegetation. The *capping* of petroleum-contaminated soils at Site 6 was eliminated from further consideration. The size of the surface area affected at Site 6 is moderate.

Landfarming was retained for further evaluation. The volume of soil contaminated above cleanup levels varies. Several areas exist at Northeast Cape where soils could be spread out for landfarming. The cold temperatures may limit the effectiveness of this technology. Costs will be relatively moderate.

Phytoremediation was retained for further evaluation. The short growing season is enhanced by the long days. Phytoremediation has been demonstrated effective at treating petroleum hydrocarbons. The costs are relatively moderate.

Thermal treatment was retained for further evaluation. Soil burning is a proven technology to remediate diesel-contaminated soils. Costs are moderate to high. Implementability may be more difficult given the remote location, lack of power, and no permanent residents nearby. All materials must be flown in or transported by barge. The larger volume of contaminated soil at this site may result in more cost effectiveness to perform treatment on-site. Greater efficiencies may also be realized if other areas at Northeast Cape are remediated concurrently.

Off-site treatment/disposal was retained for further evaluation. Soil excavation, containerization, transport and disposal are straightforward methods to remediate the site. Adverse environmental impacts could include damaging the tundra by heavy equipment.

Reactive matting was also eliminated from further consideration at Site 6. The primary media affected is gravel soils near the Cargo Beach Road.

Chemical oxidation was not retained for further evaluation. The shallow groundwater at Site 6 contains anomalous metals, which are not typically degraded using chemical oxidants and likely represent background concentrations. The intermittent nature and shallow depth of the groundwater would limit the effectiveness of treatment using chemical oxidants. Chemical oxidation would be most effective for enhancing the degradation process of DRO in shallow groundwater, but the recent sampling results indicate DRO does not exceed the ADEC Table C cleanup level of 1.5 mg/L. Costs are relatively high due to the logistics and support needed to implement the chemical oxidation. Implementability may be more difficult at a remote site such as St. Lawrence Island, with a field season of 90-120 days.

Reactive walls were eliminated from consideration at Site 6, based on the limited extent of contamination, the shallow depth of contamination, low flow of water, intermittent nature of the shallow groundwater, and presence of permafrost at 5 to 10 feet. The magnitude and extent of shallow groundwater contamination is small.

Constructed wetlands were eliminated from consideration. The area surrounding the gravel pad is native tundra, and enhancing this natural system would achieve limited benefits.

7.3 Cargo Beach Road Drum Field - Proposed Alternatives

The contaminated soil at Site 6 can be addressed by the following response actions: institutional controls, natural attenuation, long term monitoring, landfarming, phytoremediation, thermal treatment, or off-site treatment/disposal. Alternative cleanup levels can be applied under two scenarios: ingestion risk or migration to groundwater pathway.

- Alternative 1 is the no action response.
- Alternative 2 is institutional controls. Institutional controls appropriate for Site 6 may include placing a restriction on consumption of shallow groundwater, fencing the gravel pad, placing a deed restriction which limits the construction of permanent residences on the gravel pad, or restrictions on excavating the contaminated soils.
- Alternative 3 allows the petroleum hydrocarbons to naturally attenuate over time under existing biological conditions. This alternative also includes future monitoring of the soil and shallow groundwater to measure the rate of natural degradation at the site.
- Alternative 4 involves the use of landfarming technology to remediate the contaminated soils from this site. Under Scenario A, petroleum-contaminated soils from an estimated 14,000 sq ft area at the former drum dump would be excavated and staged onsite for incorporation of amendments to break down the contaminants. Under Scenario B, the entire gravel area, approximately 41,000 sq ft, would be excavated.
- Alternative 5 utilizes phytoremediation to attenuate the petroleum-contaminated soils under Scenarios A and B.
- Alternative 6 utilizes onsite thermal treatment to remediate the contaminated soils under Scenarios A and B.
- Alternative 7 is excavation and off-site transport of DRO-contaminated soils under Scenarios A and B. The contaminated soils would be treated and/or disposed at a permitted facility.

7.3.1 Cargo Beach Road Drum Field Alternative 1 – No Action

Description
Under the no action alternative, the site would be left in its current state, with no activities to control or mitigate exposure to site contaminants. The no action alternative provides a baseline for comparing other remedial alternatives and is required for consideration by the NCP. There are no costs associated with Alternative 1.

Overall protection of human health and the environment
The existing levels in soil pose a potential risk to future seasonal or permanent residents. The site does not currently pose a risk to site visitors. The former drum dump site is located adjacent to Cargo Beach Road, about 0.5 miles from the native fishing and hunting camp which slightly increases the likelihood that seasonal residents could be exposed to the contamination. The shallow groundwater contamination could migrate downgradient to ephemeral surface waters. The no action alternative would not be protective of future permanent residents exposed to the contaminated soil. The no action alternative would not prevent current and future residents from

attempting to access the shallow groundwater for a drinking water source, which could pose a potential risk if consumed year-round. The shallow groundwater surrounding Site 6 is not considered a reasonably expected potential future drinking water source, based on its limited availability. The anomalous metals in the shallow groundwater are likely due to naturally occurring minerals in the soil.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons in soil will continue to occur even if no actions are taken. It would likely take many years to reach the site-specific soil ACLs under this approach. However, a relatively large area of gravel soil is affected at levels that could pose a future threat to human health. The shallow groundwater is not a reasonably expected potential future drinking water source.

Short-term effectiveness
The risk assessment determined there are no current risks to human health. The risk assessment suggests there is a potential for adverse effects in representative ecological receptors (e.g., tundra vole) exposed to the maximum concentration of DRO at Site 6.

Long-term effectiveness and permanence
The no action alternative would not be protective of future permanent residents who could be exposed daily to the contaminated soil. The no action alternative would not prevent current and future residents from attempting to access the shallow groundwater for a drinking water source, which could pose a risk if consumed year-round. The feasibility of accessing the shallow groundwater surrounding Site 6 as a future water supply is low. The shallow groundwater is not a reasonable potential future drinking water source. The anomalous metals in the shallow groundwater are likely due to naturally occurring minerals in the soil.

Reduction in toxicity, mobility, or volume through treatment
No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
The no action alternative is easily implemented.

Cost
The estimated cost of Alternative 1 is $ 0.

7.3.2 Cargo Beach Road Drum Field Alternative 2 – Institutional Controls

Description
Institutional controls at the former Cargo Beach Road Drum Field could involve physical, legal, or administrative mechanisms to restrict the use of or access to the site to prevent future risks to human health, safety, or the environment. Such controls could include a deed notice to provide information to current or future landowners about the presence of diesel-contaminated soil at the site and the need for proper management of the soil if excavated. Institutional controls may also include a deed notice to inform current and future landowners that the shallow groundwater is not a reasonably expected potential future drinking water source. Other measures could involve

restrictions on future construction of buildings or controls to prevent excavation of contaminated soils.

Overall protection of human health and the environment
Institutional controls would prevent exposure of current and future residents to contaminated soils and shallow groundwater through a drinking water consumption advisory and restrictions on soil excavations. The existing levels in soil pose a potential risk to future seasonal or permanent residents. The site does not currently pose a risk to site visitors. The former drum dump site is located adjacent to Cargo Beach Road, about 0.5 miles from the native fishing and hunting camp which slightly increases the likelihood that residents could be exposed to the contamination. The shallow groundwater contamination could migrate downgradient to ephemeral surface waters. The feasibility of accessing the shallow groundwater surrounding Site 6 as a permanent future water supply is low, and it is not considered a reasonable potential future drinking water source. The anomalous metals in the shallow groundwater are likely due to naturally occurring minerals in the soil.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons in soil will continue to occur if institutional controls are implemented. It would likely take many years to reach the site-specific soil ACLs under this approach. However, a limited area of gravel soil is affected at levels that could pose a future threat to human health. The feasibility of accessing the shallow groundwater surrounding Site 6 as a future water supply is low. The anomalous metals in the shallow groundwater are likely attributable to suspended solids in the water column.

Short-term effectiveness
Since the site is adjacent to Cargo Beach Road, and 0.5 mile from the seasonal native fishing/hunting camp, there is a medium potential for exposure to site contaminants over a short period of time. The risk assessment determined the site posed no current risk to visitors.

Long-term effectiveness and permanence
Institutional controls can be effective in the long term. Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Reduction in toxicity, mobility, or volume through treatment
No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
Institutional controls are typically easily implemented. The need for, and likelihood of, landowner acceptance and compliance with ICs is a consideration for alternatives requiring them. The land at Northeast Cape is owned jointly by two local Native Corporations, Savoonga Native Corporation and Sivuqaq, Inc. The ability of the Corporations to accept and maintain land use controls is unknown.

Cost
The estimated cost of Alternative 2 is $ 186,000.

7.3.3 Cargo Beach Road Drum Field Alternative 3 – Natural Attenuation and LTM

Description
Under this alternative, natural attenuation would be combined with long term monitoring of the shallow groundwater and surrounding soils. The rate of petroleum hydrocarbon degradation has not been established and the extreme climate conditions on St. Lawrence Island could slow natural attenuation processes. Monitoring activities would establish a baseline, evaluate the reduction of contaminant concentrations over time, and determine if off-site migration is occurring. Institutional controls (e.g., a deed notice) may be necessary to inform current and future landowners that the shallow groundwater is not a reasonably expected potential future drinking water source.

Overall protection of human health and the environment
Natural attenuation processes would reduce risks to human health and the environment over the long term. The former drum field does not pose a risk to current site visitors. However, the level of DRO contamination in soil could pose a potential future risk to seasonal or permanent residents. The shallow groundwater at Site 6 is not currently used as a drinking water source, and is not a reasonably expected potential future source of drinking water. The feasibility of accessing the shallow groundwater surrounding Site 6 as a future water supply is low.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons in soil will continue to occur over time if this alternative is implemented. It would likely take many years to reach the site-specific soil ACLs under this approach. The shallow groundwater is not a reasonably expected potential future drinking water source. The anomalous metals in the shallow groundwater are likely attributable to suspended solids in the water column from naturally occurring minerals in the soil.

Short-term effectiveness
Since the site is adjacent to the Cargo Beach Road, but about 0.5 mile from the seasonal native fishing/hunting camp, there is a medium potential for exposure to site contaminants over a short period of time. The risk assessment determined no current risks to human health.

Long-term effectiveness and permanence
Natural attenuation and monitoring can be effective in the long term. Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and monitoring results would be required as part of this alternative.

Reduction in toxicity, mobility, or volume through treatment
No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
Natural attenuation with long term monitoring is easily implemented. Long term monitoring would involve an initial site visit to establish baseline conditions and periodic monitoring of well points and soils.

Cost
The estimated cost of Alternative 3 is $619,000.

7.3.4 Cargo Beach Road Drum Field Alternative 4A and 4B – Landfarming

Description
Under Scenario A, an estimated 1,050 cubic yards of petroleum-contaminated soils at the former Cargo Beach Road Drum Field would be excavated and spread out in a designated area at Northeast Cape. Under Scenario B, an estimated 5,700 cubic yard of POL-contaminated soils would be excavated and landfarmed. Simply excavating and mixing the soils, as well as incorporating amendments (e.g., fertilizer, compost) will promote biological activity and the natural breakdown of the petroleum hydrocarbons. Excavation of the major source of contamination would prevent potential transport of contaminants to the shallow groundwater. The anomalous metals in shallow groundwater are likely attributable to suspended sediments in the water column.

Overall protection of human health and the environment
Landfarming would reduce risks to human health and the environment over the long term. The contaminated soils would be removed and treated to meet either the risk-based or migration to groundwater ACLs. Institutional controls (e.g., a deed notice) may be necessary to inform current and future landowners that the shallow groundwater is not a reasonably expected potential future drinking water source. Since no permanent residents currently reside at Northeast Cape, there is no current risk to human health. The shallow groundwater at Site 6 is not currently used as a drinking water source, and is not a reasonably expected potential future drinking water source. The feasibility of accessing the shallow groundwater surrounding Site 6 as a permanent future water supply is low.

Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Compliance with ARARs
Landfarming should meet cleanup levels within one or two field seasons for the petroleum-contaminated soils. The shallow groundwater is not a reasonably expected potential future drinking water source. The anomalous metals in the shallow groundwater are likely attributable to suspended solids in the water column from naturally occurring minerals in the soil.

Short-term effectiveness

Since the site is adjacent to the Cargo Beach Road, but about 0.5 mile from the seasonal native fishing/hunting camp, there is a medium potential for exposure to site contaminants over a short period of time. The risk assessment determined no current risks to human health.

Long-term effectiveness and permanence
Landfarming is a proven technique to break down petroleum hydrocarbons.

Reduction in toxicity, mobility, or volume through treatment
Landfarming would significantly decrease the petroleum hydrocarbon concentrations. For the shallow groundwater, natural processes are assumed to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
Landfarming is relatively easy to implement. A flat area, such as the main operations complex, would be necessary to conduct the remedial activity. The progress of the soil treatment would need to be monitored, and the soils periodically turned over or tilled with a machine.

Cost
Under Scenario A, the estimated cost of Alternative 4 is $ 1,630,000.
Under Scenario B, the estimated cost of Alternative 4 is $ 2,640,000.

7.3.5 Cargo Beach Road Drum Field Alternative 5 – Phytoremediation

Description
Under Scenario A, an estimated 1,050 cubic yards of petroleum-contaminated soils at the former Cargo Beach Road Drum Field would be addressed using phytoremediation techniques. Under Scenario B, an estimated 5,700 cy of petroleum-contaminated soils would be remediated. The soils would be planted with a mixture of plants such as arctic red fescue or other grasses. Amendments may also be incorporated (e.g., fertilizer, straw, microbes, compost) to promote biological activity and accelerate the natural breakdown of the petroleum hydrocarbons. Phytoremediation processes can be conducted in conjunction with landfarming (e.g., excavating the soils and spreading out in a separate area) or separately by incorporating plants directly into the existing contaminated soil without prior excavation. The shallow groundwater would not be actively treated. The metals in shallow groundwater are likely attributable to suspended solids in the water column. Excavation of the major source of contamination would prevent potential transport of contaminants to the shallow groundwater.

Overall protectiveness of human health and the environment
Phytoremediation would reduce risks to human health and the environment over the long term. The contaminated soils above the Scenario A or Scenario B alternate cleanup levels would be excavated and treated, or treated in place using phytoremediation techniques. Institutional controls (e.g., a deed notice) may be necessary to inform current and future landowners that the shallow groundwater is not a reasonably expected potential future drinking water source. The shallow groundwater at Site 6 is not currently used as a drinking water source, and is not a reasonably expected potential future source of drinking water. The shallow groundwater does not pose a current risk to human health. The feasibility of accessing the shallow groundwater surrounding Site 6 as a permanent future water supply is low.

Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Compliance with ARARs
Phytoremediation should meet cleanup levels within several years for the petroleum-contaminated soils. The shallow groundwater is not a reasonably expected potential future drinking water source. The anomalous metals in the shallow groundwater are likely attributable to suspended solids in the water column from naturally occurring minerals in the soil.

Short-term effectiveness
Phytoremediation of the contaminated soils would be effective at reducing potential exposures in the short term. Under this alternative, the potential excavation of the soils poses potential adverse impacts to the construction personnel on site. However, these impacts are easily controlled with proper construction safety and equipment handling techniques. The short-term effectiveness of this alternative for treating metals-contaminated groundwater is considered low.

Long-term effectiveness
Phytoremediation is a proven technique to remediate petroleum hydrocarbons.

Reduction in toxicity, mobility, or volume through treatment
Phytoremediation would significantly decrease the petroleum hydrocarbon concentrations in soil.

Implementability
Excavating soils, spreading onsite and seeding with plants and grasses are relatively simple processes. Plant growth could be adversely affected by short growing season, but the abundant daylight compensates for the cold temperatures. The alternative would have less maintenance requirements than landfarming. There are no long term maintenance requirements such as periodic tilling of the soil, or adding of amendments. However, there are more uncertainties associated with achieving good rates of plant growth.

Cost
Under Scenario A, the estimated cost of Alternative 5 is $ 1,610,000.
Under Scenario B, the estimated cost of Alternative 6 is $ 2,700,000.

7.3.6 Cargo Beach Road Drum Field Alternative 6 – Thermal Treatment

Description
Under Scenario A, an estimated 1,050 cubic yards of petroleum-contaminated soils at the former Cargo Beach Road Drum Field would be excavated and treated onsite using a soil burner to destroy the petroleum hydrocarbons using high temperatures. The soil would be treated to meet the ACL of 9,200 mg/kg DRO. Under Scenario B, an estimated 5,700 cubic yards of petroleum-contaminated soils would be excavated and treated onsite to meet the migration to groundwater ACL of 2,200 mg/kg DRO. The treated soil would be returned to the site or used as fill material

elsewhere at Northeast Cape. A power source (e.g., generator) would be necessary to run the equipment. The shallow groundwater would not be actively remediated. Excavation of the major source of contamination would prevent potential transport of contaminants to the shallow groundwater.

Overall protectiveness of human health and the environment
Excavation and thermal treatment would reduce risks to human health and the environment over the short and long term. The contaminated soils would be removed and treated to meet risk-based ACLs or migration to groundwater ACLs. Institutional controls (e.g., a deed notice) may be necessary to inform current and future landowners that the shallow groundwater is not a reasonably expected potential future drinking water source. The shallow groundwater at Site 6 is not currently utilized as a drinking water source, and is not a reasonably expected potential future source of drinking water. The shallow groundwater does not pose a current risk to human health. The feasibility of accessing the shallow groundwater surrounding Site 6 as a permanent future water supply is low.

Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Compliance with ARARs
Thermal treatment would meet the both the risk-based and migration to groundwater cleanup levels for the petroleum-contaminated soils. The shallow groundwater is not a reasonably expected potential future drinking water source. The anomalous metals in the shallow groundwater are likely attributable to suspended solids in the water column from naturally occurring minerals in the soil.

Short-term effectiveness
Excavation and treatment of the contaminated soils would be effective at reducing potential exposures in the short term.

Long-term effectiveness
Thermal treatment such as soil burning is a proven technique to remediate petroleum hydrocarbons.

Reduction in toxicity, mobility, or volume through treatment
Thermal treatment destroys the petroleum hydrocarbons thus reducing the toxicity, mobility and volume of the contaminants in the soil.

Implementability
Thermal treatment is slightly more complex than excavating the soils under the landfarming or phytoremediation alternatives. In addition to heavy equipment needed for soil excavation, a soil burner would need to be transported to Island. A suitable power source is also necessary. The cold temperatures and harsh climate may limit the operating timeframe of the soil burner.

Cost
Under Scenario A, the estimated cost of Alternative 6 is $ 2,330,000.
Under Scenario B, the estimated cost of Alternative 6 is $ 3,880,000.

7.3.7 Cargo Beach Road Drum Field Alternative 7 – Off-site Treatment and Disposal

Description
Under Scenario A, an estimated 1,050 cubic yards of petroleum-contaminated soils at the former Cargo Beach Road Drum Field would be excavated and transported off-site for treatment and/or disposal at a permitted landfill facility. Under Scenario B, an estimated 5,700 cubic yards of soils would be excavated and transported off-site. The shallow groundwater would not be actively remediated. Excavation of the major source of contamination would prevent potential transport of contaminants to the shallow groundwater.

Overall protectiveness of human health and the environment
Excavation and offsite treatment/disposal of soils would reduce risks to human health and the environment. Under Scenario A, the contaminated soils would be removed and treated to meet risk-based ACLs. Under Scenario B, the contaminated soils would be removed and treated to meet migration to groundwater ACLs. Under both Scenarios, institutional controls (e.g. a deed notice) would be necessary to notify current and future landowners of the presence of residual contamination at the site and the need for proper management of the contaminated soil if disturbed. Institutional controls (e.g., a deed notice) may also be necessary to inform current and future landowners the shallow groundwater is not a reasonably expected potential future drinking water source. The shallow groundwater at Site 6 is not currently used as a drinking water source. The shallow groundwater does not pose a current risk to human health. The feasibility of accessing the shallow groundwater surrounding Site 6 as a permanent future water supply is low.

Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Compliance with ARARs
Excavation and off-site treatment/disposal would meet the risk-based soil cleanup levels under Scenario A, and the migration to groundwater cleanup soil levels for the petroleum-contaminated soils under Scenario B. The shallow groundwater is not a reasonably expected potential future drinking water source. The anomalous metals in the shallow groundwater are likely attributable to suspended solids in the water column from naturally occurring minerals in the soil.

Short-term effectiveness
Excavation and offsite treatment/disposal of the soils would meet the applicable cleanup level(s) in one field season. Under this alternative, excavation of the soil may pose potential adverse impacts to the construction personnel on site. However, these impacts are easily controlled with proper construction safety, and equipment handling techniques. Tundra soil/sediment would not disturbed or require restoration.

Long-term effectiveness
Excavation and off-site treatment/disposal permanently removes the source of contaminated soils.

Reduction in toxicity, mobility, or volume through treatment
Excavation and off-site treatment or disposal permanent removes the petroleum hydrocarbons thus reducing the toxicity, mobility and volume of the contaminants in the soil. The anomalous metals in the shallow groundwater are likely attributable to suspended solids in the water column from naturally occurring minerals in the soil.

Implementability
Excavation and offsite transport is a straightforward remedial alternative that is commonly implemented at contaminated sites. The remote location will add complexity to this alternative and barge services will be required. This alternative can be completed in 1 field season.

Cost
Under Scenario A, the estimated cost of Alternative 7 is $ 1,460,000.
Under Scenario B, the estimated cost of Alternative 7 is $ 3,900,000.

7.4 Cargo Beach Road Drum Field - Comparative Analysis of Alternatives

The cost difference between the active remedial alternatives is not large. Off-site treatment and disposal is the most protective and least expensive if the smaller area of contamination is addressed. As the volume of contaminated soil to be addressed increases, the on-site alternatives of landfarming or phytoremediation appear more cost effective. However, the time until cleanup levels is reached is increased under both on-site alternatives.

Institutional controls would also be effective at preventing potential future exposure to the soil and shallow groundwater contamination. Table 7-3 provides a comparative evaluation of each remedial alternative using the CERCLA criteria. A summary of the estimated cost of each alternative only is shown below.

Site 6 Cargo Beach Road Drum Field	**Cost**
1 - No Action	$ 0
2 - Institutional Controls	$ 186,000
3 - Nat. Attenuation and LTM	$ 619,000
4A - Landfarming	$ 1,630,000
4B - Landfarming	$ 2,640,000
5A – Phytoremediation	$ 1,610,000
5B - Phytoremediation	$ 2,700,000
6A - Thermal Treatment	$ 2,330,000
6B - Thermal Treatment	$ 3,880,000
7A - Off-site Treatment/Disposal	$ 1,460,000
7B - Off-site Treatment/Disposal	$ 3,900,000

8.0 AREA OF CONCERN C - LANDFILLS

Photo (2005). View from northeast side of Site 7, looking southwest towards Cargo Beach Road (top of slope), showing completed cleanup of exposed debris on eastern edge of landfill.

Two unpermitted landfills exist at the Northeast Cape installation. The main solid waste dump for the installation was located along Cargo Beach Road, between the main complex and the beach. A second dump area was located closer to the main complex, just east of the road. The landfills were used throughout the period of construction and use of the facilities. Some buildings and warehouses were also reportedly torn down before the facility was completely deactivated and disposed of locally.

8.1 Site 7 – Cargo Beach Road Landfill

8.1.1 Background

The Cargo Beach Road Landfill is located approximately 0.8 mile south of the Cargo Beach, midway between the main operations complex and the beach. The unpermitted landfill was used at the installation's solid waste disposal area from 1965 until closure in 1974 and contains a wide variety of materials. The landfill appears to have been created by dumping debris off the sides of a large glacial drumlin. The debris was apparently covered by frequently grading soil out from the top of the drumlin.

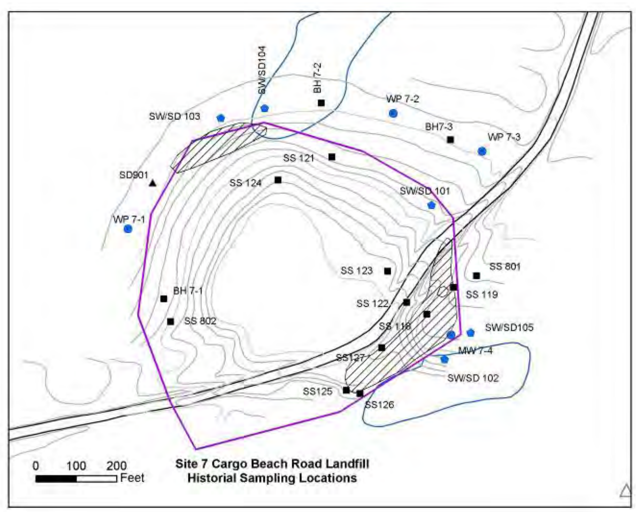
8.1.2 Previous Removal/Remedial Actions

Scattered drums and exposed metal debris surrounding the landfill were removed from the site during previous removal actions. Several full drums of used petroleum products (e.g., waste oil) were discovered during the 2005 removal activities around the exposed perimeter edges of the landfill. One drum was emptied of its contents, pumped into a new drum and overpacked for off-site disposal. The oil was tested, did not contain chlorinated hydrocarbons, and was classified as waste oil. Several other drums with partial contents were left in place, but protected from tampering by placement of large rocks around them. A new containerized waste project was approved to specifically address the identified drums observed at the edge of the Site 7 Landfill. The new project consists of conducting a geophysical survey of the landfill mass, and completing an engineering evaluation and cost analysis to determine additional investigation needs and methods to address the observed drums. PCB-contaminated soils (14 tons) from 6 discrete areas along the southeastern exposed edge of the landfill were also excavated and shipped offsite during the 2005 field season. Additional PCB-contaminated subsurface soils exist in two areas at the site.

8.1.3 Nature and Extent of Contamination

Soil, sediment, surface water, and shallow groundwater samples have been collected from the perimeter of the landfill during multiple years of remedial investigation. The primary contaminant of concern in soil is DRO. PCBs have also been detected in soils on the eastern edge of the landfill. One out of 19 surface soil samples exceeded the site-specific alternate cleanup level of 9,200 mg/kg DRO. The remaining samples ranged from ND to 2,300 mg/kg DRO. The sample with an elevated concentration of DRO was collected in 1994 (SS119), and contained 32,000 mg/kg DRO. The sampling location was approximately 75 feet east of Cargo Beach Road, at the base of the exposed debris slope. The exposed debris has been subsequently cleaned up, and it is highly unlikely the original sampling location could be accurately identified. A large amount of debris has been removed from this location by heavy equipment. Arsenic was detected in soil at several locations at levels which exceeded background. The highest hits of arsenic were co-located with sampling locations containing elevated PCBs. The PCB-contaminated soils were excavated and transported offsite for disposal during the 2005 field season. The soil confirmation sampling results demonstrated that PCBs were successfully removed to below 1 mg/kg at 4 of the 6 locations. The confirmation samples were not analyzed for arsenic. Subsurface soils (2.0 to 3.5 ft bgs) at two discrete locations on the eastern slope of the Site 7 landfill still contain PCBs above the cleanup level of 1 mg/kg based on immunoassay screening results. According to field observations, the soil contamination is commingled with buried landfill debris materials and further excavation was not practical. The two excavations were lined with plastic sheeting and backfilled with clean fill.

Contaminants of potential concern were identified in shallow groundwater during the remedial investigation. Elevated metals were detected primarily at one well point (WP 7-1) installed in 2001 (southwest side of landfill). A summary of historical groundwater data is provided in Table 8-1. Historical sampling locations are shown on Figure 8-1 and the inset (below, right). A wide range of metals were detected above screening levels but only nickel, chromium and lead exceeded the default ADEC Table C cleanup levels. Elevated levels of aluminum and other metals were also detected in well points during the 2001 investigation. Despite being installed in saturated ground, well point WP 7-1 in particular was extremely difficult to sample, required 3 days to obtain sufficient volume of water, and the water was noted as "silty" in the field notes. The water samples collected from WP 7-2 and WP 7-3 were actually "pits" dug 36 to 40 inches in the ground and allowed to fill with water. The original attempted well point locations for WP 7-2 and WP 7-3 were dry after 48 hours. The water samples were not filtered, therefore it is very likely the metals detected in the samples originated from suspended sediments in the water column and are not representative of shallow groundwater conditions at the site. Aluminum, arsenic, chromium, cobalt, manganese, vanadium, and zinc were thus eliminated as COCs in shallow groundwater at Site 7.



Nickel and lead were retained as COCs in shallow groundwater, although the potential source is either naturally occurring in mineral soils or the result of materials deposited in the landfill.

On the north side of the landfill (SW101), DRO was detected in surface water at one location only during the 1994 investigation (just west of Cargo Beach Road). The average DRO concentration from a triplicate sample was 8.9 mg/L. A downgradient shallow groundwater sample from WP 7-3 collected during the 2001 investigations contained 0.39 mg/L DRO. Benzene and RRO were also identified as COPCs during the remedial investigation. Benzene did not exceed cleanup levels, but RRO was detected above the Table C cleanup level at one well point in 2001. RRO was retained as a COC.

Sampling of the shallow groundwater is problematic at Site 7 due to the tundra/wetland environment. Groundwater samples collected under these circumstances are highly turbid (i.e., low quality). The groundwater exposure pathway is incomplete at this site because the shallow groundwater is not a reasonably expected potential future drinking water source.

The landfill was inspected during the 2001 field season and areas of concern were noted and consisted of exposed debris, unvegetated areas, eroded areas, and other signs that the landfill cover was inadequate. The existing landfill cover was inspected for protruding debris, sinkholes, and evidence of erosion. The landfill perimeter was surveyed to meet ADEC closure requirements. The central portion of the landfill area is unvegetated and free of surface debris. In the area of the landfill northwest of Cargo Beach Road, eroded and sunken areas and pockets of exposed debris were observed along the northern toe of the landfill, with large concentrations of debris at several locations. Site use by animals was evidenced by burrows, droppings, rodent skeletons, and the presence of active adult cross fox. Most of the vegetation is concentrated along the north side of the landfill. Vegetative cover is estimated at 80 percent. The slope east of Cargo Beach Road is not vegetated and would require 100% revegetation. The site was relatively dry and some of the ephemeral ponds observed in the past had disappeared, so surface runoff pathways may not have been evident. Erosion appears to be concentrated on the southeast side of Cargo Beach Road due to a lack of vegetation.

During the 2005 field season, exposed debris was removed from the perimeter of the landfill. Several drums containing used oil were encountered protruding from the landfill but were left in place. Previous investigations focused on the potential for contaminant migration away from the landfill. Sampling has included soils that are co-mingled with the landfill debris, as well as water samples at downgradient locations. A geophysical investigation is being planned for the 2007 field season to better determine extent of buried debris in the landfill mass. An engineering evaluation and cost analysis will then be conducted to determine methods to address the observed drums.

8.1.4 Conceptual Site Model

The primary media potentially affected is gravel pad and/or tundra soils and shallow groundwater. Potential exposure pathways include incidental ingestion of soils by recreational site users or subsistence gatherers (future permanent residents). Ecological receptors may also be affected through the food chain.

Materials in the landfill have the potential to breakdown over time and may leach to the surrounding soils and water. Remedial investigation activities have not demonstrated significant contamination surrounding or migrating from the landfill. However, drums containing petroleum liquids were identified in two locations on the edge of the landfill face. These drums may pose a threat to human health and the environment in the future if they deteriorate and the contents are released. The landfill is surrounded by tundra and presumably underlain by permafrost at some depth.

The shallow groundwater surrounding Site 7 is not a reasonably expected potential future source of drinking water. The shallow groundwater at Site 7 would not be accessible year round due to the climate, presence of permafrost, shallow bedrock, and freeze/thaw cycles. The well points at Site 7 were installed to a maximum depth of 6 feet, shallow groundwater has been difficult to sample, and the feasibility of accessing the shallow groundwater surrounding Site 7 as a future water supply is low.

8.1.5 Risk Assessment

At Site 7, the Human Health and Ecological Risk assessment identified potential future human health risks based on exposure to site soil and consumption of shallow groundwater containing metals, benzene, PAHs, PCBs, or petroleum hydrocarbons. Arsenic was identified as the primary risk driver in soil. The overall cancer risk is within the USEPA acceptable risk range of $1x10^{-4}$ and $1x10^{-6}$. Arsenic was thus eliminated as a contaminant of concern in soil. Nickel[10,11] was identified as the primary noncancer risk driver in shallow groundwater because it was the only contaminant to exceed a hazard quotient (HQ) of 1. Lead is not evaluated using the hazard quotient method, but exceeded the MCL of 0.015 mg/L in WP 7-1 and WP 7-2.

The ecological risk assessment indicated the potential for adverse ecological effects to small mammals (e.g., tundra vole) from exposure to the highest concentrations of diesel range organics. However, the highest concentration of DRO was detected at a single location, not site-wide; the sampling location was adjacent to a large debris removal action and this area has been extensively modified by vehicle traffic, heavy equipment, and the removal of drums and other miscellaneous debris.

[10] Barium also contributed to potential noncancer risks according to the risk assessment (MWH 2004), however toxicity values for barium have since been updated in IRIS (7/2005) and the observed concentrations do not pose a risk.
[11] The maximum nickel concentration of 3.5 mg/L resulted in a future residential noncancer HQ of 6. The cumulative HI for all COPCs was 8.

Table 8-1. Site 7 Groundwater Data and Alternate Cleanup Levels

Contaminants of Potential Concern	MW 7-4 1994 (mg/L)	MW 7-4 1998 (mg/L)	WP 7-1 2001 (mg/L)	WP 7-2 2001 (mg/L)	WP 7-3 2001 (mg/L)	MAX (mg/L)	HQ at max. conc. (unitless)	ADEC Table C Level [a] (mg/L)	Cleanup Level [b] (mg/L)	HQ (unitless)
NONCARCINOGENS										
Aluminum	NA	NA	10.6	25.8	14.7	25.8	0.9	--	N/A	
Arsenic	ND (0.005)	NA	0.010	0.004	0.004	0.010	1.1	0.05	N/A	
Chromium	ND (0.02)	NA	0.255	0.014	0.014	0.255	0.006	0.1	N/A	
Cobalt	NA	NA	0.064	0.004	0.004	0.064	0.1	--	N/A	
Lead	0.005	NA	**0.040**	**0.017**	0.006	**0.040**	--	0.015	0.15	--
Lead, dissolved	ND (0.002)	NA	NA	NA	NA	--	--	--	--	--
Manganese	NA	NA	0.593	0.060	0.105	0.593	0.15	--	N/A	
Nickel	ND (0.05)	NA	**3.54**	ND (0.01)	ND (0.01)	**3.54**	5.9	0.1	1	1
Vanadium	NA	NA	0.079	0.035	0.029	0.079	0.4	0.26	N/A	
Zinc	ND (0.05)	NA	2.47	0.023	0.020	2.47	0.3	11	N/A	
Benzene	0.0021	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	0.0021	0.04	0.005	N/A	
PETROLEUM HYDROCARBONS										
Diesel Range Organics	0.62	1.1 VR	0.66	ND (0.25)	0.39	0.66		1.5	N/A	
Residual Range Organics	NA	NA	**2.7**	1.1	**1.4**	**2.7**		1.1	11	1
CARCINOGENS										
Benzene	0.0021	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)	0.0021	3.30E-06	0.005	N/A	
Arsenic	ND (0.005)	NA	0.010	0.004	0.004	0.010	2.3E-04	0.05	N/A	

Notes:

Lead and petroleum hydrocarbons are not included in cumulative risk calculations per ADEC Cumulative Risk Guidance (ADEC, 2002)

Data included for contaminants detected above 1/10th 18 AAC 75.345 Table C cleanup levels. **Bold** values exceed ADEC Table C.

[a] 18 AAC 75.345 Table C (as amended through December 30, 2006)

[b] 18 AAC 75.345 (b)(2)

ACL - alternate cleanup level
HQ - hazard quotient
mg/L - milligrams per liter
MW- monitoring well
NA - not analyzed for
ND - non detect
WP - well point
VR - data rejected
N/A - not applicable

8.2 Site 9 – Housing and Operations Landfill

8.2.1 Background

Site 9 is located approximately 500 feet northeast of the main complex. The landfill was a waste disposal area from 1952 until 1965 and contains miscellaneous metal debris, drums and other trash.

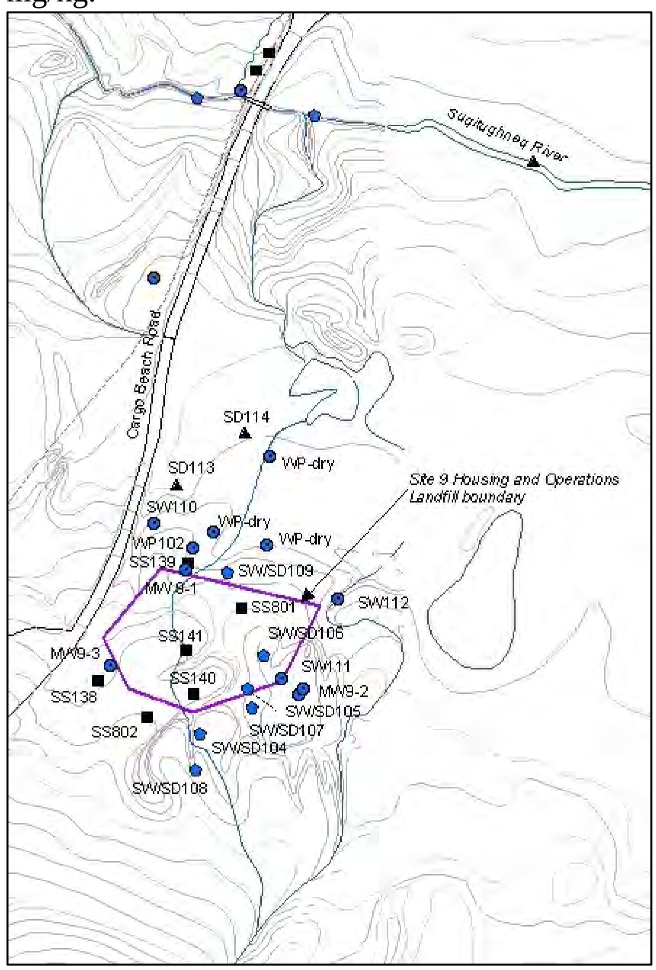
8.2.2 Previous Removal/Remedial Actions

Exposed drums, debris, and batteries were removed during removal actions in 2001 and 2005.

8.2.3 Nature and Extent of Contamination

Environmental sampling activities have included the collection of soil, sediment, surface, and shallow groundwater samples. The primary contaminants of concern are metals in soil, and metals and DRO in shallow groundwater.

Arsenic concentrations in soil ranged from 3.6 to 30 mg/kg, with a 95%UCL of 17 mg/kg. The maximum concentration of DRO in soil was 375 mg/kg.



Shallow groundwater COPCs include: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, lead, manganese, nickel, vanadium, zinc, benzene, dioxin/furans, DRO and RRO. A summary of the shallow groundwater data from Site 9 is shown in Table 8-2. Historical sampling locations at Site 9 are also shown on Figure 8-2 and the inset (right).

Aluminum in shallow groundwater can be eliminated as a COC. The elevated level of aluminum was detected in shallow groundwater from MW9-3 during the 2001 investigation. The field notes[12] indicated that MW9-3 was "very silty", with unreadable turbidity, and was bailed dry to collect the sample. In addition, MW9-3 was observed to have "bottom very soft, material mostly creamy with some grit, bentonite and silt". Thus, the presence of bentonite in the bottom of MW9-3 in particular is evidence that the groundwater sample contained suspended solids. Bentonite is an aluminum

[12] The other well points had lower turbidity readings, WP-1 measured 2.27 NTUs; WP 9-2 measured 9.28 NTUs. The field observations at MW9-2 were "bottom very soft, material on depth sounder creamy, no grit, must be bentonite in well".

phyllosilicate clay used to grout monitoring wells. The elevated water concentrations of aluminum are probably due to interference from well construction materials.

Other metals were eliminated as COCs in shallow groundwater at Site 9, including antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, manganese, nickel, vanadium, and zinc. The presence of several metals in the 2001 water sample from MW9-3 above screening levels suggests that the water sample was turbid. Metals were not detected above screening levels in MW 9-3 during the previous 1994 sampling event. Since the elevated metals were predominantly detected in MW 9-3, and this well was of questionable integrity and usability, the results should be used with caution and do not provide a strong line of evidence for contaminants migrating from the solid waste disposed in the vicinity. In addition, arsenic, barium, cadmium, chromium, vanadium, and zinc concentrations did not exceed the Table C cleanup levels and the detections were attributable to natural background.

Although metals are commonly detected in poorly developed monitoring well samples, lead was consistently detected over time above the cleanup level, and is considered a COC and primary risk driver for cleanup decisions. The lead detected in the shallow groundwater could be due to materials deposited within the landfill. Filtered water samples would be necessary to determine if the observed lead concentrations represent a dissolved phase problem in water, or a suspended sediment problem. Currently, the State of Alaska does not allow filtering of groundwater samples for regulatory monitoring. Surface water samples have also been collected from ephemeral ponds surrounding the landfill and lead has either not been detected or did not exceed the drinking water criteria. Lead was detected in one out of ten surface water samples, but the concentration did not exceed the Table C cleanup level of 0.015 mg/L. Sample SW/SD106, collected in 1994 from a pond within the boundary of the landfill contained 0.011 mg/L total lead, however dissolved lead was not detected in this same sample. All surface water samples collected downgradient and within the landfill during the 2001 investigation demonstrated that no metals were detected in surface water samples at concentrations exceeding the groundwater cleanup levels, and no DRO, RRO, GRO, VOCs, PAHs, or PCBs were detected.

Fuels in shallow groundwater, including DRO and RRO are considered COCs at the Site 9 landfill. Benzene was eliminated as a COC because the detected concentrations do not exceed the Table C cleanup level. DRO was historically elevated at MW9-3 (1994 sampling result), but the most recent 2001 data showed non-detectable levels. RRO exceeded cleanup levels at one monitoring well point in 2001 (WP102).

Dioxins/furans were detected at very low concentrations in shallow groundwater at Site 9 during the Phase I remedial investigation (1994). However, some of the detected compounds in the water samples from Site 9 were qualified “BL” (analyte found in method blank or trip blank).

Sampling of the shallow groundwater is problematic at Site 9 due to the tundra/wetland environment. Installing good well points for sampling is largely futile here. Groundwater samples collected under these circumstances are highly turbid (i.e., low quality). Installation of several additional well points was attempted in 2001, but the well points did not yield water.

Table 8-2. Site 9 Groundwater Data and Alternate Cleanup Levels

Contaminants of Potential Concern	MW 9-1 1994 (mg/L)	MW 9-2 1994 (mg/L)	MW 9-3 1994 (mg/L)	MW 9-3 1998 (mg/L)	MW 9-3 2001 (mg/L)	WP 102 2001 (mg/L)	Maximum (mg/L)	HQ at max conc. (unitless)	ADEC Table C Level [a] (mg/L)	Cleanup Level [b] (mg/L)	HQ (unitless)
NONCARCINOGENS											
Aluminum	NA	NA	NA	NA	164	48.9	164	5.6	--	N/A	
Antimony	ND (0.1)	ND (0.1)	ND (0.1)	NA	0.12	ND (0.05)	0.12	10.3	0.006	N/A	
Arsenic	0.011	0.025	0.006	NA	ND (0.005)	0.012	0.025	2.9	0.05	N/A	
Barium	NA	NA	NA	NA	1.16	0.271	1.16	0.2	2	N/A	
Beryllium	ND (0.02)	ND (0.02)	ND (0.02)	NA	0.014	0.004	0.014	0.2	0.004	N/A	
Cadmium	ND (0.02)	ND (0.02)	ND (0.02)	NA	0.004	0.002	0.004	0.1	0.005	N/A	
Chromium	ND (0.02)	0.04	0.03	NA	0.099	0.075	0.099	0.002	0.1	N/A	
Cobalt	NA	NA	NA	NA	0.037	0.012	0.037	0.06	--	N/A	
Lead	**0.019**	**0.045**	**0.038**	NA	**0.3**	**0.056**	**0.3**	--	0.015	0.15	--
Manganese	NA	NA	NA	NA	2.24	0.326	2.24	0.6	--	N/A	
Nickel	ND (0.05)	ND (0.05)	ND (0.05)	NA	0.08	0.11	0.11	0.2	0.1	N/A	
Vanadium	NA	NA	NA	NA	0.149	0.097	0.149	0.7	0.26	N/A	
Zinc	ND(0.05)	0.12	0.09	NA	0.512	0.419	0.419	0.05	11	N/A	
Benzene	ND(0.001)	0.0012	ND(0.001)	ND(0.001)	ND(0.001)	ND(0.001)	0.0012	0.02	0.005	N/A	
PETROLEUM HYDROCARBONS											
DRO	0.71	0.51 JU	0.95	**7.7**	ND (0.25)	0.93	**7.7**	5	1.5	15	1
RRO	NA	NA	NA	NA	ND (0.5)	**4.2** VJ	**4.2**	1.4	1.1	11	1
CARCINOGENS								Risk (unitless)			Risk (unitless)
Dioxin/Furans	NA	1.8E-10	4.1E-10	NA	NA	NA	4.1E-10	1.8E-05	3.0E-08	N/A	
Benzene	ND (0.001)	0.0012	ND(0.001)	ND(0.001)	ND (0.001)	ND (0.001)	0.0012	1.9E-06	0.005	N/A	

Notes: Lead and petroleum hydrocarbons are not included in cumulative risk calculations per ADEC Cumulative Risk Guidance (ADEC, 2002)

Data included for contaminants detected above 1/10th 18 AAC 75.345 Table C cleanup levels. **Bold** values exceed ADEC Table C .

[a] 18 AAC 75.345 Table C (as amended through December 30, 2006)

[b] 18 AAC 75.345 (b)(2)

ACL - alternate cleanup level
JU or VJ - result estimated
MW- monitoring well
ND - non detect
N/A – not applicable
HQ - hazard quotient
mg/L - milligrams per liter
NA - not analyzed for
WP - well point

8.2.4 Conceptual Site Model

The shallow groundwater surrounding Site 9 is not a reasonably expected potential future source of drinking water. The shallow groundwater at Site 9 would not be accessible year round due to the climate, presence of permafrost, shallow bedrock, and freeze/thaw cycles. The monitoring wells at Site 9 were installed to a maximum depth of 9 feet, and shallow groundwater has been measured at depths ranging from 1 to 6 feet below ground surface. Well points installed downgradient of the landfill during the 2001 field season did not yield water. Surface water samples collected downgradient from Site 9 did not contain any COPCs. The shallow groundwater is not a reasonably expected potential future drinking water source. The anomalous metals in the shallow groundwater are likely attributable to suspended solids in the water column from naturally occurring minerals in the soil.

Several prominent surface water drainages are present in the form of erosion pathways formed by run-off and standing surface water. Surface water runs through Site 9 in several locations and eventually enters the Suqitughneq River approximately ¼ mile to the north. Debris is exposed in some of the channels and could become more exposed during periods of high rainfall or as run-off changes course. Iron-stained sediment was observed in some of the channels during 2001. Partially exposed debris has also been observed in tundra materials at Site 9. Exposed debris in the vicinity was addressed by Bristol during the 2005 field season as part of the site debris removal activities.

8.2.5 Risk Assessment

The site data was evaluated in a risk assessment, and the primary risk drivers were arsenic in soil and aluminum, antimony, lead, dioxin/furans and DRO in shallow groundwater. The risk assessment identified arsenic in soils as a potential risk driver. The maximum concentration of 30 mg/kg arsenic is within the range of ambient concentrations for the site, and the calculated cumulative risk for the future permanent resident scenario ($3x10^{-5}$) is within the USEPA's acceptable risk range of $1x10^{-4}$ and $1x10^{-6}$. The ecological risk assessment indicated no potential for adverse ecological effects. Arsenic was eliminated as a COC in soil at Site 9.

At Site 9, the risk assessment identified potential future risks based on year-round consumption of shallow groundwater. The future residential scenario assumed persons would drink shallow groundwater from the immediate vicinity of Site 9 for 350 days/year. The feasibility of accessing the shallow groundwater surrounding Site 9 as a future permanent water supply is low. The noncancer risk was attributable to antimony, aluminum, lead, and DRO. Aluminum and antimony were eliminated as COCs, based on the presence of bentonite and suspended sediments in the water sample. The shallow groundwater is not a reasonably expected potential future drinking water source. The anomalous metals in the shallow groundwater are likely attributable to suspended solids in the water column from naturally occurring minerals in the soil. The risk assessment also identified dioxin/furans[13] as a cancer risk driver in the shallow groundwater. However, the excess lifetime cancer risk from shallow groundwater for a future permanent resident is 2×10^{-5} (2E-05), which is within the acceptable risk range (1E-04 to 1E-06)

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[13] The risk calculations for shallow subsurface water at Site 9 in the Final HHERA (MWH, 2004), contain a units conversion error. The numbers were erroneously based on a Toxicity Equivalency units (TEQ) of $5.4x10^{-9}$, the correct TEQ is 5.4×10^{-10}. The revised risk numbers are used in the text of the Feasibility Study.

established by the USEPA. The total dioxin toxicity equivalent (TEQ) concentration of 5.4 x 10^{-10} is two orders of magnitude less than the ADEC Table C groundwater cleanup level of 3 x 10^{-8}. Since dioxins were also found in the method or trip blanks, the overall risk is low that the shallow groundwater poses a threat to human health. Moreover, the original groundwater samples were not filtered and probably contained suspended sediments which could have contributed to the detections. Dioxins were thus eliminated as a contaminant of concern in shallow groundwater at the Site 9.

8.3 Sites 7 and 9 Combined

8.3.1 Remedial Action Objectives

The identified contaminants of concern at Area of Concern C Landfills are PCBs and DRO in soil; and lead, nickel, DRO and RRO in shallow groundwater. The applicable completed exposure pathways are incidental ingestion of or dermal contact with soil. The shallow groundwater at the landfills is not a current drinking water source, and is not a reasonably expected potential future drinking water source.

Site-specific soil cleanup levels appropriate for the landfills are based on Scenario A which assumes exposure pathways identified in the human health risk assessment are complete (i.e., incidental ingestion of or contact with contaminated soil). For PCBs, a future seasonal resident scenario was used to calculate a cleanup level of 10 mg/kg at a target risk level of 1E-5. Soil cleanup levels based on the migration to groundwater pathway are not appropriate for the landfills because it is unreasonable to assume the shallow groundwater immediately surrounding Sites 7 or 9 could be accessed as a permanent future drinking water source. Concentrations of petroleum hydrocarbons and other compounds have been measured directly in shallow groundwater and do not demonstrate that contaminants are migrating from soil as leachate.

The shallow groundwater surrounding the landfill cannot be feasibly utilized as a permanent water source. Since the shallow groundwater is not a reasonably expected potential future drinking water source, the cleanup levels are based on 18 AAC 75.345(b)(2) for a non-drinking water source. The cleanup levels for COCs in shallow groundwater are shown below. Lead, nickel, DRO, and RRO were retained as contaminants of concern in shallow groundwater.

The remedial action objectives for the landfills are to prevent migration of contamination to surface water or shallow groundwater above cleanup levels, achieve risk-based alternate cleanup goals for soils, and prevent future impacts to the environment from leaching of materials in the landfill. Secondary goals include stabilization of the landfill, preventing access or exposure to the landfill contents, and removing future sources of contamination to the surrounding tundra and shallow groundwater.

According to State of Alaska regulations (18 AAC 60.200), a permit is not required for closure of an inactive reserve pit, solid waste facility or dump. However, Alaska does regulate the closure of Class III municipal solid waste landfills and these landfills must meet certain closure criteria as described in 18 AAC 60.390. Class III landfill closure is based on the following criteria:

- Revegetation of the site

- Cover of 24 inches thickness or greater that promotes drainage
- Absence of surface runoff that could lead to erosion of the cover
- Survey and documentation of the landfill area
- Absence of groundwater or soil contamination

Scenario A – Soil Alternate Cleanup Levels (risk-based, soil ingestion)

- DRO 9,200 mg/kg
- RRO 9,200 mg/kg
- PCBs 10 mg/kg

Shallow groundwater cleanup levels
Non-drinking water source:

- Lead 0.15 mg/L
- Nickel 1.0 mg/L
- DRO 15 mg/L
- RRO 11 mg/L

8.3.2 Site Parameters

The entire Site 7 landfill surface area is approximately 11 acres, with a perimeter of 2,500 feet. The total depth of materials placed in the landfill is unknown but could vary between 10 and 20 feet in depth based on surface contour elevations shown on site drawings. The ground surface elevation of the landfill ranges from 50 to about 70 feet above sea level (ASL). Assuming an average depth of 15 feet, the total volume to be removed would be 266,000 cubic yards. For cost estimating purposes, it was assumed that 70% of the total landfill volume is non-hazardous solid waste (e.g., debris, drums, metal), 15% is clean soil, 10% is POL-contaminated soil, and 5% is a regulated waste (e.g., batteries, contaminated soil, other unknowns).

The depth to shallow groundwater adjacent to the Site 7 landfill ranges between 2 and 6 feet below ground surface. The shallow groundwater is not readily captured by monitoring wells or well points. The groundwater flow gradient is likely very low and influenced by the tundra soil structure which tends to restrict water flow.

The Site 9 landfill is approximately 3 acres in surface area, with a perimeter of 1,400 feet. Assuming debris is present to a depth of 5 feet, there is a volume of 24,000 cubic yards of material in the landfill. The surrounding area is very wet and debris was previously observed protruding from stream and lake banks. The protruding debris was removed during the 2005 field season. Remedial actions associated with the Site 9 landfill area may require additional coordination or permitting depending on the amount of disturbance anticipated in a wetland or wet tundra environment.

8.4 Landfills - Screening of Alternatives

The technologies presented in Section 4 were evaluated with respect to the COCs, media, and exposure pathways at the two landfills.

Institutional controls were retained for consideration to prevent future construction of buildings on top of the landfills, construct fencing, and ensure erosion doesn't occur. In addition, a deed notice informing landowners the shallow groundwater is not a reasonably expected potential future drinking water source may be necessary.

Natural attenuation and *long term monitoring* allow natural surface and sub-surface processes to reduce contaminant concentrations to acceptable levels over time. Natural attenuation would not cause damage to the surrounding tundra/wetland environment. The costs associated with long term monitoring are relatively low. Monitoring the shallow groundwater will allow future evaluation of site conditions and detect possible contaminant migration from the landfill.

The surface soils surrounding both landfills do not pose a significant risk to human health or the environment. Subsurface soils (2.0 to 3.5 feet bgs) at two discrete locations on the eastern edge of the Site 7 contain PCBs above the alternate cleanup level of 10 mg/kg. The soil contamination is commingled with buried landfill debris materials and is covered with plastic sheeting and clean backfill. The residual PCBs do not naturally attenuate but are not expected to migrate laterally or vertically. The primary contaminants of concern are metals and fuels in shallow groundwater.

Capping was retained for the landfills because it is a standard practice employed for closing solid waste disposal sites. Capping provides containment by minimizing vertical movement of contamination and reducing the likelihood of human and animal contact with contamination. Capping consists of covering the (contaminated area/landfill mass) with a low-permeability cover to prevent the infiltration of surface water, a drain layer above the cap to direct precipitation, and a vegetative covering that prevents erosion and restores the area's native vegetation.

Landfarming, *phytoremediation*, and *thermal treatment*, were eliminated from further consideration at this site because there are no areas of contaminated soil to be addressed which exceed the risk-based remedial action goals.

Reactive matting was eliminated from further consideration at the landfills because the surrounding sediments are not contaminated.

Chemical oxidation was eliminated from further consideration because it would not be effective at these sites.

Reactive walls were eliminated from further consideration at the landfills because the identified shallow groundwater contamination is limited in extent.

Off-site treatment and disposal of the entire landfill contents was retained for further evaluation.

8.5 Landfills – Detailed Analysis of Alternatives

The proposed alternatives for the landfills include:

- Alternative 1 - No Action
- Alternative 2 - Institutional Controls

- Alternative 3 - Natural Attenuation
- Alternative 4 - Long term monitoring of the shallow groundwater
- Alternative 5 - Engineered capping of the landfills using adequate cover materials and monitoring of cap integrity
- Alternative 6 - Excavate entire landfill mass, dispose off-site

8.5.1 Landfills Alternative 1 – No Action

Description
Under the no action alternative, the landfills would be left in their current state, with no activities to control or mitigate exposure to site contaminants. The no action alternative provides a baseline for comparing other remedial alternatives and is required for consideration by the NCP. There are no costs associated with Alternative 1.

Overall protection of human health and the environment
The Site 7 and 9 landfills do not currently pose a risk to site visitors. The landfills may pose a potential risk to future seasonal or permanent residents due to exposure to soil contaminated with PCBs or DRO. However, the identified soil PCB hotspots were excavated and disposed offsite during the 2005 field season. Some PCBs remain in subsurface soils at two discrete locations at the Cargo Beach Road landfill. In addition, the sampling location with the highest level of DRO at Site 7, east of Cargo Beach Road, has likely been addressed through the previous debris removals. Thus, the future risk to human health and the environment posed by contaminated soil is substantially lower than originally calculated, and is within the risk range established by the USEPA. The no action alternative would not be protective of future permanent residents if the residual PCB-contaminated soils are excavated or otherwise exposed to the surface. The no action alternative would not prevent current and future residents from accessing the shallow groundwater for a drinking water source, which could pose a risk if consumed year-round. The shallow groundwater is not currently used as a drinking water source, and is not a reasonably expected potential future drinking water source. The feasibility of accessing the shallow groundwater as a future drinking water source is low. The shallow groundwater contamination could migrate downgradient to ephemeral surface waters, but historical sampling indicates the surface waters are not contaminated.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons will continue to occur even if no actions are taken. It could take several years to reach the site-specific ACLs under this approach. The PCBs in subsurface soils do not comply with the unrestricted use cleanup level promulgated by the ADEC. However, since the soils are beneath a plastic liner and 2 to 3 feet of clean backfill, and seasonal use is the most likely future use scenario in the immediate vicinity, the risk-based alternative cleanup level of 10 mg/kg PCBs is appropriate. The shallow groundwater is not a reasonably expected potential future drinking water source. The anomalous metals in the shallow groundwater are likely attributable to suspended solids in the water column from naturally occurring minerals in the soil.

Short-term effectiveness
The risk assessment determined there are no current risks to human health. The risk assessment suggests there is a potential for adverse effect in representative ecological receptors (e.g., tundra vole) exposed to the maximum concentration of DRO at Site 7. However, the single sampling location with this elevated DRO result has likely been addressed through previous debris removal activities, and is not representative of site conditions over the entire area to which ecological receptors would be exposed. There were no potential adverse ecological effects identified at Site 9. The no action alternative would not address the potential for tampering with the partially exposed drums left on the edge of the Site 7 landfill.

Long-term effectiveness and permanence
The no action alternative would not be effective in the long term.

Reduction in toxicity, mobility, or volume through treatment
No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
The no action alternative is easily implemented.

Cost
The estimated cost of Alternative 1 is $ 0.

8.5.2 Landfills Alternative 2 - Institutional Controls.

Description
Institutional controls at the Cargo Beach Road and Housing and Operations landfills could involve physical, legal, or administrative mechanisms to restrict the use of or access to the site to prevent future risks to human health, safety, or the environment. Such controls could include a deed notice to provide information to current or future landowners about the presence of buried debris at the site and the need for proper management of the soil if excavated. Institutional controls may also include a deed notice to inform current and future landowners that the shallow groundwater is not a reasonably expected potential future drinking water source. Other measures could involve restrictions on future construction of buildings on top of the landfill, prohibitions on altering the existing cover materials, controls to prevent excavation in the landfill and adjacent soils, or constructing a fence around the landfill to prevent access by site residents and visitors.

Overall protection of human health and the environment
Institutional controls would prevent exposure of current and future residents to contaminated soils by placing restrictions on soil excavations, informing landowners of the need for proper management in the future if excavated, and providing notice that the shallow groundwater is not a reasonably expected potential drinking water source. The historical levels of DRO in soil at Site 7 may pose a potential risk to future seasonal or permanent residents, however this area was addressed during prior debris removal activities and the identified contamination was not widespread. The sites do not currently pose a risk to site visitors. The shallow groundwater

contamination could migrate downgradient to ephemeral surface waters, but existing data indicates the surface waters are not impacted.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons will continue to occur if institutional controls are implemented. It would likely take many years to reach the site-specific ACLs under this approach. However, a limited area of soil is affected with DRO at levels that could pose a future threat to human health. Institutional controls comply with the alternate cleanup level of 10 mg/kg for PCBs in subsurface soils. The shallow groundwater is not a reasonably expected potential future drinking water source. The anomalous metals in the shallow groundwater are likely attributable to suspended solids in the water column from naturally occurring minerals in the soil.

Short-term effectiveness
The Cargo Beach Road landfill is located adjacent to the road, about 0.8 miles from the native fishing/hunting camp. The Housing and Operations landfill is located closer to the Main Operations Complex, about 1.5 miles from the beach. There is a medium potential for exposure to site contaminants over a short period of time. The risk assessment determined the sites posed no current risk to site visitors.

Long-term effectiveness and permanence
Institutional controls can be effective in the long term. Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Reduction in toxicity, mobility, or volume through treatment
No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity. The anomalous metals in the shallow groundwater are likely attributable to suspended solids in the water column from naturally occurring minerals in the soil.

Implementability
Institutional controls are typically easily implemented. The need for, and likelihood of, landowner acceptance and compliance with ICs is a consideration for alternatives requiring them. The land at Northeast Cape is owned jointly by two local Native Corporations, Savoonga Native Corporation and Sivuqaq, Inc. The ability of the Corporations to accept and maintain land use controls is unknown.

Cost
The estimated cost of Alternative 2 is $ 480,000.

8.5.3 Landfills Alternative 3 - Natural Attenuation

Description
Under this alternative, the soils, shallow groundwater and adjacent ephemeral surface water would be allowed to naturally attenuate.

Overall protection of human health and the environment
Natural attenuation processes would continue to reduce risks to human health and the environment over the long term. The Cargo Beach Road Landfill and the Housing and Operations Landfill do not pose a current risk to site visitors. However, the limited area of soil containing elevated DRO levels, if still present, could pose a potential future risk to permanent residents. The remaining PCBs in subsurface soils do not pose a current risk, but could pose a potential future risk if excavated or otherwise exposed to the surface. Shallow groundwater is not currently used for drinking water purposes and is not a reasonably expected potential future drinking water source. The anomalous metals in the shallow groundwater are likely attributable to suspended solids in the water column from naturally occurring minerals in the soil.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons will continue to occur under implementation of this alternative. It would likely take many years to reach the site-specific soil ACLs under this approach. The residual PCBs are located in the subsurface soils and are covered with plastic and 2 to 4 feet of clean fill. The most likely future use scenario in the immediate vicinity is seasonal residents, thus the risk-based alternate cleanup of 10 mg/kg is appropriate. The shallow groundwater is not a reasonably expected potential future drinking water source. The anomalous metals in the shallow groundwater are likely attributable to suspended solids in the water column from naturally occurring minerals in the soil.

Short-term effectiveness
Since the landfills are adjacent to the Cargo Beach Road, but between 0.8 and 1.5 miles from the seasonal native fishing/hunting camp, there is a medium potential for exposure to site contaminants over a short period of time. The risk assessment determined no current risks to human health.

Long-term effectiveness and permanence
Natural attenuation can be effective in the long term. Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions would be required as part of this alternative.

Reduction in toxicity, mobility, or volume through treatment
No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
Natural attenuation is easily implemented. The remote location and distance from an established community will pose some logistical challenges. This alternative would involve an initial site

visit and limited sampling to establish baseline conditions. The data would be used to evaluate potential biodegradation rates.

Cost
The estimated cost of Alternative 3 is $ 236,000.

8.5.4 Landfills Alternative 4 – Long Term Monitoring

Description
Under this alternative, the shallow groundwater and adjacent ephemeral surface water would be monitored to ensure the landfill contents are not leaching into the environment or migrating from the landfill. Sampling would be conducted once every 5 years for a period of 25 years. Monitoring activities would establish a baseline, evaluate the reduction of contaminant concentrations over time, and determine if off-site migration is occurring. Eight new monitoring wells would be installed between the two areas.

Overall protection of human health and the environment
Long term monitoring would ensure potential future contamination is identified. Natural attenuation processes would continue to reduce risks to human health and the environment over the long term. The Cargo Beach Road Landfill and the Housing and Operations Landfill do not pose a current risk to site visitors. However, the limited area of soil containing elevated DRO levels, if still present, could pose a potential future risk to permanent residents. The remaining PCBs in subsurface soils do not pose a current risk, but could pose a potential future risk if excavated or otherwise exposed to the surface. Shallow groundwater is not currently used for drinking water purposes, and is not a reasonably expected potential future water source. The feasibility of accessing the shallow groundwater as a future drinking water source is low. The anomalous metals in the shallow groundwater are likely attributable to suspended solids in the water column from naturally occurring minerals in the soil.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons will continue to occur if long term monitoring is implemented. It would likely take many years to reach the site-specific soil ACLs under this approach. The residual PCBs located in the subsurface meet the ACL of 10 mg/kg assuming potential future seasonal residential use. Over time, long term monitoring may demonstrate that metals are not present in shallow groundwater at concentrations above drinking water standards. The anomalous metals in the shallow groundwater are likely attributable to suspended solids in the water column from naturally occurring minerals in the soil.

Short-term effectiveness
Since the landfills are adjacent to the Cargo Beach Road, but between 0.8 and 1.5 miles from the seasonal native fishing/hunting camp, there is a medium potential for exposure to site contaminants over a short period of time. The risk assessment determined no current risks to human health.

Long-term effectiveness and permanence
Natural attenuation and long term monitoring can be effective in the long term. Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every

5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions, implemented controls, and monitoring results would be required as part of this alternative.

Reduction in toxicity, mobility, or volume through treatment
No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
Long term monitoring programs are typically easily implemented. The remote location and distance from an established community will pose logistical challenges. Long term monitoring would involve an initial site visit to establish baseline conditions and periodic monitoring of well points and/or soils. The monitoring data would be used to evaluate trends in contaminant concentrations and potential future leaching of contaminants.

Cost
The estimated cost of Alternative 3 is $704,000.

8.5.5 Landfills Alternative 5 – Capping

Description
Capping both landfills will follow the general state of Alaska requirements to close solid waste disposal facilities. Capping consists of covering the contaminated area with a low-permeability cover to prevent the infiltration of surface water, a drain layer above the cap to direct precipitation, and a vegetative covering that prevents erosion and restores the area's native vegetation. After placement of the fill materials and site re-vegetation, the landfill cap integrity will be inspected every 5 years for 25 years.

Several additional measures may be necessary prior to placing the fill on the Cargo Beach Road landfill. First, there are two known locations along the exposed slopes of the landfill with drums containing POL products. These known drums were partially exposed during prior debris removal efforts, but left in place. The drums would be drained to remove any remaining contents. An estimated 7 to 10 drums are assumed to be present at the western edge and the slope east of Cargo Beach Road. Additional drums may be identified through visual inspection of the landfill face. After addressing these drums, adequate cover materials will be placed over the entire landfill surface, up to 24 inches, including the eastern exposed slope of the landfill on edge of Cargo beach Road. All major exposed debris pieces were removed during the 2005 field season, with the exception of the noted drums.

PCB-contaminated soils were removed in 2005 from six discrete locations along the eastern slope of the landfill, east of Cargo Beach Road. Soil confirmation samples from four of the six locations confirmed that all PCBs above 1 mg/kg were removed. Two excavations contain residual PCB-contaminated soils/debris above the EnSys test kit field screening level of 0.5 mg/kg. These areas are not recommended for further excavation. According to the field report, the two soil excavations extended into landfill debris and further excavation was impractical. The soil was excavated to depths of 2.0 and 3.5 feet below ground surface, and the excavations were lined with plastic and backfilled with clean fill. In addition, the landfill surface will be capped by up to an additional 2 feet of soil, thus the exposure pathway will be removed and the soils will not pose a future risk.

Capping of the Site 7 landfill mass east of Cargo Beach Road may require an additional volume of cover materials/fill to adequately stabilize the slope. Gravel fill materials are available at the base of Kangukhsam Mountain; however this local source may not be suitable for landfill capping. Thus, topsoil/peat may need to be shipped to the site for the final cover. An impermeable liner may also be required prior to adding final cover materials and fill.

This alternative is a viable method for stabilizing the landfill and preventing exposure to human and ecological receptors. There is some uncertainty regarding whether the liner could be breached by small burrowing animals such as the tundra vole.

Overall protectiveness of human health and the environment
Capping provides containment by minimizing vertical movement of contamination and reducing the likelihood of human and animal contact with contamination. Capping also prevents human exposure to any surface soil contamination. The shallow groundwater is not a reasonably expected potential future drinking water source.

Compliance with ARARs
Capping complies with the alternate soil cleanup level of 10 mg/kg for PCBs. The shallow groundwater is not a reasonably expected potential future drinking water source. The anomalous metals in the shallow groundwater are likely attributable to suspended solids in the water column from naturally occurring minerals in the soil.

Short-term effectiveness
Capping provides an effective means of preventing exposure to the landfill materials, and prevents migration of water through the landfill contents. There are some inherent risks to construction workers hauling materials and operating heavy equipment. However, these impacts are easily controlled with proper construction safety and equipment handling techniques.

Long-term effectiveness
Capping requires periodic monitoring to ensure integrity of the cap materials. Major maintenance is not anticipated, but damage could occur in the future and there are uncertainties associated with reliability, settlement of landfill contents, permafrost changes, etc.

Reduction in toxicity, mobility, or volume through treatment
Capping does not remove the source materials or provide any reduction in the volume of contaminants. Capping decreases the mobility of contaminants within the landfill mass by preventing infiltration of water.

Implementability
Capping is a relatively straightforward technology that has been implemented at many solid waste disposal sites. Capping is moderately difficult given the remote location, logistical challenges, and assumption that large amounts of fill may be required from off-site sources.

Cost
The estimated cost of Alternative 4 is $ 9.5 million.

8.5.6 Landfills Alternative 6 - Off-site treatment and disposal

Description
Under this alternative, the contents of the both landfills would be excavated and shipped off-site for disposal at a permitted facility. The majority (70%) of the landfills was assumed to include general solid waste such as miscellaneous metal, empty drums, wood, etc. A portion of the landfills was assumed to contain POL-contaminated soils that would require disposal. A smaller portion of the landfills (10%) was assumed to contain hazardous materials such as batteries, PCBs, asbestos or other items. There is the potential for a large volume of unknown materials to be handled. The potential for encountering larger quantities of hazardous materials could increase disposal costs. It is unknown if the underlying soils would also need to be addressed. The total volume of debris and other materials to be removed is highly uncertain.

Overall protectiveness of human health and the environment
Removal of the landfill contents provides the highest level of protectiveness by removing contaminated soils and potentially hazardous materials contained within the landfill and shipping them to a permitted disposal facility.

Compliance with ARARs
Excavation of the landfills complies with ARARs. However, it is unknown whether a large amount of soils at the base of the landfills will also need to be addressed.

Short-term effectiveness
Excavation and removal will be effective in the short term. There is a higher risk of injuring construction workers because more persons would be involved over longer period of time. In addition, there will be increased transportation hazards associated with multiple barge shipments across long ocean distances. Containerizing the landfill materials into connexes can be accomplished fairly easily with engineering controls. This remedial action would cause increased traffic on the Cargo Beach Road for several field seasons, and could require substantial alterations to the existing barge landing area adjacent to the fishing/hunting camp. The increased traffic could cause a temporary increase in dust and possible remobilization of contaminants from the excavation areas. The field work could take several field seasons. If the landfills are partially excavated, additional measures to protect the public on a temporary basis would also be needed. There is the possibility of stirring up more contamination by digging in the landfill mass, remobilizing contaminants into shallow groundwater, or increasing surface runoff of contaminants. These hazards can be controlled with storm water pollution prevention plans, public education, access controls during construction, and proper job safety procedures.

Excavation at Site 9 could cause more damage to the tundra in the short term because it is located adjacent to several small ponds and some debris is located within very wet areas. The ecosystem could require a long period of recovery to revegetate.

Long-term effectiveness
The removal and off-site disposal of the entire landfill contents has the highest degree of long term effectiveness. The excavation and removal of the materials prevents future off-site migration of contaminants from items that may degrade within the landfill.

Reduction in toxicity, mobility, or volume through treatment
Excavation and off-site treatment and/or disposal permanently removes the landfill contents thus reducing the toxicity, mobility and volume of the contaminants which could be released over time. The shallow groundwater is allowed to naturally attenuate. Removal of the landfills transfers the debris and/or contaminated soils to another location.

Implementability
Removal of the entire landfill mass will be relatively difficult and will require huge quantities (over 13,000) of shipping containers to transport the anticipated large volume of waste materials off-island. The type, quantity, and depth of waste materials in the landfill has not been thoroughly assessed, thus there are many unknowns. The landfill removal would likely need to occur over several field seasons to allow sufficient shipping container and barge capacity to be secured. The estimated number of barge trips (27) could be impractical in Alaska. Excavation and off-site disposal of the entire landfill contents would be logistically challenging and costly.

Excavation of the Site 9 landfill could be more difficult given the wet surroundings and greater possibility of impacts to the tundra vegetation. Additional coordination with other regulatory agencies would likely be required. A coastal zone consistency review would be needed.

Cost
The estimated cost of Alternative 6 is $ 84 million.

8.6 Landfills – Comparative Analysis of Alternatives

The different alternatives vary by orders of magnitude in terms of estimated costs. Table 8-3 provides a comparative evaluation of each remedial alternative using the CERCLA criteria. A summary of the estimated cost of each alternative only is shown below.

Site 7 and 9 Landfills	Cost
1 - No Action	$ 0
2 - Institutional Controls	$480,000
3 - Nat. Attenuation	$236,000
4 - LTM	$704,000
5 - Capping	$9,500,000
6 - Off-site Treatment/Disposal	$84,000,000

9.0 AREA OF CONCERN D - PIPELINE BREAK

9.1 Site 8 – POL Spill Site

9.1.1 Background

Photo (2004) View of POL Spill Site 8 adjacent to Cargo Beach Road

The POL Spill Site is located near the intersection of Cargo Beach Road and the Airport Access Road. The site is a wetland with thick surface vegetation, typical of locations along roads and the airstrip where a thick tundra mat was removed before construction. The roughly 40-foot wide wetland slopes southward for approximately 300 feet toward the Suqitughneq River. The wetland narrows as it approaches the river and a spring of flowing water is present. A fuel pipeline extended from the pumphouse at Cargo Beach to the bulk storage tanks at the main operations complex. A reported break in the pipeline was located on the west side of the main road embankment south of the Cargo Beach Road and north of the Suqitughneq River. The area downgradient of this location is a wetland with thick surface vegetation that drains to the Suqitughneq River. The vegetation in the wetland did not appear to be stressed or petroleum stained according to field observations.

Water flowed clear and cold at several gallons per minute from the spring that was sampled at the toe of the wetland drainage. A stringy sheen, possibly indicating petroleum hydrocarbons, was observed when the sediment in the spring was disturbed. It is possible that the water emanating from the spring is not drainage from the active surface of the wetland. Permafrost channeling may bring the water from a source not apparent from the ground surface. At the time of sampling, the spring was the only apparent surface flow, although water from the wetland may enter the Suqitughneq River as near surface flow through the vegetation mat.

The material encountered in the wetland consisted of dense, grassy vegetation and roots with little soil or peat development. Some sand was encountered between cobbles under the vegetation mat at one sampling location (04NE08SD102). Sampling locations are shown on Figure 9-1. Sheen and odors that may have been biogenic with a hint of petroleum were also noted while collecting sample 04NE08SD102. A sheen and apparent petroleum odor were observed while digging at the sample location 04NE08SD103. The vegetation in the wetland did not appear to be stressed or petroleum stained.

9.1.2 Previous Removal/Remedial Actions

The fuel pipeline was drained and removed during a prior removal action.

9.1.3 Nature and Extent of Contamination

Sediment and surface water samples were collected in 2004 to assess possible fuel impacts to the site. The samples were analyzed for DRO, GRO, RRO, BTEX, and PAHs. DRO was detected in the sediment and the chromatographic interpretation resembled a weathered middle distillate (diesel). Concentrations of DRO ranged from 6,700 to 19,500 mg/kg. RRO concentrations ranged from 2,920 to 4,360 mg/kg. GRO, BTEX and PAHs were not detected above screening levels. The surface water did not contain compounds of concern above screening levels.

9.1.4 Conceptual Site Model

The primary media of concern is sediments at Site 8. The primary exposure route for humans is via incidental ingestion or dermal contact with sediments or exposure through the food chain for ecological receptors. The primary contaminant of concern is DRO. Benzene was not detected; however the practical quantitation levels (PQLs) were above cleanup criteria, likely due to the high water and organic contents of the samples. Given the limited surface area potentially affected by elevated levels of DRO, the potential for significant adverse effects to either human or ecological receptors is low.

9.1.5 Remedial Action Objectives

Given the wetlands environment, applicable cleanup levels should be based on an assessment of the total organic carbon content of the sediment. Assuming the ingestion or dermal contact exposure pathways are complete, the Scenario A alternate cleanup level of 9,200 mg/kg DRO would be applicable.

9.1.6 Site Parameters

The two sediment samples which contained DRO above the alternate cleanup level were spaced 50 feet apart. The pipeline break was about 50 feet upgradient of the first sample, based on field observations. The roughly 40-foot wide wetland slopes southward for approximately 300 feet toward the Suqitughneq River. According to Phase IV RI report, both samples were within 150 feet of the Suqitughneq River. Under a worst-case scenario, the entire 40 by 300 feet of wetland (1,200 square feet) could be impacted.

9.2 Screening of Alternatives

Potential response actions for the contaminated sediments at Site 8 include institutional controls, long term monitoring, landfarming/composting, phytoremediation, and reactive matting.

Capping was eliminated from further consideration because of potential for destruction of the wetland, and no fill is generally allowed.

Thermal treatment was eliminated due to small quantity of soils present. *Landfarming* and *phytoremediation* were retained for consideration because the quantity of soil is not as critical to implementing these technologies. *Reactive matting* was retained for consideration because of its ability to prevent exposure to sediments, and prevent migration of contaminants from sediments to surface water. No surface water contamination was identified, thus *chemical oxidation* and *reactive walls* were eliminated from further consideration.

9.3 Pipeline Break - Detailed Analysis of Alternatives

9.3.1 Pipeline Break Alternative 1 – No Action

Description
Under the no action alternative, Site 8 would be left in its current state, with no activities to control or mitigate exposure to site contaminants. The no action alternative provides a baseline for comparing other remedial alternatives and is required for consideration by the NCP. There are no costs associated with Alternative 1.

Overall protection of human health and the environment
The existing levels in sediment may pose a potential risk to future seasonal or permanent residents, because the DRO levels exceed the Scenario A alternate soil cleanup levels based on exposure of humans via incidental ingestion or dermal contact with soil/sediment. However, there is a low probability that future seasonal or permanent residents could be exposed to the contaminated sediments for long enough duration to pose a potential risk. Furthermore, the petroleum hydrocarbons detected in the sediments are tightly bound with other naturally occurring organic carbons, and are not bioavailable to ecological receptors. The site does not currently pose a risk to site visitors. The POL Spill Site is located at the intersection of Cargo Beach Road and Airport Road and could be more easily accessed than other areas further from the road. The abundance of natural vegetation indicates the site is naturally filtering the diesel range organics and hydrocarbon enrichment may be enhancing plant growth.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons will continue to occur even if no actions are taken. It would likely take many years to reach the site-specific ACLs under this approach. However, a relatively small area of wetland is affected at levels that could pose a future threat to human health.

Short-term effectiveness
Although not formally evaluated in the 2004 risk assessment document, the site is unlikely to pose a current risk to site receptors.

Long-term effectiveness and permanence
Over the long term, the petroleum hydrocarbons will naturally attenuate and break down in the environment.

Reduction in toxicity, mobility, or volume through treatment
No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
The no action alternative is easily implemented.

Cost
The estimated cost of Alternative 1 is $ 0.

9.3.2 Pipeline Break Alternative 2 – Institutional Controls

Description
Institutional controls at the POL Spill Site may include physical, legal, or administrative mechanisms to restrict the use of or access to the site to prevent future risks to human health, safety, or the environment. Such controls could include a deed notice to provide information to current or future landowners about the presence of contaminated sediments at the site and the need for proper management of the sediments if excavated. Other measures could involve restrictions on future excavation and movement of the petroleum-contaminated sediments, access controls, restrictions on harvesting plants from this location, or other methods of public education. An assessment of the status and effectiveness of the institutional controls would be made after 5 years.

Overall protection of human health and the environment
Institutional controls would prevent exposure of current and future residents to contaminated sediments by restricting digging activities or subsistence harvesting in the immediate vicinity. The site does not currently pose a risk to site visitors. The existing levels in soil may pose a potential risk to future seasonal or permanent residents if continuously exposed to the sediments.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons will continue to occur if institutional controls are implemented. It would likely take many years to reach the site-specific ACLs under this approach. However, a limited area of wetland is affected at levels that could pose a future threat to human health.

Short-term effectiveness
Although not formally evaluated in the risk assessment, the existing levels do not pose a current risk to seasonal residents or site visitors.

Long-term effectiveness and permanence
Institutional controls can be effective in the long term. Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Reduction in toxicity, mobility, or volume through treatment
No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity. The natural vegetation would continue to filter the petroleum hydrocarbons.

Implementability
Institutional controls are typically easily implemented. The need for, and likelihood of, landowner acceptance and compliance with ICs is a consideration for alternatives requiring

them. The land at Northeast Cape is owned jointly by two local Native Corporations, Savoonga Native Corporation and Sivuqaq, Inc. The ability of the Corporations to accept and maintain land use controls is unknown.

Cost
The estimated cost of Alternative 2 is $ 186,000.

9.3.3 Pipeline Break Alternative 3 – Natural Attenuation

Description
Under this alternative, natural attenuation processes would be allowed to biodegrade the petroleum contamination over time. The rate of petroleum hydrocarbon degradation has not been established and the extreme climate conditions on St. Lawrence Island could slow natural attenuation processes. An initial sampling event would establish baseline conditions and provide a report on the potential for reduction of contaminant concentrations over time. This alternative could also further evaluate the contribution from biogenic compounds to total petroleum hydrocarbon sampling results.

Overall protection of human health and the environment
Natural attenuation processes would reduce risks to human health and the environment over the long term. The POL Spill Site does not pose a risk to current site visitors. However, the level of DRO contamination could pose a potential future risk to seasonal or permanent residents.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons will continue to occur over time. It would likely take many years to reach the site-specific ACLs under this approach.

Short-term effectiveness
Although not formally evaluated in the risk assessment, there are no current risks to human health.

Long-term effectiveness and permanence
Natural attenuation can be effective in the long term. Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions, implemented controls, and monitoring results would be required as part of this alternative.

Reduction in toxicity, mobility, or volume through treatment
No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
Natural attenuation is easily implemented. This alternative would include an initial sampling event to establish baseline conditions.

Cost
The estimated cost of Alternative 3 is $ 126,000.

9.3.4 Pipeline Break Alternative 4 – Long Term Monitoring

Description
Under this alternative, long term monitoring of the sediment and/or surface water would be conducted. The rate of petroleum hydrocarbon degradation has not been established and the extreme climate conditions on St. Lawrence Island could slow natural attenuation processes. Monitoring activities would establish a baseline, evaluate the reduction of contaminant concentrations over time, and determine if off-site migration is occurring. This alternative could also further evaluate the contribution from biogenic compounds to total petroleum hydrocarbon sampling results.

Overall protection of human health and the environment
Natural attenuation processes would continue to reduce risks to human health and the environment over the long term. The POL Spill Site does not pose a risk to current site visitors. However, the level of DRO contamination could pose a potential future risk to seasonal or permanent residents.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons will continue to occur if long term monitoring activities are implemented. It would likely take many years to reach the site-specific ACLs under this approach.

Short-term effectiveness
Although not formally evaluated in the risk assessment, there are no current risks to human health.

Long-term effectiveness and permanence
Long term monitoring of natural attenuation processes can be effective in the long term. Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions, implemented controls, and monitoring results would be required as part of this alternative.

Reduction in toxicity, mobility, or volume through treatment
No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity. Periodic monitoring would be conducted to confirm the reduction in contaminant concentrations.

Implementability
Long term monitoring activities are typically easily implemented. This alternative would include periodic sampling of the site to evaluate trends in contaminant concentrations. Long term monitoring would involve an initial site visit to establish baseline conditions and periodic monitoring of water and soils.

Cost
The estimated cost of Alternative 4 is $ 188,000.

9.3.5 Pipeline Break Alternative 3 and 4 combined – Natural Attenuation and LTM

Description
Under this alternative, natural attenuation would be combined with long term monitoring of the sediment and/or surface water. The rate of petroleum hydrocarbon degradation has not been established and the extreme climate conditions on St. Lawrence Island could slow natural attenuation processes. Monitoring activities would establish a baseline, evaluate the reduction of contaminant concentrations over time, and determine if off-site migration is occurring. This alternative could also further evaluate the contribution from biogenic compounds to total petroleum hydrocarbon sampling results.

Overall protection of human health and the environment
Natural attenuation processes would reduce risks to human health and the environment over the long term. The POL Spill Site does not pose a risk to current site visitors. However, the level of DRO contamination could pose a potential future risk to seasonal or permanent residents.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons will continue to occur if institutional controls are implemented. It would likely take many years to reach the site-specific ACLs under this approach.

Short-term effectiveness
Although not formally evaluated in the risk assessment, there are no current risks to human health.

Long-term effectiveness and permanence
Natural attenuation and monitoring can be effective in the long term. Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions, implemented controls, and monitoring results would be required as part of this alternative.

Reduction in toxicity, mobility, or volume through treatment
No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
Natural attenuation and long term monitoring activities are typically easily implemented. This alternative would include periodic sampling of the site to evaluate trends in contaminant concentrations. Long term monitoring would involve an initial site visit to establish baseline conditions and periodic monitoring of water and soils.

Cost
The estimated cost of Alternative 3 and 4 combined is $314,000.

9.3.6 Pipeline Break Alternative 5 – Landfarming

Description
An estimated 90 cubic yards of petroleum-contaminated sediment at the POL Spill Site would be excavated and spread out in a designated area at Northeast Cape. Simply excavating and mixing the soils, as well as incorporating amendments (e.g., fertilizer, compost) will promote biological activity and the natural breakdown of the petroleum hydrocarbons. Sediments would be excavated to meet the Scenario A alternate cleanup levels for DRO/RRO. Excavation of the major source of contamination would prevent future transport of contaminants to surface water or shallow groundwater.

Overall protection of human health and the environment
Landfarming would reduce risks to human health and the environment over the long term. The contaminated sediments would be removed and treated to meet Scenario A alternate cleanup levels for DRO/RRO. Since no permanent residents currently reside at Northeast Cape, there is no current risk to human health.

Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Compliance with ARARs
Landfarming should meet cleanup levels within one or two field seasons for the petroleum-contaminated sediment.

Short-term effectiveness
Excavation of the sediments will cause damage to the tundra and wetland environment in the short term. The site does not pose a current risk to human health.

Long-term effectiveness and permanence
Landfarming is a proven technique to break down petroleum hydrocarbons.

Reduction in toxicity, mobility, or volume through treatment
Landfarming would significantly decrease the petroleum hydrocarbon concentrations.

Implementability
Landfarming is relatively easy to implement. A flat area, such as the main operations complex, would be necessary to conduct the remedial activity. The progress of the soil treatment would need to be monitored, and the soils periodically turned over or tilled with a machine.

Cost
The estimated cost of Alternative 5 is $ 1,320,000.

9.3.7 Pipeline Break Alternative 6 – Phytoremediation

Description
An estimated 90 cubic yards of petroleum-contaminated sediments at the POL Spill Site would be excavated and spread out in a designated area at Northeast Cape. The excavated sediments would be planted with a mixture of plants such as arctic red fescue or other grasses. Amendments such as fertilizer or compost may also be added to promote biological activity and accelerate the natural breakdown of the petroleum hydrocarbons. Sediments would be excavated to meet the Scenario A alternate cleanup levels for DRO/RRO. Excavation of the major source of contamination would prevent future transport of contaminants to the surface waters or shallow groundwater.

Overall protectiveness of human health and the environment
Phytoremediation would reduce risks to human health and the environment over the long term. The contaminated sediments would be removed and treated to meet Scenario A ACLs. Since no permanent residents currently reside at Northeast Cape, there is no current risk to human health.

Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Compliance with ARARs
Phytoremediation should meet cleanup levels within several years for the petroleum-contaminated sediments,

Short-term effectiveness
Excavation of the contaminated sediment would be effective at reducing potential exposures in the short term. This alternative would cause short term damage to the tundra and wetland environment.

Long-term effectiveness
Phytoremediation is a proven technique to remediate petroleum hydrocarbons.

Reduction in toxicity, mobility, or volume through treatment
Phytoremediation would significantly decrease the petroleum hydrocarbon concentrations.

Implementability
Excavating the sediments, spreading it onsite and seeding with plants and grasses is a relatively simple process. Plant growth could be adversely affected by short growing season, but the abundant daylight compensates for the cold temperatures. The alternative would have less maintenance requirements than landfarming. There are no long term maintenance requirements such as periodic tilling of the soil or adding amendments. However, there are more uncertainties associated with achieving good rates of plant growth.

Cost
The estimated cost of Alternative 6 is $ 1,310,000.

9.3.8 Pipeline Break Alternative 7 – Off-site Treatment and Disposal

Description
An estimated 90 cubic yards of petroleum-contaminated sediments at the POL Spill Site would be excavated and transported off-site for treatment and/or disposal at a permitted landfill facility. Sediments would be excavated to meet the Scenario A alternate cleanup levels for DRO/RRO. Excavation of the major source of contamination would prevent future transport of contaminants to surface water or shallow groundwater.

Overall protectiveness of human health and the environment
Excavation and offsite treatment and/or disposal of sediments would reduce risks to human health and the environment. The contaminated sediments would be excavated to meet the risk-based Scenario A alternate cleanup levels. Since no permanent residents currently reside at Northeast Cape, there is no current risk to human health.

Compliance with ARARs
Excavation and off-site treatment/disposal would meet the Scenario A alternate cleanup levels for DRO/RRO.

Short-term effectiveness
Excavation and offsite treatment/disposal of the sediments would meet the cleanup level in one field season. Excavation may cause short term damage to the wetland environment.

Long-term effectiveness
Excavation and off-site treatment/disposal permanently removes the source of contaminated soils.

Reduction in toxicity, mobility, or volume through treatment
Excavation and off-site treatment or disposal permanently removes the petroleum hydrocarbons thus reducing the toxicity, mobility and volume of the contaminants in the sediment.

Implementability
Excavation and offsite transport is a straightforward remedial alternative that is commonly implemented at contaminated sites. Excavation of the sediments will be slightly more complicated given the wetland environment and additional permitting requirements. The remote location will add complexity to this alternative and barge services will be required. Additional measures to prevent release of contaminants to adjacent surface waters may be necessary during excavation activities. This alternative can be completed in one field season.

Cost
The estimated cost of Alternative 7 is $ 1,040,000.

9.3.9 Pipeline Break Alternative 8 - Reactive Matting

Description
Reactive matting consists of placing a permeable fabric on top of the contaminated sediments to filter organic compounds and prevent the petroleum hydrocarbons from entering the surface water. The particular technology evaluated was the Reactive Core Mat^{TM} (RCM), which is a patented permeable composite mat consisting of reactive material(s) encapsulated in a nonwoven core matrix bound between two geotextiles. For petroleum hydrocarbons, granular activated carbon is used in the matting to reliably adsorb organics from pore water. Sand is also incorporated into the mixture to provide weight to the mat. The RCM has been used for in-situ underwater capping of contaminated sediments or post-dredge residual sediments. This reactive cap allows for thinner cap thickness than a traditional sand cap. Geotextiles also provide stability and physical isolation. RCM can also be used for embankment seepage control and groundwater remediation.

Overall protectiveness of human health and the environment
The reactive matting would be protective of human health and the environment by preventing receptors from becoming exposed to the sediments.

Compliance with ARARs
The reactive matting would comply with ARARs because the sediment exposure pathway would be controlled.

Short-term effectiveness
The matting would provide immediate benefit of preventing exposure and leaching of dissolved hydrocarbons to surface water.

Long-term effectiveness
The reactive matting's ability to withstand harsh climate conditions is unknown. The location of the POL Spill Site, however, is located in a drainage with low flow and would not be subject to large ice scour.

Reduction in toxicity, mobility, or volume through treatment
The matting would filter any releases from the diesel-contaminated sediments as water flowed from the sediments, through the matting, and into the surface water.

Implementability
The actual placement of the reactive matting should be relatively straightforward. However, the presence of a significant amount of vegetation may require modifications to the width of the standard product.

Cost
The estimated cost of Alternative 8 is $ 840,000.

9.4 Pipeline Break – Comparative Analysis of Alternatives

Natural attenuation will continue to breakdown the petroleum hydrocarbons. The risk reduction provided by landfarming, phytoremediation, or offsite treatment/disposal is relatively minor, given the small area affected. The potential future risks are manageable using institutional controls and it is highly unlikely receptors would be exposed for long enough duration to be adversely affected. Table 9-1 provides a comparative evaluation of each remedial alternative using the CERCLA criteria. A summary of the estimated cost of each alternative only is shown below.

Site 8 POL Spill	Cost
1 - No Action	$ 0
2 - Institutional Controls	$186,000
3 - Nat. Attenuation	$126,000
4 - LTM	$188,000
3+4 - Nat. Attenuation and LTM	$314,000
5 - Landfarming	$1,320,000
6 - Phytoremediation	$1,310,000
7 - Off-site Treatment/Disposal	$ 1,040,000
8 - Reactive Matting	$840,000

10.0 AREA OF CONCERN E - MAIN OPERATIONS COMPLEX

The Main Operations Complex at the Northeast Cape installation included the majority of the site buildings, power source, fuel storage tanks, housing quarters, and personnel during site operation. Although areas within the main complex were investigated as individual sites and numbered as such, they were grouped together for this Feasibility Study to evaluate an overall response action for the known contamination. These sites are located on the northeast portion of the main complex gravel pad and include Sites 10, 11, 13, 15, 19, and 27. A basic description of each site comprising the main operations complex area of concern is included in the following sections.

Photos (2003, 2005). View south towards Main Complex, and Main Complex post demolition.

10.1 Site 10 – Buried Drums

10.1.1 Background

Site 10 is located approximately 400 feet northeast of the main operations complex, on the northwest side of the main access road that leads to Cargo Beach. The site is a wide gravel area that is level with the road. The gravel extends westward and drops off approximately 8 feet to a shallow wetland basin at the base of the embankment. The embankment on the northwest side has a few pieces of decomposing drums exposed. The site was reportedly used as a drum storage area for a variety of petroleum products. A large stained area exists at both the surface and along the bermed west edge of the site. The gravel pad consists of compacted fine to medium gravels with sand. The transition between fill material (gravel) and native soil is likely between 1.5 and 5 feet below ground surface. Frozen ground was suggested by the presence of wet silt noted between 10 and 11 feet bgs, and wet sand and cobbles at 16 feet bgs.

10.1.2 Previous Removal/Remedial Actions

All exposed debris was removed from the site during removal actions in 2001 and 2003.

10.1.3 Nature and Extent of Contamination

Environmental sampling at Site 10 included the collection of samples from soil, sediment, surface water, and shallow groundwater. The primary contaminant of concern is diesel range organics in soil. Three test pits were excavated by hand in 1999. Test Pit #2 encountered buried drums, one of which contained fluid with faint petroleum odor. The drum was sealed and left in place. It is unclear if the drums, timbers and debris have been addressed. Surface soil samples collected in 1994, 1996, and 1998 contained DRO at concentrations ranging from 59 to 26,500 mg/kg. Additional investigation was conducted in 2004 to determine the total depth of contamination. Two soil borings were drilled to depths of 11 ft bgs and the DRO concentrations were not significant. The maximum detected concentration of DRO was an estimated 619 mg/kg, at 5 feet bgs from boring 10B1. Previous soil sampling indicated much higher levels of DRO and RRO in the surface and near surface. Historical sampling locations are shown on Figure 10-1.

10.1.4 Site Parameters

Boring 10B1 was located near the northern extent of the gravel fill area. The transition from fill to native soil was not clear based on the samples recovered during the 2004 investigation, but was likely between 1.5 and 5 feet bgs. Frozen ground was suspected between 10 and 11 feet bgs and evidenced by wet silt and sand at 16 feet bgs. Boring 10B2 was located in the area where the fill appeared to be the thickest, up gradient of the wetland basin. The transition from fill to native soil was at 5 feet bgs, and frozen ground appeared to start at 11 to 12 feet bgs.

10.2 Site 11 – Fuel Storage Tanks

10.2.1 Background

Three large above ground fuel storage tanks (400,000 gallons each) were formerly located on the northeast corner of the main operations complex, between the perimeter access road and Site 10. The tanks were situated on a constructed gravel pad, and the gravel embankment drops to a shallow tundra drainage basin to the northeast. The center tank was punctured during snow removal activities in the late 1960’s and released a large amount of diesel fuel to the surrounding area.

10.2.2 Previous Removal/Remedial Actions

The tanks were dismantled and removed during prior removal actions.

10.2.3 Nature and Extent of Contamination

The primary compounds of potential concern are DRO, benzene and naphthalene in shallow groundwater, and DRO in soils. DRO concentrations in the shallow groundwater at MW11-2 and MW11-3 (see Figure 10-1) ranged from 1.4 to 6.1 mg/L (1994), 0.34 to 45 mg/L (1998), and 15.2 mg/L (2004). DRO in

Photo: Stained soil footprints from Site 11 tanks (2006) soil ranges from 11 to 69,100 mg/kg. The shallow groundwater contamination appears connected to a wider petroleum-hydrocarbon plume at the Main Operations Complex. Sediments and tundra soils downgradient of the fuel tank pads also contain high concentrations of DRO ranging from 280 to 83,000 mg/kg.

10.2.4 Site Parameters

Visibly stained soil exists within the footprint of each of the dismantled fuel storage tanks. The circular pads measure approximately 50 feet in diameter. The total depth of contamination is unknown; adjacent soil borings (not within the tank footprint), revealed DRO concentrations of 358 mg/kg at 4 ft depth and 22,000 mg/kg at 11.5 ft depth. Immediately downgradient of the tank footprints, DRO concentration have been measured at 43,300 mg/kg (0-2 ft depth, BH10-3).

10.3 Site 13 – Heat and Electrical Power Building and Site 15 – Buried Fuel Line Spill

10.3.1 Background

Site 13 consists of Building 110 (Heat and Electrical Power) and the immediately surrounding area of the main operating complex. Several ASTs and USTs were located near the building. The former Heat and Electrical Power Building also included three transformer banks and diesel generators. Site 15 is adjacent to Building 110 and includes the area east of former UST 13-2 and the corridor connecting to the diesel fuel pump island at Site 27. A break in this fuel line resulted in a reported 40,000 gallon diesel fuel spill.

10.3.2 Previous Removal/Remedial Actions

The building, tanks, fuel lines, and contaminated concrete were removed under previous removal actions. PCB-contaminated soils surrounding Building 110 were also excavated and disposed offsite during the 2001 (25 tons) and 2005 (116 tons) field seasons. Additional PCB-contaminated subsurface soil remains at Site 13. A large tank, UST #13-2 (20,000 gallons) and associated piping were removed and approximately 900 cubic yards of petroleum-contaminated soil were excavated and disposed off-site in 2001 (Foster-Wheeler, 2002). The excavation included removal of stained soils and the ancillary piping extending through Site 15 and 27 to the Site 11 above ground bulk fuel storage tanks. Contractual limits limited the amount of soil excavated. Soil confirmation samples from the bottom of the tank and piping excavations indicate additional fuel-contaminated soil is present in subsurface soils (USACE, 2004).

10.3.3 Nature and Extent of Contamination

Soil sampling activities during the phase I remedial investigation (1994) around Building 110 and the former UST #13-2 indicated DRO at concentrations up to 10,800 mg/kg (BH13-3, 11 ft bgs). Historical sampling locations are shown on Figure 10-4. An additional 18 soil borings and 10 monitoring wells were installed in 2002 throughout the northeast corner of the main complex, including Sites 13, 15, 19, and 27. Petroleum hydrocarbon compounds were detected at maximum concentrations of 51,000 mg/kg DRO, 6,000 mg/kg RRO, and 81 mg/kg naphthalene in soil boring SB88-11 (7-9 ft bgs) during the 2002 investigation. The maximum concentration of benzene was detected in SB88-13 (6-8 ft bgs) at a concentration of 0.37 mg/kg. The maximum detections of benzene and naphthalene are below the Scenario A risk-based soil alternate cleanup levels of 2 mg/kg and 92 mg/kg, respectively, but exceed the Scenario B migration to groundwater alternate cleanup levels of 0.02 mg/kg and 64 mg/kg, respectively. In 2004, two additional soil borings were installed to evaluate depth of contamination (SB13B1 and

SB19B1). DRO was detected at a maximum of 11,700 mg/kg west of former Building 110 (SB13B1) at 6 ft bgs, and at a maximum of 3,590 mg/kg southwest of former Building 108 (SB19B1) at 13 ft bgs. GRO was also detected at concentrations up to 513 mg/kg (estimated) at SB13B1.

During the 1994 investigation, eight groundwater monitoring wells were installed between Sites 11, 13, 15, 19, and 27. Groundwater samples were collected and analyzed for petroleum hydrocarbons, BTEX, and metals. In 1998, another round of groundwater samples were collected from the monitoring wells and analyzed for DRO, RRO, and BTEX. Ten new monitoring wells were installed during the 2002 investigation and the samples were analyzed for petroleum hydrocarbons and BTEX. DRO concentrations in groundwater ranged from 0.71 to 72 mg/L throughout the Main Complex area. GRO ranged from 0.42 to 1.5 mg/L, whereas RRO ranged from 0.22 to 2.3 mg/L. Benzene was detected in six monitoring wells (MW11-3, 13-2, 19-1, 88-4, 88-5, 88-7) above the Table C groundwater cleanup level of 0.005 mg/L, ranging from 0.01 to 0.12 mg/L. Arsenic was detected above the Table C cleanup level of 0.05 mg/L at two monitoring wells (MW13-1, 15-1) in 1994 (0.073 and 0.11 mg/L). However, the dissolved phase concentrations of arsenic in the samples (0.011 and 0.006 mg/L, respectively) did not exceed the cleanup level. In 2004, the existing monitoring wells at the main complex were sampled a second time, if possible, and analyzed for petroleum hydrocarbons, BTEX, PAHs, and selected metals (chromium, lead, mercury, zinc). Lead exceeded the Table C cleanup levels at eight locations (MWs 13-1, 13-2, 15-1, 19-1, 19-2, 27-1, 88-2, 88-10). The groundwater sampling results confirmed the presence of fuels (DRO, RRO, GRO), benzene, and lead above drinking water standards. Table 10-1 summarizes the historic groundwater data at the Main Complex. Groundwater monitoring well locations are also shown on Figure 10-4.

The UST, associated pipeline, and POL-contaminated soils were excavated and removed in 2001. Soil confirmation samples from the bottom and sides of the excavation indicate petroleum hydrocarbons remain in subsurface soils (see Figure 10-2 for sample locations). The soil confirmation sampling results indicate GRO ranged from ND to 400 mg/kg; DRO ranged from ND to 36,500 mg/kg (UST-CS-27-EN-04-001); and RRO ranged from ND to 9,100 mg/kg (UST-CS-27-ES-04-001). DRO exceeded the risk-based alternate cleanup level of 9,200 mg/kg. Benzene ranged from ND to 0.798 mg/kg (UST-CS-27-WS01-04-01); toluene ranged from ND to 7.55 mg/kg (UST-CS-27-WS01-04-01); ethylbenzene ranged from ND to 8.09 mg/kg (UST-CS-27-WS01-04-01). Benzene exceeded the migration to groundwater alternate cleanup level of 0.02 mg/kg, but not the risk-based alternate cleanup level of 2 mg/kg. Naphthalene ranged from 6.2 to 191 mg/kg (UST-CS-27-EN-04-01) and exceeded the Scenario A risk-based alternate cleanup level of 120 mg/kg and the Scenario B migration to groundwater ACL of 64 mg/kg at only one location. Confirmation soil sample depths varied between 4 and 7 ft bgs.

The tank excavation dimensions were 25 ft wide x 53 feet long and 10 to 12 ft deep. The excavation was backfilled with medium to coarse-grained sand. The fuel line excavation was irregularly shaped. Soils removed consisted of intermixed clay, sand, gravel, and cobbles consistent with fill materials of gravel pad. Groundwater was encountered in the excavation at a depth of 7.5 feet bgs (UST 13-2) and between 4 to 7 ft bgs along the fuel pipeline.

PCB-contaminated soils remain in Site 13 subsurface soils at several locations, including adjacent to former concrete transformer pads #13-1 and #13-3. Soil screening and laboratory confirmation samples following the 2005 removal action indicate residual PCB concentrations up to 37.1 mg/kg. An estimated 150 cubic yards of soil remain with PCBs above the cleanup level of 1 mg/kg. In addition, soil samples collected during the 2003 demolition of the wooden utilidor corridor south of Building 110 indicated two discrete hits of PCBs ranging from 2.4 to 16.9 mg/kg, at depths of 4 to 5 feet below ground surface. The utilidor trenches were backfilled with clean fill.

Table 10-1. Main Complex Groundwater Data Summary

Contaminants of Potential Concern	Units	Results 2004	Results 2002	Results 1998	Results 1994	Table C Level [a] (mg/L)	HQ (unitless)
NONCARCINOGENS							
Arsenic	mg/L	NA	NA	NA	0.006 – 0.11	0.05	4.6[b]
Arsenic, dissolved					ND – 0.011		
Lead	mg/L	ND – 0.0546	NA	NA	0.023 – 0.68	0.015	--
Lead, dissolved					ND – 0.015		
Benzene	mg/L	ND – 0.033	ND – 0.03	ND	ND – 0.12	0.005	0.1
Ethylbenzene	mg/L	ND – 0.098	ND – 0.12	ND – 0.066	ND – 0.15	0.7	0.2
Toluene	mg/L	ND – 0.082	ND – 0.12	ND	ND – 0.176	1	0.14
PETROLEUM HYDROCARBONS							
DRO	mg/L	0.345 – 15.2	0.7 – 72	0.34 – 960	1.4 – 34	1.5	
GRO	mg/L	0.014 – 1.5	ND – 1.5	ND	ND – 6.1	1.3	
RRO	mg/L	0.168 – 2.28	ND – 2.3	ND – 3.8	ND – 190	1.1	
CARCINOGENS							Cancer Risk
Arsenic	mg/L	NA	NA	NA	0.006 – 0.11	0.05	8.9E-04
Benzene	mg/L	ND – 0.033	ND – 0.03	ND	ND – 0.12	0.005	5.9E-06
OTHER PARAMETERS							
Dissolved Oxygen	mg/L	0.2 – 3.4 (10.7 - 14.6*)	4.1 – 8.4				
Ferrous Iron	mg/L	0.11 – 3.3	NA				
Alkalinity	mg/L	5 – 125	26 - 273				
Temperature	˚C	5.0 – 7.4	2.1 – 6.0				
Depth to Water	Ft	5 to 12	10 to 25				
pH	none	5.4 – 6.6	3.0 – 7.7				
Oxygen reduction potential	mV	-50 to 238	NA				
Turbidity	NTUs	5.3 – 289	220 ->1000				
Sulfate	mg/L	NA	0.8 – 17				

Notes: Lead and petroleum hydrocarbons are not included in cumulative risk calculations per Cumulative Risk Guidance (ADEC, 2002)

Data included for contaminants detected above 1/10th 18 AAC 75.345 Table C cleanup levels

[a] from 18 AAC 75.345 Table C (as amended through December 30, 2006)

[b] the Table C value for arsenic by itself exceeds a HQ of 1, and is considered protective of human health

*unusually high DO reading may be due to instrument malfunction

ACL - alternate cleanup level mg/L - milligrams per liter ND - non detect

HQ - hazard quotient NA - not analyzed for NTUs - nephelometric turbidity units

10.4 Site 19 – Auto Maintenance and Storage Facilities

10.4.1 Background

This site includes the former auto maintenance facility (Building 109), and the auto storage facility (Building 108). These buildings were constructed with concrete floors and floor drains.

10.4.2 Previous Removal/Remedial Actions

Both buildings were demolished during the 2003 removal action. The north end of Building 109 contained a grease pit/sump, which was also cleaned out during the removal action. An AST outside of Building 108 was removed during 2000. An upper layer of PCB-contaminated concrete from Building 109 and a portion of the floor at Building 108 were also demolished and disposed off-site during the 2005 removal action. After removal of the contaminated concrete sections, confirmation samples were collected from either the underlying concrete or soil. The samples confirmed that PCBs were successfully removed.

10.4.3 Nature and Extent of Contamination

Soil and groundwater samples were initially collected during the Phase I remedial investigation (1994). Surface and subsurface soils, as well as monitoring wells indicated the presence of petroleum hydrocarbons at concentrations exceeding screening levels. Three soil borings and monitoring wells were installed in the vicinity of Site 19 during the 2002 field season (see Figure 10-4). During the 2004 remedial investigation, additional sampling activities were conducted, including completion of a soil boring (SB19B1) between Buildings 108 and 109 to determine the depth of contamination and site-specific soil characteristics. Soil at Site 19 contains DRO at concentrations of 13,300 mg/kg at 12 ft bgs (1994), 5,000 mg/kg at 18 ft bgs (2002), and 3,590 mg/kg at 14 ft bgs (2004). Groundwater monitoring wells downgradient and surrounding Site 19 were also sampled for fuels, BTEX, and metals. The shallow groundwater in the vicinity contained benzene, DRO, GRO, and RRO above the ADEC Table C cleanup levels (see Section 10.3).

10.5 Site 27 – Diesel Fuel Pump Island

10.5.1 Background

The diesel fuel pump island was originally used to refuel heavy equipment and vehicles. The site included a small shed and cement valve box, and a buried pipeline from the bulk fuel storage tanks at Site 11.

10.5.2 Previous Removal/Remedial Actions

The pumphouse shed was demolished and removed during 2001 fieldwork activities. The buried pipeline was also removed and stained soils were excavated along the corridor.

10.5.3 Nature and Extent of Contamination

Soil confirmation sampling in 2001 from the pipeline excavation work indicates petroleum contamination remains in the subsurface soils. A total of 18 samples were collected from the side and bottom walls of the excavation (see Figure 10-2). DRO concentrations ranged from 144 to 36,500 mg/kg and exceed the risk-based alternate cleanup level of 9,200 mg/kg at 7 sampling locations. GRO and RRO were detected but did not exceed alternate cleanup levels. GRO concentrations ranged from ND to 491 mg/kg. RRO concentrations ranged from 92 to 9,100 mg/kg. Naphthalene concentrations ranged from 0.036 to 191 mg/kg and exceeded the Scenario A risk-based alternate cleanup level of 120 mg/kg at one location. Soil borings completed in 2002 also indicate petroleum contamination in soil at depths up to 11 feet bgs. DRO concentrations ranged from 20 – 51,000 mg/kg; RRO ranged from 16 to 6,000 mg/kg; benzene ranged from ND to 0.37 mg/kg; and naphthalene ranged from 0.0011 to 81 mg/kg.

10.6 Main Operations Complex Combined

10.6.1 Conceptual Site Model

The primary affected media is gravel pad soil and shallow groundwater. PCB contaminated soils adjacent to the former Building 110 will be evaluated separately under Area of Concern I – PCB Contaminated Soils (see Section 14). The shallow groundwater is contaminated throughout the northeast portion of the site. The potential complete exposure pathways include future residential use and incidental ingestion of or dermal contact with soils, and consumption of groundwater as a future drinking water source. The site topography and historical groundwater elevation measurements indicates groundwater flow is generally north towards the Drainage Basin, and somewhat northwestern from the site. Shallow groundwater migration patterns in the subsurface could also be influenced by fractures in the bedrock. The fuel contamination is assumed to have reached the smear zone along shallow groundwater interface, which ranges from 10 to over 20 feet below ground surface. Soil contamination may extend below the water table elevation, depending on actual aquifer conditions.

10.6.2 Risk Assessment

Each site was evaluated separately in the risk assessment. The risk assessment evaluated a future permanent resident scenario that assumed long term exposure to soils and shallow groundwater. At each site (Sites 10, 11, 13, 15, 19, and 27), DRO concentrations in soil contributed to potential risks for a future resident that exceeded a threshold of 1. At Site 11, naphthalene also contributed to potential risks from contaminated soils. PCBs in soil were the primary risk driver at Site 13. The shallow groundwater at the Main Complex also contains contaminants which contribute to potential risks if the water is utilized as a permanent future drinking water supply. The concentrations of DRO, GRO, RRO, benzene, and arsenic were the primary risk drivers which contributed to the risks. Lead also exceeded drinking water maximum contaminant levels. Arsenic is found naturally in the environment and the observed concentrations in groundwater are likely within background levels for Alaska. The cumulative risk from multiple contaminants of potential concern in the shallow groundwater was evaluated and does not exceed 1 (with the exception of arsenic, see note in Table 10-1). Table C cleanup levels are assumed protective of human health and the ingestion of groundwater. Table C values were developed using EPA's maximum contaminant levels (MCLs), maximum contaminant level goal (MCLGs), or health based limits (HBLs). MCLs and MCLGs incorporate other factors including feasibility and cost into determining the cleanup levels. For some chemicals, such as arsenic, the cleanup level in Table C exceeds the cumulative risk standard.

10.6.3 Remedial Action Objectives

Soil

Site-specific soil cleanup levels appropriate for the Main Complex area were developed based on two scenarios. Under Scenario A, the cleanup levels were calculated using the completed exposure pathways from the human health risk assessment (i.e., incidental ingestion of or contact with contaminated soil). The Scenario A soil cleanup levels are protective of future residents. Under Scenario B, soil cleanup levels were calculated using site specific information for the migration to groundwater pathway only. Site-specific characteristics of the soil matrix are used to derive cleanup levels. The Scenario B soil cleanup levels assume that contamination may migrate through the subsurface to the groundwater and cause exceedances of a drinking water standard. Note that concentrations of petroleum hydrocarbons and other compounds have been measured directly in shallow groundwater. The shallow groundwater or an alternate drinking water source is evaluated separately in the next section.

Scenario A – Soil Alternate Cleanup Levels (risk-based on soil ingestion)

- DRO 9,200 mg/kg
- RRO 9,200 mg/kg
- Benzene 2 mg/kg
- Ethylbenzene 21 mg/kg
- Toluene 180 mg/kg
- Naphthalene 120 mg/kg

Scenario B – Soil Alternate Cleanup Levels (migration to groundwater pathway, 0.3% TOC)

- DRO 850 mg/kg
- RRO 22,000 mg/kg
- Benzene 0.02 mg/kg
- Ethylbenzene 13 mg/kg
- Toluene 10 mg/kg
- Naphthalene 64 mg/kg

Groundwater

Cleanup levels for shallow groundwater are based on the ADEC groundwater cleanup levels found in 18 AAC 75, Table C.

- DRO 1.5 mg/L
- GRO 1.3 mg/L
- RRO 1.1 mg/L
- Benzene 0.005 mg/L
- Lead 0.015 mg/L

10.6.4 Site Parameters

Soil
An estimated 13,000 cubic yards of petroleum-contaminated soil exists at the Main Operations Complex which exceeds the Scenario A alternate cleanup levels. Scenario A is applicable to the Main Operations Complex because the area may be used as a future residential site and the incidental ingestion/dermal contact pathways would be complete. If the Scenario B migration to groundwater alternate cleanup levels are applied to the Main Operations Complex, an additional 15,000 cubic yards of petroleum-contaminated soil are present which exceed these cleanup levels.

The migration to groundwater pathway is potentially complete in this area because a shallow groundwater aquifer has been documented that could be used as a future drinking water source. The shallow groundwater within the northeast portion of the Main Operation Complex is known to be contaminated with petroleum and other compounds. A potential alternate drinking water source is a deeper aquifer present beneath the area or shallow groundwater upgradient of the known contamination. The Scenario B soil cleanup levels should be applied with caution. The Scenario B model predicts alternate migration to groundwater cleanup levels based on very conservative assumptions which do not accurately account for the presence of non-aqueous phase liquids (NAPL) in the soil above the soil saturation limit (Csat). The Scenario B alternate cleanup levels may overestimate soil concentrations that could cause an exceedance of the groundwater standards.

The horizontal extent of soil contamination above the Scenario A and Scenario B alternate cleanup levels is shown by the polygons on Figure 10-3. The depth of petroleum-contaminated soil ranges from 8 to 16 feet below ground surface. The petroleum-contaminated soil likely exists across a smear zone from shallow groundwater fluctuations. Excavation of contaminated soils below the water table or at depths greater than 15 feet is more difficult to implement and typically not conducted. The northeast corner of the main complex is considered the source area for contamination in the drainage basin (e.g., sediments) to the north (Site 28).

Shallow groundwater
Shallow groundwater at the Main Operations Complex contains petroleum hydrocarbons and other contaminants of concern which exceed ADEC Table C cleanup levels. COCs in the shallow groundwater include: lead, benzene, DRO, GRO, and RRO. The depth to groundwater across the northeast portion of the main complex varies from 10 to 25 feet below ground surface, or between an elevation of 53 and 61 ft above mean sea level. The gravel pad slopes north and the depth to native soil and permafrost decreases north of the perimeter edge road. Natural attenuation parameters were also measured during the 2002 and 2004 sampling events.

10.7 Main Operations Complex Screening of Alternatives

No Action is retained for further evaluation per the requirements of the NCP. There are no costs associated with this alternative.

Institutional controls are applicable to the Main Operations Complex and could involve physical, legal, or administrative mechanisms to restrict the use of or access to the site to prevent future risks to human health, safety, or the environment. Such controls could include a deed notice to provide information to current or future landowners about the presence of contaminated soils at the site and the need for proper management of the soils if excavated. Other measures could involve future building restrictions or an advisory limiting the consumption of shallow groundwater. ICs are an effective tool to prevent exposure to the contaminants, can be implemented and typically have minimal costs. ICs are retained for further evaluation.

Natural attenuation and *long term monitoring* allow natural surface and sub-surface processes to reduce contaminant concentrations to acceptable levels over time. This alternative is applicable to the Main Operations Complex because the primary contaminant of concern is petroleum hydrocarbons, which are known to naturally break down in the environment. Natural attenuation would not cause damage to the surrounding tundra/wetland environment. The costs associated with long term monitoring are relatively low.

The *capping* of petroleum-contaminated soils at the Main Operations Complex was eliminated from further consideration. The size of the surface area affected at the Main Complex is relatively large, and includes significant subsurface contamination. Capping would not eliminate the potential source area for shallow groundwater contamination.

Landfarming was retained for further evaluation. The volume of soil contaminated above cleanup levels is relatively large. Several areas exist at Northeast Cape where soils could be spread out for landfarming. The cold temperatures may limit the effectiveness of this technology. Costs will be relatively moderate.

Phytoremediation was retained for further evaluation. The short growing season is enhanced by the long days. Phytoremediation has been demonstrated effective at treating petroleum hydrocarbons. The costs are relatively moderate.

Thermal treatment was retained for further evaluation. Soil burning is a proven technology to remediate diesel-contaminated soils. Costs are moderate to high. Implementability may be more difficult given the remote location, lack of power, and no permanent residents nearby. All materials must be flown in or transported by barge. The large volume of contaminated soil at this site may increase cost effectiveness to perform treatment on-site.

Off-site treatment/disposal was retained for further evaluation. Soil excavation, containerization, transport and disposal are straightforward methods to remediate the site. Adverse environmental impacts could include damaging the tundra by heavy equipment.

Reactive matting was eliminated from further consideration at the Main Operations Complex. The primary media affected is gravel fill soils. The downgradient sediments are addressed under the Drainage Basin area of concern.

Chemical oxidation was retained for further evaluation. The shallow groundwater at the Main Operations Complex contains elevated levels of petroleum hydrocarbons and other organic compounds. Introducing chemical oxidation into the shallow groundwater may enhance achieving the remedial action objectives in a shortened time period. This technology could also reduce the toxicity of the contaminants. Costs are relatively high due to the logistics and support needed to implement the chemical oxidation. Chemical oxidation would be effective for enhancing the degradation process of the petroleum hydrocarbon contaminated groundwater. Implementability may be more difficult at a remote site such as St. Lawrence Island, with a field season of 90-120 days. Due to the short field season, the treatment application process may exceed one field season.

Reactive walls were retained for consideration at the Main Operations Complex.

Constructed wetlands were eliminated from consideration. The primary media affected is gravel fill soils. Although the area surrounding the gravel pad is native tundra, enhancing this natural system would achieve limited benefits for the existing gravel pad petroleum contamination.

10.8 Main Operations Complex Detailed Analysis of Alternatives

10.8.1 Main Operations Complex Alternative 1 – No Action

Description
Under the no action alternative, the site would be left in its current state, with no activities to control or mitigate exposure to site contaminants. The no action alternative provides a baseline for comparing other remedial alternatives and is required for consideration by the NCP. There are no costs associated with Alternative 1.

Overall protection of human health and the environment
The existing levels of petroleum hydrocarbons and other constituents in soil may pose a potential risk to future seasonal or permanent residents, because the levels exceed the alternate soil cleanup levels based on human ingestion exposure. The concentration of PCBs in subsurface soils also exceeds the default ADEC cleanup level of 1 ppm and may pose a risk to future permanent residents if soil is excavated for construction activities. PCB-contaminated soils are evaluated separately in Section 14. The shallow groundwater may also pose a potential risk if used for drinking water purposes by future seasonal or permanent residents. The site does not currently pose a risk to site visitors. The Main Operations Complex is located approximately 2 miles from the Cargo Beach and the seasonal native fishing/hunting camp.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons will continue to occur even if no actions are taken. However, it would likely take many years to reach the site-specific ACLs under this approach. A relatively large volume of soil is contaminated above the ACLs.

Short-term effectiveness
The no action alternative would not be protective of future permanent residents who could be exposed daily to the contaminated soil. The no action alternative would not prevent current and future residents from accessing the shallow groundwater for a drinking water source, which could pose a risk if consumed year-round.

Long-term effectiveness and permanence
The no action alternative will not be effective in the long term. Future seasonal and permanent residents could be exposed to contaminants in the soil and groundwater at levels exceeding risk-

based cleanup levels. There would be no restrictions implemented to prevent the use of shallow groundwater for a drinking water source, or the excavation of contaminated soils.

Reduction in toxicity, mobility, or volume through treatment
No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
The no action alternative is easily implemented.

Cost
The estimated cost of Alternative 1 is $ 0.

10.8.2 Main Operations Complex Alternative 2 – Institutional Controls

Description
Institutional controls at the Main Operations Complex may include physical, legal, or administrative mechanisms to restrict the use of or access to the site to prevent future risks to human health, safety, or the environment. Such controls could include a deed notice to provide information to current or future landowners about the presence of contaminated soil at the site and the need for proper management of the soil if excavated. Other measures could involve restrictions on future construction of buildings, access controls, a drinking water restriction, or other methods of public education. An assessment of the status and effectiveness of the institutional controls would be made after 5 years.

Overall protection of human health and the environment
Institutional controls would prevent exposure of current and future residents to contaminated soils by restricting digging activities in the immediate vicinity. The site does not currently pose a risk to site visitors. The existing levels in soil may pose a potential risk to future seasonal or permanent residents if exposed to the soil on a daily basis.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons will continue to occur if institutional controls are implemented. It would likely take many years to reach the site-specific ACLs under this approach.

Short-term effectiveness
Since the site is accessible by Cargo Beach Road, and 2.0 miles from the seasonal native fishing/hunting camp, there is a medium potential for exposure to site contaminants over a short period of time.

Long-term effectiveness and permanence
Institutional controls can be effective in the long term. Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Reduction in toxicity, mobility, or volume through treatment
No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
Institutional controls are typically easily implemented. The need for, and likelihood of, landowner acceptance and compliance with ICs is a consideration for alternatives requiring them. The land at Northeast Cape is owned jointly by two local Native Corporations, Savoonga Native Corporation and Sivuqaq, Inc. The ability of the Corporations to accept and maintain land use controls is unknown.

Cost
The estimated cost of Alternative 2 is $ 186,000.

10.8.3 Main Operations Complex Alternative 3 – Natural Attenuation and LTM

Description
Under this alternative, natural attenuation would be combined with long term monitoring of the soil and shallow groundwater. The rate of petroleum hydrocarbon degradation has not been established and the extreme climate conditions on St. Lawrence Island could slow natural attenuation processes. Monitoring activities would establish a baseline, evaluate the reduction of contaminant concentrations over time, and determine potential off-site migration. This alternative could also further evaluate the contribution from biogenic compounds to total petroleum hydrocarbon sampling results.

Overall protection of human health and the environment
Natural attenuation processes would reduce risks to human health and the environment over the long term. The Main Operations Complex does not pose a risk to current site visitors. However, the levels of petroleum contamination could pose a potential future risk to seasonal or permanent residents.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons will continue to occur if long term monitoring is implemented. It would likely take many years to reach the site-specific ACLs under this approach.

Short-term effectiveness
Since the site is accessible by Cargo Beach Road, and 2.0 miles from the seasonal native fishing/hunting camp, there is a medium potential for exposure to site contaminants over a short period of time.

Long-term effectiveness and permanence
Natural attenuation and monitoring can be effective in the long term. Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site

conditions, implemented controls, and monitoring results would be required as part of this alternative.

Reduction in toxicity, mobility, or volume through treatment
No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
Natural attenuation and long term monitoring activities are typically easily implemented. This alternative would include periodic sampling of the site to evaluate trends in contaminant concentrations. Long term monitoring would involve an initial site visit to establish baseline conditions and periodic monitoring of soil and shallow groundwater.

Cost
The estimated cost of Alternative 3 is $ 843,000.

10.8.4 Main Operations Complex Alternative 4 – Landfarming

Description
An estimated 28,000 cubic yards of petroleum-contaminated soils at the Main Operations Complex would be excavated and spread out in a designated area at Northeast Cape. Simply excavating and mixing the soils, as well as incorporating amendments (e.g., fertilizer, compost) will promote biological activity and enhance the natural breakdown of the petroleum hydrocarbons. Soils would be excavated to meet the Scenario B alternate cleanup level of 850 mg/kg for DRO. Excavation of the major source of contamination would prevent future transport of contaminants to the sediments, surface water or shallow groundwater.

Overall protection of human health and the environment
Landfarming would reduce risks to human health and the environment over the long term. The contaminated soil would be removed and treated to meet Scenario B migration to groundwater ACL. Since no permanent residents currently reside at Northeast Cape, there is no current risk to human health.

Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Compliance with ARARs
Landfarming should meet cleanup levels within one or two field seasons for the petroleum-contaminated soils.

Short-term effectiveness
Excavation of a large volume of gravel soils may cause resuspension of sediments or migration of contaminants to the adjacent tundra in the short term. The site does not pose a current risk to human health.

Long-term effectiveness and permanence
Landfarming is a proven technique to break down petroleum hydrocarbons.

Reduction in toxicity, mobility, or volume through treatment
Landfarming would significantly decrease the petroleum hydrocarbon concentrations.

Implementability
Landfarming is relatively easy to implement. A flat area, such as the main operations complex, would be necessary to conduct the remedial activity. The progress of the soil treatment would need to be monitored, and the soils periodically turned over or tilled with a machine. Excavation of contaminated soils below the water table or at depths greater than 15 feet is more difficult to implement and typically not conducted.

Cost
The estimated cost of Alternative 4 is $ 6,840,000.

10.8.5 Main Operations Complex Alternative 5 – Phytoremediation

Description
An estimated 28,000 cubic yards of petroleum-contaminated soil at the Main Operations Complex would be excavated and spread out in a designated area at Northeast Cape. The excavated soil would be planted with a mixture of plants such as arctic red fescue or other grasses. Amendments such as fertilizer or compost can also be added to promote biological activity and enhance the natural breakdown of the petroleum hydrocarbons. Soil would be excavated to meet the Scenario B alternate cleanup level of 850 mg/kg for DRO. Excavation of the major source of contamination would prevent future transport of contaminants to the sediment, surface waters or shallow groundwater.

Overall protectiveness of human health and the environment
Phytoremediation would reduce risks to human health and the environment over the long term. Since no permanent residents currently reside at Northeast Cape, there is no current risk to human health.

Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Compliance with ARARs
Phytoremediation should meet cleanup levels within several years for the petroleum-contaminated soils.

Short-term effectiveness
Excavation of the contaminated soil would be effective at reducing potential exposures in the short term.

Long-term effectiveness
Phytoremediation is a proven technique to remediate petroleum hydrocarbons.

Reduction in toxicity, mobility, or volume through treatment
Phytoremediation would significantly decrease the petroleum hydrocarbon concentrations. For the shallow groundwater, natural processes are assumed to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
Excavating soils, spreading it onsite and seeding with plants and grasses is a relatively simple process. Excavation of contaminated soils below the water table or at depths greater than 15 feet is more difficult to implement and typically not conducted. Plant growth could be adversely affected by short growing season, but the abundant daylight compensates for the cold temperatures. The alternative would have less maintenance requirements than landfarming. Phytoremediation does not require long term maintenance such as periodic tilling of the soil. However, there are more uncertainties associated with achieving good rates of plant growth.

Cost
The estimated cost of Alternative 5 is $ 6,950,000.

10.8.6 Main Operations Complex Alternative 6 – Thermal Treatment

Description
An estimated 28,000 cubic yards of petroleum-contaminated soil at the Main Operations Complex would be excavated and treated onsite using a soil burner to destroy the petroleum hydrocarbons using high temperatures. The soil would be treated to meet the Scenario B alternate cleanup level of 850 mg/kg for DRO. The treated soils would be returned to the site or used as fill material elsewhere at Northeast Cape. A power source (e.g., generator) would be necessary to run the equipment. Excavation of the major source of contamination would prevent future transport of contaminants to the sediment, surface water or shallow groundwater.

Overall protectiveness of human health and the environment
Excavation and thermal treatment of the soils would reduce risks to human health and the environment over the short and long term. The contaminated soil would be removed and treated to meet the Scenario B ACLs. Since no permanent residents currently reside at Northeast Cape, there is no current risk to human health.

Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Compliance with ARARs
Excavation and thermal treatment would meet the migration to groundwater cleanup levels for the petroleum-contaminated soils.

Short-term effectiveness
Excavation and treatment of the contaminated soil would be effective at reducing potential exposures in the short term. Excavation may cause short term damage to the adjacent tundra environment. It may be more difficult to treat the soils from within the smear zone that are saturated using thermal treatment. Additional dewatering of the excavation pits may be necessary.

Long-term effectiveness
Thermal treatment is a proven technique to remediate petroleum hydrocarbons.

Reduction in toxicity, mobility, or volume through treatment
Thermal treatment destroys the petroleum hydrocarbons thus reducing the toxicity, mobility and volume of the contaminants in the soils.

Implementability
Thermal treatment is slightly more complex than excavating the soils under the landfarming or phytoremediation alternatives. In addition to heavy equipment needed for soil excavation, a soil burner would need to be transported to Island. A suitable power source is also necessary. The cold temperatures and harsh climate will limit the operating timeframe of the soil burner. If contamination is present across the water table, the soils may also need to be dewatered prior to treatment. Excavation of contaminated soils below the water table or at depths greater than 15 feet is more difficult to implement and typically not conducted.

Cost
The estimated cost of Alternative 6 is $ 7,200,000.

10.8.7 Main Operations Complex Alternative 7 – Off-site Treatment and Disposal

Description
An estimated 28,000 cubic yards of petroleum-contaminated soil at the Main Operations Complex would be excavated and transported off-site for treatment and/or disposal at a permitted landfill facility. Soils would be excavated to meet the Scenario B alternate cleanup level of 850 mg/kg for DRO. Excavation of the major source of contamination would prevent future transport of contaminants to sediment, surface water or shallow groundwater.

Overall protectiveness of human health and the environment
Excavation and offsite treatment/disposal of soils would reduce risks to human health and the environment. The contaminated soil would be removed to meet the Scenario B ACLs. Since no permanent residents currently reside at Northeast Cape, there is no current risk to human health.

Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Compliance with ARARs
Excavation and off-site treatment/disposal would meet the migration to groundwater cleanup levels for the petroleum-contaminated soil.

Short-term effectiveness
Excavation and offsite treatment/disposal of the soil could meet the cleanup levels in one field season. Excavation may cause short term damage to the adjacent tundra environment.

Long-term effectiveness
Excavation and off-site treatment/disposal permanently removes the source of contaminated soils.

Reduction in toxicity, mobility, or volume through treatment
Excavation and off-site treatment or disposal permanently removes the petroleum hydrocarbons thus reducing the toxicity, mobility and volume of the contaminants in the soil.

Implementability
Excavation and off-site transport is a straightforward remedial alternative that is commonly implemented at contaminated sites. Excavation of contaminated soils below the water table or at depths greater than 15 feet is more difficult to implement and typically not conducted. The remote location will add complexity to this alternative and barge services will be required. Additional measures to prevent release of contaminants to adjacent surface waters may be necessary during excavation activities. This alternative can be completed in one field season.

Cost
The estimated cost of Alternative 7 is $ 11,000,000.

10.8.8 Main Operations Complex Alternative 8 – Chemical Oxidation

Description
The shallow groundwater contamination would be actively addressed under this alternative. The area in the northeast portion of the Main Operation Complex gravel pad would be targeted for treatment. Temporary well points are typically installed throughout the plume to inject oxidizing compounds (e.g., ozone, hydrogen peroxide, etc.) into the subsurface. Chemical oxidation will promote the increased degradation of the petroleum hydrocarbons. The introduction of chemical oxidation into the shallow groundwater may enhance achieving the remedial action objectives in a shortened time period. This option chemically converts hazardous contaminants to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. The oxidizing agents most commonly used are ozone, hydrogen peroxide, hypochlorites, chlorine, and chlorine dioxide. The chemical oxidants most commonly employed to date include peroxide, ozone, and permanganate. These oxidants have been able to cause the rapid and complete chemical destruction of many toxic organic chemicals; other organics are amenable to partial degradation as an aid to subsequent bioremediation. Field applications have clearly affirmed that matching the oxidant and *in situ* delivery system to the contaminants of concern (COCs) and the site conditions is the key to successful implementation and achieving performance goals. The soil contamination is not directly addressed under this alternative.

Overall protectiveness of human health and the environment
The alternative would be protective of human health and the environment. Treatment of the contaminated groundwater would require design of the quality, placement, and monitoring of the chemical oxidation process. The shallow groundwater would be treated to meet the groundwater cleanup levels over time. The contaminated soil is evaluated under the other alternatives.

Compliance with ARARs
This alternative would likely comply with ARARs over time, and the shallow groundwater would meet the cleanup levels in a shortened period of time.

Short-term effectiveness
Under this alternative, drilling and implementation of the chemical oxidation process poses potential adverse impacts to the construction personnel on site. However, these impacts are easily controlled with proper construction safety, equipment, and chemical handling techniques. The short-term effectiveness of this alternative for treating contaminated groundwater is still considered low.

Long-term effectiveness
The long-term effectiveness and permanence of the alternative would likely achieve the groundwater cleanup levels in a reasonable time frame. The treatment would increase the oxidation process of the petroleum hydrocarbons and allow the shallow groundwater to meet the cleanup levels in a shortened period of time.

Reduction in toxicity, mobility, or volume through treatment
This alternative would greatly reduce the toxicity, mobility and volume of the shallow groundwater contamination. The chemical oxidation would be effective for enhancing the degradation process of the petroleum hydrocarbon contaminated groundwater. The contaminated soils would not be directly addressed by this alternative.

Implementability
Chemical oxidation would be more complex than the other remedial alternatives. This alternative would require greater logistics planning and chemical handling due to the remoteness of the St. Lawrence Island site and with a limited field season of 90-120 days. Chemical oxidation techniques vary from vendor to vendor. In most cases this technology is a straightforward option that is commonly implemented at contaminated sites. Depending on the design study and field conditions, several applications of the chemical oxidants may be required to achieve cleanup levels for the contaminated shallow groundwater.

Cost
The estimated cost of Alternative 8 is $ 4,000,000.

10.8.9 Main Operations Complex Alternative 9 – Reactive Walls

Description
An estimated 900 lineal feet of sheet piling would be buried along the north edge of the Main Operations Complex to intercept and direct the contaminated shallow groundwater towards a 300

foot length reactive/permeable barrier for treatment. The reactive wall will contain a mixture of activated carbon, proprietary oxidizing powders, and pea gravel.

Overall protectiveness of human health and the environment
Use of the reactive wall would reduce risks to human health and the environment. The contaminated shallow groundwater would be directed and treated to meet the groundwater cleanup levels. Since the shallow groundwater is not currently used for drinking water, there is no current risk to human health.

Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Compliance with ARARs
Treatment of the shallow groundwater using the reactive wall system would meet the cleanup levels.

Short-term effectiveness
Diversion and passive treatment of the shallow groundwater would meet the cleanup levels over time.

Long-term effectiveness
The passive treatment of the shallow groundwater permanently filters the petroleum contaminants. The materials within the reactive walls may "max out' and need to be replaced at a future date.

Reduction in toxicity, mobility, or volume through treatment
Passive treatment of the shallow groundwater remediates the petroleum hydrocarbons and other constituents thus reducing the toxicity, mobility and volume of the contaminants in the water.

Implementability
A reactive wall is a relatively straightforward remedial alternative that is commonly implemented at contaminated sites. The remote location will add complexity to this alternative and barge services will be required. Additional measures to prevent release of contaminants to adjacent surface waters may be necessary during placement of the steel barrier. The reactive walls can be constructed in one field season, but would operate over time.

Cost
The estimated cost of Alternative 9 is $ 8,200,000.

10.9 Main Operations Complex – Comparative Analysis of Alternatives

A combination of alternatives would achieve the highest degree of protection for human health and the environment. Different alternatives are more effective at addressing the contaminated soil versus the shallow groundwater impacts. Table 10-2 provides a comparative evaluation of each remedial alternative using the CERCLA criteria. A summary of the estimated cost of each alternative only is shown below. A combination of two or more technologies may be selected during the Proposed Plan phase. For example, to address soil contamination and groundwater impacts, the final remedy may include excavation and treatment of soils and installation of a chemical oxidation system for the groundwater.

Main Operations Complex	Cost
1 - No Action	$ 0
2 - Institutional Controls	$186,000
3 - Nat. Attenuation and LTM	$843,000
4 - Landfarming	$6,840,000
5 - Phytoremediation	$6,950,000
6 - Thermal Treatment	$7,200,000
7 - Off-site Treatment/Disposal	$11,000,000
8 - Chemical Oxidation	$4,000,000
9 - Reactive Walls	$8,200,000

11.0 AREA OF CONCERN F – DRAINAGE BASIN

11.1 Site 28 – Drainage Basin

11.1.1 Background


Eastern drainage view west towards Main Complex (2001)


View east (2006)

The Drainage Basin lies north of the Main Operations Complex and flows north into the Suqitughneq River. This site has been impacted by fuel releases from the bulk fuel storage tanks and other spill/releases. Surface water run-off and subsurface water seeps from the Main Operations Complex gravel pad drain into this tundra/wetland area.

Three discrete drainages originate from the Main Operations Complex gravel pad and contribute flow to the Site 28 Drainage Basin. The eastern drainage flows from the area adjacent to Sites 10 and 11, the middle drainage originates from a culvert which directs flow from the Site 27 former diesel fuel pump island, and the western drainage is adjacent to Site 13.

According to the Human Health and Ecological Risk Assessment Report (MWH, 2004), heavy black staining has been observed at the head of the eastern drainage, on the edge of the gravel pad at Site 10. In addition, a 120 by 30 foot area of soil staining and distressed vegetation was observed downgradient of the Site 11 former tank footprints.

The middle drainage originates as a small swale south of the perimeter access road, which collects surface water run-off from the vicinity of the Site 27 diesel fuel pump island. The run-off is then routed under the road via a culvert to an artificially created swale north of the Main Complex. An approximately 40 by 20 foot area of ponded water periodically exists immediately north of the culvert outlet. The swale is filled with grasses. Near the terminus of the swale, on the east side of the fill bank, is an approximately 20 by 30 foot area where the soils are stained black, with no vegetation. Staining also occurs 40 feet east of the swale, extended 2 to 5 feet up the embankment. The area is generally heavily vegetated with grass.


Middle drainage view south towards Main Complex (2001)


Drainage Basin view north from Main Complex (2006)

The western drainage originates from an artificially-created swale which contains a manhole and small (3x3 foot) concrete supporting structure just north of Site 13. According to Eugene Toolie, this manhole served as the drain for Building 110 Heat and Electric Power. North of the manhole, an approximately 10 foot wide by 40 foot long area of surface water drains to the north. The surface water had no petroleum sheen, but the sediments in this area are stained dark brown and black, and produce a heavy sheen when disturbed. Staining has also been observed about 2 feet up the embankment. Vegetation (grasses) grows freely in the drainage and does not appear adversely affected by hydrocarbon contamination.

Western drainage view north towards pond (2001)

(2006)

A hydrocarbon sheen has also been observed at the middle drainage (Site 27) during periods of high water flow (e.g., Spring run-off, snow melt, or heavy rain) according to the USACE Quality Assurance Representative (QAR) on-site during prior site-cleanup work involving building demolition and debris removal.

Drainage Basin – View south towards Main Complex (2001)

11.1.2 Previous Removal/Remedial Actions

Not applicable.

11.1.3 Nature and Extent of Contamination

The drainage basin has been investigated since 1994. Sediment, soil, surface water, and shallow groundwater samples have been collected and analyzed for various constituents. Sampling activities occurred in 1994, 1996, 1998, and 2001.

Sediment samples were collected 1994, 1996, 1998, and 2001. A summary of the range of detected analytes is presented in Table 11-1 (see Attachments). The primary contaminants of potential concern are chromium, lead, zinc, PCBs, PAHs, DRO, and RRO. The highest concentrations are predominantly located closest to the edge of the main complex (upgradient). Figure 11-1 shows the distribution of DRO concentrations in surface sediments of the Drainage Basin.

During the 1994 investigation, two monitoring wells (MW10-1 and MW 10-4) were installed within the eastern drainage of Site 28 to evaluate the subsurface water. MW10-1 was resampled during the 2004 investigation. COPCs were identified in the risk assessment using maximum concentrations of chemicals, instead of data from more recent sampling events. The COPCs include arsenic, copper, lead, nickel, and DRO. Arsenic was detected at a concentration of 0.039 mg/L (total) and ND (0.005) (dissolved) in MW10-1, but arsenic was not analyzed for in groundwater at MW10-4 or during the 2004 investigation. Lead was detected at concentrations ranging from 0.008 to 0.2 mg/L in 1994, but was not detected in the dissolved phase. During the 2004 investigation, lead was detected at a concentration of 0.00457 mg/L, which does not exceed the cleanup level of 0.015 mg/L. The maximum concentration of DRO detected was 3.2 mg/L during the 1994 investigation. Subsequent sampling of MW10-1 showed DRO was not detected (ND 0.333 mg/L).

Surface water samples were collected in the drainage basin in 1994, 1996, and 2001. The samples were analyzed for a comprehensive list of analytes in 1994, including fuels, BTEX, SVOCs, PAHs, PCBs, and metals. Concentrations of DRO, TRPH, PCBs, and lead were elevated in 1994. Lead ranged from ND to 0.11 mg/L. DRO ranged from 0.79 to 14 mg/L. PCBs ranged from ND to 0.0016 mg/L. The elevated concentrations of DRO, lead, and PCBs were all detected in one 1994 sample analyzed in triplicate (SW110/210/310). The total lead concentrations in this sample ranged from 0.051 - 0.11 mg/L, but the dissolved lead concentrations ranged from 0.0011 - 0.018 mg/L. Sample SW110 also contained PCB-1260 ranging from ND(0.001) - 0.0016 mg/L, and DRO from 12 - 14 mg/L.

In 1996, additional surface water samples were collected and analyzed for DRO and PCBs only. Unusually high concentrations of DRO and PCBs were reported in one triplicate surface water sample during the 1996 investigation. The primary sample result for DRO was reported as 610 mg/L, but qualified as an estimated value. The duplicate sample result of 41 mg/L was also qualified as estimated and the triplicate result of 22 mg/L was qualified as present in the blank. PCB-1260 was detected at the method detection limit of 0.0013 mg/L in the primary sample, and the duplicate and triplicate samples also contained reportable concentrations ranging from 0.0024 mg/L to 0.0026 mg/L. In 2001, surface water samples were collected and analyzed for DRO, RRO, and PCBs. PCBs (detection limit of 0.001 mg/L) and RRO were not detected, and DRO ranged from 0.39 to 2.3 mg/L.

Surface water samples were collected in 2001 and analyzed for DRO, RRO, and PCBs. The samples were not analyzed for lead. DRO was detected at concentrations ranging from 0.39 to 2.3 mg/L. PCBs (method detection limit of 0.0003 mg/L) and RRO were not detected.

Surface water samples were not collected in the Drainage Basin during the 2004 investigation. However, surface water samples were collected immediately downgradient of the drainage basin in the Suqitughneq River in 2004. PCBs were not detected at a method detection limit of 0.0005 mg/L.

11.1.4 Risk Assessment

Sediment

The COPCs in sediment are DRO, RRO, PAHs, PCBs, benzene, ethylbenzene, pesticides, dibenzofuran, chromium, lead, and zinc. The risk assessment assumed the wetland environment of the drainage basin site could only be used on a seasonal basis for subsistence or recreational activities. The only chemicals which contributed to potential human health risks from incidental contact with the sediment were DRO and lead. Using the exposure assumptions of the human health risk assessment (MWH 2004), DRO levels in sediment greater than 25,000 mg/kg exceed a hazard quotient of 1.

The ecological risk assessment (MWH 2004) predicted the potential for ecological risks to the tundra vole based on exposure to soil/sediment/water/plants in the Drainage Basin. The primary risk drivers were DRO, PCBs, barium, and zinc. DRO was detected in the soil/sediment and surface water, PCBs were detected in sediments, water and plants, whereas the barium was only measured in plant tissue, and zinc was measured in plant tissue and surface water.

The ecological risk assessment (MWH 2004) did not predict the potential for any ecological risks to other indicator ecological receptors (e.g., glaucous gull, cross fox) based on exposure to contaminants in the drainage basin. The ecological risk assessment concluded that higher trophic level ecological receptors such as the glaucous gull, a piscivorous bird, are not adversely affected by high levels (less than 400,000 mg/kg) of DRO or other contaminants in the sediment, soil, or water. Higher tropic level ecological receptors are more mobile, transient, and frequently move across large areas.

A Tier 1 screening of the COPCs against ecological benchmarks was also conducted as part of the ecological risk assessment (MWH 2004). The ecological screening benchmarks were selected based on a hierarchy of sources including consensus-based freshwater threshold effects concentrations and other threshold effects levels. The Tier 1 risk-based screening then compared site media concentrations to $1/10^{th}$ of the identified benchmark levels. Thus, a large range of chemicals were included in the Tier 2 ecological risk calculations for higher trophic level receptors. For this feasibility study, another comparison was made between various sediment quality guidelines (ecological screening values for sediment) and exposure point concentrations in the Drainage Basin and the Suqitughneq River (see Table 11-1). The state of Alaska recommends a first tier screening for evaluation of sediments at contaminated sites using a hierarchy of values starting with the threshold effects level (TEL) and probable effects level (PEL) from the NOAA Screening Quick Reference Table (SQuiRT) (September 1999). Additional sources of sediment screening values include consensus-based sediment quality guidelines developed since NOAA published their summary table. The State of Wisconsin Department of Natural Resources recommends use of consensus-based threshold effects concentration and probable effects concentrations developed by MacDonald et al. (2000) and Canadian environmental agencies. The State of Washington, Department of Ecology has also promulgated sediment management standards with two sets of numerical chemical criteria that apply to the marine environment. Table 11-1 shows that a majority of PAHs detected in the Drainage Basin exceed the threshold and probable effects levels as well as other sediment management standards. It is important to note, however, that the PAH exposure point concentration used for most of the comparisons was the maximum concentration detected, and in general the highest levels of PAHs which exceeded the identified sediment guidelines were found in only a few locations, usually closest to the main complex. Ecological screening levels do not exist for the petroleum fractions such as diesel, gasoline, or residual range organics.

The state of Alaska recommends using a weight of evidence approach to make final site-specific decisions regarding sediment contamination. The screening levels tabulated in Table 11-1 focus on adverse effects to low-trophic level organisms such as benthic invertebrates. The chemical data indicates the potential for adverse environmental impacts based on maximum PAH concentrations. Furthermore, field observations have noted black-stained soils and a sheen on the water closest to the main complex (western and middle drainages), which provides another line of evidence supporting the conclusion that the contaminated sediments in the Drainage Basin may pose a risk to the environment. The potential for ecological risks from petroleum hydrocarbon fractions is more difficult to quantify. Overall, the data indicate a low potential for adverse ecological effects to higher trophic level receptors based on the worst-case sediment concentrations. Higher trophic level receptors do not spend as much time in one particular location, have a larger home range relative to the impacted area, and thus are not exposed for a long enough duration to predict potential impacts.

A Tier II ecological assessment was also performed in 1999 by the University of Alaska's Environment and Natural Resources Institute (ENRI) as part of the Phase II remedial investigation activities. The objectives were to evaluate sediment toxicity, assess the macroinvertebrate community, and quantify toxins in fish tissue at 4 locations in the Suqitughneq River drainage, and a reference drainage the Quangeghsaq River. Physical habitat quality was similar between all locations. The field team noted that diesel oils were evident in the substrate during sampling in the Drainage Basin and in the Suqitughneq River near the Airport Road bridge. Microtox® bioassay results indicated that Drainage Basin and Airport Bridge locations had the highest toxicity units and were elevated in relation to the control sites. The macroinvertebrate community assessments also indicated impairment in the Drainage Basin and the Airport Bridge location according to the ENRI report. The report did not evaluate data from a quantitative ecological risk assessment perspective. The ENRI work did not include laboratory analysis of the sediments or surface water, thus a relationship between the field observations and chemical concentrations cannot be determined.

The sediments in the Drainage Basin are likely a continuing source of contaminants migrating downgradient to the Suqitughneq River and Estuary.

Soil

The COPCs in soil are beryllium, thallium, ethylbenzene, methylene chloride, PCBs, PAHs ((benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene), DRO, GRO, and RRO. The only chemical that contributed to potential human health cancer risk was benzo(a)pyrene. The calculated excess lifetime cancer risk for a future seasonal resident was $1x10^{-5}$. However, this value is within the acceptable risk range of the US EPA ($1x10^{-4}$ to $1x10^{-6}$). The DRO concentrations in soil may pose a potential noncancer risk based on a hazard index greater than 1. The ecological risk assessment concluded that only the tundra vole had the potential to be adversely effected by exposure to DRO levels in soil.

Surface water

The COPCs in surface water are chromium, copper, lead, zinc, PCBs, DRO and GRO. The data was evaluated in the human health risk assessment, and only two chemicals contributed to potential risks, PCBs and DRO.

Shallow Groundwater

COPCs were identified using maximum historic concentrations of chemicals, instead of data from more recent sampling events. The COPCs identified in the risk assessment included arsenic, copper, lead, nickel, and DRO. The primary risk driver was a single detection of total arsenic in groundwater. However, dissolved arsenic was not detected in the groundwater sample. The maximum concentration of DRO, 3.2 mg/L from the 1994 investigation, exceeded the ADEC Table C groundwater cleanup level, but according to the human health risk assessment does not pose an ingestion risk. Subsequent sampling of MW10-1 in 2004 showed DRO was not detected. No contaminants of concern were retained for the shallow groundwater.

11.1.5 Conceptual Site Model

The main source of contamination for the Drainage Basin is fuel spills and releases from site operations at the main complex. In particular, a large fuel spill was documented in 1967 from one of the above ground storage tanks at Site 11. The potentially impacted media within the Site 28 Drainage Basin includes the soil/sediments, surface water/groundwater, and plants. The potential human exposure pathways include direct contact pathways with soil/sediment (i.e., incidental ingestion of soil, dermal contact with soil/sediment, and inhalation of soil in the form of dust in indoor air). The consumption of surface or shallow subsurface water during occasional subsistence plant gathering activities by future residents was also considered, as well as the consumption of plants harvested from the Drainage Basin. Ecological exposure pathways included contact with soil/sediment, water, and food chain impacts from consumption of plants or fish.

The contribution of the Drainage Basin to the overall flow in the Suqitughneq River was measured[14] in 2001 and 2002. Based on stream discharge measurements upgradient and downgradient of the confluence, the Drainage Basin is estimated to comprise between 41 and 43 percent of the total Suqitughneq River flow.

11.1.6 Remedial Action Objectives

The primary remedial action objective for the Drainage Basin is to prevent future migration of contamination to the Suqitughneq River via suspended sediments or dissolved phase surface water transport. A second remedial action objective is to prevent future exposure of human receptors to contamination above risk-based cleanup levels.

The cleanup level targets for the soil and intermittently submerged sediments in the Drainage Basin were developed based on two different scenarios. Under Scenario A, soil alternate cleanup levels are based on the potentially complete exposure pathways from the human health risk assessment, i.e., incidental ingestion and dermal contact with contaminated soil/sediment. However, it is important to note these values were calculated using an exposure frequency of 270 days/year, and future subsistence users or site visitors would only be exposed to soil/sediment in the Drainage Basin approximately 90 days/year. Thus, the Scenario A soil alternate cleanup levels are conservative and overly protective of potential human receptors. Construction of

[14] In August 2001, the stream discharge was 4.92 cubic feet per second upgradient of the confluence, and 8.35 cfs downgradient. The difference, 3.43 cfs, is assumed to be the total contribution from the Drainage Basin. The Drainage basin comprised 41 percent of the total Suqitughneq River flow in 2001. In 2002, stream discharge was 1.46 cfs at the upgradient cross section and 2.55 cfs at the downgradient cross section. The difference in discharge, 1.09 cfs, equals 43 percent of the Suqitughneq River flow in 2002.

future residential structures within the Drainage Basin itself is not possible given the tundra conditions.

Scenario A – Soil Alternate Cleanup Levels (ingestion/dermal contact)

- 9,200 mg/kg DRO
- 9,200 mg/kg RRO

Under Scenario B the migration to groundwater pathway is considered complete and soil alternate cleanup levels are calculated using site-specific data including the fraction organic carbon in the soil/sediment. The ADEC and USEPA assume a default fraction organic carbon of 0.1%. Total organic carbon (TOC) measured in Drainage Basin sediments (2001 data, DU method) ranged from 0.55 to 49%, with an average TOC of 14% to 18 % (excluding DRO > 1,000 mg/kg). TOC ranged from 2.7 to 6.9% in 4 soil/sediment samples from Drainage Basin (1998 and 1994 data, WBLACK and 415.1 methods). Therefore, a more realistic, site-specific fraction organic carbon level for tundra soil/sediments at Northeast Cape is 5%. Organic carbon typically binds contaminants to the sediment or soil matrix, and slows the transport and conversion of chemicals into an aqueous form (e.g., prevents migration through the soil/sediment column to water).

Scenario B – Soil Alternate Cleanup Levels (migration to groundwater pathway, 5% TOC)

- 12,500 mg/kg DRO
- 22,000 mg/kg RRO

For sediments, proposed alternate cleanup levels are described in more detail in Section 3.6.5. The proposed sediment cleanup levels for total DRO and total RRO are conservative values based on potential human exposures and modified lower to account for potential ecological impacts. The proposed cleanup levels for the metals, PCBs, and PAHs are based on the potential for adverse ecological effects.

Sediment Alternate Cleanup Levels

- 3,500 mg/kg DRO
- 3,500 mg/kg RRO
- 400 mg/kg Lead
- 270 mg/kg Chromium
- 960 mg/kg Zinc
- 0.7 mg/kg PCBs
- 0.6 mg/kg 2–methylnaphthalene
- 0.5 mg/kg Acenaphthene
- 1.7 mg/kg Benzo(g,h,i)perylene
- 2.0 mg/kg Fluoranthene
- 0.8 mg/kg Fluorene
- 3.2 mg/kg Indeno(1,2,3-cd)pyrene
- 1.7 mg/kg Naphthalene
- 4.8 mg/kg Phenanthrene
- 7.8 mg/kg Total LPAH
- 9.6 mg/kg Total HPAH

Surface water and groundwater cleanup levels are based on the ADEC Table C standards. Surface water must also meet the no sheen standard for surface water from 18 AAC 70.

11.1.7 Site Parameters

The Drainage Basin was evaluated using the proposed alternate cleanup levels for soil and sediment and two primary areas of concern were identified. Under Scenario A, contaminated soil/sediment above the human health risk-based cleanup level of 9,200 mg/kg DRO closest to the Main Operations Complex is targeted for remediation. The proposed areas under Scenario A and B are depicted on Figure 11-1. Figure 11-2 shows historical subsurface sediment sampling results (DRO only) from the 2001 remedial investigation. Some locations downgradient of the identified Scenario A polygons exceed the target DRO cleanup level of 9,200 mg/kg, based on historical sediment/tundra soil sampling results. However, these exceedances are intermixed between sampling results that are significantly below the proposed cleanup levels. The Scenario A proposed excavation area was delineated based on considerations which included ease of access using heavy equipment from the main gravel pad area, standing water levels (e.g., ponds), and causing less disturbance to the entire wetland system. The three small drainage areas closest to the Main Complex contain the highest concentrations of contaminants which exceed the risk-based ACLs for soils. These locations also correspond to areas which are most easily accessed from the existing gravel pads and do not always contain significant amounts of standing water.

Under Scenario B, it was assumed the entire channel length of the Drainage Basin from the Main Complex to the confluence with the Suqitughneq River exceeded the more conservative sediment ACLs, e.g., the target level of 3,500 mg/kg DRO. Thus, a much larger area was considered for each remedial alternative, including areas with standing or flowing water such as the ponded portion of the Drainage Basin and lower reaches which flow into the Suqitughneq River.

11.2 Drainage Basin Screening of Alternatives

The response actions identified in Section 4 were evaluated for the site-specific contaminants of concern and affected media at Site 28, including the contaminated sediments, surface water, and tundra soil.

No Action is retained for further evaluation per the requirements of the NCP. There are no costs associated with this alternative.

Institutional controls are applicable to Site 28 and could involve could involve physical, legal, or administrative mechanisms to restrict the use of or access to the site to prevent future risks to human health, safety, or the environment. Such controls could include a deed notice to provide information to current or future landowners about the presence of contaminated soil/sediment at the site and the need for proper management of the soil/sediment if excavated. Other measures could involve an advisory limiting the consumption of shallow groundwater. ICs are an effective tool to prevent exposure to the contaminants, can be implemented and typically have minimal costs. ICs are retained for further evaluation.

Natural attenuation and *long term monitoring* allow natural surface and sub-surface processes to reduce contaminant concentrations to acceptable levels over time. This alternative is applicable to Site 28 because the primary contaminant of concern is petroleum hydrocarbons, which are known to naturally break down in the environment. The potential for significant impacts to human or ecological receptors is limited due to the nature of the contamination. Natural attenuation would not cause damage to the surrounding tundra/wetland environment. The costs associated with long term monitoring are relatively low.

The *capping* of petroleum-contaminated soils at Site 28 was eliminated from further consideration. However, in-situ capping of contaminated sediments was considered under the reactive matting technology.

Landfarming was retained for further evaluation. Several areas exist at Northeast Cape where soils could be spread out for landfarming. The cold temperatures may limit the effectiveness of this technology. Costs will be relatively moderate.

Phytoremediation was retained for further evaluation. The short growing season is enhanced by the long days. Phytoremediation has been demonstrated effective at treating petroleum hydrocarbons. The costs are relatively moderate.

Onsite *Thermal Treatment* of diesel contaminated sediments was not retained for further evaluation. The efficiency of thermal desorption is directly related to particle size of the material, organic material, and water content. Sediments tend to have very fine particle size and usually contain high organic material. Sediments will also generally have very high water content. In addition, weathered residual diesel contamination requires additional time and effort to fully treat with thermal desorption. Although it is feasible to thermally treat diesel-contaminated sediments, implementation in the field would require dewatering and added extra fuel and time required to maintain an increased thermal treatment process. Thus, given the site logistics and time considerations, the alternative for thermal treatment of sediments was not retained for further consideration. The technology may become more feasible to implement at the Drainage Basin site if sediments are treated in conjunction with additional thermal treatment of soils from other sites.

Off-site treatment/disposal was retained for further evaluation. Soil excavation, containerization, transport and disposal are straightforward methods to remediate the site. Adverse environmental impacts could include damaging the tundra/wetlands by heavy equipment. Excavation of sediments would require additional design and coordination efforts.

Reactive matting was retained for further consideration at Site 28 because of its ability to prevent exposure to underlying sediment and prevent migration of contamination from sediment to the surface water column. The primary media affected is sediment and intermittently submerged soils.

Chemical oxidation was eliminated for further evaluation at Site 28. The primary source area for impacted groundwater is the Main Operations Complex and treatment options were evaluated under Section 10.

Reactive walls were eliminated from consideration at Site 28. The primary source area for impacted groundwater is the Main Operations Complex and this technology was evaluated as part of the alternatives for the Main Complex which is immediately adjacent and upgradient of the Drainage Basin.

Constructed wetlands were retained for consideration. The drainage basin area is surrounded by native tundra. Enhancing the existing natural system or diverting flow into the surrounding area could succeed in filtering the contaminated water and prevent downgradient migration of suspended sediments into the main channel of the Suqitughneq River.

11.3 Drainage Basin Detailed Analysis of Alternatives

11.3.1 Drainage Basin Alternative 1 – No Action

Description
Under the no action alternative, the Drainage Basin would be left in its current state, with no activities to control or mitigate exposure to site contaminants. The no action alternative provides a baseline for comparing other remedial alternatives and is required for consideration by the NCP. There are no costs associated with Alternative 1.

Overall protection of human health and the environment
The existing levels in sediment may pose a potential risk to future seasonal or permanent residents, because the DRO, PAH, and PCB levels exceed the alternate soil cleanup levels based on human ingestion exposure. However, there is a low probability that future seasonal or permanent residents could be exposed to the contaminated sediments for a long enough duration to pose a potential risk. Furthermore, the petroleum hydrocarbons detected in the sediments are tightly bound with other naturally occurring organic carbons, and are not bioavailable to ecological receptors. The site does not currently pose a risk to site visitors. The Drainage Basin is located immediately north and downgradient of the Main Operations Complex and some areas could be more easily accessed than other areas further from the road. The abundance of vegetation indicates the site is naturally filtering the diesel range organics and hydrocarbon enrichment may be enhancing plant growth.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons will continue to occur even if no actions are taken. It would likely take many years to reach the site-specific ACLs under this approach. However, a relatively small area of wetland is affected at levels that could pose a future threat to human health.

Short-term effectiveness
The site does not pose a current risk to site visitors.

Long-term effectiveness and permanence
Over the long term, the petroleum hydrocarbons will naturally attenuate and break down in the environment.

Reduction in toxicity, mobility, or volume through treatment

No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
The no action alternative is easily implemented.

Cost
The estimated cost of Alternative 1 is $ 0.

11.3.2 Drainage Basin Alternative 2 – Institutional Controls

Description
Institutional controls at the Drainage Basin could include physical, legal, or administrative mechanisms to restrict the use of or access to the site to prevent future risks to human health, safety, or the environment. Such controls could include a deed notice to provide information to current or future landowners about the presence of contaminated sediments at the site and the need for proper management of the soil or sediment if excavated. Other measures may include deed restrictions to prevent future excavation and movement of the petroleum-contaminated sediments, access controls, restrictions on harvesting plants from this location, utilization of alternate water sources, or other methods of public education. An assessment of the status and effectiveness of the institutional controls would be made after 5 years.

Overall protection of human health and the environment
Institutional controls would prevent exposure of current and future residents to contaminated sediments by restricting digging activities or subsistence harvesting in the immediate vicinity. The site does not currently pose a risk to site visitors. The existing levels in soil may pose a potential risk to future seasonal or permanent residents if continuously exposed to the sediments.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons will continue to occur if institutional controls are implemented. It would likely take many years to reach the site-specific ACLs under this approach. However, areas closest to the Main Complex gravel pad are affected at levels that could pose a future threat to human health.

Short-term effectiveness
The existing levels do not pose a current risk to site visitors. There is a potential risk to future seasonal residents.

Long-term effectiveness and permanence
Institutional controls can be effective in the long term. Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Reduction in toxicity, mobility, or volume through treatment
No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity. The natural vegetation would continue to filter the petroleum hydrocarbons.

Implementability
Institutional controls are typically easily implemented. The need for, and likelihood of, landowner acceptance and compliance with ICs is a consideration for alternatives requiring them. The land at Northeast Cape is owned jointly by two local Native Corporations, Savoonga Native Corporation and Sivuqaq, Inc. The ability of the Corporations to accept and maintain land use controls is unknown.

Cost
The estimated cost of Alternative 2 is $ 186,000.

11.3.3 Drainage Basin Alternative 3 – Natural Attenuation and Long Term Monitoring

Description
Under this alternative, natural attenuation would be combined with long term monitoring of the sediment and/or surface water. The rate of petroleum hydrocarbon degradation has not been established and the extreme climate conditions on St. Lawrence Island could slow natural attenuation processes. Monitoring activities would establish a baseline, evaluate the reduction of contaminant concentrations over time, and determine if off-site migration is occurring. This alternative could also further evaluate the contribution from biogenic compounds to total petroleum hydrocarbon sampling results.

Overall protection of human health and the environment
Natural attenuation processes would slowly reduce risks to human health and the environment over the long term. The Drainage Basin does not pose a risk to current site visitors. However, the level of DRO contamination could pose a potential future risk to seasonal or permanent residents.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons will continue to occur if institutional controls are implemented. It would likely take many years to reach the site-specific ACLs under this approach.

Short-term effectiveness
The existing levels do not pose a current risk to site visitors. There is a potential risk to future seasonal residents.

Long-term effectiveness and permanence
Natural attenuation and monitoring can be effective in the long term. Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions, implemented controls, and monitoring results would be required as part of this alternative.

Reduction in toxicity, mobility, or volume through treatment
No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
Natural attenuation and long term monitoring activities are typically easily implemented. This alternative would include periodic sampling of the site to evaluate trends in contaminant concentrations. Long term monitoring would involve an initial site visit to establish baseline conditions and periodic monitoring of well points and soils.

Cost
The estimated cost of Alternative 3 is $622,000.

11.3.4 Drainage Basin Alternative 4 – Landfarming

Description
Under Scenario A, an estimated 3,400 cubic yards of contaminated sediments in the Drainage Basin closest to the Main Complex (see Figure 11-1) would be excavated and spread out in a designated area at Northeast Cape. Under Scenario B, an estimated 15,000 cubic yards of petroleum-contaminated sediments would be excavated or dredged. Simply excavating and mixing the soils, as well as incorporating amendments (e.g., fertilizer, compost) will promote biological activity and enhance the natural breakdown of the petroleum hydrocarbons. Sediments would be excavated to meet the alternate cleanup levels. Excavation of the major source of contamination would prevent future transport of contaminants to surface water or shallow groundwater.

Overall protection of human health and the environment
Landfarming would reduce risks to human health and the environment over the long term. The contaminated sediments would be removed and treated to meet the alternate cleanup levels. Since no permanent residents currently reside at Northeast Cape, there is no current risk to human health.

Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Compliance with ARARs
Landfarming should meet the alternate cleanup levels within one or two field seasons for the petroleum-contaminated sediment.

Short-term effectiveness
Excavation of the sediments will cause damage to the tundra and wetland environment in the short term. The site does not pose a current risk to human health.

Long-term effectiveness and permanence
Landfarming is a proven technique to break down petroleum hydrocarbons.

Reduction in toxicity, mobility, or volume through treatment
Landfarming would significantly decrease the petroleum hydrocarbon concentrations.

Implementability
Landfarming is relatively easy to implement. A flat area, such as the main operations complex, would be necessary to conduct the remedial activity. The progress of the soil treatment would need to be monitored, and the soils periodically turned over or tilled with a machine.

Cost
Under Scenario A, the estimated cost of Alternative 4 is $ 2,200,000.
Under Scenario B, the estimated cost of Alternative 4 is $ 5,000,000.

11.3.5 Drainage Basin Alternative 5 – Phytoremediation

Description
Under Scenario A, an estimated 3,400 cubic yards of contaminated sediments in the Drainage Basin closest to the Main Complex (see Figure 11-1) would be excavated and spread out in a designated area at Northeast Cape. Under Scenario B, an estimated 15,000 cubic yards of petroleum-contaminated sediments would be excavated or dredged. The excavated sediments would be planted with a mixture of plants such as arctic red fescue or other grasses. Other amendments such as fertilizer or compost could also be added to the soil to promote biological activity and enhance the natural breakdown of the petroleum hydrocarbons. The sediments would be excavated to meet the alternate cleanup levels. Excavation of the major source of contamination would prevent future transport of contaminants to the surface waters or shallow groundwater.

Overall protectiveness of human health and the environment
Phytoremediation would reduce risks to human health and the environment over the long term. The contaminated sediments would be removed and treated to meet alternate cleanup levels. Since no permanent residents currently reside at Northeast Cape, there is no current risk to human health.

Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Compliance with ARARs
Phytoremediation should meet alternate cleanup levels within several years for the petroleum-contaminated sediments.

Short-term effectiveness
Excavation of the contaminated sediment would be effective at reducing potential exposures in the short term. This alternative would cause short term damage to the tundra and wetland environment.

Long-term effectiveness
Phytoremediation is a proven technique to remediate petroleum hydrocarbons.

Reduction in toxicity, mobility, or volume through treatment
Phytoremediation would significantly decrease the petroleum hydrocarbon concentrations. For the shallow groundwater, natural processes are assumed to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
Excavating sediment, spreading onsite and seeding with plants and grasses is a relatively simple process. Plant growth could be adversely affected by the short growing season, but the abundant daylight compensates for the cold temperatures. The alternative would have less maintenance requirements than landfarming. Phytoremediation has no long term maintenance requirements such as periodic tilling of or adding amendments to the soil. However, there are more uncertainties associated with achieving good rates of plant growth.

Cost
Under Scenario A, the estimated cost of Alternative 5 is $ 2,200,000.
Under Scenario B, the estimated cost of Alternative 5 is $ 5,100,000.

11.3.6 Drainage Basin Alternative 6 – Off-site Treatment and Disposal

Description
Under Scenario A, an estimated 3,400 cubic yards of contaminated sediments in the Drainage Basin closest to the Main Complex (see Figure 11-1) would be excavated. Under Scenario B, an estimated 15,000 cubic yards of petroleum-contaminated sediments would be excavated or dredged and transported off-site for treatment and/or disposal at a permitted landfill facility. Sediments would be excavated to meet the alternate cleanup levels. Excavation of the major source of contamination would prevent future transport of contaminants to surface water or shallow groundwater. Scenario B would likely require dewatering of the drainage basin, construction of a gravel access road, and destruction of the ecosystem in the short term. Additional measures to restore the system after excavation/dredging may also be necessary.

Overall protectiveness of human health and the environment
Excavation and offsite treatment/disposal of sediments would reduce risks to human health and the environment. The contaminated sediment would be removed and treated to meet the alternate cleanup levels. Since no permanent residents currently reside at Northeast Cape, there is no current risk to human health.

Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Compliance with ARARs
Excavation and off-site treatment/disposal would meet the alternate cleanup levels for the petroleum-contaminated sediment.

Short-term effectiveness
Excavation and offsite treatment/disposal of the sediments would meet the alternate cleanup levels in one field season. Under Scenario A, only areas most easily accessed from the existing gravel pads would be addressed, thus limiting short term damage to the environment. The major hotspots of contamination would be addressed under Scenario A. Under Scenario B, the extensive excavation and dredging activity would cause short term destruction of or significant damage to the wetlands environment. The larger excavation size may cause a temporary increase in suspended sediment inputs to the Suqitughneq River.

Long-term effectiveness
Excavation and off-site treatment/disposal permanently removes the source of contaminated soils.

Reduction in toxicity, mobility, or volume through treatment
Excavation and off-site treatment or disposal permanent removes the petroleum hydrocarbons thus reducing the toxicity, mobility and volume of the contaminants in the sediment.

Implementability
Excavation and offsite transport is a straightforward remedial alternative that is commonly implemented at contaminated sites. Under Scenario B, excavation or dredging of the entire length of the Drainage Basin would be significantly more complex than the hotspot removals under Scenario A. The remote location will add complexity to this alternative and barge services will be required. Additional measures to prevent release of contaminants to adjacent surface waters will be necessary during excavation activities under either Scenario. This alternative can be completed in one field season. Additional water diversion measures and site accessibility considerations such as temporary road/trails are needed under Scenario B.

Cost
Under Scenario A, the estimated cost of Alternative 7 is $ 2,500,000.
Under Scenario B, the estimated cost of Alternative 7 is $ 7,100,000.

11.3.7 Drainage Basin Alternative 7 – Constructed Wetlands

Description
Under this alternative, the existing tundra/wetlands would be used as a natural filter for the contaminants of concern. Water flow from the Drainage Basin would be diverted before it reached the Suqitughneq River, and redirected into the surrounding wetlands. Wetlands naturally filter out contaminants from the water column and trap suspended sediments. The existing vegetation can remove, transfer, stabilize, and destroy contaminants in the sediments and water.

Overall protectiveness of human health and the environment
Constructed wetlands would prevent further impacts to the Suqitughneq River and minimize the downgradient migration of contamination. The constructed wetlands would not immediately address the potential risk to human health and the environment posed by the areas of contamination closest the Main Operations Complex. However, the site does not pose a risk to

current site visitors. Potential future risks to seasonal subsistence users or future residents can be controlled using access restrictions.

Compliance with ARARs
Constructed wetlands would meet the alternate cleanup levels for the petroleum-contaminated sediment over time.

Short-term effectiveness
Water flow would be immediately directed away from the major sources of contaminated sediment. Thus, the load of contaminants potentially flowing downgradient into the Suqitughneq River would be reduced. This alternative would create less disturbance to the entire ecosystem, leaving sediments in place and allowing the existing tundra/wetland environment to filter and biodegrade the contaminants.

Long-term effectiveness
The original Drainage Basin would be permanently altered under this approach. Contaminants would be filtered and sequestered or naturally biodegraded.

Reduction in toxicity, mobility, or volume through treatment
The natural vegetation in the surrounding wetlands would trap contaminants, provide a natural filter for suspended sediments and dissolved phase compounds in the water column. The petroleum contaminants would be permanently biodegraded into non-toxic compounds.

Implementability
The ability to effectively utilize the existing wetlands to provide additional filtering capacity will depend on site-specific topography, ease of work in a tundra environment, the ability to construct a diversion berm, seasonal rainfall levels, and permitting requirements.

Cost
Under Scenario A, the estimated cost of Alternative 8 is $ 1,100,000.
Under Scenario B, the estimated cost of Alternative 8 is $ 1,600,000.

11.3.8 Drainage Basin Alternative 8 - Reactive Matting

Description
Under this alternative, the contaminated sediments would be covered with a layer of geotextile material. Reactive matting consists of placing a permeable fabric on top of the contaminated sediments to filter organic compounds and prevent the petroleum hydrocarbons from entering the surface water. The particular technology evaluated was the Reactive Core Mat™ (RCM), which is a patented permeable composite mat consisting of reactive material(s) encapsulated in a nonwoven core matrix bound between two geotextiles. The RCM provides a reactive material that treats contaminants which are carried by advective or diffusive flow through the sediments into the water column. For petroleum hydrocarbons and PCBs, granular activated carbon is used in the matting to reliably adsorb organics from sediment pore water. Sand, typically 40% by weight, is also incorporated into the mixture to provide weight to the mat and counteract any buoyancy effects. The RCM has been used for in-situ underwater capping of contaminated sediments or post-dredge residual sediments. This reactive cap allows for thinner cap thickness

than a traditional sand cap. Geotextiles also provide stability and physical isolation. RCM can also be used for embankment seepage control and groundwater remediation.

The manufacturer recommends sufficient cover and armoring (e.g., rip rap or articulating concrete block) of the reactive core matting (RCM) to protect it from flooding and ice scouring. The amount of covering would be site specific. According to the manufacturer, the organoclay used in the matting is not adversely affected by freeze-thaw cycling. Laboratory tests have shown that particle size distribution and oil removal capability of the clay was not impacted by freeze/thaw conditions.

The RCM product specifications indicate the geotextile roll width is 16 feet 2 inches. The effective product width measures 15 ft 10 inches as approximately 2" on either edge are folded and sealed along each edge without activated carbon in it. Each roll is 100 feet long. In the Drainage Basin, the most highly contaminated sediments from the three primary drainages (western, middle, eastern) cover approximately 1,200 feet. The total length of the Drainage Basin from its confluence with the Suqitughneq River to the Pond area is 1,350 feet.

Drainage Basin	Feet
Confluence w/Suqitughneq to Pond area	1,350
Pond Area to Perimeter Road	400
Pond Area to Site 10 embankment	800
TOTAL	2,550

Overall protectiveness of human health and the environment
The reactive matting would be protective of human health and the environment by preventing receptors from becoming exposed to the sediments.

Compliance with ARARs
The reactive matting would comply with ARARs because the sediment exposure is controlled.

Short-term effectiveness
The matting would provide an immediate benefit of preventing exposure and leaching of dissolved hydrocarbons to surface water.

Long-term effectiveness
The reactive matting's ability to withstand harsh climate conditions is unknown. The Drainage Basin has a relatively low flow rate and would not be subject to large ice scour. There is the possibility the matting could degrade over the long term. Sufficient cover material and/or armoring would be needed to keep the matting in place. Freeze thaw cycling is not expected to have an adverse effect on the matting's ability to remove oil from the water column.

Reduction in toxicity, mobility, or volume through treatment
The matting would filter and treat any releases from the diesel-contaminated sediments as water flowed from the sediments, through the matting, and into the surface water.

Implementability
The actual placement of the reactive matting should be relatively straightforward. However, the presence of a significant amount of vegetation may require modifications to the width of the standard product.

Cost
Scenario A. The estimated cost of Alternative 9 is $ 1,900,000.
Scenario B. The estimated cost of Alternative 9 is $ 4,200,000.

11.4 Drainage Basin Comparative Analysis of Alternatives

The proposed remedial alternatives are summarized by the evaluation criteria and compared in Table 11-2. A summary of the estimated cost of each alternative only is shown below. A combination of two or more alternatives may be selected during the Proposed Plan phase. For example, limited excavation and off-site treatment/disposal of contaminated sediments with continued long term monitoring.

Site 28 Drainage Basin	Cost
1 - No Action	$ 0
2 - Institutional Controls	$ 186,000
3 - Natural Attenuation + LTM	$ 622,000
4A – Landfarming	$2,200,000
4B - Landfarming	$5,000,000
5A - Phytoremediation	$2,200,000
5B - Phytoremediation	$5,100,000
6A- Off-site Treatment/Disposal	$2,500,000
6B - Off-site Treatment/Disposal	$7,100,000
7A - Constructed Wetlands	$1,100,000
7B - Constructed Wetlands	$1,600,000
8A - Reactive Matting	$1,900,000
8B - Reactive Matting	$4,200,000

12.0 AREA OF CONCERN G – SUQITUGHNEQ RIVER AND ESTUARY

12.1 Site 29 – Suqitughneq River and Estuary

12.1.1 Background

The Suqitughneq River flows north from the Kinipaghulghat Mountains, originating south of the main complex. The Suqitughneq River flows through the tundra to a lagoon/estuary located east of the Northeast Cape airstrip where it drains into the Bering Sea. The lagoon/estuary is separated from the Bering Sea by a sand berm that forms at the beach and occasionally breaches. Several smaller tributaries (west and east), as well as the Site 28 drainage basin, contribute flow to the Suqitughneq River.

12.1.2 Previous Removal/Remedial Actions

Not applicable.

12.1.3 Nature and Extent of Contamination

The COPCs in the Suqitughneq River are metals, PAHs, BTEX, PCBs and petroleum hydrocarbons. Historical sampling locations are shown on Figure 12-1. DRO concentrations in sediment of the River ranged from non-detect (ND) to 25,000 mg/kg at one location (96NE29SD111), which was not duplicated or substantiated in subsequent sampling events. DRO concentrations in the estuary portion of the system range from 15 to 1,400 mg/kg. PCBs have not been detected in the Suqitughneq River sediments, with the exception of one sample collected downstream of the airport road bridge in 2004 by Shannon & Wilson. PCBs were detected at 0.452 mg/kg in sediment sample 04NE29SD105. PAHs were also detected at low levels during the 2004 investigation, but do not exceed ecological screening levels based on consensus-based probable effects concentrations (PELs). Thus, the likelihood of adverse ecological risks is very low. See Table 11-1 for a summary of the historical sediment data and screening results in the Suqitughneq River.

Photo (2002). Measuring streamflow in the Suqitughneq River downgradient of the Drainage Basin/Main Complex.

Photo (2006). View north of the lagoon/estuary and Suqitughneq River from the Airport Road bridge.

Co-located surface water samples were also collected from the Suqitughneq River. Sediment and surface water samples were collected to characterize downgradient migration of contaminants from the main operations complex and other areas. During fieldwork performed in 2004, sediment and surface water samples were collected from the estuary area and three locations in the main flow. Samples analyzed for fuel hydrocarbons were also evaluated for the presence of natural biogenic compounds. The DRO detections were predominantly attributed to biogenic compounds, not fuel hydrocarbons. Only one sediment sample result was noted as a weathered middle distillate, but the concentration (173 J mg/kg) was significantly below the proposed alternate cleanup level of 3,500 mg/kg, as well as the ADEC Table B2 soil cleanup of 250 mg/kg based on the migration to groundwater pathway.

All surface water sampling results from the Suqitughneq River have been below drinking water standards. Early PCB sampling data, with its high detection limits, served only to indicate that the water was not grossly contaminated. The most recent sampling results from 2004 confirm that PCBs are not present in the Suqitughneq River above detection limits ranging from 0.105 to 0.115 ug/L (primary lab) and 0.5 ug/L (QA lab), compared to the ADEC Table C cleanup level of 0.5 ug/L.

Fish and plants were also collected from the vicinity of Site 29. A risk assessment evaluated exposure scenarios for future residents and indicates potential future carcinogenic risk due to consumption of plants with arsenic, PCBs, and PAHs. These results are very similar to the risk due to consumption of plants from non-impacted areas.

12.1.4 Conceptual Site Model

The primary exposure route is through incidental ingestion of, or dermal contact with sediments. The use of the Suqitughneq River as a drinking water source is also possible for either seasonal residents or potential future residents. Human receptors may also be exposed to contaminants via consumption of subsistence food items such as fish or plants.

The width of the Suqitughneq River and Estuary system varies depending on location, seasonal rainfall/runoff, and condition of the berm at the outlet to the Bering Sea. Upgradient of the Drainage Basin confluence, the Suqitughneq River spanned approximately 7.5 feet (2001 and 2002). Downgradient of the confluence with the drainage basin, the Suqitughneq River stream width ranged from 6.5 feet (2001) to 7.75 feet (2002). Water depth ranged from 2.5 to 1.3 ft upgradient and 2.2 to 1.8 ft downgradient. Water depths in the estuary exceed 4 feet. The total length of the Suqitughneq River system from the Drainage Basin confluence to the Bering Sea is approximately 2 miles or 11,000 feet.

12.2 Suqitughneq River Proposed alternatives

The weight of evidence for the Suqitughneq River and Estuary indicates the system is not adversely affected by contaminants of potential concern. Therefore, no further remedial actions are recommended. The concentrations of petroleum hydrocarbons and PAHs do not exceed human health risk-based standards, or ecological risk-based screening levels. However, visual observations by local residents, other researchers, and a Corps of Engineers biologist have indicated the presence of a sheen when wading in the estuary. Laboratory sampling results have not identified heavily contaminated sediments. Additional investigation may be necessary to resolve stakeholder concerns related to the health of the Suqitughneq River ecosystem, the presence or absence of significant petroleum contamination, and the potential for significant adverse impacts to human health or the environment.

13.0 AREA OF CONCERN H – WHITE ALICE COMPLEX

13.1 Site 31 – White Alice Site

13.1.1 Background

The White Alice site is located southeast and uphill from the main operations complex in a glacial valley at the base of Mt. Kangukhsam. The site included four large billboard antennas, a central main electronics building, other supporting structures, and seven ASTs.


Photo (2003) Site 31 view north

13.1.2 Previous Removal/Remedial Actions

The antennas, buildings, and ASTs were demolished and removed during the 2003 field season. A total of 118 tons of PCB-contaminated soil was excavated south and west of the former Main Electronics Building (Bldg 1001) adjacent to a former transformer pad, and at the septic tank outfall during the 2005 field season. PCB-contaminated concrete (79 tons) was also removed from portions of the Building 1001 foundation.


Former Building 1001 concrete foundation (2006)

13.1.3 Nature and Extent of Contamination

Surface and subsurface soil samples were collected over several years to evaluate the extent of petroleum hydrocarbon contamination associated with former fuel tanks and piping, and the extent of PCB contamination near transformer pads and outfalls. Soil and water samples were collected during the 2001 remedial investigation. Soil samples were also collected from beneath fuel pipelines and tank outfalls during building demolition and debris removal activities during the 2003 field season. Additional soil samples were then collected during the 2004 field season to further define the depth of contamination surrounding former fuel tanks and impoundments. After final building demolition and debris removal activities, including removal of contaminated concrete and excavation of PCB-contaminated soils, additional soil confirmation samples were collected in 2005.

DRO was initially detected at concentrations ranging from 310 to 3,400 mg/kg near the ASTs and fuel tank impoundment during the 2001 field season. Samples along the former fuel pipeline corridors indicated DRO at concentrations ranging from 42.9 to 5,400 mg/kg. Samples collected in 2004 indicated DRO up to 1,280 mg/kg. Historical sampling results for DRO in soil at Site 31 are shown on Figure 13-1. RRO concentrations ranged from ND to 11,000 mg/kg at one location (beneath a fuel tank valve). The 2004 sampling results indicated RRO up to an estimated 474 mg/kg. No COPCs were identified in the surface water samples. PCBs were identified at a possible sewage outfall and adjacent to the main electronics building transformer pad. Additional sampling for PCBs was conducted in 2004, and PCBs were detected at concentrations up to 14.8 mg/kg. PCB-contaminated soils were excavated from the septic tank outfall (13 tons), west of the main electronics building (50 tons), and adjacent to the former transformer pad (55 tons) in 2005. Soil confirmation samples from the excavations indicate PCBs still remain at concentrations above 1 ppm adjacent to the former transformer pad. PCBs remain in subsurface soils at concentrations ranging from 1.53 to 7.09 mg/kg. The excavations at the septic tank outfall and west of the building successfully removed all PCB contamination to below 1 ppm.

13.2 Site 32 – Lower Tram Terminal

13.2.1 Background

The lower tram terminal was located south of the White Alice Site at the northern base of Mt. Kangukhsam. The site consisted of a tram terminal building, substation transformer bank, two ASTs, a water well and anchor pit for the aerial tram line.

13.2.2 Previous Removal/Remedial Actions

The building, ASTs, and tram structures were demolished and removed during the 2003 and 2005 field seasons.

13.2.3 Nature and Extent of Contamination

During the 2001 remedial investigation, soil samples were collected to determine the presence or absence of contamination associated with the site. DRO concentrations ranged from 230 to 13,000 mg/kg. Historical sampling results for DRO are shown on Figure 13-2. The highest results were associated with an area of heavy soil staining beneath the valve of the exterior AST.

The anchor pit also contained DRO at a concentration of 11,000 mg/kg. RRO concentrations ranged from ND to 3,600 mg/kg.

Soil confirmation samples were collected following the building demolition activities and removal of the AST outside the tram terminal building (Bristol, 2004). DRO concentrations ranged from 1,150 to 10,400 mg/kg surrounding the former AST. DRO was also detected from 374 to 2,350 mg/kg in soils surrounding concrete transformer pad CTP-2. No other COPCs (BTEX, lead, PCBs, PAHs) were detected above screening levels.

13.3 White Alice Complex Sites 31 and 32 Combined

13.3.1 Conceptual Site Model

The primary exposure route is incidental ingestion of, or dermal contact with soil. The primary contaminant of concern is petroleum hydrocarbons (DRO) in soil. The PCB-contaminated soils adjacent to the Main Electronics Building will be evaluated separately (see Section 14). The site is located on top of fractured bedrock and upgradient of the Main Operations Complex.

13.3.2 Risk Assessment

A risk assessment evaluated the White Alice site data and concluded potential noncancer risk exists from DRO levels in soil under a future resident scenario. No other COCs were identified based on the sampling results and screening risk assessment.

13.3.3 Remedial Action Objectives

Site-specific soil cleanup levels appropriate for the White Alice Complex area were developed based on two scenarios. Scenario A assumes a risk-based approach with the primary exposure point being incidental ingestion of or dermal contact with contaminated soil. Scenario B assumes contaminants in soils may leach into groundwater and models this possibility using conservative modeling equations. Site-specific characteristics of the soil matrix are used to derive cleanup levels. The total organic carbon content of soils from Site 31 were assumed representative of the site conditions at the entire White Alice complex including the lower tram terminal. Concentrations of petroleum hydrocarbons and other compounds have been measured directly and were not detected in downgradient surface water.

Scenario A - Soil Alternate Cleanup Levels (risk-based, soil ingestion)

- DRO 9,200 mg/kg
- RRO 9,200 mg/kg

Scenario B – Soil Alternate Cleanup Levels (migration to groundwater pathway, 0.6% TOC)

- DRO 1,600 mg/kg
- RRO 22,000 mg/kg

13.3.4 Site Parameters

The estimated quantities of soils exceeding the proposed alternate cleanup levels are shown on Figures 13-1 and 13-2. Under Scenario A, two small areas of approximately 15 cubic yards at Site 32 are impacted above the risk-based, soil ingestion cleanup levels. Under Scenario B, an additional 97 cubic yards of contaminated soils in scattered areas at Site 31 and Site 32 contain petroleum contamination above the proposed migration to groundwater alternate cleanup levels.

13.4 White Alice Complex Screening of Alternatives

The response actions identified in Section 4 were evaluated for the site-specific contaminants of concern and affected media at the White Alice Complex.

No Action is retained for further evaluation per the requirements of the NCP. There are no costs associated with this alternative.

Institutional controls are applicable to the White Alice Complex and could involve could involve physical, legal, or administrative mechanisms to restrict the use of or access to the site to prevent future risks to human health, safety, or the environment. Such controls could include a deed notice to provide information to current or future landowners about the presence of contaminated soils at the site and the need for proper management of the soils if excavated. Other measures could involve future building restrictions or public education. ICs are an effective tool to prevent exposure to the contaminants, can be implemented and typically have minimal costs. ICs are retained for further evaluation.

Natural attenuation and *long term monitoring* allow natural surface and sub-surface processes to reduce contaminant concentrations to acceptable levels over time. This alternative is applicable to the White Alice Complex because the primary contaminant of concern is petroleum hydrocarbons, which are known to naturally break down in the environment. The potential for significant impacts to human or ecological receptors is limited due to the nature of the contamination. Natural attenuation would not cause damage to the surrounding tundra/wetland environment. The costs associated with long term monitoring are relatively low.

The *capping* of petroleum-contaminated soils at the White Alice Complex was eliminated from further consideration. The POL-contaminated areas at the White Alice Complex are small, non-contiguous, discrete areas of contamination related to tanks and underground piping.

Landfarming was retained for further evaluation. The volume of soil contaminated above cleanup levels is not large. Several areas exist at Northeast Cape where soils could be spread out for landfarming. The cold temperatures may limit the effectiveness of this technology. Costs will be relatively moderate.

Phytoremediation was retained for further evaluation. The short growing season is enhanced by the long days. Phytoremediation has been demonstrated effective at treating petroleum hydrocarbons. The costs are relatively moderate.

Thermal treatment was retained for further evaluation. Soil burning is a proven technology to remediate diesel-contaminated soils. Costs are moderate to high. Implementability may be more difficult given the remote location, lack of power, and no permanent residents nearby. All materials must be flown in or transported by barge. The small volume of contaminated soil at this site may preclude cost effectiveness to perform treatment on-site, unless other areas of the site are remediated concurrently.

Off-site treatment/disposal was retained for further evaluation. Soil excavation, containerization, transport and disposal are straightforward methods to remediate the site. Adverse environmental impacts could include damaging the tundra by heavy equipment.

Reactive matting was eliminated from further consideration at the White Alice Complex. The primary media affected is gravel fill soils or unconsolidated materials near the former buildings. Reactive matting is typically applied to underwater sediments, which is not applicable at this location.

Chemical oxidation was not retained for further evaluation. The shallow groundwater at the White Alice Complex is not impacted.

Reactive walls were eliminated from consideration at the White Alice Complex because the shallow groundwater is not impacted.

Constructed wetlands were eliminated from consideration. The area surrounding the former buildings and antenna structures is gravel pad or native tundra, and enhancing this natural system would achieve limited benefits.

13.5 White Alice Complex Detailed Analysis of Alternatives

13.5.1 White Alice Complex Alternative 1 – No Action

Description
Analysis of the No Action Alternative is required by the NCP. This alternative involves no further action at the site and is sometimes referred to as the "walk-away" alternative. Under this alternative, no remedial actions would be taken.

Overall protection of human health and the environment
The No Action Alternative does not reduce the potential future risk posed by the White Alice Complex sites. The potential risks at the White Alice Complex are relatively low, since a very limited area contains DRO above levels which may pose a risk to human health based on a future residential scenario. The site is currently uninhabited, and there is no identified risk to site visitors.

Compliance with ARARs
The No Action Alternative does not comply with the identified alternate soil cleanup levels for DRO at the White Alice Complex, since there would be no immediate reduction in the concentration or quantity of contaminants in soil at that site. However, natural attenuation of the petroleum hydrocarbons will continue to occur even if no actions are taken. It would likely take

many years to reach the site-specific ACLs under this approach, but a very limited area of gravel soil is affected at levels that could pose a future threat to human health.

Short-term effectiveness
There are no short-term risks posed by the site or implementation of the no action alternative, since there are no actions included in this alternative. The risk assessment determined there are no current risks to human health or the environment.

Long-term effectiveness
The no action alternative does not reduce the long-term risks associated with the site.

Reduction of Toxicity, Mobility, or Volume
The No Action Alternative will not reduce the toxicity, mobility, or volume of contaminated soil. Some of the petroleum hydrocarbons will naturally break down in the environment over time under biologic processes, reducing their toxicity and volume.

Implementability
No technical or administrative implementability issues have been identified for the No Action Alternative.

Cost
There are no costs associated with the No Further Action Alternative.

13.5.2 White Alice Complex Alternative 2 – Institutional Controls

Description
Institutional controls at the White Alice Complex could include physical, legal, or administrative mechanisms to restrict the use of or access to the site to prevent future risks to human health, safety, or the environment. Such controls could include a deed notice to provide information to current or future landowners about the presence of contaminated soil at the site and the need for proper management of the soils if excavated. Other measures could involve restrictions on future construction of buildings or controls to prevent excavation of contaminated soils adjacent to former electronics building foundation.

Overall protectiveness of human health and the environment
The institutional controls would prevent potential future exposures to contaminants of concern in subsurface soils. Institutional controls would prevent exposure of current and future residents to contaminated soils through restrictions on soil excavations. The existing levels in soil do not pose a potential risk to current site visitors or seasonal subsistence residents.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons will continue to occur if institutional controls are implemented. It would likely take many years to reach the site-specific ACLs under this approach. However, a limited area of gravel soil is affected at levels that could pose a future threat to human health.

Short-term effectiveness
Institutional controls are relatively easy to implement, and can be an effective way to inform site users of potential risks.

Long-term effectiveness
Institutional controls can be effective in the long term. Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions, implemented controls, and monitoring results would be required as part of this alternative.

Reduction in toxicity, mobility, or volume through treatment
Natural biological processes would continue to naturally break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
Institutional controls are typically easily implemented. The need for, and likelihood of, landowner acceptance and compliance with ICs is a consideration for alternatives requiring them. The land at Northeast Cape is owned jointly by two local Native Corporations, Savoonga Native Corporation and Sivuqaq, Inc. The ability of the Corporations to accept and maintain land use controls is unknown.

Cost
The estimated cost of Alternative 2 is $ 186,000.

13.5.3 White Alice Complex Alternative 3 – Natural Attenuation

Description
Natural attenuation relies on existing processes in the environment to break down the contaminants. The rate of petroleum hydrocarbon degradation has not been established and the extreme climate conditions on St. Lawrence Island could slow natural attenuation processes. An initial sampling event and natural attenuation report would be used to establish a baseline for evaluating the potential for reduction of contaminant concentrations over time.

Overall protectiveness of human health and the environment
Natural attenuation processes would reduce risks to human health and the environment over the long term. The White Alice Complex does not pose a risk to current site visitors or future seasonal residents. The site could pose a risk to future permanent residents, if soils are excavated or otherwise exposed to the surface.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons will continue to occur over time. It would likely take many years to reach the site-specific ACLs for the petroleum hydrocarbons under this approach. However, a limited area of gravel soil is affected at levels that could pose a future threat to human health.

Short-term effectiveness
There are no current risks to site visitors.

Long-term effectiveness
Natural attenuation can be effective in the long term, as contaminants break down in the environment to reach ACLs. Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions, implemented controls, and monitoring results would be required as part of this alternative.

Reduction in toxicity, mobility, or volume through treatment
No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
Natural attenuation activities are typically easily implemented. This alternative would include a baseline sampling event at the site to evaluate the potential for contaminant reduction in the future.

Cost
The estimated cost of Alternative 3 is $ 193,000.

13.5.4 White Alice Complex Alternative 4 – Long Term Monitoring

Description
Long term monitoring can be utilized in conjunction with the natural attenuation processes described under Alternative 3. A baseline sampling event would establish current levels of petroleum hydrocarbons, and document natural attenuation parameters such as soil conditions and the presence of microbes. Additional samples would be collected at 10 years and 20 years and documented in reports to periodically evaluate the rate of degradation.

Overall protectiveness of human health and the environment
Natural attenuation processes would reduce risks to human health and the environment over the long term. The White Alice Complex does not pose a risk to current site visitors or future seasonal residents. However, the level of DRO contamination could pose a potential future risk to permanent residents.

Compliance with ARARs
Natural attenuation of the petroleum hydrocarbons will continue to occur if long term monitoring is implemented. It would likely take many years to reach the site-specific ACLs under this approach.

Short-term effectiveness
The risk assessment determined there are no current risks to human health.

Long-term effectiveness
Monitoring can be effective in the long term. Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions, implemented controls, and monitoring results would be required as part of this alternative

Reduction in toxicity, mobility, or volume through treatment
No active treatment would occur under this alternative. However, natural biological processes would continue to break down the petroleum hydrocarbons over time to reduce toxicity.

Implementability
Natural attenuation and long term monitoring activities are typically easily implemented. This alternative would include periodic sampling of the site to evaluate trends in contaminant concentrations. Long term monitoring would involve an initial site visit to establish baseline conditions and periodic monitoring of well points and soils.

Cost
The estimated cost of Alternative 4 is $ 184,000.

13.5.5 White Alice Complex Alternative 5 – Landfarming

Description
Under this alternative, the identified areas of petroleum contaminated soils would be excavated and spread out at a designated location onsite. Amendments (e.g., fertilizer or compost) may also be incorporated into the soils to promote biological activity and enhance the natural breakdown of the petroleum hydrocarbons. Simply excavating and mixing the petroleum contaminated soils to aerate the media has been shown to significantly decrease concentrations of petroleum constituents. Under Scenario A, an estimated 15 cubic yards of petroleum-contaminated soils at the Lower Tram Building would require excavation and treatment based on the risk-based ACL of 9,200 mg/kg DRO. Under Scenario B, an estimated 110 cubic yards of petroleum-contaminated soils from the Lower Tram and White Alice areas would be targeted for excavation based on the migration to groundwater ACL of 1,600 mg/kg DRO.

Overall protectiveness of human health and the environment
Landfarming is a proven technology to reduce concentrations of petroleum hydrocarbons in the environment. Landfarming would reduce risks to human health and the environment over the long term. The contaminated soils would be removed and treated to meet either the Scenario A ACLs (risk-based) or the Scenario B ACLs (migration to groundwater pathway). Since no permanent residents currently reside at Northeast Cape, there is no current risk to human health. Scenario B provides more potential risk reduction, assuming the contaminants may migrate to shallow groundwater.

Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Compliance with ARARs
Landfarming should meet cleanup levels within one or two field seasons for the petroleum-contaminated soils.

Short-term effectiveness
The risk assessment determined there are no current risks to human health.

Long-term effectiveness and permanence
Landfarming is a proven technique to break down petroleum hydrocarbons.

Reduction in toxicity, mobility, or volume through treatment
Landfarming would significantly decrease the petroleum hydrocarbon concentrations over time.

Implementability
Landfarming is relatively easy to implement. A flat area, such as the main operations complex, would be necessary to conduct the remedial activity. The progress of the soil treatment would need to be monitored, and the soils periodically turned over or tilled with a machine.

Cost
Scenario A. The estimated cost of Alternative 5 is $ 371,000.
Scenario B. The estimated cost of Alternative 5 is $ 1,330,000.

13.5.6 White Alice Complex Alternative 6 – Phytoremediation

Description
Alternative 6 is similar to the landfarming alternative described above. Under this alternative, the petroleum-contaminated soils would be excavated, spread out at a temporary or permanent location onsite, and seeded with a mixture of grasses and other plants such as arctic red fescue. The soil would be watered, fertilized, and allowed to vegetate. Other amendments may also be incorporated into the soil, such as fertilizer, straw, microbes, or compost, which can promote biological activities and enhance the natural breakdown of the petroleum hydrocarbons. The grasses would be allowed to remain as part of the landscape. Phytoremediation processes can also be conducted in-situ, with the plants incorporated directly into the existing contaminated soil without prior excavation.

There are two different target volumes of soil to be addressed. Under Scenario A, a relatively small volume of 15 cubic yards exceeds the identified alternate cleanup levels. Under Scenario B, an estimated 110 cubic yards of soil would be addressed.

Overall protectiveness of human health and the environment
Phytoremediation would reduce risks to human health and the environment over the long term. The contaminated soils above the risk-based ACL or migration to groundwater ACL would be excavated and treated, or treated in place using phytoremediation techniques.

Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Compliance with ARARs
Phytoremediation should meet cleanup levels within several years for the petroleum-contaminated soils.

Short-term effectiveness
Excavation of the contaminated soils would be effective at reducing potential exposures in the short term. Under this alternative, excavation of the soils poses potential adverse impacts to the construction personnel on site. However, these impacts are easily controlled with proper construction safety and equipment handling techniques.

Long-term effectiveness
Phytoremediation is a proven technique to remediate petroleum hydrocarbons.

Reduction in toxicity, mobility, or volume through treatment
Phytoremediation would significantly decrease the petroleum hydrocarbon concentrations.

Implementability
Excavating soils, spreading onsite and seeding with plants and grasses are relatively simple processes. Plant growth could be adversely affected by the short growing season, but the abundant daylight compensates for the cold temperatures. The alternative would have less maintenance requirements than landfarming. There are no long term maintenance requirements such as periodic tilling of the soil or adding amendments. However, there are more uncertainties associated with achieving good rates of plant growth.

Cost
Scenario A. The estimated cost of Alternative 6 is $ 332,000.
Scenario B. The estimated cost of Alternative 6 is $ 1,320,000.

13.5.7 White Alice Complex Alternative 7 – Onsite Thermal Treatment

Description
Under this alternative, the identified petroleum contaminated soils would be excavated and treated onsite using a thermal desorption unit (low-temperature soil burning). The treated soil would be used to backfill the excavations or other similar areas at the site. This approach is straightforward, but does involve some uncertainties regarding the exact volume of soil to be addressed. The identified contamination is clearly associated with former fuel tanks and fuel pipelines, therefore the likelihood that the estimates are wrong by an order of magnitude are low. The total depth of contamination at several areas is unknown and could be larger than anticipated, e.g., near the AST or the Anchor Pit at Site 32.

Under Scenario A, an estimated 15 cubic yards of petroleum-contaminated soils would be excavated based on the ACL of 9,200 mg/kg DRO. Under Scenario B, approximately 110 cubic yards of POL-contaminated soil would be addressed. See Figures 13-1 and 13-2 for the proposed excavation areas and estimated depth of contamination.

Overall protectiveness of human health and the environment
This alternative would reduce the potential future risk posed by the White Alice Complex by excavating soil containing DRO above the alternate cleanup levels. The petroleum-contaminated soil would be treated and used as backfill at the site.

Compliance with ARARs
Excavation and thermal treatment would meet the risk-based alternate cleanup levels under Scenario A, and the migration to groundwater alternate cleanup levels for the petroleum-contaminated soils under Scenario B.

Short-term effectiveness
There is a potential for exposure to site workers while excavating, transporting and treating the contaminated soil. Following a health and safety plan and using appropriate personal protective equipment, would minimize exposure of site workers to contaminants. Additional measures would be taken to prevent exposure to visitors entering the areas during implementation of the alternative. The short-term risks are manageable.

Long-term effectiveness
The residual risk posed by the site would be reduced by this alternative because the contaminated soil would be removed and treated. Institutional controls would not be necessary since no soil with contaminants above cleanup levels would remain on site.

Reduction in toxicity, mobility, or volume through treatment
Removal of the contaminated soils reduces the volume of contaminated materials onsite. The thermal desorption unit would treat the soil to destroy the petroleum hydrocarbons to meet the cleanup levels.

Implementability
Excavating contaminated soil is a relatively straightforward task. Transportation of the materials and soil burner involves logistical challenges in remote Alaska, but are commonly addressed. There should be no difficulty excavating the DRO-contaminated soil from Sites 31 and 32. The thermal soil burner will require additional resources such as a power source, generator, and oversight from a contractor during its operation. The short field season and lack of permanent facilities at Northeast Cape pose additional challenges for implementation of this alternative.

Cost
Scenario A. The estimated cost of Alternative 7 is $ 1,100,000.
Scenario B. The estimated cost of Alternative 7 is $ 1,230,000.

13.5.8 White Alice Complex Alternative 8 – Excavation and Off-site Treatment/Disposal

Description
Under this alternative, the identified petroleum contaminated soils would be excavated and transported off-site for treatment and/or disposal at a permitted landfill facility. This approach is straightforward, but does involve some uncertainties regarding the exact volume of soil to be addressed. The identified petroleum contamination is clearly associated with former fuel tanks and fuel pipelines, therefore the likelihood that the estimates are wrong by an order of magnitude are low. The total depth of contamination at several areas is unknown and could be larger than anticipated, e.g., near the AST or the Anchor Pit at Site 32.

Under Scenario A, an estimated 15 cubic yards of petroleum-contaminated soils would be excavated based on the ACL of 9,200 mg/kg DRO. Under Scenario B, approximately 110 cubic yards of petroleum-contaminated soil would be addressed which exceeds the ACL of 1,600 mg/kg DRO. See Figures 13-1 and 13-2 for proposed excavation areas and estimated depth of contamination.

Overall protectiveness of human health and the environment
This alternative would reduce the potential future risk posed by the White Alice Complex by excavating soil containing DRO above the alternate cleanup level. All contaminated soil would be removed and properly disposed at an approved off-site landfill.

Compliance with ARARs
Excavation and off-site treatment/disposal would meet the risk-based alternate cleanup levels under Scenario A, and the migration to groundwater alternate cleanup levels for the petroleum-contaminated soils under Scenario B.

Short-term effectiveness
There is a potential for exposure to site workers while excavating, transporting and treating the contaminated soil. Following a health and safety plan and using appropriate personal protective equipment, would minimize exposure of site workers to contaminants. Additional measures would be taken to prevent exposure to visitors entering the areas during implementation of the alternative. The short-term risks are manageable.

Long-term effectiveness
The residual risk posed by the site would be reduced by this alternative because the contaminated soil would be removed. Institutional controls would not be necessary since soil with contaminants above cleanup levels would not remain on site.

Reduction in toxicity, mobility, or volume through treatment
Removal of the contaminated soils reduces the volume of contaminated materials onsite. The disposal facility may treat or otherwise stabilize the contaminated soils to meet permit requirements.

Implementability
Excavation of contaminated soil is a relatively straightforward task. Transportation of the materials involves logistical challenges in remote Alaska, but these issues are commonly

addressed. There should be no difficulty excavating or transporting the DRO-contaminated soil from Sites 31 and 32. However, rain and surface water runoff could impact the excavations and require diversion or temporary treatment. There should also be no difficulty locating an approved landfill for the contaminated soil.

Cost
Scenario A. The estimated cost of Alternative 8 is $ 1,010,000.
Scenario B. The estimated cost of Alternative 8 is $ 1,060,000.

13.6 White Alice Complex Comparative Analysis of Alternatives

A comparative evaluation of the alternatives described above for the White Alice Complex is provided in Table 13-1. A summary of the estimated cost for each alternative is shown below.

White Alice Complex	Cost
1 - No Action	$ 0
2 - Institutional Controls	$186,000
3 - Natural Attenuation	$193,000
4 - LTM	$184,000
5A - Landfarming	$371,000
5B - Landfarming	$1,330,000
6A - Phytoremediation	$332,000
6B - Phytoremediation	$1,320,000
7A - Thermal Treatment	$1,100,000
7B - Thermal Treatment	$1,230,000
8A - Off-site Treatment/Disposal	$1,010,000
8B - Off-site Treatment/Disposal	$1,060,000

14.0 AREA OF CONCERN I – PCB CONTAMINATED SOILS

14.1 Site 13 – Heat and Electrical Power Building 110

14.1.1 Background

Site 13 contained the Heat and Electrical Power Building 110. The former Building 110 included three transformer banks and diesel generators.

14.1.2 Previous Removal/Remedial Actions

The building and contaminated concrete were removed under previous removal actions. PCB-contaminated soils surrounding Building 110 were also excavated and disposed offsite during the 2001 (25 tons) and 2005 (116 tons) field seasons. Additional PCB-contaminated soil remains in subsurface soils at Site 13.

14.1.3 Nature and Extent of Contamination

Surface and subsurface soil samples were collected over several years to evaluate the extent of PCB contamination near the building and transformer pads. Soil screening and laboratory confirmation samples following the 2005 removal action indicate residual PCB concentrations up to 37.1 mg/kg (excavation 13B-2). An estimated 150 cubic yards of soil remain with PCBs above the cleanup level of 1 mg/kg. In addition, soil samples collected during the 2003 demolition of the wooden utilidor corridor south of Building 110 indicated two discrete hits of PCBs ranging from 2.4 to 16.9 mg/kg, at depths of 4 to 5 feet below ground surface. The utilidor trenches were backfilled with clean fill. The three excavations conducted north of Building 110 (13C, 13D, and 13E) during the 2005 field season successfully removed all PCB contamination to below 1 ppm.

14.2 Site 31 – Main Electronics Buildings

14.2.1 Background

The White Alice site is located southeast and uphill from the main operations complex in a glacial valley at the base of Mt. Kangukhsam. The site included four large billboard antennas, a central main electronics building, other supporting structures, and seven ASTs.

14.2.2 Previous Removal/Remedial Actions

The antennas, buildings, and ASTs were demolished and removed during the 2003 field season. A total of 118 tons of PCB-contaminated soil was excavated south and west of the former Main Electronics Building (Bldg 1001) adjacent to a former transformer pad, and at the septic tank outfall during the 2005 field season. PCB-contaminated concrete (79 tons) was also removed from portions of the Building 1001 foundation.

14.2.3 Nature and Extent of Contamination

Surface and subsurface soil samples were collected over several years to evaluate the extent of PCB contamination near transformer pads and outfalls. After final building demolition and debris removal activities, including removal of contaminated concrete and excavation of PCB-contaminated soils, additional soil confirmation samples were collected in 2005.

PCBs were identified at a possible sewage outfall and adjacent to the main electronics building transformer pad. Additional sampling for PCBs was conducted in 2004, and PCBs were detected at concentrations up to 14.8 mg/kg. PCB-contaminated soils were excavated from the septic tank outfall (13 tons), west of the main electronics building (50 tons), and adjacent to the former transformer pad (55 tons) in 2005. Soil confirmation samples from the excavations indicate PCBs still remain at concentrations above 1 ppm adjacent to the former transformer pad (Excavation area 31A). PCBs remain in soils at concentrations ranging from 1.53 to 7.09 mg/kg. The excavations at the septic tank outfall (31C) and west of the building (31B) successfully removed all PCB contamination to below 1 ppm.

14.3 PCB Contaminated Soils

14.3.1 Conceptual Site Model

The primary exposure route is incidental ingestion of, or dermal contact with soil. The sites are located on gravel pads.

14.3.2 Risk Assessment

PCB-contaminated soils were evaluated in the human health and ecological risk assessment. The future residential scenario assumed residents would occupy the site year-round. A future seasonal use scenario (subsistence, recreational) assumed site use for 6 months/year. Under the future residential use scenario, PCBs in soil exceeded the risk based threshold of 1x10-5. The residual PCBs adjacent to the Main Electronics Building at Site 31 do not exceed a risk-based cleanup level of 10 mg/kg based on a future seasonal resident scenario.

14.3.3 Remedial Action Objectives

Site-specific soil cleanup levels appropriate for the PCB-contaminated soils were developed based on two scenarios. Scenario A assumes a future permanent resident scenario with no land use restrictions. Scenario B assumes a low-occupancy scenario or future seasonal residents. The primary exposure point is incidental ingestion of or dermal contact with contaminated soil.

Scenario A - Soil Alternate Cleanup Level (future residential)

- PCBs 1 mg/kg

Scenario B – Soil Alternate Cleanup Level (current/future seasonal residents)

- PCBs 10 mg/kg

14.4 PCB Contaminated Soil Screening of Alternatives

The response actions identified in Section 4 were evaluated for the site-specific contaminants of concern and affected media.

No Action is retained for further evaluation per the requirements of the NCP. There are no costs associated with this alternative.

Institutional controls are applicable to the PCB-contaminated soils and could involve physical, legal, or administrative mechanisms to restrict the use of or access to the site to prevent future risks to human health, safety, or the environment. Such controls could include a deed notice to provide information to current or future landowners about the presence of contaminated soils at the site and the need for proper management of the soils if excavated. Other measures could involve future building restrictions or public education. ICs are an effective tool to prevent exposure to the contaminants, can be implemented and typically have minimal costs. ICs are retained for further evaluation.

Natural attenuation and *long term monitoring* allow natural surface and sub-surface processes to reduce contaminant concentrations to acceptable levels over time. This alternative is not applicable for PCB-contaminated soils, because PCBs are persistent organic compounds which do not readily break down in the environment.

The *capping* of PCB-contaminated soils was retained for further consideration. The remaining areas with PCB-contaminated soils are relatively small and discrete, adjacent to former transformer pads.

*Landfarming a*nd *phytoremediation* were not retained for further evaluation. These technologies are not applicable to PCB-contaminated soils.

Thermal treatment was not retained for further evaluation. Soil burning is a proven technology to remediate diesel-contaminated soils, but is typically only applicable to low-level PCB contamination.

Off-site treatment/disposal was retained for further evaluation. Soil excavation, containerization, transport and disposal are straightforward methods to remediate the site.

Reactive matting was eliminated from further consideration. The primary media affected is gravel fill soils or unconsolidated materials near the former buildings. Reactive matting is typically applied to underwater sediments, which is not applicable at this location.

Chemical oxidation was not retained for further evaluation. The shallow groundwater is not impacted with PCBs.

Reactive walls were eliminated from consideration because the shallow groundwater is not impacted.

Constructed wetlands were eliminated from consideration. The areas with PCB-contaminated soils are gravel pads, and enhancing this natural system would achieve limited benefits.

14.5 PCB Contaminated Soils Detailed Analysis of Alternatives

14.5.1 PCB Contaminated Soils Alternative 1 – No Action

Description
Analysis of the No Action alternative is required by the NCP. This alternative involves no further action at the site and is sometimes referred to as the "walk-away" alternative. Under this alternative, no remedial actions would be taken.

Overall protection of human health and the environment
The No Action alternative does not reduce the potential future risk posed by the PCB-contaminated soils adjacent to the Heat and Electrical Power Building (Site 13) and the Main Electronics Building (Site 31). The potential risks at these sites are relatively low, since a limited area contains PCBs above levels which may pose a risk to human health based on a future permanent resident scenario. The residual PCBs adjacent to the Main Electronics Building at Site 31 do not exceed a risk-based cleanup level of 10 mg/kg based on a future seasonal resident scenario. The PCB-contaminated soils at both sites are currently covered by plastic (visqueen) and 0.5 to 2.5 feet of clean fill. PCB-contaminated soils would remain above health-based levels in the subsurface soils. The sites are currently uninhabited, and there is no identified risk to site visitors.

Compliance with ARARs
The No Action alternative does not comply with the identified alternate soil cleanup levels for PCBs, since there would be no immediate reduction in the concentration or quantity of contaminants in soil. The PCBs are not likely to reach cleanup levels via natural attenuation processes.

Short-term effectiveness
There are no short-term risks posed by the site or implementation of the no action alternative, since there are no actions included in this alternative. The risk assessment determined there are no current risks to human health or the environment.

Long-term effectiveness
The No Action alternative does not reduce the long-term risks associated with the site.

Reduction of Toxicity, Mobility, or Volume
The No Action alternative will not reduce the toxicity, mobility, or volume of contaminated soil. PCBs are considered persistent in the environment and degrade very slowly over time.

Implementability
No technical or administrative implementability issues have been identified for the No Action alternative.

Cost
There are no costs associated with the No Further Action alternative.

14.5.2 PCB Contaminated Soils Alternative 2 – Institutional Controls

Description
Institutional controls at the Heat and Electrical Power and the Main Electronics Buildings could include physical, legal, or administrative mechanisms to restrict the use of or access to the site to prevent future risks to human health, safety, or the environment. Such controls could include a deed notice to provide information to current or future landowners about the presence of PCB-contaminated soil at the site and the need for proper management of the soil if excavated. Other measures could involve restrictions on future construction of buildings over contaminated soils, and preventing soil excavation adjacent to former electronics building foundation. Typical examples of institutional controls include deed notices, building and excavation restrictions, or fencing.

Overall protectiveness of human health and the environment
The institutional controls would prevent potential future exposures to contaminants of concern in subsurface soils. Institutional controls would prevent exposure of current and future residents to contaminated soils through restrictions on soil excavations. The existing levels in soil at the Main Electronics Building do not pose a potential risk to current site visitors or seasonal subsistence residents. The maximum level in subsurface soil at the Heat and Electrical Power Building may pose a potential risk to future seasonal or permanent residents if exposed to the surface.

Compliance with ARARs
Exposure to the PCB-contaminated soils would be mitigated by using institutional controls.

Short-term effectiveness
Institutional controls are relatively easy to implement, and can be an effective way to inform site users of potential risks.

Long-term effectiveness
Institutional controls can be effective in the long term. Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions and implemented controls would be required as part of this alternative.

Reduction in toxicity, mobility, or volume through treatment
PCBs are persistent organic compounds and do not easily break down over time, the reduction in toxicity and mobility of the contaminants would be limited.

Implementability
Institutional controls are typically easily implemented. The need for, and likelihood of, landowner acceptance and compliance with ICs is a consideration for alternatives requiring them. The land at Northeast Cape is owned jointly by two local Native Corporations, Savoonga

Native Corporation and Sivuqaq, Inc. The ability of the Corporations to accept and maintain land use controls is unknown.

Cost
The estimated cost of Alternative 2 is $ 186,000.

14.5.3 PCB Contaminated Soils Alternative 5 - Capping

Description
Capping consists of covering the contaminated areas with a low-permeability cover and fill to prevent the infiltration of surface water and exposure to the underlying soil. Capping the PCB-contaminated soils will follow ADEC guidance for capping of PCB-contaminated soils. The cap will be constructed with an appropriate material to prevent exposure of humans and the environment to PCBs; and will be designed and constructed of a material of sufficient strength and durability to withstand the use of the surface that is exposed to the environment. The capped areas will be periodically inspected to ensure cap integrity and minor repairs will be made after discovery of any problems. Capping also requires that a deed notation is made in the appropriate land records, documenting that PCBs remain in the soil, that the contaminated soil has been capped, and that subsequent interest holders may have legal obligations with respect to the cap and the contaminated soil.

Overall protectiveness of human health and the environment
Capping would reduce risks to human health and the environment by preventing exposure to the contaminated soils. The area of concern adjacent to the Main Electronics Building does not pose a risk to current site visitors or future seasonal residents. The area of concern adjacent to the Heat and Electrical Power Building does not pose a risk to current site visitors. Natural attenuation of the PCB-contaminated soil is not likely to occur given the persistent nature of these compounds in the environment. The site could pose a risk to future permanent residents, if soils are excavated or otherwise exposed to the surface. Capping minimizes the vertical movement of contamination and significantly reduces the likelihood of human and animal contact with the PCB-contaminated soils. Capping also prevents human exposure to any surface soil contamination.

Compliance with ARARs
Capping would comply with the alternate soil cleanup level of 10 mg/kg for PCBs.

Short-term effectiveness
Capping provides an effective means of preventing exposure to the PCB-contaminated soils, and prevents migration of water through the subsurface soils. There are some inherent risks to construction workers hauling materials and operating heavy equipment. However, these impacts are easily controlled with proper construction safety and equipment handling techniques.

Long-term effectiveness
Capping requires periodic monitoring to ensure integrity of the cap materials. Major maintenance is not anticipated, but damage could occur in the future and there are uncertainties associated with reliability, erosion, permafrost changes, etc.

Remedial actions that do not allow unlimited use and unrestricted exposure must be reviewed at least every 5 years after the start of the remedial action. This review is conducted to ensure that the remedial actions remain protective of human health, safety, and the environment. Thus, a periodic review of site conditions, implemented controls, and monitoring results would be required as part of this alternative.

Reduction in toxicity, mobility, or volume through treatment
Capping does not remove the source materials or provide any reduction in the volume of contaminants. Capping decreases the mobility of contaminants by preventing infiltration of water.

Implementability
Capping is a relatively straightforward technology that has been implemented at many sites. Capping is moderately difficult given the remote location and logistical challenges.

Cost
The estimated cost of Alternative 4 is $ 1,035,000.

14.5.4 PCB Contaminated Soils Alternative 4 – Excavation and Off-site Treatment/Disposal

Description
Under this alternative, the identified PCB-contaminated soils would be excavated and transported off-site for treatment and/or disposal at a permitted landfill facility. This approach is straightforward, but does involve some uncertainties regarding the exact volume of soil to be addressed. The identified PCB contamination is clearly associated with former transformer pads, but the total depth of contamination is unknown and could be larger than anticipated based on previous soil excavation experiences.

An estimated 260 cubic yards of PCB-contaminated soils above 1 ppm would be excavated and transported off-site for disposal at a permitted landfill facility. PCB-contaminated soil remains in the subsurface at two discrete locations; adjacent to the former Heat and Electrical Power Building and the Main Electronics Building. As part of the 2005 removal action, PCB-contaminated soils were excavated to various depths and clean fill was placed on top of a layer of plastic (visqueen) to delineate the extent of the prior excavations.

Overall protectiveness of human health and the environment
This alternative would reduce the potential future risk posed by the PCB-contaminated soils by excavating soil containing PCBs above 1 mg/kg. All contaminated soil would be removed and properly disposed at an approved off-site landfill.

Compliance with ARARs
Excavation and off-site treatment/disposal would meet the risk-based alternate cleanup level of 1 mg/kg.

Short-term effectiveness
There is a potential for exposure to site workers while excavating, transporting and treating the contaminated soil. Following a health and safety plan and using appropriate personal protective

equipment, would minimize exposure of site workers to contaminants. Additional measures would be taken to prevent exposure to visitors entering the areas during implementation of the alternative. The short-term risks are manageable.

Long-term effectiveness
The residual risk posed by the site would be reduced by this alternative because the contaminated soil would be removed. Institutional controls would not be necessary since soil with contaminants above cleanup levels would not remain on site.

Reduction in toxicity, mobility, or volume through treatment
Removal of the contaminated soils reduces the volume of contaminated materials onsite. The disposal facility may treat or otherwise stabilize the contaminated soils to meet permit requirements.

Implementability
Excavation of contaminated soil is a relatively straightforward task. Transportation of the materials involves logistical challenges in remote Alaska, but these issues are commonly addressed. The PCB-contaminated soil adjacent to the former Main Electronics Building will be slightly more complex to excavate because clean fill exists in the upper 0.5 to 2 feet and must be removed prior to encountering the contaminated material. In addition, rain and surface water runoff could impact this excavation and require diversion or temporary treatment. The PCB-contaminated soil adjacent to the former Heat and Electrical Power Building 110 is also covered by a 1.5 to 2.5 ft. layer of clean fill. There should also be no difficulty locating an approved landfill for the contaminated soil.

Cost
The estimated cost of Alternative 4 is $ 1,200,000.

14.6 PCB Contaminated Soils Comparative Analysis of Alternatives

The potential future risks are manageable using institutional controls. It is unlikely that human receptors would be exposed for a long enough duration to be adversely affected. Capping and off-site disposal have similar costs, but there is more uncertainty associated with the estimated volume of soil to be excavated which could increase costs. A summary of the estimated cost of each alternative only is shown below.

PCB Contaminated Soils	Cost
1 - No Action	$ 0
2 - Institutional Controls	$ 186,000
3 – Capping	$ 1,035,000
4 - Off-site Treatment/Disposal	$ 1,200,000

15.0 SUMMARY

A range of alternatives was evaluated for the various areas of concern at Northeast Cape. A number of sites require no further action based on the summary of historical sampling results and previous removal activities. A summary of estimated costs for all proposed alternatives evaluated is shown in Table 15-1.

Table 15-1. Cost Summary of all Proposed Alternatives

Alternatives	Sites 3 and 4	Site 6 Former Drum Field	Site 7 and 9 Landfills	Site 8 POL Spill	Main Complex	Drainage Basin	White Alice Complex	PCB-contaminated Soils
No Action	$0	$0	$0	$0	$0	$0	$0	$0
Institutional Controls	$186,000	$186,000	$480,000	$186,000	$186,000	$186,000	$186,000	$186,000
Natural Attenuation		$212,000	$236,000	$126,000	$212,000	$207,000	$193,000	
LTM		$407,000	$704,000	$188,000	$631,000	$415,000	$184,000	
Natural Attenuation and LTM	$619,000	$619,000	$940,000	$314,000	$843,000	$622,000		
Landfarming (A)	$1,310,000	$1,630,000		$1,320,000	$6,840,000	$2,200,000	$371,000	
Landfarming (B)		$2,640,000				$5,000,000	$1,330,000	
Phytoremediation (A)	$1,190,000	$1,610,000		$1,310,000	$6,950,000	$2,200,000	$332,000	
Phytoremediation (B)		$2,700,000				$5,100,000	$1,320,000	
Thermal Treatment (A)	$1,190,000	$2,330,000			$7,200,000		$1,100,000	
Thermal Treatment (B)		$3,880,000					$1,230,000	
Off-Site Treatment and Disposal (A)	$1,030,000	$1,460,000	$84,000,000	$1,040,000	$11,000,000	$2,500,000	$1,010,000	$1,200,000
Off-Site Treatment and Disposal (B)		$3,900,000				$7,100,000	$1,060,000	
Chemical Oxidation	$1,240,000				$4,000,000			
Capping			$9,500,000					$1,035,000
Reactive Walls					$8,200,000			
Constructed Wetlands (A)						$1,100,000		
Constructed Wetlands (B)						$1,600,000		
Reactive Matting (A)				$840,000		$1,900,000		
Reactive Matting (B)						$4,200,000		

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ATTACHMENTS

Additional Tables

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TABLE 4-3. Detailed breakdown of costs estimates by phases for each alternative

Alternatives	Sites 3 and 4	Site 6 Former Drum Field	Site 8 POL Spill	Combined Sites 3, 4, 6, 8	Main Complex (MOC)	Drainage Basin (Site 28)	White Alice Complex (Site 31)	Combined Sites MOC, 28, 31	Combined Sites 3, 4, 6, 8, MOC, 28, 31	Site 7 and 9 Landfills	PCB-contaminated Soils
Institutional Controls	$186,000	$186,000	$186,000	**$186,000**	$186,000	$186,000	$186,000	**$186,000**	**$186,000**	$480,000	$186,000
Natural Attenuation	$212,000	$212,000	$126,000	**$212,000**	$212,000	$207,000	$193,000	**$212,000**	**$212,000**	$236,000	
LTM	$407,000	$407,000	$188,000	**$1,002,000**	$631,000	$415,000	$184,000	**$1,230,000**	**$2,232,000**	$704,000	
Natural Attenuation and LTM	$619,000	$619,000	$314,000	**$1,214,000**	$843,000	$622,000	$377,000	**$1,442,000**	**$2,444,000**	$940,000	
Landfarming (A)	**$1,320,000**	**$1,630,000**	**$1,320,000**	**$2,418,000**	**$6,840,000**	**$2,210,000**	**$380,000**	**$8,308,000**	**$9,831,000**		
Mod/Demob	$894,000	$895,000	$891,000	$895,000	$903,000	$897,000	$155,000	$903,000	$903,000		
Field Overhead	$12,000	$14,000	$12,000	$38,000	$64,000	$21,000	$14,000	$99,000	$137,000		
Technologies	$71,000	$301,000	$72,000	$444,000	$4,630,000	$869,000	$77,000	$5,576,000	$6,020,000		
Reporting	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$70,000		
Professional Labor Mgt.	$312,000	$382,000	$312,000	$1,006,000	$1,208,000	$392,000	$95,000	$1,695,000	$2,701,000		
Landfarming (B)		**$2,640,000**		**$3,429,000**		**$5,000,000**	**$1,330,000**	**$11,302,000**	**$13,834,000**		
Mod/Demob		$897,000		$897,000		$897,000	$891,000	$903,000	$903,000		
Field Overhead		$22,000		$46,000		$33,000	$13,000	$110,000	$156,000		
Technologies		$1,216,000		$1,359,000		$3,141,000	$79,000	$7,850,000	$9,209,000		
Reporting		$35,000		$35,000		$35,000	$35,000	$35,000	$70,000		
Professional Labor Mgt.		$468,000		$1,092,000		$882,000	$314,000	$2,404,000	$3,496,000		
Phytoremediation (A)	**$1,310,000**	**$1,610,000**	**$1,310,000**	**$2,391,000**	**$6,950,000**	**$2,220,000**	**$370,000**	**$8,423,000**	**$9,928,000**		
Mod/Demob	$886,000	$886,000	$886,000	$886,000	$909,000	$890,000	$155,000	$909,000	$909,000		
Field Overhead	$4,000	$6,000	$5,000	$15,000	$51,000	$13,000	$7,000	$71,000	$86,000		
Technologies	$75,000	$305,000	$76,000	$456,000	$4,727,000	$885,000	$80,000	$5,692,000	$6,148,000		
Reporting	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$70,000		
Professional Labor Mgt.	$309,000	$380,000	$310,000	$999,000	$1,228,000	$393,000	$95,000	$1,716,000	$2,715,000		
Phytoremediation (B)		**$2,700,000**		**$3,487,000**		**$5,100,000**	**$1,320,000**	**$11,482,000**	**$14,079,000**		
Mod/Demob		$890,000		$890,000		$890,000	$886,000	$909,000	$909,000		
Field Overhead		$14,000		$23,000		$24,000	$6,000	$81,000	$104,000		
Technologies		$1,288,000		$1,439,000		$3,212,000	$82,000	$8,021,000	$9,460,000		
Reporting		$35,000		$35,000		$35,000	$35,000	$35,000	$70,000		
Professional Labor Mgt.		$481,000		$1,100,000		$895,000	$313,000	$2,436,000	$3,536,000		
Thermal Treatment (A)	**$1,190,000**	**$2,330,000**		**$2,682,000**	**$7,200,000**		**$1,100,000**	**$7,512,000**	**$8,749,000**		
Mod/Demob	$796,000	$1,445,000		$1,445,000	$1,607,000		$750,000	$1,607,000	$1,607,000		
Field Overhead	$6,000	$10,000		$16,000	$115,000		$4,000	$119,000	$135,000		
Technologies	$69,000	$416,000		$485,000	$4,140,000		$51,000	$4,191,000	$4,676,000		
Reporting	$35,000	$35,000		$35,000	$35,000		$35,000	$35,000	$70,000		
Professional Labor Mgt.	$280,000	$421,000		$701,000	$1,301,000		$259,000	$1,560,000	$2,261,000		
Thermal Treatment (B)		**$3,880,000**		**$4,235,000**			**$1,230,000**	**$7,589,000**	**$10,217,000**		
Mod/Demob		$1,607,000		$1,607,000			$808,000	$1,607,000	$1,607,000		
Field Overhead		$42,000		$48,000			$7,000	$122,000	$170,000		
Technologies		$1,493,000		$1,562,000			$92,000	$4,232,000	$5,794,000		
Reporting		$35,000		$35,000			$35,000	$35,000	$70,000		
Professional Labor Mgt.		$703,000		$983,000			$292,000	$1,593,000	$2,576,000		
Off-Site Treatment and Disposal (A)	**$1,030,000**	**$1,460,000**	**$1,040,000**	**$2,003,000**	**$11,100,000**	**$2,540,000**	**$1,020,000**	**$13,048,000**	**$14,287,000**	**$84,000,000**	**$1,200,000**
Mod/Demob	$728,000	$764,000	$728,000	$764,000	$2,296,000	$813,000	$728,000	$2,296,000	$2,296,000	$2,305,000	$751,000
Field Overhead	$3,000	$5,000	$3,000	$11,000	$54,000	$11,000	$3,000	$68,000	$79,000	$467,000	$4,000
Technologies	$8,000	$50,000	$9,000	$67,000	$1,263,000	$312,000	$6,000	$1,581,000	$1,648,000	$7,301,000	$25,000
Tranportation/Disposal	$14,000	$256,000	$22,000	$292,000	$5,868,000	$910,000	$4,000	$6,782,000	$7,074,000	$67,355,000	$99,000
Reporting	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$35,000	$70,000	$35,000	$35,000
Professional Labor Mgt.	$243,000	$345,000	$246,000	$834,000	$1,590,000	$457,000	$239,000	$2,286,000	$3,120,000	$6,499,000	$283,000
Off-Site Treatment and Disposal (B)		**$3,910,000**		**$4,462,000**		**$7,100,000**	**$1,060,000**	**$16,882,000**	**$19,954,000**		
Mod/Demob		$1,390,000		$1,390,000		$1,577,000	$728,000	$2,296,000	$2,296,000		
Field Overhead		$12,000		$18,000		$29,000	$3,000	$86,000	$104,000		
Technologies		$329,000		$346,000		$896,000	$11,000	$2,170,000	$2,516,000		
Tranportation/Disposal		$1,439,000		$1,475,000		$3,271,000	$31,000	$9,170,000	$10,645,000		
Reporting		$35,000		$35,000		$35,000	$35,000	$35,000	$70,000		
Professional Labor Mgt.		$709,000		$1,198,000		$1,286,000	$249,000	$3,125,000	$4,323,000		
Chemical Oxidation	**$1,240,000**				**$4,000,000**						
Mod/Demob	$601,000				$880,000						
Field Overhead	$4,000				$26,000						
Technologies	$307,000				$2,381,000						
Reporting	$35,000				$35,000						
Professional Labor Mgt.	$289,000				$715,000						
Reactive Walls					**$8,200,000**						
Mod/Demob					$882,000						
Field Overhead					$80,000						
Technologies					$6,025,000						
Reporting					$35,000						
Professional Labor Mgt.					$1,166,000						
Constructed Wetlands (A)						**$1,100,000**					
Mod/Demob						$647,000					
Field Overhead						$8,000					
Technologies						$171,000					
Reporting						$35,000					
Professional Labor Mgt.						$263,000					
Constructed Wetlands (B)						**$1,600,000**					
Mod/Demob						$647,000					
Field Overhead						$8,000					
Technologies						$663,000					
Reporting						$35,000					
Professional Labor Mgt.						$290,000					
Reactive Matting (A)			**$840,000**			**$1,900,000**					
Mod/Demob			$554,000			$681,000					
Field Overhead			$3,000			$10,000					
Technologies			$19,000			$822,000					
Reporting			$35,000			$35,000					
Professional Labor Mgt.			$226,000			$338,000					
Reactive Matting (B)						**$4,200,000**					
Mod/Demob						$886,000					
Field Overhead						$67,000					
Technologies						$2,444,000					
Reporting						$35,000					
Professional Labor Mgt.						$753,000					
Capping										**$9,500,000**	**$1,035,000**
Mod/Demob										$1,210,000	$751,000
Field Overhead										$98,000	$4,000
Technologies										$6,636,000	$38,000
Monitoring										$151,000	$60,000
Reporting										$35,000	$35,000
Professional Labor Mgt.										$1,336,000	$148,000

Notes:
Combined costs for multiple sites under Scenario B also include costs from Scenario A if none specified for B.
LTM costs are assumed to be additive, but cost savings likely due to shared mobilization costs that are not itemized using the cost estimating program.

Alternative	Overall Protection of Human Health and the Env.	Compliance with ARARs	Short term Effectiveness	Long term Effectiveness	Reduction of Toxicity, Mobility, or Volume through treatment	Implementability	Cost
	Low/Medium/High	None/Partial/All	Low/Medium/High	Low/Medium/High	Low/Medium/High	Difficult/Average/Easy	Low/Medium/High
1 - No Action	Medium No current risks identified. Not protective of potential future use.	Partial. Site currently meets risk-based ingestion standards for soil. Fails drinking water standards for groundwater.	Medium No current site users potentially affected, if landuse changes significantly in short term, unlikely that natural attenuation processes will have reduced levels to meet cleanup goals.	Medium Natural attenuation will continue to break down petroleum hydrocarbons.	Medium Natural degradation processes will continue to break down the petroleum hydrocarbons at the site.	Easy No active measures to be implemented.	None $ 0
2- Institutional Controls	High Protective of current and potential future use.	All Soil and groundwater will attain cleanup levels in the future.	High Controls will be implemented immediately to prevent current and potential future exposure to soil/groundwater contamination.	Medium Natural attenuation processes will eventually achieve cleanup goals.	Medium Natural degradation processes will continue to break down the petroleum hydrocarbons at the site.	Average/Easy Will partially depend on ability and willingness of landowners to accept and implement the controls.	Low $186,000
3 - Nat. Attenuation and LTM	Medium/High No current risks identified. Soil and shallow groundwater will attain cleanup levels in future.	All Soil and groundwater will attain cleanup levels in the future.	Medium No current site users potentially affected, if landuse changes significantly in short term, unlikely that natural attenuation processes will have reduced levels to meet cleanup goals.	Medium Natural attenuation processes will eventually achieve cleanup goals.	Medium Natural degradation processes will continue to break down the petroleum hydrocarbons at the site.	Average/Easy Site access is somewhat complicated logistically due to remote location and lack of permanent facilities. Less contracting and construction oversight required.	Medium $619,000
4 – Landfarming	High Excavated soil will meet cleanup level for future use. Groundwater to achieve goals by natural attenuation	All Soil and groundwater will attain cleanup levels in the future.	Medium/High Concentrations will likely show greatest reduction over first field season.	Medium/High Concentrations will likely show greatest reduction over first field season.	Medium/High Excavated soil will be processed onsite to more quickly reduce concentrations of petroleum in the soil matrix.	Average Straightforward. Remote site logistics typical for Alaska with barge access to be arranged. Technology requires periodic maintenance by onsite worker.	Medium/High $1,310,000
5 - Phytoremediation	High Excavated soil will meet cleanup level for future use. Groundwater to achieve goals by natural attenuation.	All Soil and groundwater will attain cleanup levels in the future.	Medium/High Concentrations will likely show greatest reduction over first field season.	Medium/High Concentrations will likely show greatest reduction over first field season.	Medium/High Soil will be seeded to reduce concentrations of petroleum in the soil matrix using grasses/plants.	Average Straightforward. Remote site logistics typical for Alaska with barge access to be arranged. Less long term maintenance once soils are excavated and seeded.	Medium/High $1,190,000
6 - Thermal Treatment	High Excavated soil will meet cleanup level for future use. Groundwater to achieve goals by natural attenuation.	All Soil and groundwater will attain cleanup levels in the future.	Medium/High Treated soil will achieve cleanup levels in first field season. Groundwater will take many years to achieve cleanup levels for potential future drinking water source.	High Soil treated immediately. Groundwater will eventually achieve cleanup levels.	High Excavated soil will be treated onsite to quickly reduce concentrations of petroleum in the soil matrix.	Difficult/Average Slightly more difficult, although technology is standard. More equipment to be mobilized to the site, cold temp could affect performance, requires longer time onsite, provision of power source.	Medium/High $1,190,000
7 - Off-site Treatment/Disposal	High Excavated soil will meet cleanup level for future use. Groundwater to achieve goals by natural attenuation.	All Soil and groundwater will attain cleanup levels in the future.	Medium/High Soil will be immediately removed from site. Groundwater will take many years to achieve cleanup levels for potential future drinking water source.	High Soil removed immediately. Groundwater allowed to naturally attenuate and meet cleanup levels in long term.	High Excavated soil will be transported offsite, reducing volume of contamination left onsite.	Average/Easy Straightforward. Remote site logistics typical for Alaska with barge access and landfill arrangements. Less time required onsite.	Medium/High $1,030,000
8 - Chemical Oxidation	High Soil allowed to naturally attenuate. Groundwater actively treated to achieve cleanup goals in several years.	All Soil and groundwater will attain cleanup levels in the future.	Medium/High Groundwater will achieve cleanup levels in shortened timeframe. Soil does not currently pose a risk. Natural attenuation processes allowed to remediate the soil over many years.	High Groundwater will achieve cleanup levels in short time frame. Soil will achieve cleanup levels over many years.	Medium/High Groundwater will be treated over several field seasons to reduce the concentration of petroleum hydrocarbons. Concentrations in soil will more slowly be reduced via natural attenuation.	Difficult/Average Will require several field seasons and mobilizations to successfully treat the groundwater. Shallow depth of groundwater, tundra matrix, and cold temperatures could be problematic.	Medium/High $1,240,000

Table 6-1
Evaluation of Remedial Action Alternatives
AREA OF CONCERN A – Sites 3 and 4

Alternative	Overall Protection of Human Health and the Env.	Compliance with ARARs	Short term Effectiveness	Long term Effectiveness	Reduction of Toxicity, Mobility, or Volume through treatment	Implementability	Cost
	Low/Medium/High	None/Partial/All	Low/Medium/High	Low/Medium/High	Low/Medium/High	Difficult/Average/Easy	Low/Medium/High
1 - No Action	Low Site does not pose a risk to current site visitors. Shallow groundwater is not currently used for drinking water purposes, but exceeds Table C cleanup levels. Surface and subsurface soils may pose a future risk, based on potential future residual use scenario.	None. Soil does not meet migration to groundwater or risk-based cleanup levels. Shallow groundwater does not meet cleanup levels.??	Medium/Low Minor reduction in petroleum concentrations over short term.	Medium Over many years, petroleum hydrocarbons will naturally biodegrade to meet cleanup levels.	Low/Medium Natural degradation processes will continue to break down the petroleum hydrocarbons at the site.	Easy No active measures to be implemented.	None $ 0
2 - Institutional Controls	High Protective of current and potential future use.	Yes Risk exposure pathways controlled. Over time, should comply with risk-based ingestion cleanup levels. May comply with migration to groundwater cleanup levels in long term.	High Controls will be implemented immediately to prevent current and potential future exposure to soil/groundwater contamination.	Medium/High Continuing community education and/or signage may be difficult to enforce. However, over many years the petroleum hydrocarbons will naturally biodegrade to meet cleanup levels	Low/Medium Natural degradation processes will continue to break down the petroleum hydrocarbons at the site.	Average/Easy Will partially depend on ability and willingness of landowners to accept and implement the controls.	Low $ 186,000
3 - Nat. Attenuation	Yes Limited protection of human health and the environment initially, but protection will increase with time.	Partial Over time, should comply with risk-based ingestion cleanup levels. May comply with migration to groundwater cleanup levels in long term.	Medium/Low Minor reduction in petroleum concentrations over short term.	High Over many years, petroleum hydrocarbons will naturally biodegrade to meet cleanup levels.	Low/Medium Natural degradation processes will continue to break down the petroleum hydrocarbons at the site.	Average/Easy Site access is somewhat complicated logistically due to remote location and lack of permanent facilities. Less contracting and construction oversight required.	Medium $ 619,000
3 - LTM	Yes Limited protection of human health and the environment initially, but protection will increase with time.	Partial Over time, should comply with risk-based ingestion cleanup levels. May comply with migration to groundwater cleanup levels in long term.	Medium/Low Minor reduction in petroleum concentrations over short term.	High Over many years, petroleum hydrocarbons will naturally biodegrade to meet cleanup levels.	Low/Medium Natural degradation processes will continue to break down the petroleum hydrocarbons at the site.	Average/Easy Site access is somewhat complicated logistically due to remote location and lack of permanent facilities. Less contracting and construction oversight required.	Low/Medium $ 407,000
4A - Landfarming	Yes Limited protection of human health and the environment initially, but protection will increase with time.	Yes Complies with risk-based ingestion cleanup levels, over time will comply with migration to groundwater soil cleanup levels.	Medium/High Treated soil will achieve cleanup levels over several field seasons. Remaining soil may comply with migration to groundwater cleanup levels over time.	High Treated soil will likely achieve cleanup levels over the long term. Untreated remaining soil may comply with migration to groundwater cleanup levels over time.	Medium/High Excavated soil will be processed onsite to more quickly reduce concentrations of petroleum in the soil matrix.	Average Straightforward. Remote site logistics typical for Alaska with barge access to be arranged. Technology requires periodic maintenance by onsite worker.	Medium $ 1,630,000
4B - Landfarming	Yes Increased protection of human health and the environment.	Yes Complies with migration to groundwater cleanup levels.	Medium/High Several field seasons will be necessary to achieve cleanup levels.	High All soil will likely achieve cleanup levels over the long term.	Medium/High Excavated soil will be processed onsite to more quickly reduce concentrations of petroleum in the soil matrix.	Average Straightforward. Remote site logistics typical for Alaska with barge access to be arranged. Technology requires periodic maintenance by onsite worker.	Medium/High $ 2,640,000
6A – Phytoremediation	Yes Limited protection of human health and the environment initially, but protection will increase with time.	Yes Complies with risk-based ingestion cleanup levels, over time will comply with migration to groundwater soil cleanup levels.	Medium/High Treated soil will achieve cleanup levels over several field seasons. Remaining soil may comply with migration to groundwater cleanup levels over time.	High Treated soil will likely achieve cleanup levels over the long term. Untreated soil may comply with migration to groundwater cleanup levels over time.	Medium/High Soil will be seeded to reduce concentrations of petroleum in the soil matrix using grasses/plants.	Average Straightforward. Remote site logistics typical for Alaska with barge access to be arranged. Less long term maintenance once soils are excavated and seeded.	Medium $ 1,610,000

Alternative	Overall Protection of Human Health and the Env.	Compliance with ARARs	Short term Effectiveness	Long term Effectiveness	Reduction of Toxicity, Mobility, or Volume through treatment	Implementability	Cost
6B - Phytoremediation	Yes Increased protection of human health and the environment.	Yes Complies with migration to groundwater cleanup levels.	Medium/High Several field seasons will be necessary to achieve cleanup levels.	High All soil will likely achieve cleanup levels over the long term.	Medium/High Soil will be seeded to reduce concentrations of petroleum in the soil matrix using grasses/plants.	Average Straightforward. Remote site logistics typical for Alaska with barge access to be arranged. Less long term maintenance once soils are excavated and seeded.	Medium/High $ 2,700,000
7A - Thermal Treatment	Yes Limited protection of human health and the environment initially, but protection will increase with time for remainder of site.	Yes Complies with risk-based ingestion cleanup levels, over time will comply with migration to groundwater soil cleanup levels.	High Treated soil will achieve all cleanup levels during initial field season. Remaining soil may comply with migration to groundwater cleanup levels over time.	High Untreated soil will likely achieve migration to groundwater cleanup levels over the long term.	High Excavated soil will be treated onsite to quickly reduce concentrations of petroleum in the soil matrix.	Difficult/Average Slightly more difficult, although technology is standard. More equipment to be mobilized to the site, cold temperature could affect performance, requires longer time onsite, provision of power source.	Medium/High $ 2,330,000
7B - Thermal Treatment	Yes Most protective of human health and the environment.	Yes Complies with migration to groundwater cleanup levels	High Treated soil will achieve all cleanup levels during initial field season.	High All soil will achieve cleanup levels over the long term.	High Excavated soil will be treated onsite to quickly reduce concentrations of petroleum in the soil matrix.	Difficult/Average Slightly more difficult, although technology is standard. More equipment to be mobilized to the site, cold temperature could affect performance, requires longer time onsite, provision of power source.	High $ 3,880,000
8A - Off-site Treatment/Disposal	Yes Protective of human health and the environment.	Yes Complies with risk-based ingestion cleanup levels, over time will comply with migration to groundwater soil cleanup levels.	High Most highly contaminated soils immediately removed from the site. Remaining soil will naturally degrade over time.	High Contaminated source will be permanently removed from the site.	High Excavated soil will be transported offsite, reducing volume of contamination left onsite.	Average/Easy Straightforward. Remote site logistics typical for Alaska with barge access and landfill arrangements. Less time required onsite.	Medium $ 1,460,000
8B - Off-site Treatment/Disposal	Yes Most protective of human health and the environment.	Yes Complies with migration to groundwater cleanup levels	High All contaminated soils immediately removed from the site.	High Contaminated source will be permanently removed from the site.	High Excavated soil will be transported offsite, reducing volume of contamination left onsite.	Average/Easy Straightforward. Remote site logistics typical for Alaska with barge access and landfill arrangements. Less time required onsite.	High $ 3,900,000

Alternative	Overall Protection of Human Health and the Env.	Compliance with ARARs	Short term Effectiveness	Long term Effectiveness	Reduction of Toxicity, Mobility, or Volume through treatment	Implementability	Cost
	Low/Medium/High	None/Partial/All	Low/Medium/High	Low/Medium/High	Low/Medium/High	Difficult/Average/Easy	Low/Medium/High
1 - No Action	Low Limited risk from contaminated soil surrounding landfill, no measures taken to prevent use of groundwater for drinking water. No actions taken control potential future use.	None Soil may comply with ARARs over time.	Low No measures taken to prevent exposure.	Low/Medium Residual risk will diminish over time as contaminants naturally attenuate. Changing permafrost conditions could cause increased leaching in future.	Low Some reduction in contamination is expected to occur through natural attenuation processes.	Easy No actions to implement.	None $ 0
2 - Institutional Controls	Yes Prevents current and future exposure to contaminants and landfill contents.	Partial Does not comply with cleanup standards initially, but may over time.	High/Medium Exposure pathways would be controlled once the site is fenced. Drinking water restriction more difficult to enforce. Shallow groundwater is not currently used for drinking water, water is difficult to access and not a reliable source of water. Does not prevent potential environmental impacts from leaching of materials within the landfill to surrounding tundra.	Medium/Low May require periodic maintenance of fencing at remote site, continued education to prevent use of shallow groundwater for drinking water or provision of alternate water source. Does not prevent offsite migration of contaminants from within the landfill under changed conditions in the future.	Low Some reduction in contamination is expected to occur through natural attenuation processes.	Difficult/Average Will partially depend on ability and willingness of landowner to accept and maintain controls. Construction of fencing and signage is straightforward, but easily subject to vandalism at remote site with no permanent residents.	Low/Medium $480,000
3 - Nat. Attenuation and LTM	Medium Limited current risk to human health and the environment. Potential future risk dependent on use of groundwater for drinking water. Limited potential for exposure to PCBs in subsurface soils at edge of landfill.	Partial Does not comply with cleanup standards initially, but may over time.	Medium Dependant on rate of natural attenuation processes. Metals in shallow groundwater less likely to degrade in short term. Monitoring activities would establish trends in contamination.	Medium/High Dependant on rate of natural attenuation processes. Metals in shallow groundwater less likely to degrade over time, but could be related to suspended solids in water column.	Low Some reduction in contamination is expected to occur through natural attenuation processes.	Easy Site access is remote, but less equipment is necessary for monitoring purposes.	Medium $940,000
3 - LTM	Medium Limited current risk to human health and the environment. Potential future risk dependent on use of groundwater for drinking water. Limited potential for exposure to PCBs in subsurface soils at edge of landfill.	Partial Does not comply with cleanup standards initially, but may over time	Medium Dependant on rate of natural attenuation processes. Metals in shallow groundwater less likely to degrade in short term. Monitoring activities would establish trends in contamination.	Medium/High Dependant on rate of natural attenuation processes. Metals in shallow groundwater less likely to degrade over time, but could be related to suspended solids in water column.	Low Some reduction in contamination is expected to occur through natural attenuation processes.	Easy Site access is remote, but less equipment necessary for monitoring purposes.	Medium $704,000
5 - Capping	Yes Protective of human health and the environment.	Partial. Prevents exposure to contaminated soils and landfill contents. Shallow groundwater does not comply with drinking water standards initially, but may in time.	High Remedial activities can be completed in shorter time frame. Remedial objectives will be attained upon completed installation of the cap. Long term monitoring will be required.	High Long term monitoring of cap integrity will be required. Five year review also required. Arctic environment could adversely affect cap stability or effectiveness in the future.	Medium/High Mobility of contaminants within landfill will be reduced by a cap which covers the soil and prevents precipitation from leaching contaminants into the water table.	Average Standard practice for landfills. Remote site logistics challenges still apply to transport materials and equipment.	Medium/High $9,500,000

Table 8-3
Evaluation of Remedial Action Alternatives
AREA OF CONCERN C – Site 7 and 9 Landfill

Alternative	Overall Protection of Human Health and the Env.	Compliance with ARARs	Short term Effectiveness	Long term Effectiveness	Reduction of Toxicity, Mobility, or Volume through treatment	Implementability	Cost
6 - Off-site Treatment/Disposal	Yes Protective of human health and the environment.	Yes Complies with all ARARs for soil exposure. Shallow groundwater not actively addressed, but source removal will allow levels to comply over time.	Medium/High Construction activities will be disruptive to seasonal residents, health and safety plans will be required for construction workers. Disturbance of tundra will have short term environmental impacts including exposed soil, dust, potential runoff. Complete removal of landfill could take several years based on availability of funding, short field season, and large volume of material to be processed and shipped. Temporary measures to secure the site over the winter will be necessary.	High All potential contaminated source materials will be permanently removed. Confirmation sampling will verify underlying soil is clean.	High All landfill contents and contaminated materials will be removed from the site and properly disposed at a permitted disposal facility.	Difficult Volume of material to be excavated, transported, and disposed is enormous. Logistics to procure adequate equipment, barge services, connexes will be extremely complicated. Contracting will be more difficult if remedial action is spread out over many years, increasing total cost and number of site mobilizations.	High $84,000,000

Alternative	Overall Protection of Human Health and the Env.	Compliance with ARARs	Short term Effectiveness	Long term Effectiveness	Reduction of Toxicity, Mobility, or Volume through treatment	Implementability	Cost
	Low/Medium/High	None/Partial/All	Low/Medium/High	Low/Medium/High	Low/Medium/High	Difficult/Average/Easy	Low/Medium /High
1 - No Action	Partial No current risks identified. Potential future risk is relatively low.	Yes Over time, petroleum hydrocarbons will naturally attenuate and should meet risk-based ingestion cleanup levels.	Low No immediate reduction in site concentrations	Medium Over time, petroleum will continue to naturally attenuate.	Medium Over time, petroleum will continue to naturally attenuate.	Easy No active measures taken	None $ 0
2 - Institutional Controls	Medium/High Protective of human health by controlling potential future exposures though education and/or signage. Low potential for ecological risk, no stressed vegetation observed.	Yes Over time, petroleum hydrocarbons will naturally attenuate and should meet risk-based ingestion cleanup levels.	Medium/High Signs, fencing, education are effective means to prevent human exposure	Medium Ability of landowner to maintain controls is unknown.	Medium Natural attenuation processes will continue to degrade the petroleum hydrocarbons	Average/Easy Will partially depend on ability and willingness of landowners to accept and implement the controls.	Low $186,000
3 - Nat. Attenuation	Medium No current risks identified. Potential future risk is relatively low.	Yes Over time, petroleum hydrocarbons will naturally attenuate and should meet risk-based ingestion cleanup levels.	Low No immediate reduction in site concentrations	Medium Concentrations will continue to decrease over time.	Medium Natural attenuation processes will continue to degrade the petroleum hydrocarbons	Average/Easy Site access is somewhat complicated logistically due to remote location and lack of permanent facilities. Only one site visit required.	Low $126,000
4 - LTM	Medium No current risks identified. Potential future risk is relatively low.	Yes Over time, petroleum hydrocarbons will naturally attenuate and should meet risk-based ingestion cleanup levels.	Low No immediate reduction in site concentrations	Medium Concentrations will continue to decrease over time.	Medium Natural attenuation processes will continue to degrade the petroleum hydrocarbons	Average/Easy Site access is somewhat complicated logistically due to remote location and lack of permanent facilities. Several site visits required. Involves some contracting/oversight.	Low $188,000
3+4 - Nat. Attenuation and LTM	Medium No current risks identified. Potential future risk is relatively low.	Yes Over time, petroleum hydrocarbons will naturally attenuate and should meet risk-based ingestion cleanup levels.	Low No immediate reduction in site concentrations	Medium Concentrations will continue to decrease over time.	Medium Natural attenuation processes will continue to degrade the petroleum hydrocarbons	Average/Easy Site access is somewhat complicated logistically due to remote location and lack of permanent facilities. Involves several site visits and some contracting/oversight.	Medium $314,000
5 - Landfarming	High No current risks identified. Protective of potential future risk.	Yes Excavated sediment should comply with risk-based ingestion cleanup levels over time.	Medium Concentrations will decrease rapidly over first several seasons.	Medium Concentrations will continue to decrease over time.	Medium/High Initial concentrations expected to decrease rapidly and continue over time.	Average Straightforward. Remote site logistics typical for Alaska with barge access to be arranged. Technology requires periodic maintenance by onsite worker.	High $1,320,000
6 - Phytoremediation	High No current risks identified. Protective of potential future risk.	Yes Excavated sediment should comply with risk-based ingestion cleanup levels over time.	Medium Concentrations will decrease rapidly over first several seasons.	Medium Concentrations will continue to decrease over time.	Medium/High Initial concentrations expected to decrease rapidly and continue over time.	Average Straightforward. Remote site logistics typical for Alaska with barge access to be arranged. Less long term maintenance once soils are excavated and seeded.	High $1,310,000
7 - Off-site Treatment/Disposal	High No current risks identified. Protective of potential future risk.	Yes Excavated sediment will comply with risk-based ingestion cleanup levels.	High Contaminated source completely removed in one field season.	High Contaminated source completely removed.	High Contaminated source completely removed.	Average/Easy Straightforward. Remote site logistics typical for Alaska with barge access and landfill arrangements. Less time onsite.	High $ 1,040,000
8 - Reactive Matting	High No current risks identified. Protective of potential future risk.	Yes Meets surface water quality criteria of no sheen.	High Capping prevents exposure to contaminated sediments and prevents potential migration through surface water column.	Medium/High Uncertain if environmental conditions may cause degradation of the matting.	Medium/High Although contaminated sediments are capped in place, components in the matting treats the water flowing through the sediments.	Slightly Difficult Technology has not been implemented in Alaska. Unknown how matting can be placed in wetland environment with abundant vegetation.	Medium/High $840,000

Table 9-1
Evaluation of Remedial Action Alternatives
AREA OF CONCERN D – Site 8 POL Spill

Alternative	Overall Protection of Human Health and the Env.	Compliance with ARARs	Short term Effectiveness	Long term Effectiveness	Reduction of Toxicity, Mobility, or Volume through treatment	Implementability	Cost
	Low/Medium/High	None/Partial/All	Low/Medium/High	Low/Medium/High	Low/Medium/High	Difficult/Average/Easy	Low/Medium/High
1 - No Action	Low Protective of current visitors. Limited protection for potential future receptors.	Partial Generally does not comply with ARARs. Does not comply with PCB cleanup level.	Low Dependant on rate of natural attenuation. Not effective to control potential risk from PCBs.	Low Some potential for natural attenuation processes to reduce concentrations of petroleum hydrocarbons.	Low Some reduction in contamination is expected to occur through natural attenuation processes.	Easy No active measures taken.	None $ 0
2 - Institutional Controls	Medium/High Protective of current and potential future use.	Partial Generally complies with ARARs. Does not comply with PCB cleanup level.	Medium/High Signs, fencing, education are effective means to prevent human exposure.	Medium Ability of landowner to maintain controls is unknown.	Low Some reduction in contamination is expected to occur through natural attenuation processes.	More difficult Will partially depend on ability and willingness of landowners to accept and implement the controls.	Low $186,000
3 - Nat. Attenuation	Medium Protective of current visitors. Limited risk to future receptors from petroleum hydrocarbons. Not protective of future receptors exposed to PCBs.	Partial Over time, concentrations of petroleum hydrocarbons in soil will decrease and may meet cleanup levels. Will not meet cleanup level for PCBs.	Medium Dependant on rate of natural attenuation processes. Metals in shallow groundwater less likely to degrade in short term. Monitoring activities would establish trends in contamination.	Med/High Potential for natural attenuation processes to reduce concentrations of petroleum hydrocarbons. Does not apply to PCBs in subsurface soils, or other contaminants in shallow groundwater.	Low Some reduction in contamination is expected to occur through natural attenuation processes.	Average/Easy Site access is somewhat complicated logistically due to remote location and lack of permanent facilities. Only one site visit required.	Low $212,000
3 - LTM	Medium Protective of current visitors. Limited risk to future receptors from petroleum hydrocarbons. Not protective of future receptors exposed to PCBs.	Partial Over time, concentrations of petroleum hydrocarbons in soil will decrease and may meet cleanup levels. Will not meet cleanup levels for PCBs.	Medium Dependant on rate of natural attenuation processes. Metals in shallow groundwater less likely to degrade in short term. Monitoring activities would establish trends in contamination.	Medium/High Will detect trends in concentrations over time, establish rates of natural attenuation.	Low Some reduction in contamination is expected to occur through natural attenuation processes.	Average/Easy Site access is somewhat complicated logistically due to remote location and lack of permanent facilities. Several site visits required. Involves some contracting/oversight.	Medium/Low $631,000
4 - Landfarming	Medium/High Protective of current and future receptors exposed to petroleum hydrocarbons. Does not address potential risk from PCBs.	Yes Will meet ARARs for petroleum hydrocarbons over time.	Medium/High Several field seasons will be necessary to achieve cleanup levels	Medium/High Soil should eventually meet cleanup levels for petroleum hydrocarbons.	Medium/High Excavated soil will be processed onsite to more quickly reduce concentrations of petroleum in the soil matrix.	Average Straightforward. Requires remote site access logistics and with barge arrangements. Technology requires periodic maintenance by onsite worker. Involves more trips and equipment, potential for weather/logistical delays.	Medium/High $6,840,000
5 - Phytoremediation	Medium/High Protective of current and future receptors exposed to petroleum hydrocarbons. Does not address potential risk from PCBs.	Yes Will meet ARARs for petroleum hydrocarbons over time.	Medium/High Several field seasons will be necessary to achieve cleanup levels	Medium/High Soil should eventually meet cleanup levels for petroleum hydrocarbons. Depends on optimum growing conditions.	Medium/High Soil will be seeded to reduce concentrations of petroleum in the soil matrix using grasses/plants.	Average Straightforward. Remote site logistics typical for Alaska with barge access to be arranged. Less long term maintenance once soils are excavated and seeded	Medium/High $6,950,000
6 - Thermal Treatment	Medium/High Protective of current and future receptors exposed to petroleum hydrocarbons. Does not directly address potential risk from PCBs.	Yes Meets ARARs for petroleum hydrocarbons.	High Soil will be treated to achieve cleanup levels during initial field season.	High Contaminated soil permanently treated and can be used as fill at the site	High Excavated soil will be treated onsite to quickly reduce concentrations of petroleum in the soil matrix.	Difficult/Average Slightly more difficult, although technology is standard. More equipment to be mobilized to the site, cold temperature could affect performance, requires longer time onsite, provision of power source.	Medium/High $7,200,000

Alternative	Overall Protection of Human Health and the Env.	Compliance with ARARs	Short term Effectiveness	Long term Effectiveness	Reduction of Toxicity, Mobility, or Volume through treatment	Implementability	Cost
7 - Off-site Treatment/Disposal	High Protective of current and future receptors exposed to petroleum hydrocarbons. Also reduces potential risk from PCBs.	Yes Meets ARARs for petroleum hydrocarbons and other contaminants. Removes source materials, thus groundwater more likely to naturally attenuate and meet cleanup levels over time.	High Soil will be immediately removed from the site.	High Contaminated soil permanently removed from the site.	High Excavated soil will be transported offsite, reducing volume of contamination left onsite.	More difficult Excavation activities will likely require dewatering and other measures given depth of contamination. Remote site logistics are challenging, barge transportation must be arranged well in advance.	High $11,000,000
8 - Chemical Oxidation	Medium Limited risk to current receptors, protective of potential future receptors who may utilize shallow groundwater as drinking water source. Prevents migration of contaminants to downgradient sites.	Yes Meets ARARs for groundwater cleanup levels. Does not apply to contaminated soils.	Medium/High Shallow groundwater treated to reduce contaminants in shortened timeframe. Does not address soil contamination directly.	Medium/High Treated will be verified by confirmation sampling. Long-term monitoring may not be required.	Medium/High Contaminants altered/bound by treatment with oxidizing agents.	Difficult/Average Will require several field seasons and mobilizations to successfully treat the groundwater. Shallow depth of groundwater, tundra matrix, and cold temperatures could be problematic.	Medium $4,000,000
9 - Reactive Walls	Medium Limited risk to current receptors, protective of potential future receptors who may utilize shallow groundwater as drinking water source. Prevents migration of contaminants to downgradient sites.	Yes Meets ARARs for downgradient groundwater cleanup levels. Does not apply to contaminated soils.	Medium/High Off site migration of shallow groundwater controlled and contaminants treated to meet cleanup levels. Does not address soil contamination directly.	Medium Unknown in arctic environment.	Medium/High Shallow groundwater treated as passes through the system. Passively addressed the source .	More difficult Installation between gravel pad sloping towards tundra matrix could be problematic, cold temperatures could adversely affect materials.	Medium/High $8,200,000

SEDIMENT COPCs	Frequency of Detetion	Minimum (range)	Maximum	Exposure Point Concentration (EPC)	Ambient/ Background Concentration [9]	Maximum Exceeds Background?	Consensus-base TEC[2]	Exceeds?	Consensus-based PEC[2]	Exceeds?	TEL[1] (freshwater)	Exceeds?	PEL[1] (freshwater)	Exceeds?	Other SQGs	Exceeds?	WA SQS [7,8]	Exceeds?	WA SIZ [7,8]	Exceeds?
SITE 28		**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**				**mg/kg**		**mg/kg**	
METALs																				
Chromium	67/68	ND(4) – 57.1 [j]	649 [a]	29	34	**Yes**	43	No	111	No	37.3	No	90	No			260	No	270	No
Lead	55/68	4 – 210 [j]	4,590 [a]	7.4	78	**Yes**	36	No	128	No	35	No	91.3	No			450	No	530	No
Zinc	68/68	12 – 511 [b]; 1,040 [d]	4,810 [a]	26	148	**Yes**	120	No	459	No	123.1	No	315	No			410	No	960	No
VOLATILES																				
Benzene	1/8	ND(0.0025)	0.05 [h]	0.05			0.057	No	0.11	No	--		--				--			
Ethylbenzene	2/8	ND(0.0025) – 0.053 [i]	1.77 [h]	1.8			--		--		--		--				--			
Toluene	3/8	ND(0.0025) - 0.02	0.37 [h]	0.37			0.89	No	1.8	No	--		--				--			
Xylenes	3/8	ND(0.0025) - 0.19 [e]	0.78 [h]	0.78			0.025	**Yes**	0.05	**Yes**	--		--		78 [6]	No	--			
ORGANICS																				
PCBs	27/79	ND(0.041) - 1.7 [a]; 5.1 [i]	5.4 [j]	0.52			0.06	**Yes**	0.676	No	0.0341	**Yes**	0.277	**Yes**			0.12	**Yes**	0.65	No
4,4'-DDD	6/13	ND(0.00715) - 0.47	1.165 [g]	1.2			0.0049	**Yes**	0.028	**Yes**	0.00354	**Yes**	0.00851	**Yes**	0.06 [4]	**Yes**	--			
Beta BHC	2/10	ND(0.0022)	0.012	0.01			0.005	**Yes**	0.21	No	--		--		0.1 [4]	No	--			
gamma BHC (lindane)	2/13	ND(0.00215) - 0.0029	0.0065	0.0065			0.003	**Yes**	0.005	**Yes**	0.00094	**Yes**	0.00138	**Yes**			--			
Dibenzofuran	26/68	ND(0.0077) - 5.3 [a]	5.6 [b]	4.5			0.15	**Yes**	0.58	**Yes**	--		--		5.1 [4]	No	0.15	**Yes**	0.58	Yes
Endosulfan sulfate	1/10	ND(0.0053)	0.0086	0.0086			--		--		--		--				--			
Heptaclor	2/13	ND(0.00215) - 0.0029	0.0046	0.0046			0.0025	**Yes**	0.016	No	--		--				--			
PAHs																				
Methylnaphthalene, 2	58/71	ND(0.0077) – 440 [a]	500 [c]	500			0.0202	**Yes**	0.201	**Yes**	--		--		0.67 [3]	**Yes**	0.38	**Yes**	0.64	**Yes**
Acenaphthene	40/70	ND(0.0077) - 12	14 [a]	14			0.0067	**Yes**	0.089	**Yes**	--		--				0.16	**Yes**	0.57	**Yes**
Acenaphthylene	1/71	ND(0.0062)	0.0465 [f]	0.047			0.0059	**Yes**	0.128	No	--		--				0.66	No	0.66	No
Anthracene	7/71	ND(0.0062) - 1.6 [a,e]	1.8 [b]	1.8			0.0572	**Yes**	0.845	**Yes**	--		--				2.2	No	12	No
Benzo(a)anthracene	5/71	ND(0.0062) - 1.8 [a]	1.9 [a]	1.5			0.108	**Yes**	1.05	**Yes**	0.0317	**Yes**	0.385	**Yes**			1.1	**Yes**	2.7	No
Benzo(a)pyrene	4/71	ND(0.0062) - 0.44 [d]	1.4 [a]	1.4			0.15	**Yes**	1.45	No	0.0319	**Yes**	0.782	**Yes**			0.99	**Yes**	2.1	No
Benzo(b)fluoranthene	5/71	ND(0.0062) - 1.4 [b]	1.6 [a]	1.5			0.24	**Yes**	13.4	No	--		--				2.3	No	4.5	No
Benzo(g,h,I)perylene	2/71	ND(0.0062) - 0.066	0.91 [a]	0.91			0.17	**Yes**	1.685	No	--		--				0.31	**Yes**	0.78	**Yes**
Benzo(k)fluoranthene	4/71	ND(0.0062) - 1.6 [a]	1.9 [b]	1.5			0.24	**Yes**	13.4	No	--		--				2.3	No	4.5	No
Chrysene	7/71	ND(0.0062) - 2.2 [d]	2.6 [a]	1.8			0.166	**Yes**	1.29	**Yes**	0.0571	**Yes**	0.862	**Yes**			1.1	**Yes**	4.6	No
Dibenzo(a,h)anthracene	1/71	ND(0.0062)	0.015	0.015			0.033	No	0.135	No	--		--				0.12	No	0.33	No
Fluoranthene	12/71	ND(0.0062) - 9.7 [d]	14 [e]	2.8			0.423	**Yes**	2.23	**Yes**	0.111	**Yes**	2.355	**Yes**			1.6	**Yes**	2	**Yes**
Fluorene	47/71	ND(0.0077) - 18 [b]	20 [a]	20			0.0774	**Yes**	0.536	**Yes**	--		--				0.23	**Yes**	0.79	**Yes**
Indeno(1,2,3-cd)pyrene	3/71	ND(0.0062) – 0.085	1.2 [a]	1.2			0.2	**Yes**	3.2	No	--		--				0.34	**Yes**	0.88	**Yes**
Naphthalene	55/71	ND(0.0077) - 160 [a]	220 [c]	175			0.176	**Yes**	0.561	**Yes**	--		--				0.99	**Yes**	1.7	**Yes**
Phenanthrene	42/71	ND(0.0077) - 17 [a]	21 [d]	21			0.204	**Yes**	1.17	**Yes**	0.0419	**Yes**	0.515	**Yes**			1	**Yes**	4.8	**Yes**
Pyrene	11/71	ND(0.0062) - 7.5	9.5 [e]	9.5			0.195	**Yes**	1.52	**Yes**	0.0053	**Yes**	0.875	**Yes**			10	No	14	No
LPAH				231.8													3.7	**Yes**	7.8	**Yes**
HPAH				22.1													9.6	**Yes**	53	No
PETROLEUM HYDROCARBONS																				
DRO	83/83	22	150,000	98,564			--		--		--		--				--			
GRO	2/5	ND(1)	220	220			--		--		--		--				--			
RRO	66/69	69	14,000	3,634			--		--		--		--				--			

TABLE 11-1
Drainage Basin and Suqitughneq River
Sediment Data Summary and Screening Evaluation

SEDIMENT COPCs	Frequency of Detetion	Minimum (range)	Maximum	Exposure Point Concentration (EPC)	Ambient/ Background Concentration [9]	Maximum Exceeds Background?	Consensus-base TEC[2]	Exceeds?	Consensus-based PEC[2]	Exceeds?	TEL[1] (freshwater)	Exceeds?	PEL[1] (freshwater)	Exceeds?	Other SQGs	Exceeds?	WA SQS [7,8]	Exceeds?	WA SIZ [7,8]	Exceeds?
SITE 29																				
METALs																				
Aluminum	4/4	4,820	15,900	15,900	30,357	No	--		--		--		--		18,000 [5]	No	--			
Arsenic	4/4	2.8	5.7	5.7	7.8	No	9.8	No	33	No	5.9	No	17	No			57	No	93	No
Barium	4/4	40	115	115	174	No	--		--		--		--		48 [5]	**Yes**	--			
Beryllium	4/5	0.20	1.3	1.1	9.8	No	--		--		--		--				--			
Cobalt	4/4	2.0	7.0	7.0	49	No	--		--		--		--		10 [5]	No	--			
Manganese	4/4	80	114	114	1,589	No	460	No	1,100	No	--		--				--			
Mercury	1/4	0.05	0.05	0.05	0.43	No	0.18	No	1.1	No	0.174	No	0.486	No			0.41	No	0.59	No
Vanadium	4/4	17	35	35	73	No	--		--		--		--				--			
VOLATILES									--											
m,p-Xylene	1/4	0.0032	0.0032	0.0032			0.025	No	0.05	No	--		--				--			
PAHs																				
2-Methylnaphthalene	4/21	<0.0022	0.23	0.072			0.0202	**Yes**	0.201	No	--		--		0.67 [3]	No	0.38	No	0.64	No
Acenaphthylene	1/21	<0.0022	0.010	0.010			0.0059	**Yes**	0.128	No	--		--				0.66	No	0.66	No
Anthracene	1/21	<0.0022	0.023	0.016			0.0572	No	0.845	No	--		--				2.2	No	12	No
Fluorene	3/21	<0.0022	0.022	0.020			0.0774	No	0.536	No	--		--				0.23	No	0.79	No
Naphthalene	3/21	<0.0022	0.11	0.031			0.176	No	0.561	No	--		--				0.99	No	1.7	No
Phenanthrene	4/21	<0.0022	0.037	0.025			0.204	No	1.17	No	0.0419	No	0.515	No			1	No	4.8	No
Pyrene	2/21	<0.0022	0.020	0.016			0.195	No	1.52	No	0.0053	**Yes**	0.875	No			10	No	14	No
PETROLEUM HYDROCARBONS																				
DRO	24/26	9.3 - 1,400	25,000	1,859			--		--		--		--				--			
RRO	17/18	10 - 790	1,000	1,000			--		--		--		--				--			

Note: Sediment quality guidelines for predicting potential sediment toxicity (e.g. adverse environmental effects to benthic organims), used for screening and not as a cleanup criteria or goal
All values shown as mg/kg are on a dry weight basis. Standards reported on an organic carbon basis have been converted to dry weight basis using 1% TOC

[1] Threshold Effects Level and Probable Effects Level (freshwater) from NOAA Screening Quick Reference Table (SQuiRT) (Sept. 1999)

[2] Consensus-based Threshold Effects Concentration and Probable Effects Concentration compiled by the Wisconsin Department of Natural Resources (December 2003)

[3] NOAA SQuiRT, Effects Range Medium (marine) (ERM)

[4] NOAA SQuiRT, Upper Effects Threshold (freshwater) (UET)

[5] NOAA SQuiRT, Apparent Effects Threshold (marine) (AET)

[6] ADEC Table B, Migration to Groundwater (soil)

[7] Washington State Department of Ecology, Sediment Quality Criteria, Sediment Quality Standards (SQS) and Sediment Impact Zone (SIZ) Maximum Level

[8] Note: WA Standards for organics were converted from mg/kg organic carbon to mg/kg dry weight by multiplying by 1% total organic carbon (0.01)

[9] Background Upper Tolerance Levels, value for sediment if available, otherwise value is for tundra soil, as calculated in MWH, 2002a

[a] 01NE28SD155, located in western drainage by Site 13 (CS-8)

[b] 01NE28SD156, located in western drainage by Site 13 (CS-8)

[c] 01NE28SD146, located near pond (cross section CS-6)

[d] 01NE28SD119 (cross section CS-2, near confluence with Suqi)

[e] 98NECDBSD802 (mid-gradient of Drainage basin)

[f] 01NE28SD111 (cross section CS-1, at confluence with Suqi)

[g] 01NE28SD185 (cross section CS-11, eastern drainage)

[h] 94NE10108SD (eastern drainage)

[i] 94NE10110SD (mid-gradient of Drainage Basin)

[j] 01NE28SD167 (cross section CS-10, adjacent to Main Complex, middle drainge)

LPAH - the sum of low molecular weight polynuclear aromatic hydrocarbons including: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene
HPAH - the hum of high molecular weight polynuclear aromaric hydrocarbons including: fluoranthene, pyrene, benzo(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene,and genzo(g,h,i)perylene.

Alternative	Overall Protection of Human Health and the Env.	Compliance with ARARs	Short term Effectiveness	Long term Effectiveness	Reduction of Toxicity, Mobility, or Volume through treatment	Implementability	Cost
	Low/Medium/High	None/Partial/All	Low/Medium/High	Low/Medium/High	Low/Medium/High	Difficult/Average/Easy	Low/Medium/High
1 - No Action	Low Not protective of current or potential future risks.	No Does not comply with ARARs	Low No immediate reduction in site concentrations	Medium Over time, petroleum will continue to naturally attenuate.	Low Over time, petroleum concentrations will decrease by natural attenuation.	Easy No active measures taken.	None $ 0
2 - Institutional Controls	Yes Drinking water advisory prevents use of surface/subsurface water. Potential future risks controlled using access restrictions.	Partial Generally complies with ARARs.	Medium/High Signs, fencing, education are effective means to prevent human exposure.	Medium Ability of landowner to maintain controls is unknown.	Low Some reduction in contamination is expected to occur through natural attenuation processes.	More difficult Will partially depend on ability and willingness of landowners to accept and implement the controls.	Low $ 186,000
3 - Nat. Attenuation	Medium Limited protection of human health and the environment.	Partial Over time, concentrations of petroleum hydrocarbons in soil will decrease and may meet cleanup levels. Unlikely to achieve cleanup level for metals or PCBs.	Low Partially depends on rate of natural attenuation processes. Metals in shallow groundwater less likely to degrade in short term.	Medium Partially depends on rate of natural attenuation processes. If upgradient source is controlled, higher likelihood that natural attenuation processes will be effective.	Medium/Low Over time, concentrations of petroleum hydrocarbons in soil will decrease by natural processes.	Average/Easy Site access is somewhat complicated logistically due to remote location and lack of permanent facilities. Only one site visit required.	Low $ 207,000
4 - LTM	Medium Limited current risk to human health and the environment. Potential future risk dependent on use of groundwater for drinking water.	Partial Over time, concentrations of petroleum hydrocarbons in soil will decrease and may meet cleanup levels. Unlikely to achieve cleanup level for metals or PCBs.	Medium/Low Dependant on rate of natural attenuation processes. Metals in shallow groundwater less likely to degrade in short term. Monitoring activities would establish trends in contamination.	Medium Partially depends on rate of natural attenuation processes. Monitoring activities would establish trends in contamination.	Medium/Low Over time, concentrations of petroleum hydrocarbons in soil will decrease by natural processes.	Average/Easy Site access is somewhat complicated logistically due to remote location and lack of permanent facilities. Several site visits required. Involves some contracting/oversight.	Medium/Low $ 415,000
3+4 Natural Attenuation + LTM	Medium Limited current risk to human health and the environment. Potential future risk dependent on use of groundwater for drinking water.	Partial Over time, concentrations of petroleum hydrocarbons in soil will decrease and may meet cleanup levels. Unlikely to achieve cleanup level for metals or PCBs.	Medium/Low Dependant on rate of natural attenuation processes. Metals in shallow groundwater less likely to degrade in short term. Monitoring activities would establish trends in contamination.	Medium Dependant on rate of natural attenuation processes. Monitoring activities would establish trends in contamination.	Medium/Low Over time, concentrations of petroleum hydrocarbons in soil will decrease by natural processes.	Average/Easy Site access is somewhat complicated logistically due to remote location and lack of permanent facilities. Several site visits required. Involves some contracting/oversight.	Medium/Low $ 622,000
5A – Landfarming	Medium/High Protective of human health and the environment.	Yes Complies with ingestion-based cleanup levels for soil and sediment.	Medium Removes areas of highest contamination, creates limited disturbance to tundra/wetland environment. Impacts to entire drainage basin are minimized.	Medium Upper portion of drainage basin will no longer serve as major source of contamination. Remainder of system may take even longer to recover from direct impacts of residual sediment contamination.	Medium Smaller area of contaminated soil/sediment targeted for excavation and landfarming, highest levels of petroleum hydrocarbons will be reduced.	Average Areas closest to the Main Complex are easiest to access and should not require complicated dewatering activities. Remote site logistics are typical for Alaska with barge access to be arranged. Technology requires periodic maintenance by onsite worker. Involves more trips and equipment, potential for weather or logistical delays.	Medium/High $2,200,000

Table 11-2
Evaluation of Remedial Action Alternatives
AREA OF CONCERN F – Sites 28 Drainage Basin

Alternative	Overall Protection of Human Health and the Env.	Compliance with ARARs	Short term Effectiveness	Long term Effectiveness	Reduction of Toxicity, Mobility, or Volume through treatment	Implementability	Cost
5B - Landfarming	Medium/High Most protective of human health and the environment	Yes Complies with most restrictive cleanup levels for soil and sediment.	Medium/Low Removes all areas of contaminated sediment. Causes disturbances to much larger area, creates access roads across tundra, destroys wetland habitat for several years before it can begin recovering.	Medium/High Large disturbance to ecosystem will take many years to recover, but overall health of system will be improved.	Medium/High Larger area of contaminated soil/sediment targeted for excavation and landfarming, increased reduction of petroleum hydrocarbons in the environment.	More Difficult Access to larger area of drainage basin will be more complicated, requires access road, potential dewatering activities. Remote site logistics typical for Alaska with barge access to be arranged. Technology requires periodic maintenance by onsite worker. Involves more trips and equipment, potential for weather or logistical delays.	High $5,000,000
6A - Phytoremediation	Medium Protective of future human health ingestion risk.	Yes Complies with ingestion-based cleanup levels for soil and sediment.	Medium Removes areas of highest contamination, creates limited disturbance to tundra/wetland environment. Impacts to entire drainage basin are minimized.	Medium Upper portion of drainage basin will no longer serve as major source of contamination. Remainder of system may take even longer to recover from direct impacts of residual sediment contamination.	Medium Smaller area of contaminated soil/sediment targeted for excavation and landfarming, highest levels of petroleum hydrocarbons will be reduced.	Average Areas closest to the Main Complex are easiest to access and should not require complicated dewatering activities. Remote site logistics are typical for Alaska with barge access to be arranged. Less maintenance required once contaminated soil/sediment is seeded/planted and vegetation is established.	Medium/High $2,200,000
6B - Phytoremediation	Medium/High Protective of human health and the environment.	Yes Complies with most restrictive cleanup levels for soil/sediment.	Medium/Low Removes all areas of contaminated sediment. Causes disturbances to much larger area, creates access roads across tundra, destroys wetland habitat for several years before it can begin recovering.	Medium/High Large disturbance to ecosystem will take many years to recover, but overall health of system will be improved.	Medium/High Larger area of contaminated soil/sediment targeted for excavation and landfarming, increased reduction of petroleum hydrocarbons in the environment.	More difficult Access to larger area of drainage basin will be more complicated, requires access road, potential dewatering activities. Remote site logistics are typical for Alaska with barge access to be arranged. Less maintenance required once contaminated soil/sediment is seeded/planted and vegetation is established.	High $5,100,000
7A- Off-site Treatment/Disposal	Medium/High Protective of future human health ingestion risk.	Yes Complies with ingestion-based cleanup levels for soil and sediment.	Medium/High Permanently removes major source of contaminated materials while minimizing habitat disturbance.	Medium/High Permanently removes the major source of contaminated materials.	Could create temporary increase in suspended sediments flowing downstream. Bulk of source is removed and treated off-site.	Areas closest to the Main Complex are easiest to access and should not require complicated dewatering activities. Remote site logistics are typical for Alaska with barge access to be arranged.	Medium/High $2,500,000
7B - Off-site Treatment/Disposal	Protective of human health and the environment.	Yes Complies with most restrictive cleanup levels for soil/sediment.	Medium Permanently removes all sources of contaminated sediment, but much larger area is disturbed while conducting the remedial action. Strong likelihood of short-term increase in contaminants re-suspended in the water column and potentially migrating downgradient.	High Permanently removes the contaminated soil/sediment, but additional time required for the disturbed habitat to recover.	More of source is removed and treated off-site.	More difficult Access to larger area of drainage basin will be more complicated, requires access road, potential dewatering activities. Remote site logistics are challenging, barge transportation must be arranged well in advance.	High $7,100,000
8A - Constructed Wetlands	Limited protection of human health and the environment.	Partial Does not comply initially, but filtering action should comply with water criteria over time.	Medium Direct water flow away from major contaminated sediment source areas, creates less disturbance of ecosystem.	Medium Permanently alters the original ecosystem.	Medium Wetlands vegetation traps contaminants, provides natural filter for water and dissolved phase compounds.	Average Will require engineering design to determine optimum placement and water diversion pathways.	Medium/High $1,100,000

Alternative	Overall Protection of Human Health and the Env.	Compliance with ARARs	Short term Effectiveness	Long term Effectiveness	Reduction of Toxicity, Mobility, or Volume through treatment	Implementability	Cost
8B - Constructed Wetlands	Limited protection of human health and the environment.	Partial Does not comply initially, but filtering action should comply with water criteria over time.	Medium Diverting water flow from entering the Suqi River will be prevent downgradient effects. Doesn't address potential future impacts to subsistence gathering near Drainage Basin.	Medium Permanently alters the original ecosystem.	Medium Wetlands vegetation traps contaminants, provides natural filter for water and dissolved phase compounds.	Average Will require engineering design to determine optimum placement and water diversion pathways.	Medium/High $1,600,000
9A - Reactive Matting	Protective of human health and the environment. Prevents exposure to most highly contaminated media.	Partial Complies with water quality criteria.	Medium/High Prevents exposure to sediments and migration of contamination downgradient through surface water. Creates much less disturbance than digging up sediments to treat them.	Medium/High Unknown how matting will perform over time. Unknown if underlying, capped sediments will continue to naturally attenuate. Should prevent surface water impacts for long term unless reactive components become saturated.	High Matting composition reduces and prevents dissolved phase compounds from leaching into water column from sediments.	Average Areas closest to the main operations complex are easiest to access. Shallow water depth and variable flow rates may impact ability of matting to function as intended.	Medium/High $1,900,000
9B - Reactive Matting	Most protective of human health and the environment. Prevents exposure to all areas of contaminated media.	Partial Complies with water quality criteria.	Medium/High Prevents exposure to larger area of sediment, but creates additional disturbance to access the lower reaches of the drainage basin.	Medium/High Unknown how matting will perform over time. Unknown if underlying, capped sediments will continue to naturally attenuate. Should prevent surface water impacts for long term unless reactive components become saturated.	High Matting composition reduces and prevents dissolved phase compounds from leaching into water column from sediments.	Average Although areas downgradient of the main complex are harder to access, less resources should be necessary to install the matting in the deeper water versus equipment to excavate soil/sediment.	High $4,200,000

Alternative	Overall Protection of Human Health and the Env.	Compliance with ARARs	Short term Effectiveness	Long term Effectiveness	Reduction of Toxicity, Mobility, or Volume through treatment	Implementability	Cost
	Low/Medium/High	None/Partial/All	Low/Medium/High	Low/Medium/High	Low/Medium/High	Difficult/Average/Easy	Low/Medium/High
1 - No Action	Medium/Low No current risk to human health and the environment. Does not address PCB-contaminated soil.	Partial Most areas meet risk-based ingestion soil cleanup levels, may comply with migration to groundwater cleanup levels over time. Does not meet PCB cleanup level.	Low Minor reduction in petroleum concentrations over short term.	Low/Medium Over time, the petroleum hydrocarbons will naturally biodegrade to meet cleanup levels.	Low/Medium Natural degradation processes will continue to break down the petroleum hydrocarbons at the site.	Easy No active measures taken.	None $ 0
2 - Institutional Controls	High Protective of human health and the environment. Potential future risks controlled using access restrictions.	All Risk exposure pathways controlled. Over time, should comply with risk-based ingestion cleanup levels. May comply with migration to groundwater cleanup levels in long term.	High Controls will be implemented immediately to prevent current and potential future exposure to contaminated soil.	Medium/High Continuing community education and/or signage may be difficult to enforce. However, over many years the petroleum hydrocarbons will naturally biodegrade to meet cleanup levels.	Low/Medium Natural degradation processes will continue to break down the petroleum hydrocarbons at the site.	Average Depends on ability and desire of landowners to implement selected controls	Low $186,000
3 - Natural Attenuation	Medium Protective of current visitors. Limited risk to future receptors from petroleum hydrocarbons. Not protective of future receptors exposed to PCBs.	Partial Over time, should comply with risk-based ingestion cleanup levels. May comply with migration to groundwater cleanup levels in long term. Does not comply with PCB cleanup level.	Medium Minor reduction in petroleum concentrations over short term.	High Over many years, petroleum hydrocarbons will naturally biodegrade to meet cleanup levels.	Low/Medium Natural degradation processes will continue to break down the petroleum hydrocarbons at the site.	Average/Easy Site access is somewhat complicated logistically due to remote location and lack of permanent facilities. Less contracting and construction oversight required.	Low $193,000
4 - LTM	Medium Protective of current visitors. Limited risk to future receptors from petroleum hydrocarbons. Not protective of future receptors exposed to PCBs.	Partial Over time, should comply with risk-based ingestion cleanup levels. May comply with migration to groundwater cleanup levels in long term. Does not comply with PCB cleanup level.	Medium Minor reduction in petroleum concentrations over short term.	High Over many years, petroleum hydrocarbons will naturally biodegrade to meet cleanup levels.	Low/Medium Natural degradation processes will continue to break down the petroleum hydrocarbons at the site.	Average/Easy Site access is somewhat complicated logistically due to remote location and lack of permanent facilities. Less contracting and construction oversight required.	Low $184,000
5A - Landfarming	Medium/High Limited protection of human health and the environment initially, but protection will increase with time.	Yes Complies with risk-based ingestion cleanup levels, over time will comply with migration to groundwater soil cleanup levels.	Medium/High Treated soil will achieve cleanup levels over several field seasons. Remaining soil may comply with migration to groundwater cleanup levels over time.	High Treated soil will likely achieve cleanup levels over the long term. Untreated remaining soil may comply with migration to groundwater cleanup levels over time.	Medium/High Excavated soil will be processed onsite to more quickly reduce concentrations of petroleum in the soil matrix.	Average Requires construction coordination, rights of entry, personnel to conduct periodic maintenance/ operation of the remedy.	Medium $371,000
5B - Landfarming	High Increased protection of human health and the environment.	Yes Complies with migration to groundwater cleanup levels.	Medium/High Several field seasons will be necessary to achieve cleanup levels.	High All soil will likely achieve cleanup levels over the long term.	Medium/High Excavated soil will be processed onsite to more quickly reduce concentrations of petroleum in the soil matrix.	Average Requires construction coordination, rights of entry, personnel to conduct periodic maintenance/ operation of remedy	High $1,330,000
6A - Phyto-remediation	Medium/High Limited protection of human health and the environment initially, but protection will increase with time.	Yes Complies with risk-based ingestion cleanup levels, over time will comply with migration to groundwater soil cleanup levels.	Medium/High Treated soil will achieve cleanup levels over several field seasons. Remaining soil may comply with migration to groundwater cleanup levels over time.	High Treated soil will likely achieve cleanup levels over the long term. Untreated soil may comply with migration to groundwater cleanup levels over time.	Medium/High Soil will be seeded to reduce concentrations of petroleum in the soil matrix using grasses/plants.	Average/Easy Once plants or grasses are established, requires less effort than landfarming to maintain and operate remedy.	Medium $332,000

Table 13-1
Evaluation of Remedial Action Alternatives
AREA OF CONCERN H – White Alice Complex

Alternative	Overall Protection of Human Health and the Env.	Compliance with ARARs	Short term Effectiveness	Long term Effectiveness	Reduction of Toxicity, Mobility, or Volume through treatment	Implementability	Cost
6B - Phyto-remediation	Migh Increased protection of human health and the environment.	Yes Complies with migration to groundwater cleanup levels.	Medium/High Several field seasons will be necessary to achieve cleanup levels.	High All soil will likely achieve cleanup levels over the long term.	Medium/High Soil will be seeded to reduce concentrations of petroleum in the soil matrix using grasses/plants.	Average/Easy Once plants or grasses are established, requires less effort than landfarming to maintain and operate remedy.	High $1,320,000
7A - Thermal Treatment	Medium/High Limited protection of human health and the environment initially, but protection will increase with time for remainder of site.	Yes Complies with risk-based ingestion cleanup levels, over time will comply with migration to groundwater soil cleanup levels.	High Treated soil will achieve all cleanup levels during initial field season. Remaining soil may comply with migration to groundwater cleanup levels over time.	High Untreated soil will likely achieve migration to groundwater cleanup levels over the long term.	High Excavated soil will be treated onsite to quickly reduce concentrations of petroleum in the soil matrix.	Average Technology is commonly implemented at remediation sites. However, a remote site has more complex logistics and cold weather operation challenges.	High $1,100,000
7B - Thermal Treatment	High Most protective of human health and the environment.	Yes Complies with migration to groundwater cleanup levels	High Treated soil will achieve all cleanup levels during initial field season.	High All soil will achieve cleanup levels over the long term.	High Excavated soil will be treated onsite to quickly reduce concentrations of petroleum in the soil matrix.	Average Technology is commonly implemented at remediation sites. However, a remote site has more complex logistics and cold weather operation challenges.	High $1,230,000
8A - Off-site Treatment/ Disposal	Medium/High Protective of human health and the environment.	Yes Complies with risk-based ingestion cleanup levels, over time will comply with migration to groundwater soil cleanup levels.	High Most highly contaminated soils immediately removed from the site. Remaining soil will naturally degrade over time.	High Contaminated source will be permanently removed from the site.	High Excavated soil will be transported offsite, reducing volume of contamination left onsite.	Average/Easy Requires basic construction coordination, can be completed in one field season.	High $1,010,000
8B - Off-site Treatment/ Disposal	High Most protective of human health and the environment.	Yes Complies with migration to groundwater cleanup levels	High All contaminated soils immediately removed from the site.	High Contaminated source will be permanently removed from the site.	High Excavated soil will be transported offsite, reducing volume of contamination left onsite.	Average/Easy Requires basic construction coordination, can be completed in one field season.	High $1,060,000

Figures

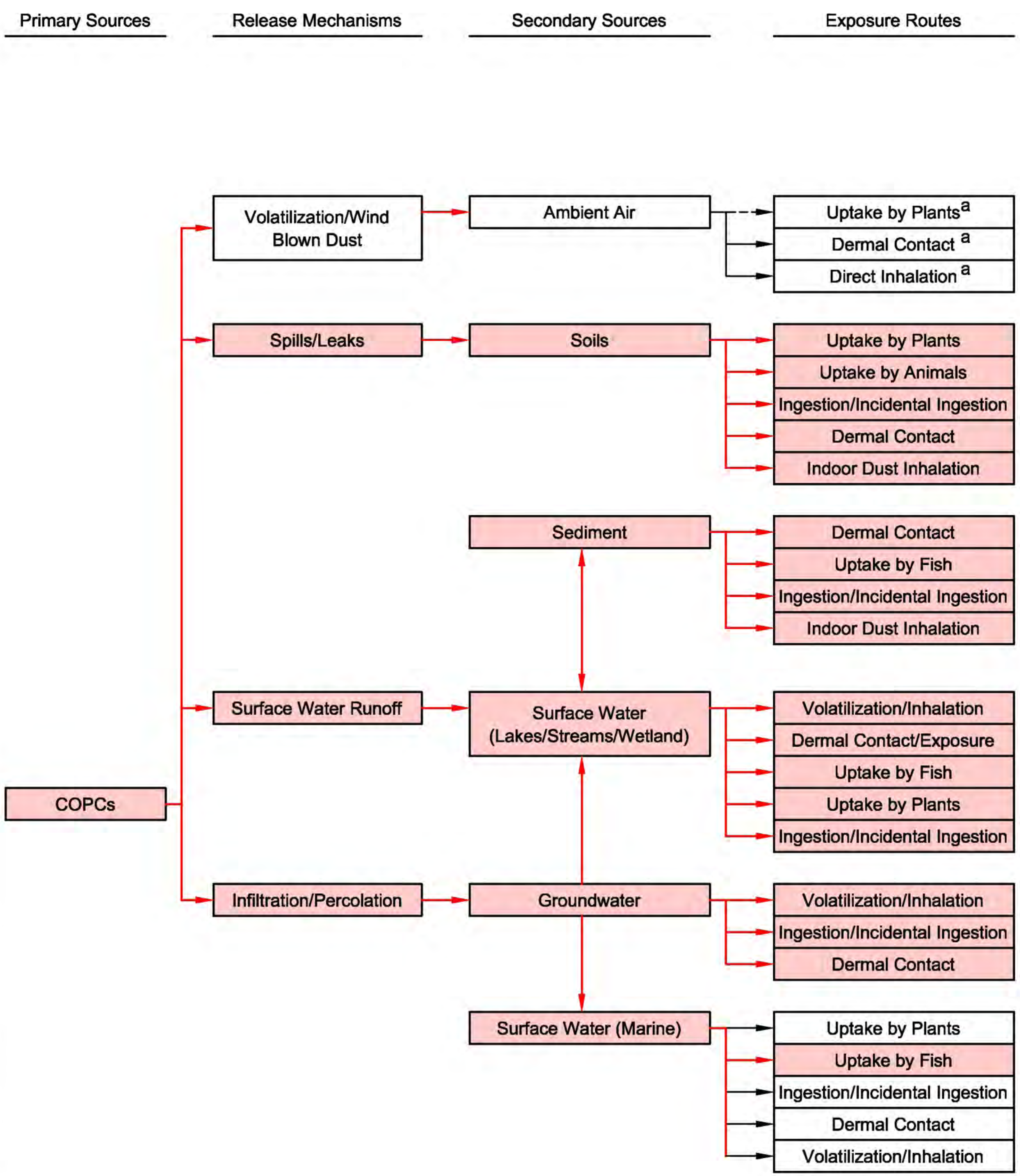
Figure 1-1

Project Location
Northeast Cape, St. Lawrence Island

US Army
Corps of Engineers
Alaska District

no scale given

Site: NE Cape AFS
Drawn: LKG
Date: 3/2006



Potential Receptors

Secondary Source	Exposure Route	Human – Seasonal Resident, Current	Human – Seasonal Resident, Future	Human – Future Permanent Resident	Human – Incidental Visitor, Current	Human – Incidental Visitor, Future
Ambient Air	Uptake by Plants[a]	o	o	o	o	o
Ambient Air	Dermal Contact[a]	o	o	o	o	o
Ambient Air	Direct Inhalation[a]	o	o	o	o	o
Soils	Uptake by Plants	●	●	●	o	o
Soils	Uptake by Animals	●	●	●	o	o
Soils	Ingestion/Incidental Ingestion	●	●	●	●	●
Soils	Dermal Contact	●	●	●	●	●
Soils	Indoor Dust Inhalation	●	●	●	●	●
Sediment	Dermal Contact	●	●	●	●	●
Sediment	Uptake by Fish	●	●	●	o	o
Sediment	Ingestion/Incidental Ingestion	●	●	●	●	●
Sediment	Indoor Dust Inhalation	●	●	●	●	●
Surface Water (Lakes/Streams/Wetland)	Volatilization/Inhalation	●	●	●	●	●
Surface Water (Lakes/Streams/Wetland)	Dermal Contact/Exposure	●	●	●	●	●
Surface Water (Lakes/Streams/Wetland)	Uptake by Fish	●	●	●	o	o
Surface Water (Lakes/Streams/Wetland)	Uptake by Plants	●	●	●	o	o
Surface Water (Lakes/Streams/Wetland)	Ingestion/Incidental Ingestion	●	●	●	●	●
Groundwater	Volatilization/Inhalation	o	●	●	o	●
Groundwater	Ingestion/Incidental Ingestion	o	●	●	o	●
Groundwater	Dermal Contact	o	●	●	o	●
Surface Water (Marine)	Uptake by Plants	o	o	o	o	o
Surface Water (Marine)	Uptake by Fish	●	●	●	o	o
Surface Water (Marine)	Ingestion/Incidental Ingestion	o	o	o	o	o
Surface Water (Marine)	Dermal Contact	o	o	o	o	o
Surface Water (Marine)	Volatilization/Inhalation	o	o	o	o	o

LEGEND

- Red arrow: Complete Exposure Pathway
- Solid black arrow: Potentially Complete but Insignificant Pathway
- Dashed arrow: Incomplete Pathway
- o: Insignificant or Incomplete Exposure Pathway
- ●: Complete Exposure Pathway

Pink boxes:
Indicate a complete exposure pathway
White boxes:
Indicate an insignificant or incomplete exposure pathway

NOTE:
a This pathway is considered insignificant due to the following:
(1) NEC is covered by snow much of the year
(2) Precipitation and cold temperatures minimize volatilization
(3) Soils at most of the sites have revegetated and there is very little opportunity for particulate emissions

U.S. ARMY CORPS OF ENGINEERS

PROJECT: Northeast Cape Risk Assessment

DRAWING TITLE: HUMAN HEALTH CONCEPTUAL SITE MODEL

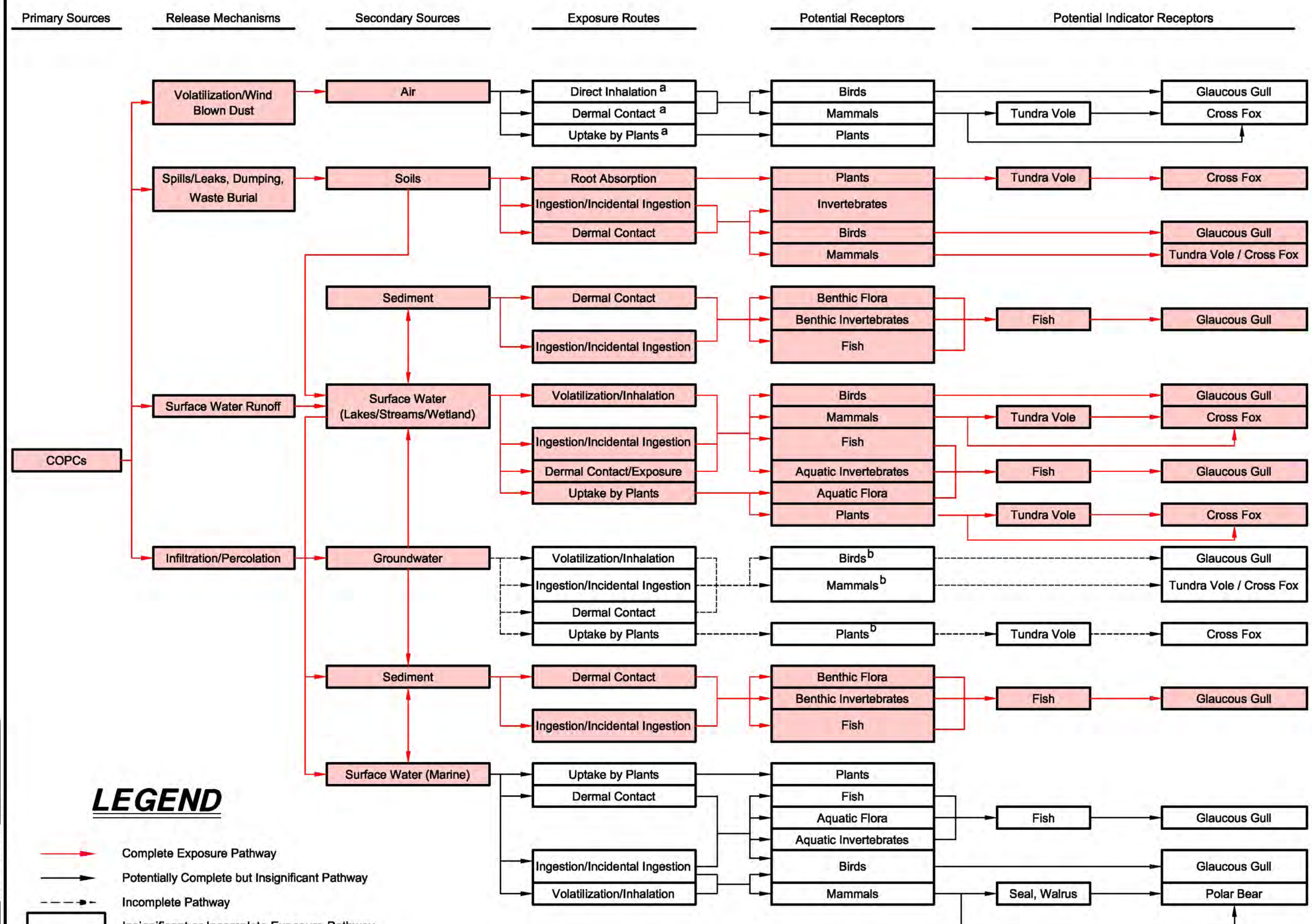
MWH MONTGOMERY WATSON HARZA

Sheet 1 Of 1 Sheets

SCALE: Not To Scale

FIGURE 3-1

AutoCAD FILE: 4-1 Health.dwg PROJECT NUMBER: 1227010



LEGEND

- Complete Exposure Pathway (red arrow)
- Potentially Complete but Insignificant Pathway (black arrow)
- Incomplete Pathway (dashed arrow)
- Insignificant or Incomplete Exposure Pathway (white box)
- Complete Exposure Pathway (pink box)

Pink boxes:
Indicate a complete exposure pathway
White boxes:
Indicate an insignificant or incomplete exposure pathway

NOTE:

a This pathway is considered insignificant due to the following:
(1) NEC is covered by snow much of the year.
(2) Precipitation and cold temperatures minimize volatilization.
(3) Soils at most of the sites have revegetated and there is very little opportunity for particulate emissions.

b This pathway is considered incomplete because these receptors do not contact groundwater.

U.S. ARMY CORPS OF ENGINEERS

PROJECT: **Northeast Cape Risk Assessment**

DRAWING TITLE: **ECOLOGICAL CONCEPTUAL SITE MODEL**

MWH MONTGOMERY WATSON HARZA

Sheet 1 Of 1 Sheets | SCALE: Not To Scale | FIGURE 3-6

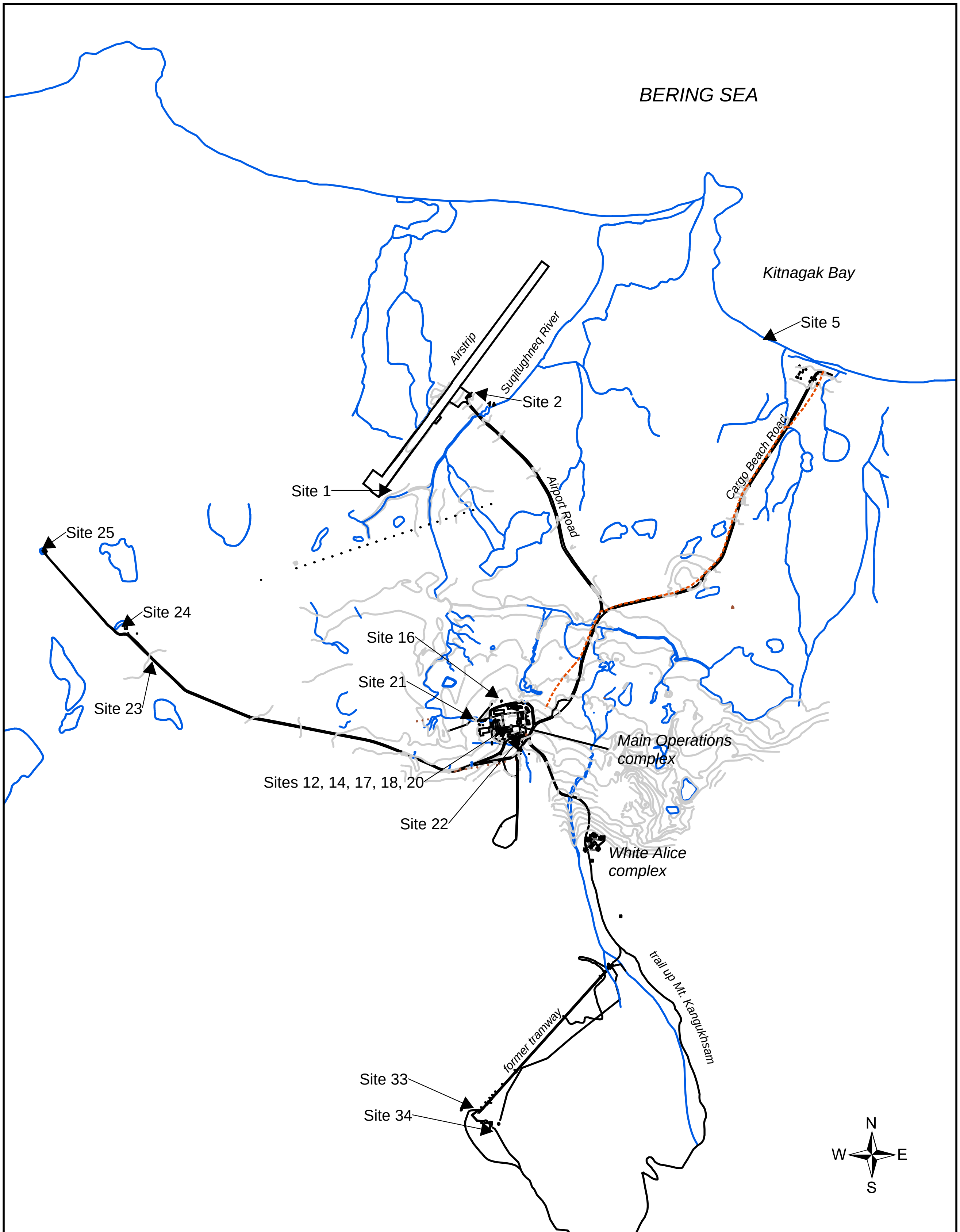


FIGURE 5-1

No Further Remedial Action Planned (NFRAP)

Sites 1, 2, 5, 12, 14, 16, 17, 18, 20, 21, 22, 23, 24, 25, 33, 34

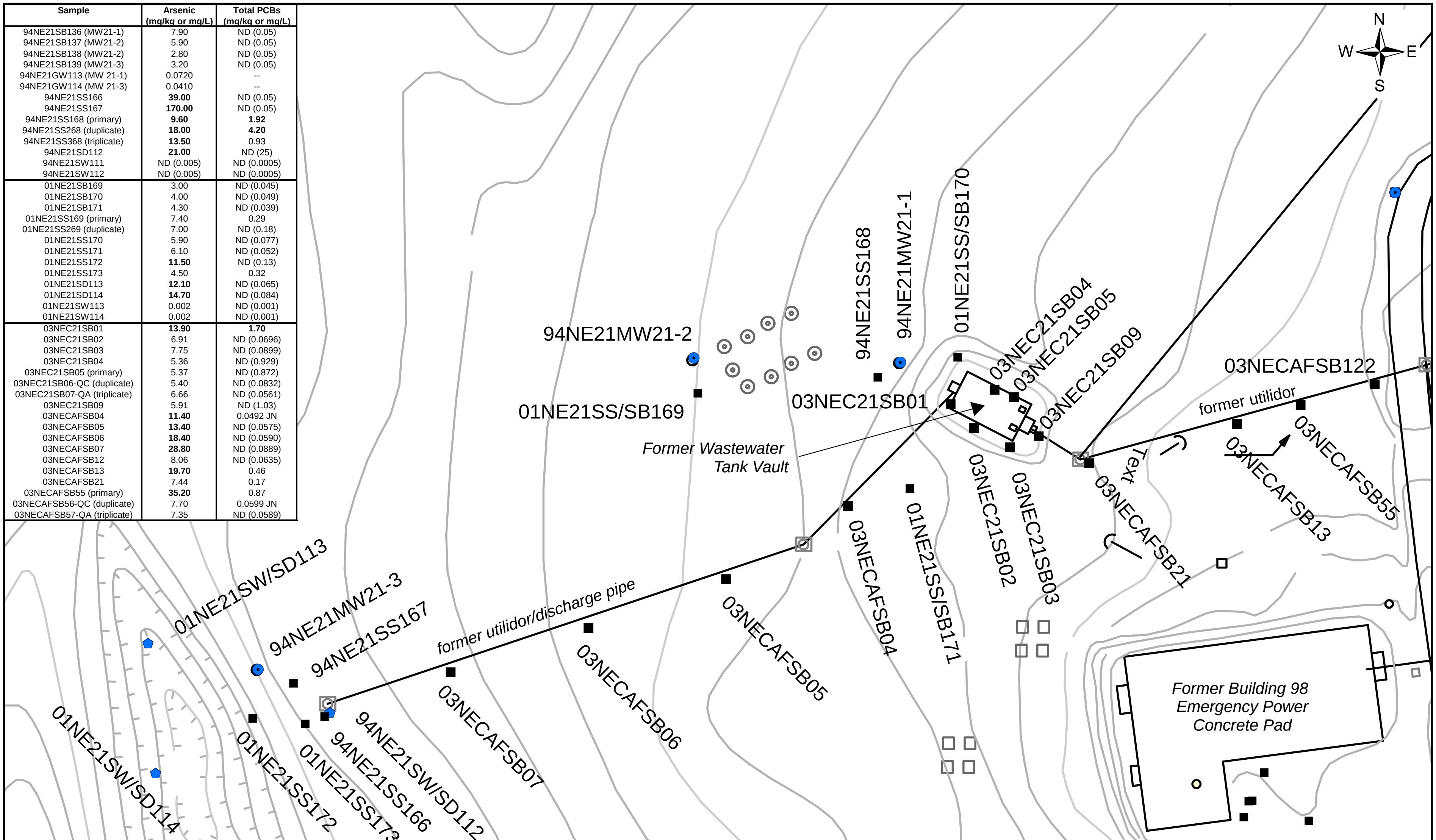
US Army
Corps of Engineers
Alaska District

0 1,000 2,000 3,000 Feet

1 inch equals 2,500 feet

Site: NE Cape AFS
Drawn: LKG
Date: 3/2006

Sample	Arsenic (mg/kg or mg/L)	Total PCBs (mg/kg or mg/L)
94NE21SB136 (MW21-1)	7.90	ND (0.05)
94NE21SB137 (MW21-2)	5.90	ND (0.05)
94NE21SB138 (MW21-2)	2.80	ND (0.05)
94NE21SB139 (MW21-3)	3.20	ND (0.05)
94NE21GW113 (MW 21-1)	0.0720	--
94NE21GW114 (MW 21-3)	0.0410	--
94NE21SS166	**39.00**	ND (0.05)
94NE21SS167	**170.00**	ND (0.05)
94NE21SS168 (primary)	**9.60**	**1.92**
94NE21SS268 (duplicate)	**18.00**	**4.20**
94NE21SS368 (triplicate)	**13.50**	0.93
94NE21SD112	**21.00**	ND (25)
94NE21SW111	ND (0.005)	ND (0.0005)
94NE21SW112	ND (0.005)	ND (0.0005)
01NE21SB169	3.00	ND (0.045)
01NE21SB170	4.00	ND (0.049)
01NE21SB171	4.30	ND (0.039)
01NE21SS169 (primary)	7.40	0.29
01NE21SS269 (duplicate)	7.00	ND (0.18)
01NE21SS170	5.90	ND (0.077)
01NE21SS171	6.10	ND (0.052)
01NE21SS172	**11.50**	ND (0.13)
01NE21SS173	4.50	0.32
01NE21SD113	**12.10**	ND (0.065)
01NE21SD114	**14.70**	ND (0.084)
01NE21SW113	0.002	ND (0.001)
01NE21SW114	0.002	ND (0.001)
03NEC21SB01	**13.90**	**1.70**
03NEC21SB02	6.91	ND (0.0696)
03NEC21SB03	7.75	ND (0.0899)
03NEC21SB04	5.36	ND (0.929)
03NEC21SB05 (primary)	5.37	ND (0.872)
03NEC21SB06-QC (duplicate)	5.40	ND (0.0832)
03NEC21SB07-QA (triplicate)	6.66	ND (0.0561)
03NEC21SB09	5.91	ND (1.03)
03NECAFSB04	**11.40**	0.0492 JN
03NECAFSB05	**13.40**	ND (0.0575)
03NECAFSB06	**18.40**	ND (0.0590)
03NECAFSB07	**28.80**	ND (0.0889)
03NECAFSB12	8.06	ND (0.0635)
03NECAFSB13	**19.70**	0.46
03NECAFSB21	7.44	0.17
03NECAFSB55 (primary)	**35.20**	0.87
03NECAFSB56-QC (duplicate)	7.70	0.0599 JN
03NECAFSB57-QA (triplicate)	7.35	ND (0.0589)



Legend

- ▲ Sediment Sample Location
- ■ Soil Sample Location
- ⬟ Surface Water/Sediment Sampling Location
- ⦿ Monitoring Well/Well Point

Figure 5-2

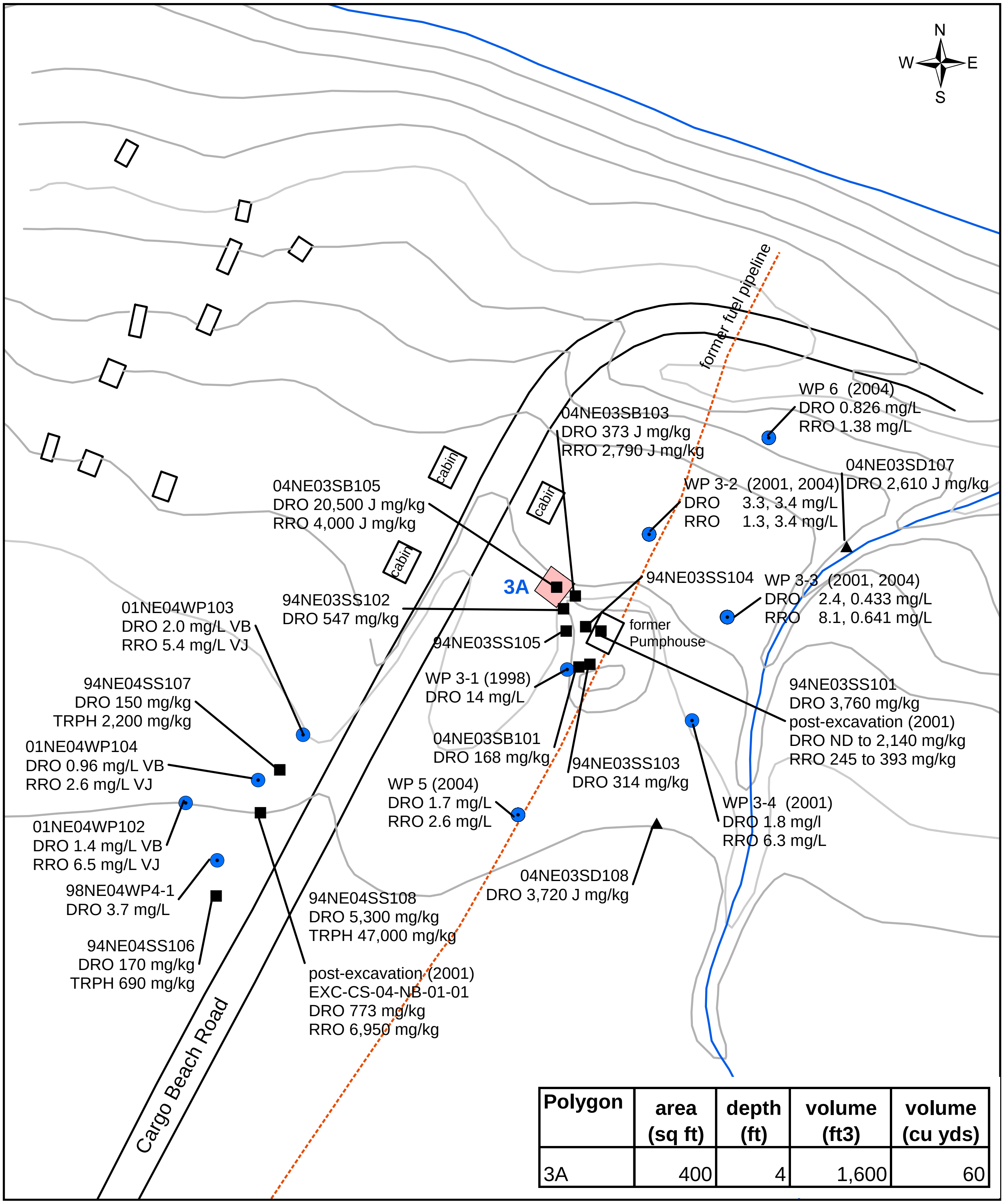
Site 21 Wastewater Treatment Tank
Historical Sampling Locations

US Army
Corps of Engineers
Alaska District

0 50 100 Feet

1 inch equals 100 feet

Site: NE Cape AFS
Drawn: LKG
Date: 6/2006



Polygon	area (sq ft)	depth (ft)	volume (ft3)	volume (cu yds)
3A	400	4	1,600	60

Legend

- ▲ Sediment Sample Location
- ■ Soil Sample Location
- ● Surface/Groundwater Sample
- Scenario A (> 9,200 mg/kg DRO)

FIGURE 6-1

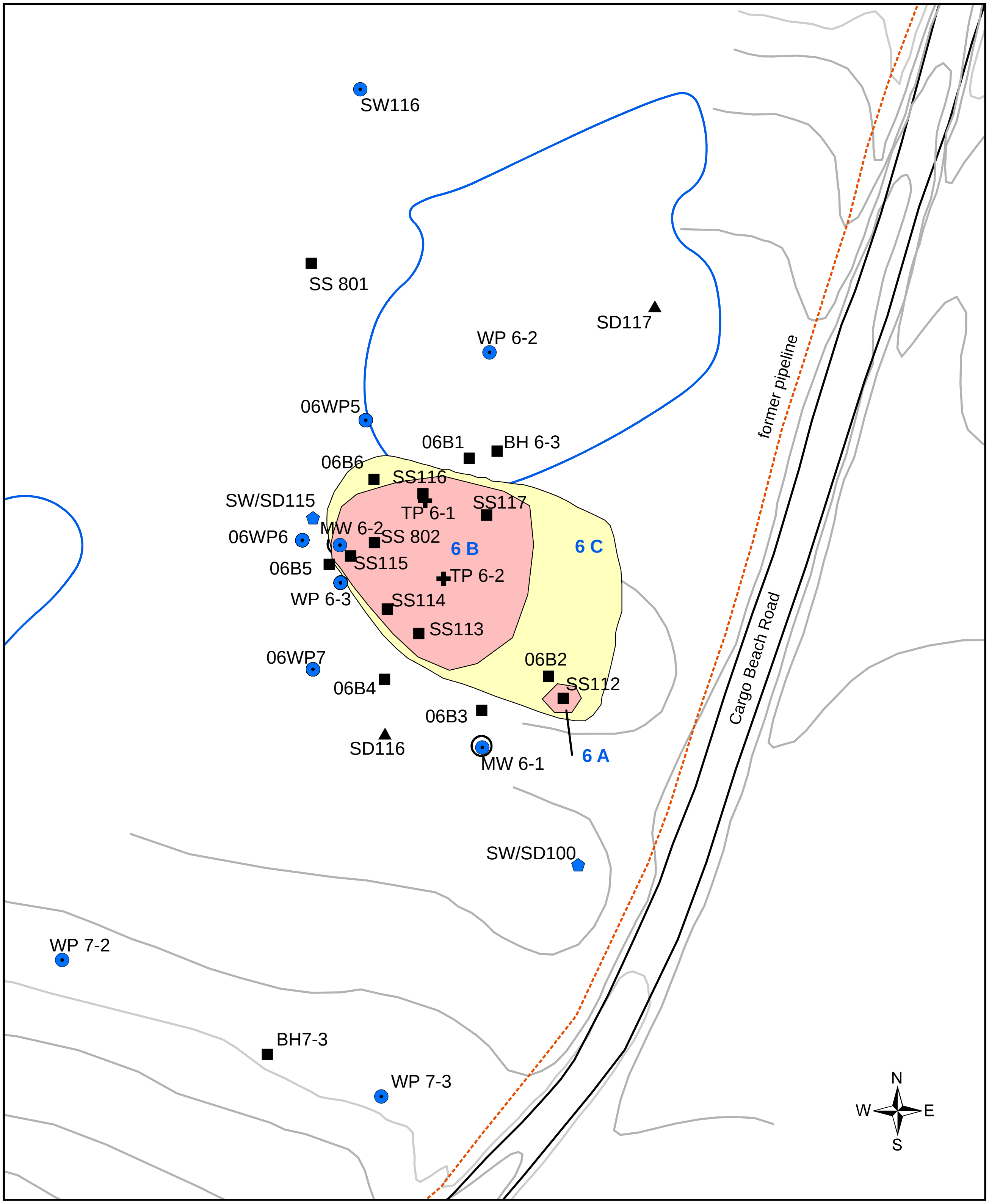
Sites 3 and 4
Fuel Pumphouse and Pipeline

US Army
Corps of Engineers
Alaska District

0 50 100 Feet

1 inch equals 100 feet

Site: Northeast Cape
Drawn: LKG
Date: 4/2006



Legend

- ▲ Sediment Sample Location
- ■ Soil Sample Location
- ⬟ Surface Water/Sediment Sample
- ⊙ Monitoring Well/Well Point

Proposed Excavation Areas

- Scenario A
- Scenario B

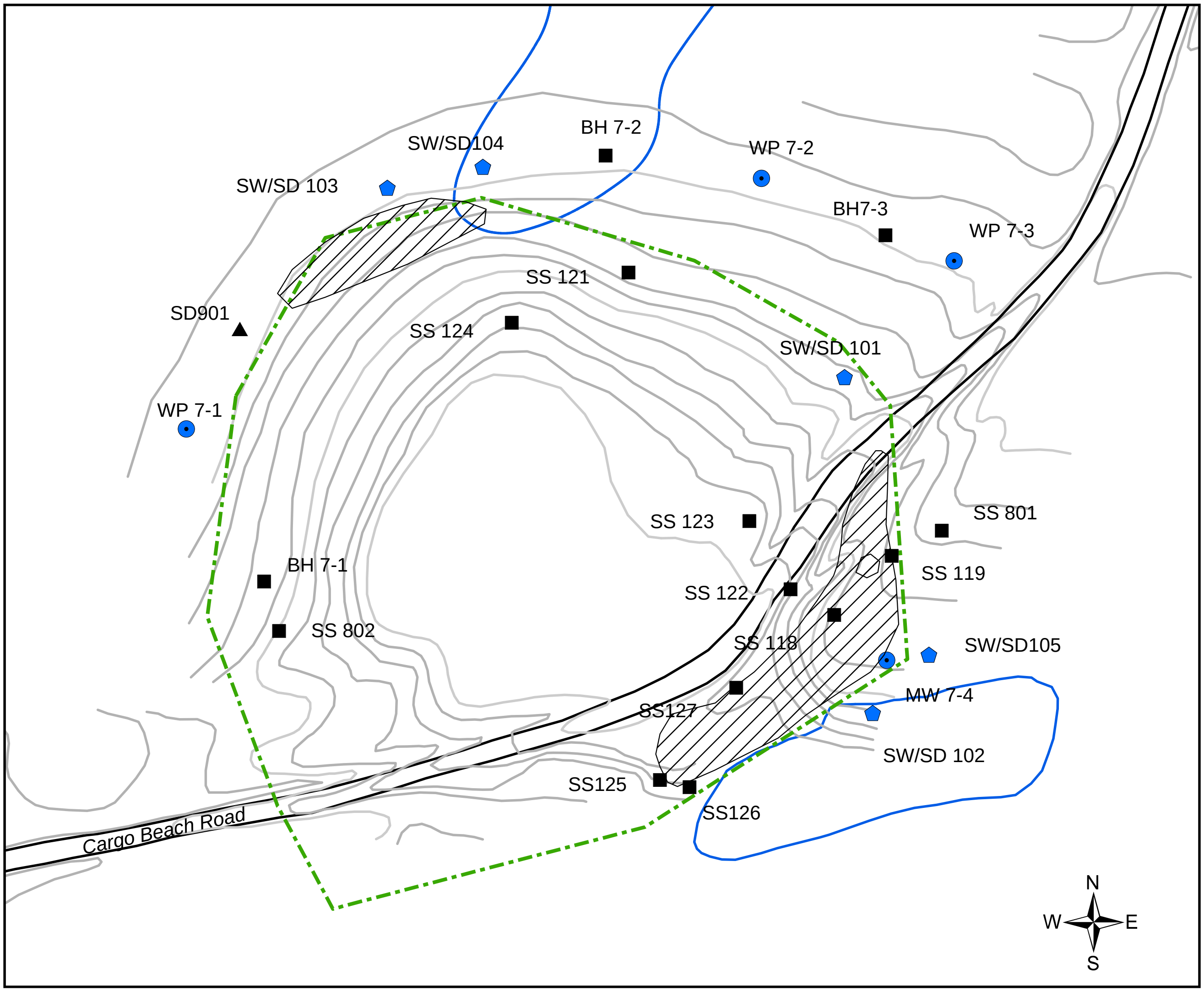
FIGURE 7-1

Site 6 Drum Dump
Historical Sampling Locations

US Army
Corps of Engineers
Alaska District

0 50 100 Feet
1 inch equals 100 feet

Site: Northeast Cape
Drawn: LKG
Date: 4/2006



Legend

- ▲ Sediment Sample Location
- ■ Soil Sample Location
- Surface Water/Sediment Sample
- Monitoring Well/Well Point
- Exposed debris
- Landfill boundary

FIGURE 8-1

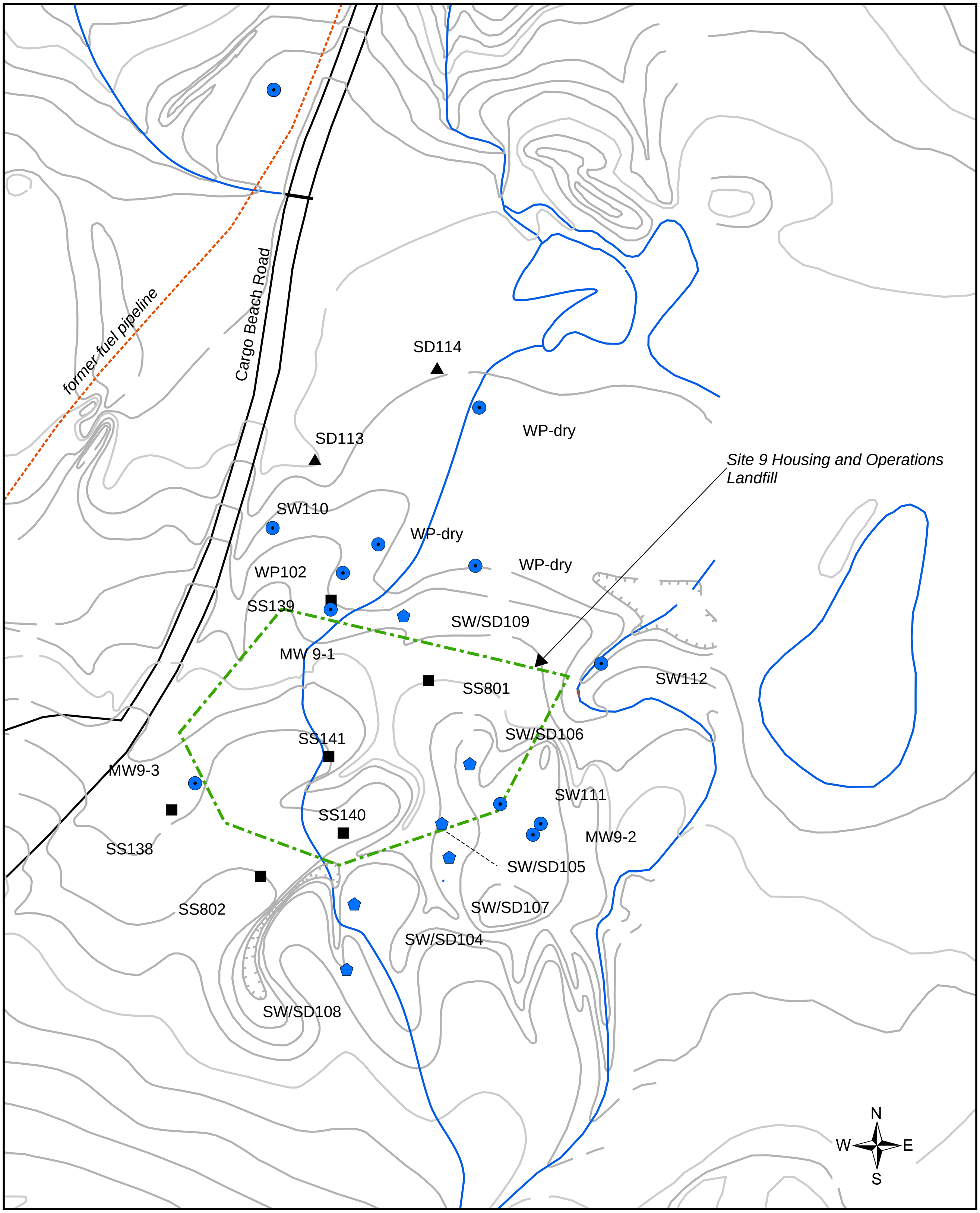
Site 7 Cargo Beach Road Landfill
Historical Sampling Locations

US Army
Corps of Engineers
Alaska District

0 100 200 Feet

1 inch equals 200 feet

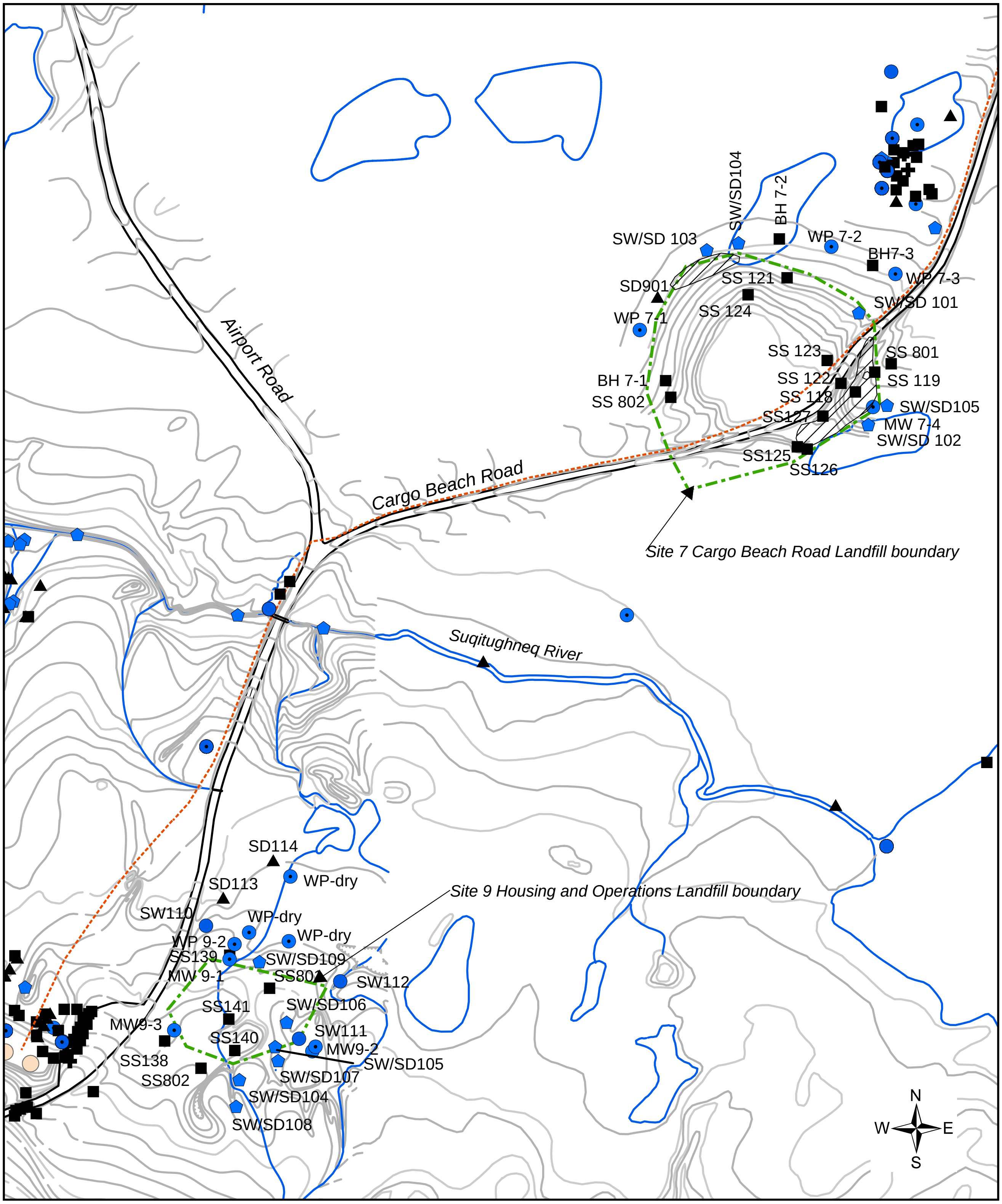
Site: Northeast Cape
Drawn: LKG
Date: 4/2006



Legend

- ▲ Sediment Sample Location
- ■ Soil Sample Location
- ⬟ Surface Water/Sediment Sample
- ⦿ Monitoring Well/Well Point
- Landfill Boundary

FIGURE 8-2	Site 9 Housing and Operations Landfill Historical Sampling Locations	
US Army Corps of Engineers Alaska District	0 100 200 Feet 1 inch equals 200 feet	Site: Northeast Cape Drawn: LKG Date: 4/2006



Legend

- ▲ Sediment Sample Location
- ■ Soil Sample Location
- ⬟ Surface Water/Sediment Sample Location
- ● Surface Water Sample Location
- ⊙ Monitoring Well/Well Point
- Exposed debris
- Landfill boundary

FIGURE 8-3

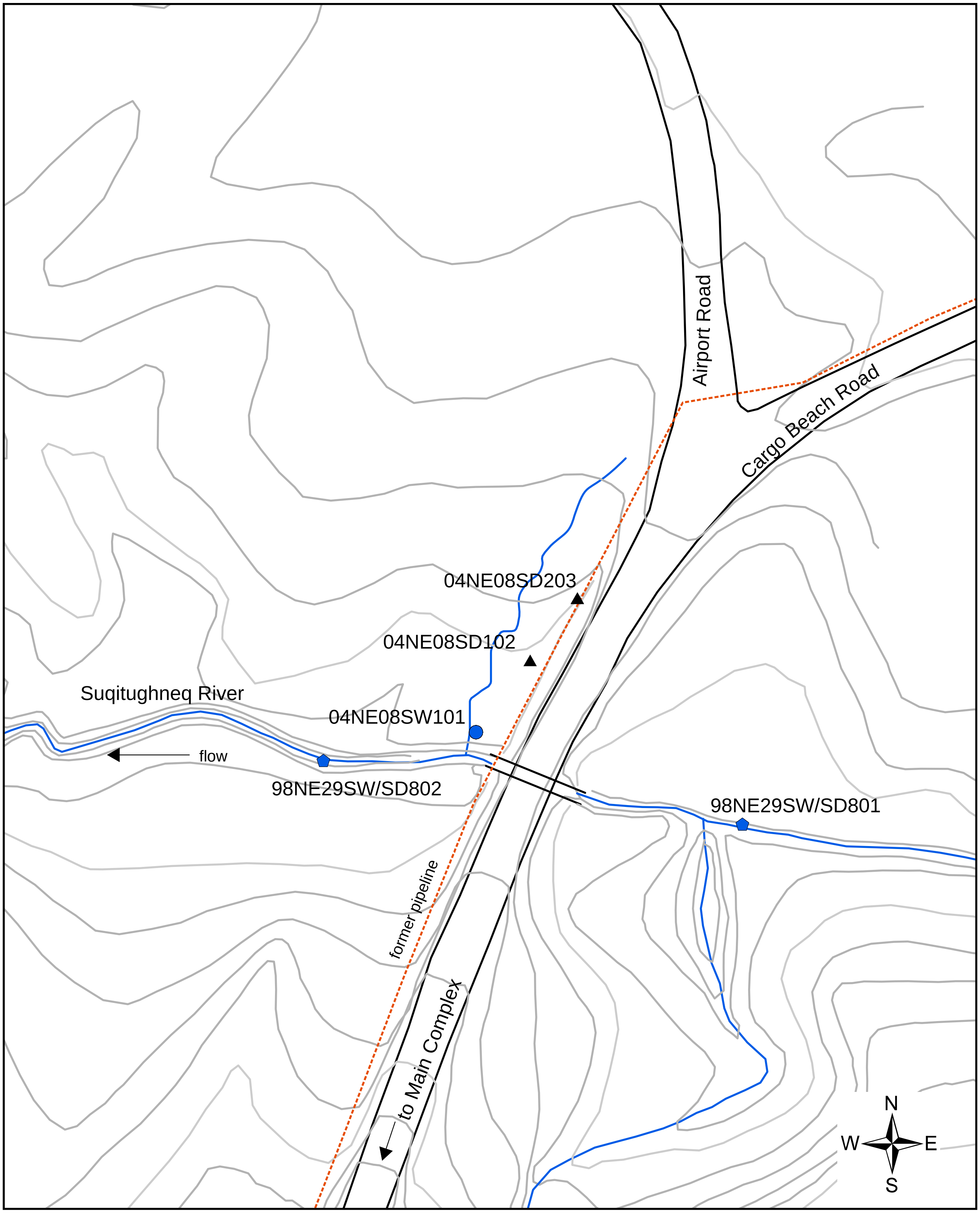
Sites 7 and 9 Landfills
Historical Sampling Locations

US Army
Corps of Engineers
Alaska District

0 250 500 Feet

1 inch equals 500 feet

Site: Northeast Cape
Drawn: LKG
Date: 4/2006



Legend

- Sediment Sample Location
- Surface Water/Sediment Sample Location
- Surface Water Sample Location

FIGURE 9-1

Site 8 POL Spill
Historical Sampling Locations

US Army
Corps of Engineers
Alaska District

0 50 100 Feet
1 inch equals 100 feet

Site: Northeast Cape
Drawn: LKG
Date: 4/2006

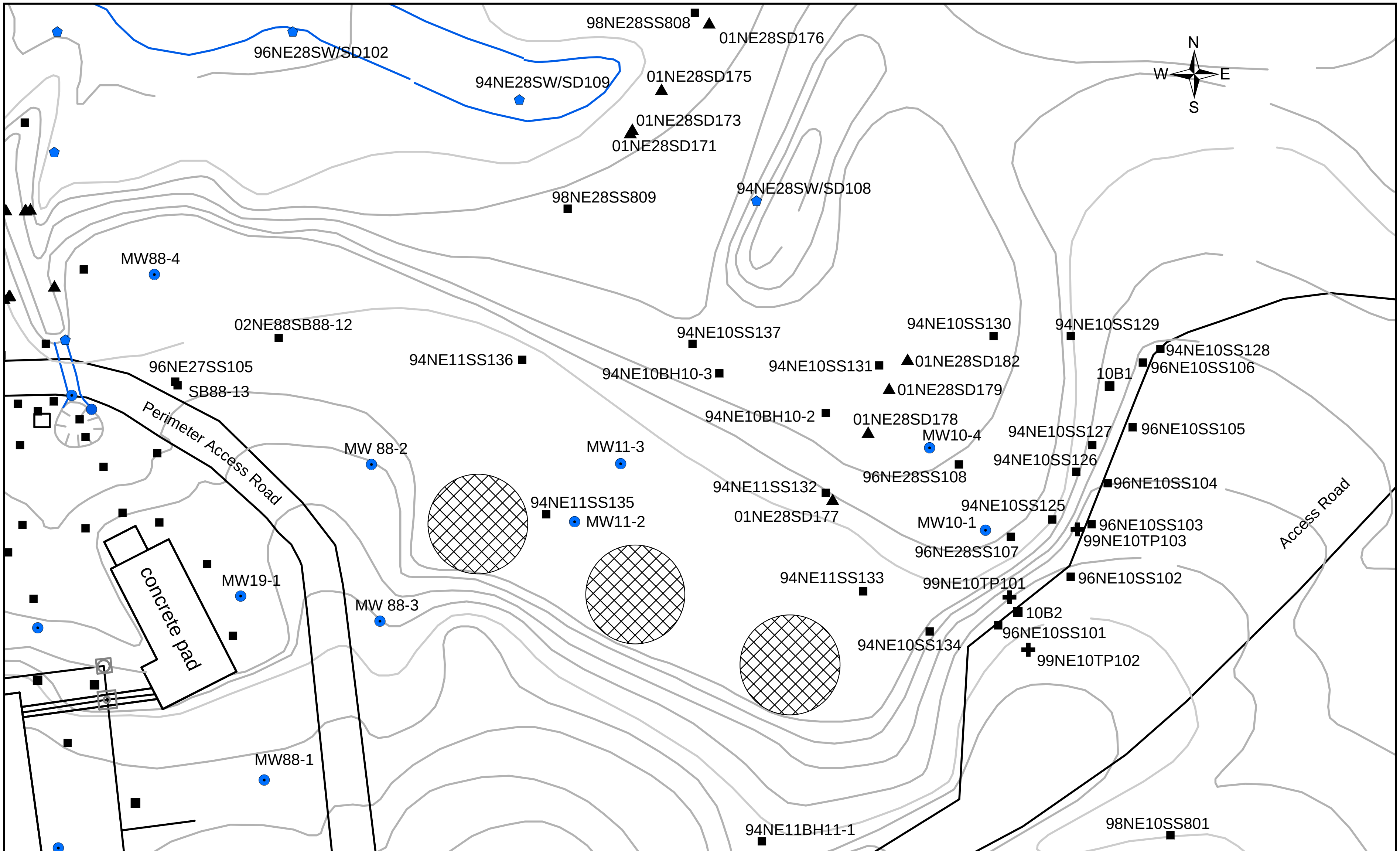


FIGURE 10-1

Main Operations Complex
Sites 10 and 11 Historical Sampling Locations

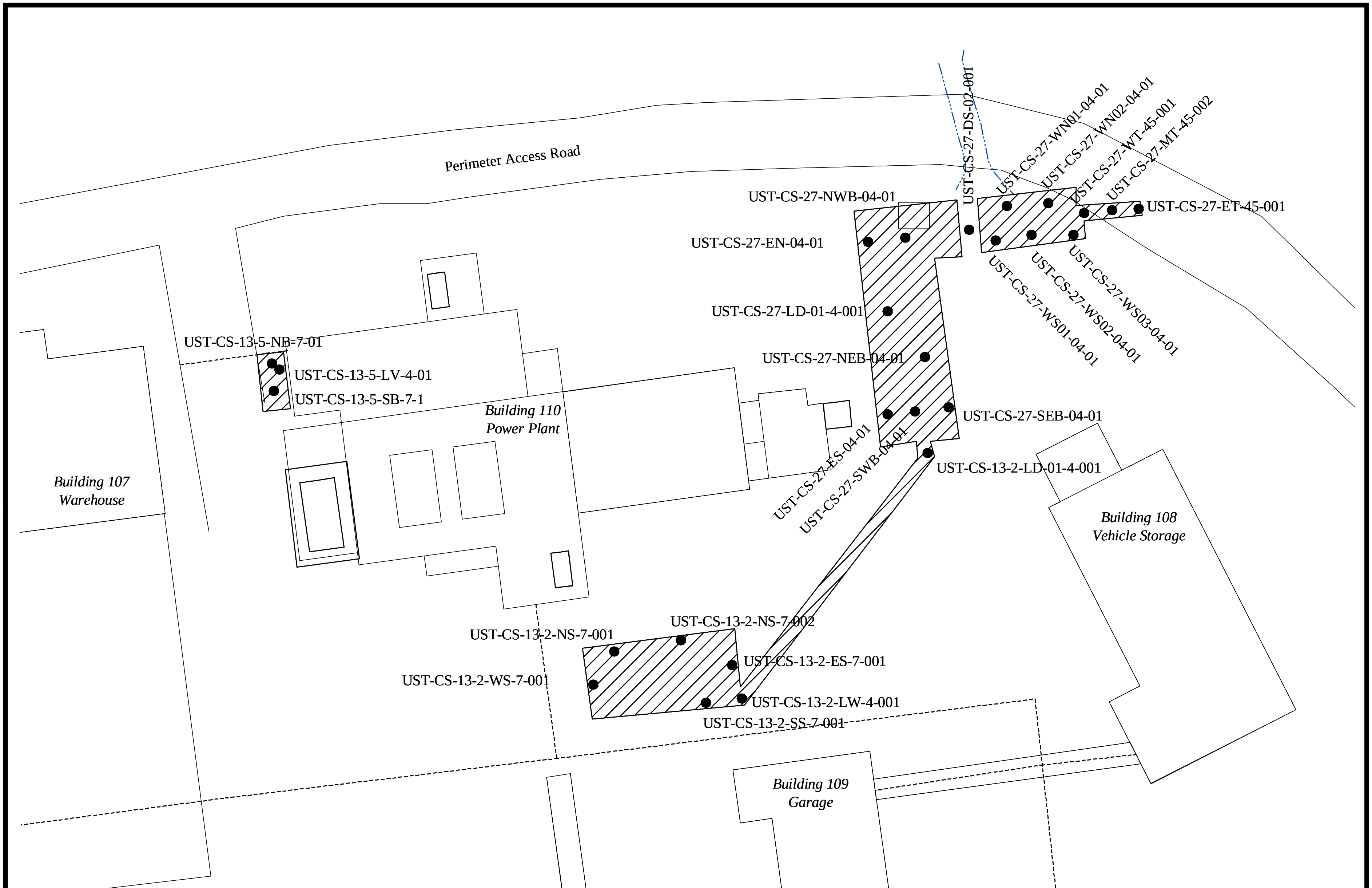
US Army
Corps of Engineers
Alaska District

0 20 40 60 80 Feet
1 inch equals 80 feet

Site: Northeast Cape
Drawn: LKG
Date: 2/2007

Legend

- Sediment Sample Location
- Soil Sample Location
- Surface Water/Sediment Sample Location
- Surface Water Sample Location
- Monitoring Well/Well Point
- Former ASTs



U.S. Army
Corps of Engineers
Alaska District

March 2006

UST Sampling Locations
Site 13 Heat and Power Building
Figure 10-2

● Sampling Location (estimated, not surveyed)
▨ Soil excavation area (approximate)

1" = 40 Feet
0 20 40 Feet

N
W E
S

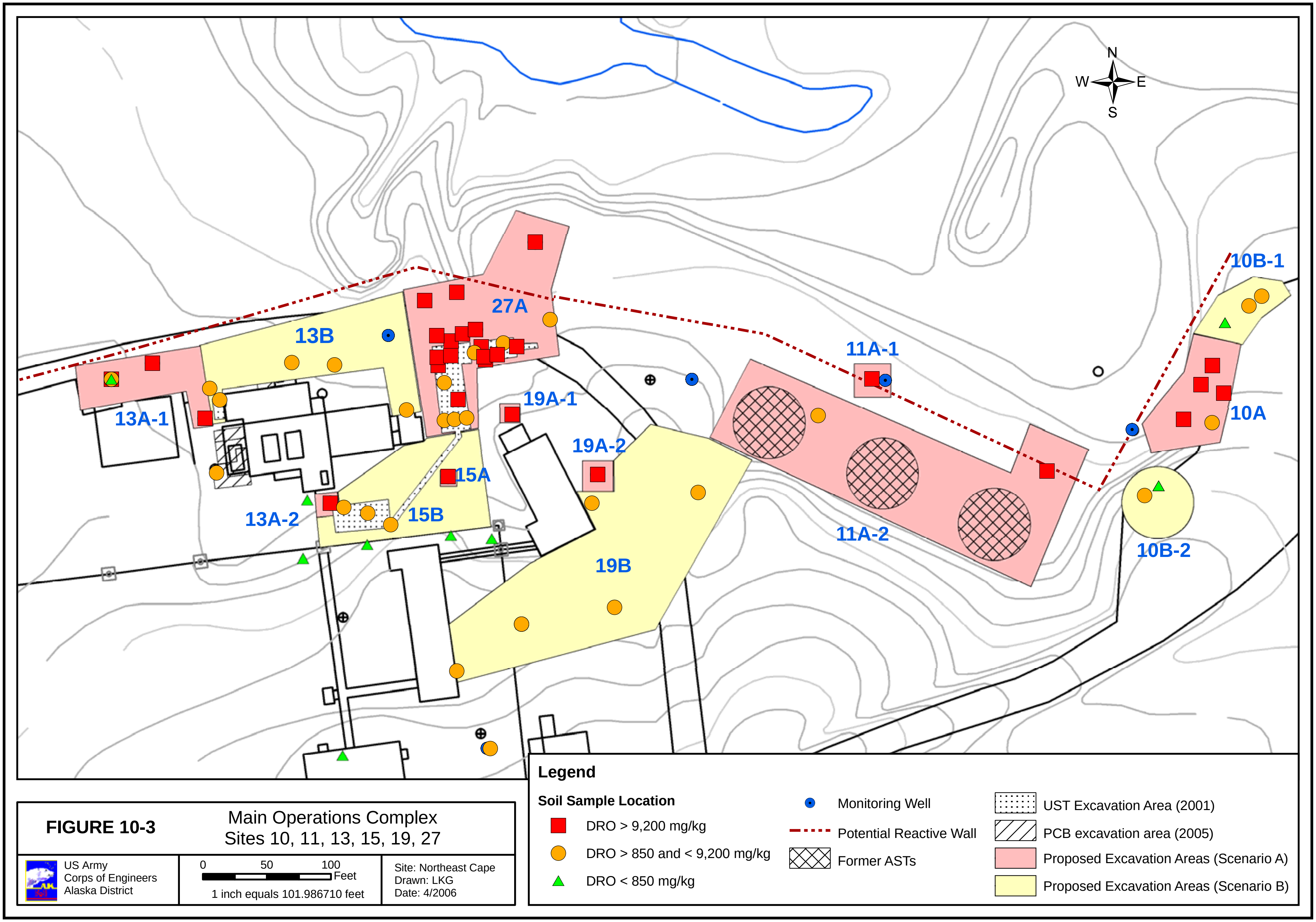


FIGURE 10-3 Main Operations Complex
Sites 10, 11, 13, 15, 19, 27

US Army
Corps of Engineers
Alaska District

Site: Northeast Cape
Drawn: LKG
Date: 4/2006

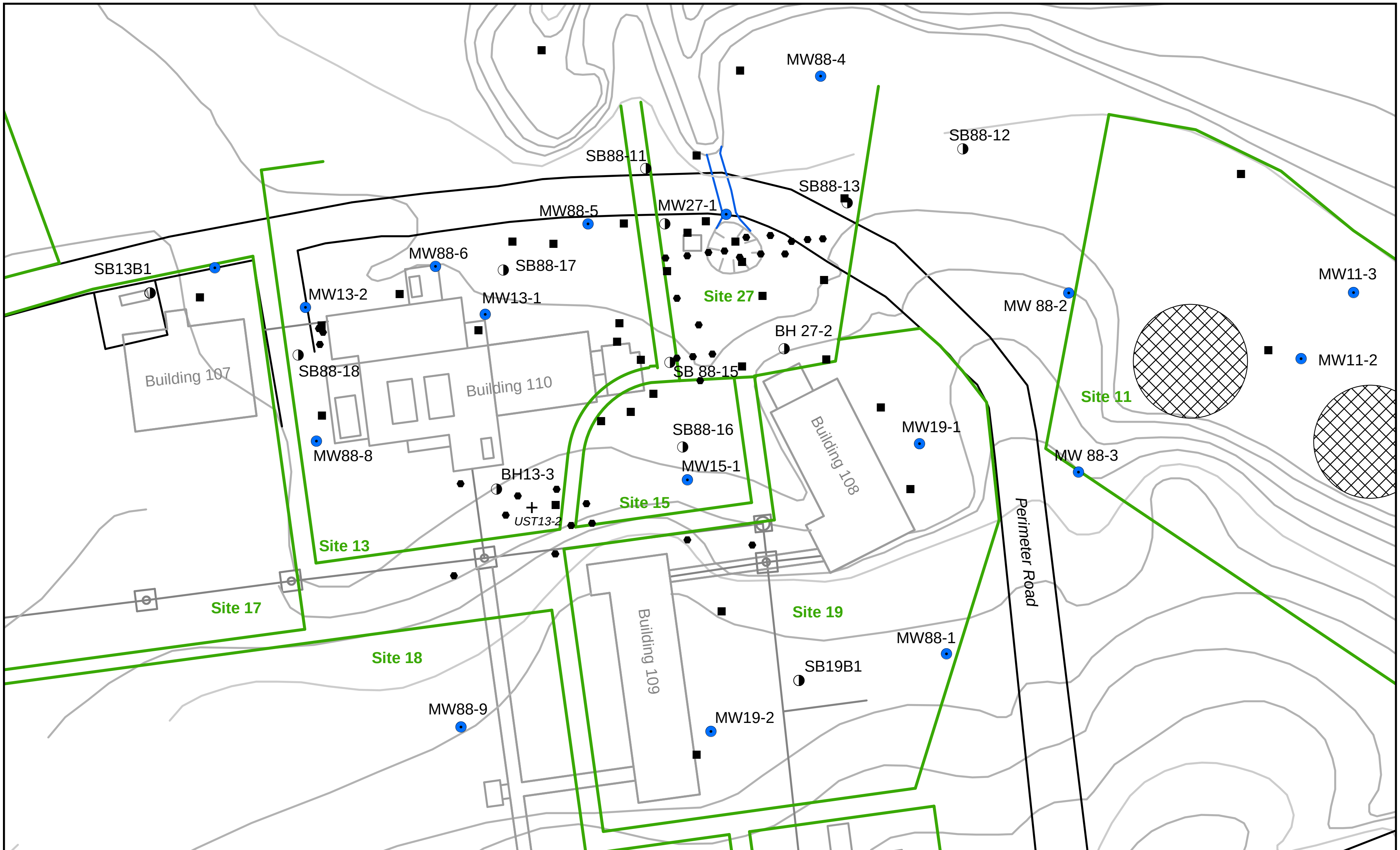


FIGURE 10-4

Main Operations Complex
Sites 13, 15, 19, 27 Historical Sampling Locations

US Army
Corps of Engineers
Alaska District

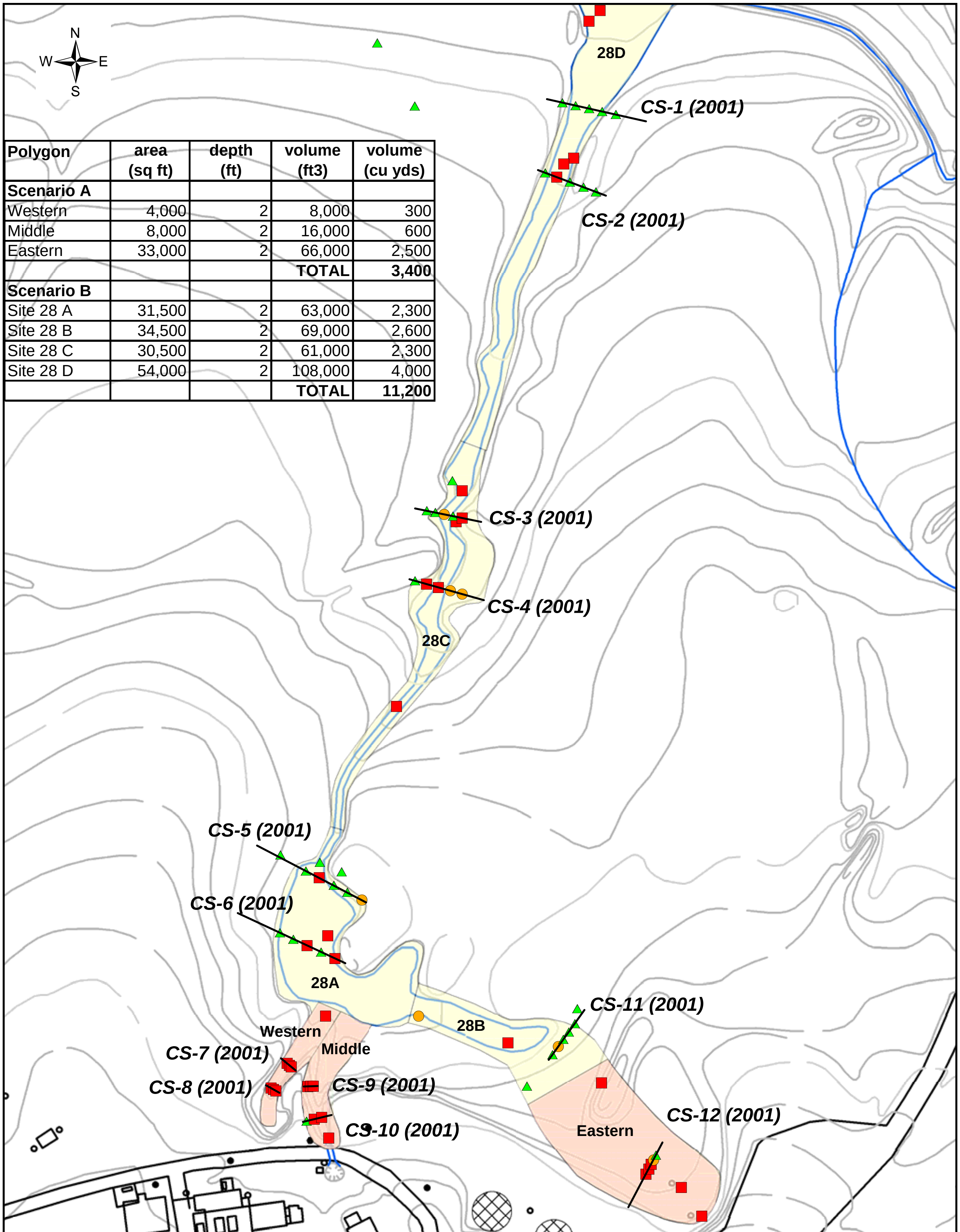
0 20 40 60 80 Feet
1 inch equals 70 feet

Site: Northeast Cape
Drawn: LKG
Date: 2/2007

N W E S

Legend

- Monitoring Well
- Soil Boring
- Surface Soil Sample
- Soil Excavation Sample
- Site outline



Polygon	area (sq ft)	depth (ft)	volume (ft3)	volume (cu yds)
Scenario A				
Western	4,000	2	8,000	300
Middle	8,000	2	16,000	600
Eastern	33,000	2	66,000	2,500
			TOTAL	**3,400**
Scenario B				
Site 28 A	31,500	2	63,000	2,300
Site 28 B	34,500	2	69,000	2,600
Site 28 C	30,500	2	61,000	2,300
Site 28 D	54,000	2	108,000	4,000
			TOTAL	**11,200**

Legend

Surface Soil/Sediment Results

- ▲ DRO < 3500 mg/kg
- ● DRO > 3500 and < 9200 mg/kg
- ■ DRO > 9200 mg/kg

Scenario A

Scenario B

FIGURE 11-1

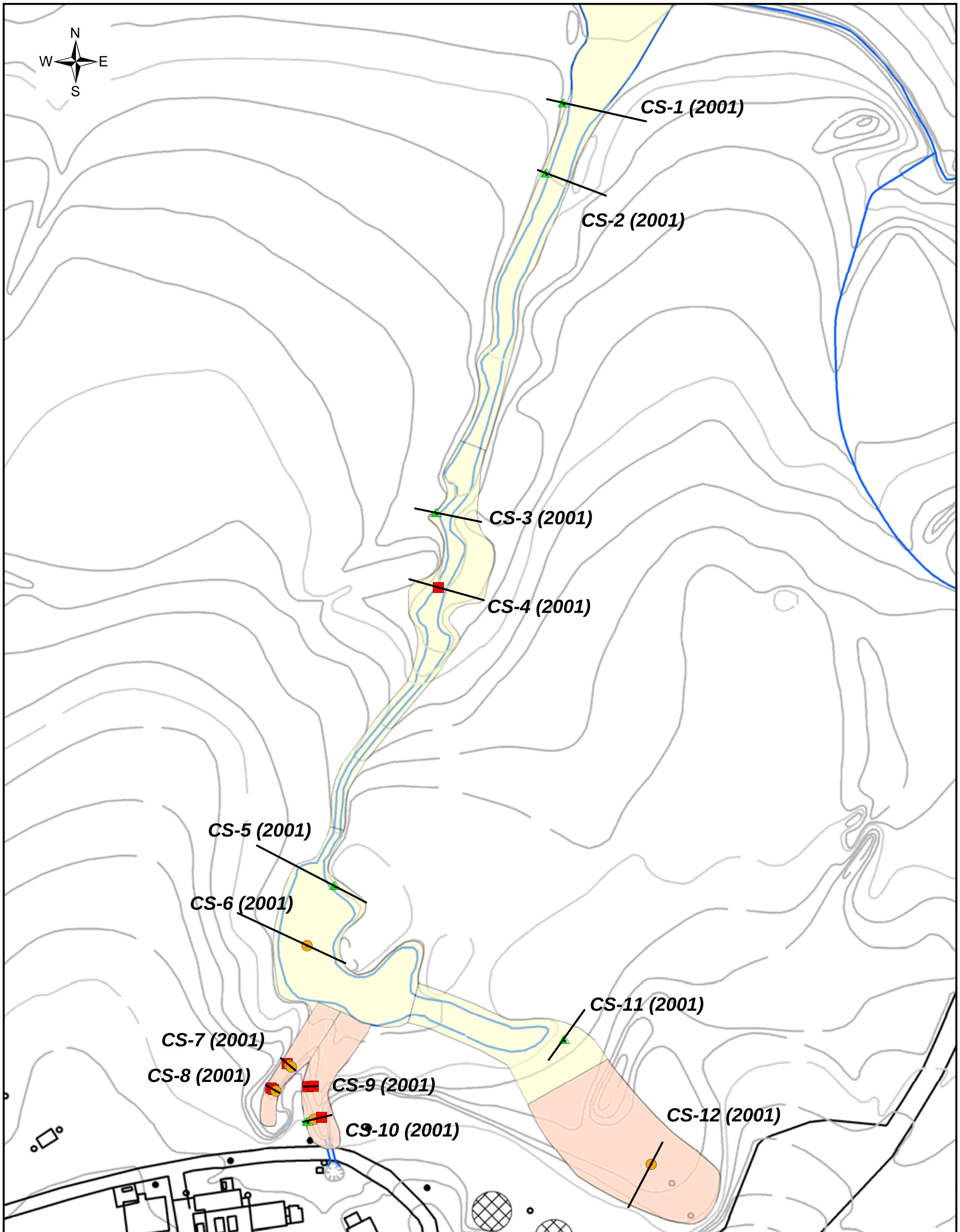
Site 28 Drainage Basin
Surface Soil/Sediment Results

US Army Corps of Engineers Alaska District

0 100 200 Feet

1 inch equals 200 feet

Site: Northeast Cape
Drawn: LKG
Date: 11/2006



Legend

Subsurface Sediment Results (2001)

- DRO < 3500 mg/kg
- DRO > 3500 and < 9200 mg/kg
- DRO > 9200 mg/kg

- Scenario A
- Scenario B

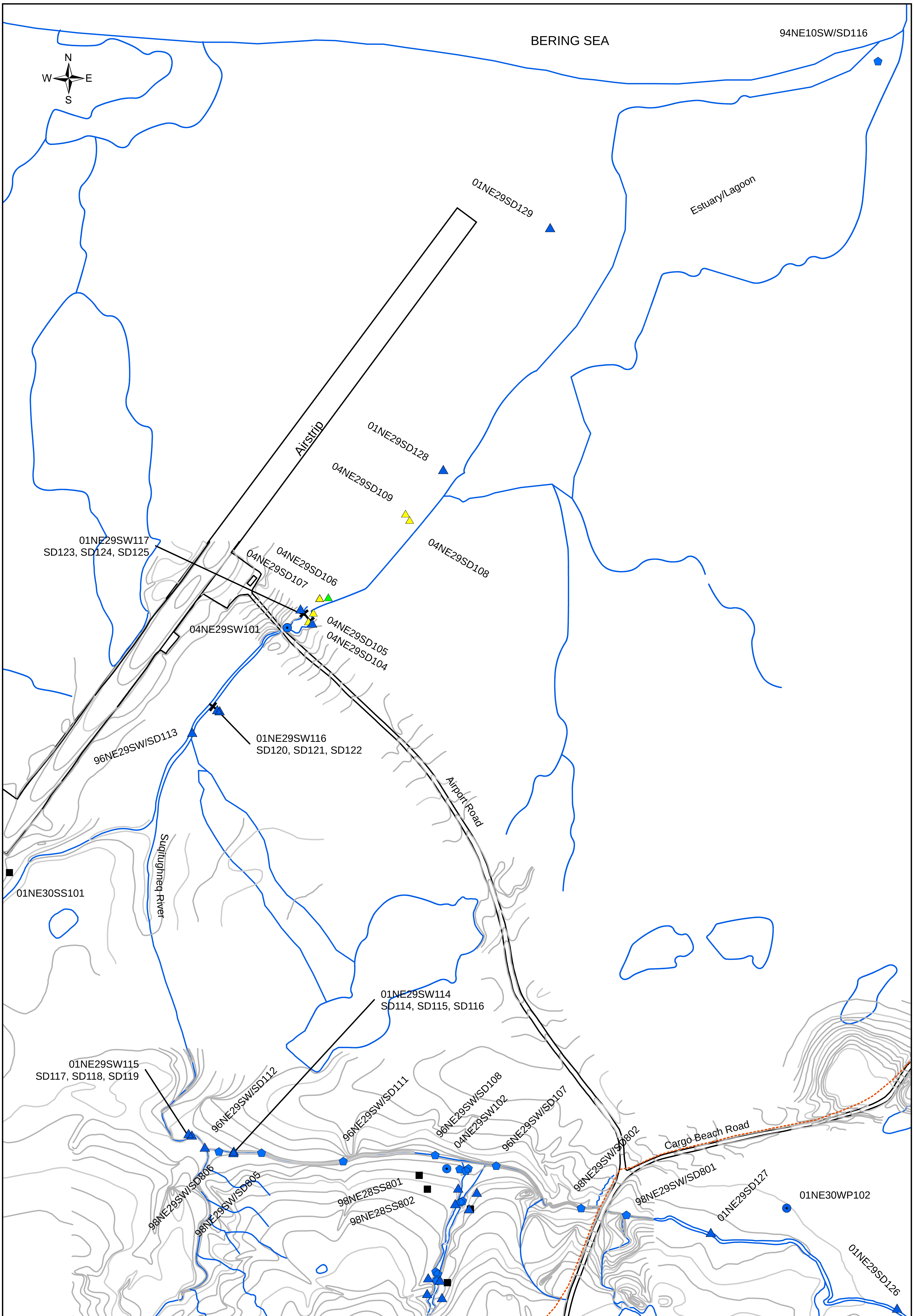
FIGURE 11-2 Site 28 Drainage Basin Subsurface Sediment Results

US Army Corps of Engineers Alaska District

0 100 200 Feet

1 inch equals 200 feet

Site: Northeast Cape
Drawn: LKG
Date: 2/2007



▲ Sediment Sample Location

■ Soil Sample Location

⬟ Surface Water/Sediment Sample Location

⦿ Surface/Groundwater Sample Location

FIGURE 12-1

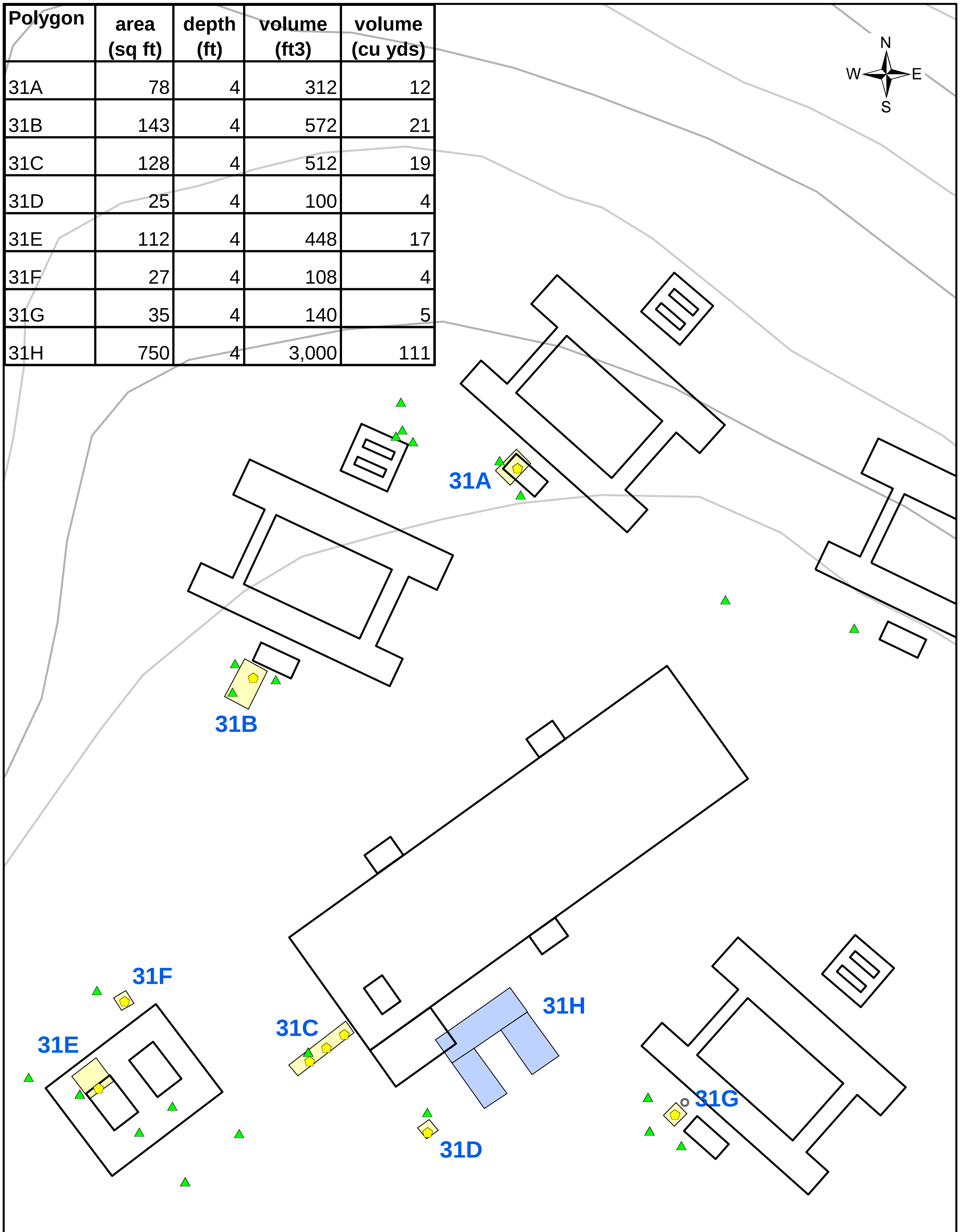
Site 29 Suqitughneq River and Estuary
Historical Sampling Locations

US Army
Corps of Engineers
Alaska District

0 200 400 600 Feet
1 inch equals 600 feet

Site: Northeast Cape
Drawn: LKG
Date: 4/2006

Polygon	area (sq ft)	depth (ft)	volume (ft3)	volume (cu yds)
31A	78	4	312	12
31B	143	4	572	21
31C	128	4	512	19
31D	25	4	100	4
31E	112	4	448	17
31F	27	4	108	4
31G	35	4	140	5
31H	750	4	3,000	111



Legend

DRO (mg/kg)
- < 1600
- 1600 - 9200
- > 9200

Proposed Excavation Areas
- Scenario A - DRO > 9,200 mg/kg
- Scenario B - DRO > 1,600 mg/kg
- PCBs > 1 mg/kg

FIGURE 13-1

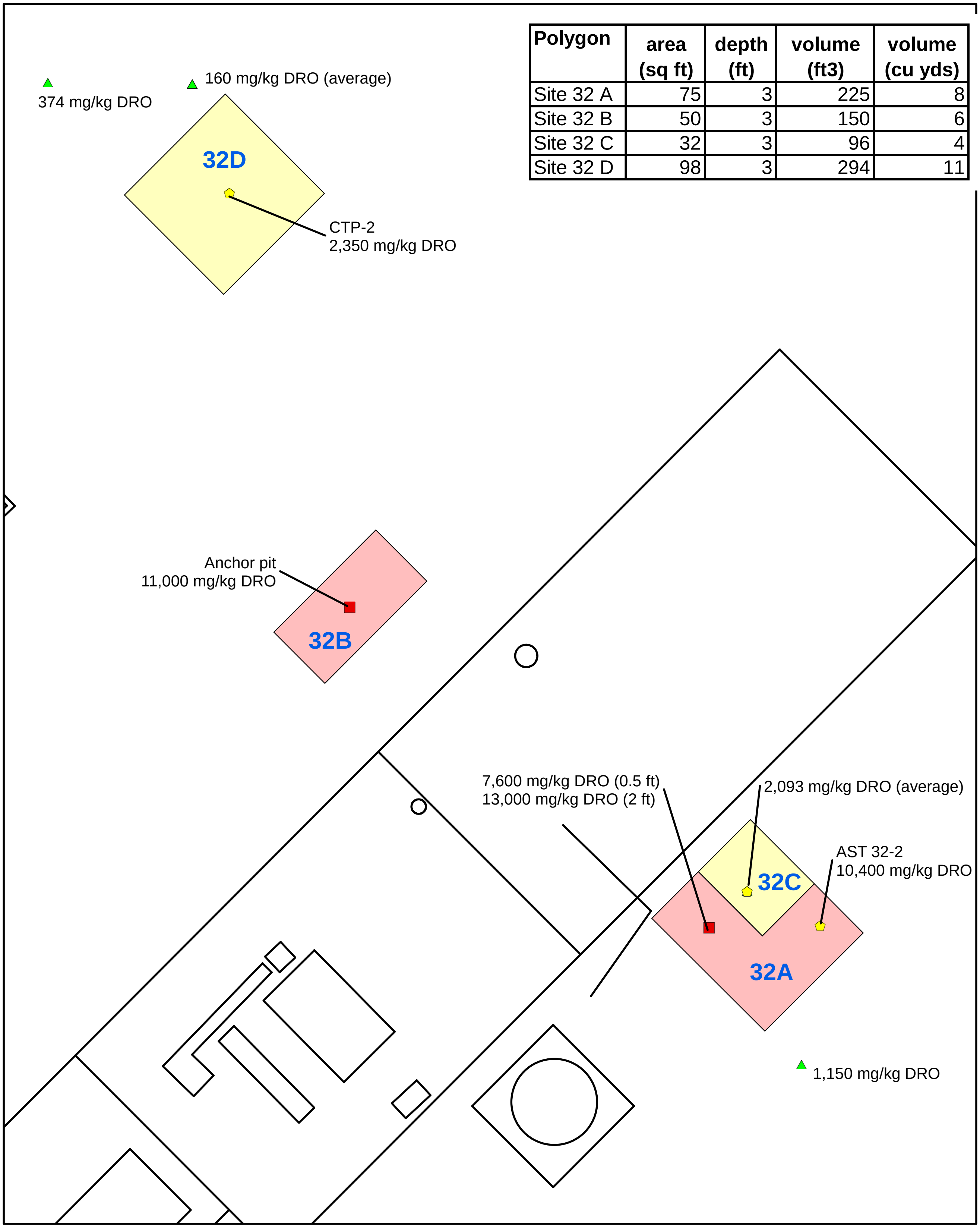
Site 31 White Alice Complex
Historical Sampling Locations

US Army
Corps of Engineers
Alaska District

0 10 20 30 40 50 Feet
1 inch equals 50 feet

Site: Northeast Cape
Drawn: LKG
Date: 3/2006

Polygon	area (sq ft)	depth (ft)	volume (ft3)	volume (cu yds)
Site 32 A	75	3	225	8
Site 32 B	50	3	150	6
Site 32 C	32	3	96	4
Site 32 D	98	3	294	11



Legend

DRO (mg/kg)
- < 1600
- 1600 - 9200
- > 9200

Proposed Excavation Areas
- Scenario A - DRO > 9,200 mg/kg
- Scenario B - DRO > 1,600 mg/kg
- PCBs > 1 mg/kg

FIGURE 13-2

Site 32 Lower Tram
Historical Sampling Locations

US Army
Corps of Engineers
Alaska District

0 5 10 Feet
1 inch equals 10 feet

Site: Northeast Cape
Drawn: LKG
Date: 3/2006

APPENDIX A – EXECUTIVE SUMMARY TABLES FROM MWH 2002A

AMBIENT LEVELS FOR SOIL, SEDIMENT, SURFACE WATER AND GROUNDWATER AT NORTHEAST CAPE

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Table E-1
Proposed Ambient Levels for Soil
Northeast Cape, St. Lawrence Island, Alaska

Chemical	NEC Soil BUTL		Ambient Soil Concentration	
	Tundra Soil	Gravel Soil	Mean	Range
Inorganic (mg/kg)				
Aluminum	30,357	nc	65,000 [a]	12,000 - 100,000 [a]
Antimony	nc	nc	na	na
Arsenic	7.8	11	9.6 [a]	<10 - 750 [a]
Barium	174	nc	678 [a]	39 - 3,100 [a]
Beryllium	3.8	nc	1.35 [a]	<1 - 7 [a]
Cadmium	1.4	3.1	0.5 [c]	0.01 - 0.70 [c]
Chromium	48	50	64 [a]	5 - 390 [a]
Cobalt	49	nc	14 [a]	<2 - 55 [a]
Copper	107	44	29 [a]	3 - 810 [a]
Lead	106	112	14 [a]	<4 - 310 [a]
Manganese	1,589	nc	670 [a]	200 - 4,000 [a]
Mercury	0.43	nc	0.046 [b]	<0.01 - 4.6 [b]
Nickel	59	30	33 [a]	<3 - 320 [a]
Selenium	nc	nc	na	na
Silver	nc	nc	na	na
Thallium	1.6	0.56	na	na
Vanadium	73	nc	129 [a]	11 - 490 [a]
Zinc	615	157	79 [a]	<20 - 2,700 [a]

Notes:
mg/kg = Milligrams per kilogram.
na - Not applicable.
nc - Not calculated.
[a] Source: Gough, L.P., R.C. Severson and H.T. Shacklette, 1984. *Element Concentrations in Soil and Other Surficial Materials of Alaska* , United States Geological Survey, Professional Paper 1458.
[b] Source: Shacklette, H.T. and J.G. Boerngen, 1984. *Element Concentrations in Soil and Other Surficial Materials of the Conterminous United States* , United States Geological Survey, Professional Paper 1270.
[c] Source: Baker, D.E. and L. Chesnin, 1975. Chemical monitoring of soils for environmental quality and animal and human health. *Advan. Agron* ., 27:306-374.

Table E-2
Proposed Ambient Levels for Sediment
Northeast Cape, St. Lawrence Island, Alaska

Chemical	NEC Freshwater Sediment BUTL	Ambient Sediment Concentration [a]	
		Mean	Range
Inorganic (mg/kg)			
Aluminum	nc	na	na
Antimony	nc	na	na
Arsenic	nc	na	na
Barium	nc	na	na
Beryllium	9.8	2.0	1.0 - 12
Cadmium	nc	na	na
Chromium	34	115	1 - 15,000
Cobalt	nc	na	na
Copper	40	37	7 - 14,000
Lead	78	12	4 - 10,000
Manganese	nc	na	na
Mercury	nc	na	na
Nickel	126	37	9 - 1,800
Selenium	nc	na	na
Silver	nc	na	na
Thallium	nc	na	na
Vanadium	nc	na	na
Zinc	148	157	14 - 4,700

Notes:
mg/kg = Milligrams per kilogram.
na - Not applicable.
nc - Not calculated.
[a] Source: Gough, L.P., R.C. Severson and H.T. Shacklette, 1984. Element Concentrations in Soil and Other Surficial Materials of Alaska, United States Geological Survey, Professional Paper 1458.

Table E-3
Proposed Ambient Levels for Surface Water
Northeast Cape, St. Lawrence Island, Alaska

Chemical	NEC Fresh Surface Water BUTL	NEC Ephemeral Surface Water BUTL	USEPA Freshwater Ambient Water Quality Criterion[a]
Inorganics, Total (mg/L)			
Aluminum	nc	2.2	0.087
Antimony	nc	nc	na
Arsenic	nc	nc	na
Barium	nc	0.034	na
Beryllium	nc	nc	na
Cadmium	nc	nc	na
Chromium	nc	nc	na
Cobalt	nc	nc	na
Copper	nc	0.083	0.009
Lead	nc	0.014	0.0025
Manganese	nc	0.12	1.0 [b]
Mercury	nc	nc	na
Nickel	nc	nc	na
Selenium	nc	nc	na
Silver	nc	nc	na
Thallium	nc	nc	na
Vanadium	nc	nc	na
Zinc	nc	0.90	0.11
Inorganics, Dissolved (mg/L)			
Antimony, Dissolved	nc	nc	na
Arsenic, Dissolved	nc	nc	na
Beryllium, Dissolved	nc	nc	na
Cadmium, Dissolved	nc	nc	na
Chromium, Dissolved	nc	nc	na
Copper, Dissolved	nc	nc	na
Lead, Dissolved	nc	nc	na
Mercury, Dissolved	nc	nc	na
Nickel, Dissolved	nc	nc	na
Selenium, Dissolved	nc	nc	na
Silver, Dissolved	nc	nc	na
Thallium, Dissolved	nc	nc	na
Zinc, Dissolved	nc	0.093	0.11

Notes:
mg/L = Milligrams per liter.
[a] Source: USEPA Ambient Water Quality Criteria - Freshwater Chronic Value. *Screening Quick Reference Tables (SQuiRTs)*. National Oceanic and Atmospheric Administration (NOAA), 2000.

Table E-4
Proposed Ambient Levels for Subsurface Water
Northeast Cape, St. Lawrence Island, Alaska

Chemical	NEC Shallow Subsurface Water BUTL	NEC Deep Subsurface Water BUTL	ADEC Table C Concentration [a]
Inorganics, Total (mg/L)			
Aluminum	nc	nc	na
Antimony	nc	nc	na
Arsenic	0.025	nc	0.05
Barium	nc	nc	na
Beryllium	0.021	nc	0.004
Cadmium	0.060	nc	0.005
Chromium	1.7	nc	36.5
Cobalt	0.011	nc	na
Copper	0.087	nc	1.3
Lead	0.013	nc	0.015
Manganese	0.20	nc	na
Mercury	0.00041	nc	0.002
Nickel	0.056	nc	0.1
Selenium	nc	nc	na
Silver	nc	nc	na
Thallium	nc	nc	na
Vanadium	0.097	nc	0.26
Zinc	0.29	nc	11
Inorganics, Dissolved (mg/L)			
Antimony, Dissolved	nc	nc	na
Arsenic, Dissolved	0.015	nc	0.05
Beryllium, Dissolved	nc	nc	na
Cadmium, Dissolved	nc	nc	na
Chromium, Dissolved	nc	nc	na
Copper, Dissolved	nc	nc	na
Lead, Dissolved	nc	nc	na
Mercury, Dissolved	nc	nc	na
Nickel, Dissolved	nc	nc	na
Selenium, Dissolved	nc	nc	na
Silver, Dissolved	nc	nc	na
Thallium, Dissolved	nc	nc	na
Zinc, Dissolved	nc	nc	na

Notes:
mg/L = Milligrams per liter.
[a] Source: ADEC Table C Groundwater Cleanup Levels (18 AAC 75.345).

APPENDIX B – ALTERNATE CLEANUP LEVEL CALCULATION TABLES

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APPENDIX B
TABLE B1 - SCENARIO A ALTERNATE CLEANUP LEVELS
CANCER RISK CALCULATIONS FOR A FUTURE PERMANENT RESIDENT
SOIL

Constituent	ADEC Method 2 Cleanup Level [a] (mg/kg)	Maximum Soil Conc. [b] (mg/kg)	Alternate Cleanup Level (mg/kg)	CS Ingestion (mg/kg)	CS Dermal (mg/kg)	CS Inhalation (mg/kg)	Soil Ingestion Dose (mg/kg-d)	Soil Dermal Dose (mg/kg-d)	Dust Inhalation Dose (mg/kg-d)	Cancer Slope Factor $(mg/kg\text{-}d)^{-1}$ Oral	Cancer Slope Factor Dermal	Cancer Slope Factor Inhalation	Pathway-Specific Cancer Risk Soil Ingestion	Pathway-Specific Cancer Risk Dermal	Pathway-Specific Cancer Risk Dust Inhalation	Maximum Chemical-Specific Risk	ACL Target Risk
INORGANICS																	
Arsenic	2	170	11 [c]	5.5E+00	4.7E+01	7.5E+03	2.1E-04	2.4E-05	1.5E-08	1.5E+00	1.5E+00	1.5E+01	3.1E-04	3.6E-05	2.3E-07	3.4E-04	1.0E-05
Beryllium	42	3.8	135	na	na	1.3E+02	3.7E-08	4.9E-09	1.1E-11	na	na	8.4E+00	na	na	0.0E+00	0.0E+00	1.0E-07
Cadmium	5	69.0	14	na	na	1.4E+01	8.3E-05	3.3E-07	6.1E-09	na	na	6.3E+00	na	na	3.8E-08	3.8E-08	8.0E-09
Cobalt	na	38	116	na	na	1.2E+02	4.6E-05	1.8E-06	3.4E-09	na	na	9.8E+00	na	na	3.3E-08	3.3E-08	1.0E-07
VOLATILE ORGANIC COMPOUNDS																	
Benzene	0.02	0.730	2	1.5E+00	3.8E+00	4.2E+04	8.8E-07	3.5E-07	6.4E-11	5.5E-02	5.5E-02	2.7E-02	4.8E-08	1.9E-08	1.7E-12	6.8E-08	1.0E-07
Ethylbenzene	5.5	3.0	21	2.1E+01	5.4E+01	2.9E+05	3.6E-06	1.4E-06	2.6E-10	3.9E-03	3.9E-03	3.9E-03	1.4E-08	5.6E-09	1.0E-12	2.0E-08	1.0E-07
Benzo(a)anthracene	6	4.4	1.1	1.1E+00	2.2E+00	1.6E+04	5.3E-06	2.7E-06	3.9E-10	7.3E-01	7.3E-01	7.3E-01	3.9E-06	2.0E-06	2.8E-10	5.9E-06	1.0E-06
Benzo(a)pyrene	1	2.3	0.6	5.7E-01	1.1E+00	7.8E+03	2.8E-06	1.4E-06	2.0E-10	7.3E+00	7.3E+00	7.3E+00	2.0E-05	1.0E-05	1.5E-09	3.1E-05	5.0E-06
Benzo(b)fluoranthene	11	2.6	1.1	1.1E+00	2.2E+00	1.6E+04	3.1E-06	1.6E-06	2.3E-10	7.3E-01	7.3E-01	7.3E-01	2.3E-06	1.2E-06	1.7E-10	3.5E-06	1.0E-06
Methylene chloride	0.015	0.1600	1.1	1.1E+00	2.8E+00	6.9E+04	1.9E-07	7.6E-08	1.4E-11	7.5E-03	7.5E-03	1.6E-03	1.4E-09	5.7E-10	2.3E-14	2.0E-09	1.0E-08
DIOXINS/FURANS																	
2,3,7,8-Tetrachlorodibenzo-p-dioxins (TCDD) Toxicity Equivalents (TEQ)	na	0.0000085	0.0000094	9.4E-06	7.9E-05	1.3E-01	1.0E-11	1.2E-12	7.5E-16	1.5E+05	1.5E+05	1.5E+05	1.5E-06	1.8E-07	1.1E-10	1.7E-06	1.7E-06
POLYCHLORINATED BIPHENYLS																	
PCB-1260 (Aroclor 1260)	1	37	1.0	1.2E+00	2.3E+00	1.7E+04	4.5E-05	2.5E-05	3.3E-09	2.0E+00	2.0E+00	2.0E+00	8.9E-05	4.9E-05	6.5E-09	1.4E-04	3.0E-06
PCB-1254 (Aroclor 1254)	1	52	0.0	0.0E+00	0.0E+00	0.0E+00	6.3E-05	3.5E-05	4.6E-09	2.0E+00	2.0E+00	2.0E+00	1.3E-04	6.9E-05	9.2E-09	1.9E-04	0.0E+00
															ILCR		**2E-05**

Notes:

[a] ADEC Method 2 Cleanup Level based on 18 AAC 75.340, Table B1 and B2, Migration to Groundwater Pathway, Under 40 Inch Zone (as amended through October 16, 2005)

[b] Based on the maximum or 95 percent upper confidence limit (95% UCL) on the mean concentration detected in soil tundra amd soil gravel at the site.

[c] Based on the site-specific ambient concentration calculated for Northeast Cape.

1) Doses and cancer risks shown only for carcinogenic chemicals with available toxicity values.
2) Absorbed doses were calculated for dermal contact with the medium, and intakes were calculated for ingestion or inhalation of a medium
3) Cancer risks are unitless values which represent the probability of incurring an adverse health effect.
They are calculated using the following formula: Cancer Risk = Exposure Dose x Cancer Slope Factor

CS Concentration in Soil
ILCR Incremental lifetime cancer risk
Inc Incomplete pathway
mg/kg Milligrams per kilogram
mg/kg-d Milligrams per kilogram per day

ACL = minimum of TargetRisk/CSF_oral/((IRsoil_a*EFsi_a*ED_a*10^-6)/(BW_a*ATcarc_a)+(IRsoil_c*EFsi_c*ED_c*10^-6)/(BW_c*ATcarc_c))
or TargetRisk/CSF_dermal/((SAsoil_a*AF_a*ABS_As*EFsd_a*ED_a*10^-6)/(BW_a*ATcarc_a)+(SAsoil_c*AF_c*ABS_As*EFsd_c*ED_c*10^-6)/(BW_c*ATcarc_c))
or TargetRisk/CSF_inh/(((1/PEF)*InhR_a*EFsinh_a*ED_a)/(BW_a*ATcarc_a)+((1/PEF)*InhR_c*EFsinh_c*ED_c)/(BW_c*ATcarc_c))

APPENDIX B
TABLE B2 - SCENARIO A ALTERNATE CLEANUP LEVELS
NONCANCER HAZARD CALCULATIONS FOR A FUTURE PERMANENT RESIDENT
SOIL

Constituent	Ambient Soil Conc. (mg/kg)	Maximum Soil Conc. [a] (mg/kg)	Alternate Cleanup Level (mg/kg)	CS Ingestion (mg/kg)	CS Dermal (mg/kg)	CS Inhalation (mg/kg)	Soil Ingestion Dose (mg/kg-d)	Dermal Dose (mg/kg-d)	Dust Inhalation Dose (mg/kg-d)	Reference Dose (mg/kg-d) Oral	Reference Dose (mg/kg-d) Dermal	Reference Dose (mg/kg-d) Inhalation	Pathway-Specific Hazard Soil Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Dust Inhalation	Maximum Chemical-Specific HQ	ACL Target HQ
INORGANICS																	
Aluminum	30,327	33,100	36,631	3.7E+04	1.2E+06	1.0E+06	3.6E-01	1.1E-02	1.8E-05	1.0E+00	1.0E+00	1.4E-03	3.6E-01	1.1E-02	1.3E-02	0.39	0.40
Arsenic	11	170	11 [f]	1.1E+01	1.2E+02	2.2E+05	1.9E-03	1.8E-04	9.2E-08	3.0E-04	3.0E-04	3.0E-04	6.2E+00	5.9E-01	3.1E-04	6.78	0.4
Cadmium	3	69	11	1.1E+01	3.6E+03	2.3E+05	7.5E-04	2.4E-06	3.7E-08	5.0E-04	5.0E-04	5.0E-04	1.5E+00	4.8E-03	7.5E-05	1.512	0.3
Chromium	50	147	687	6.9E+02	2.2E+04	1.4E+07	1.6E-03	5.1E-05	8.0E-08	1.5E+00	1.5E+00	1.5E+00	1.1E-03	3.4E-05	5.3E-08	0.00110	0.005
Cobalt	49	38	49	4.9E+01	1.6E+03	2.8E+02	4.1E-04	1.3E-05	2.1E-08	2.0E-02	2.0E-02	5.7E-06	2.1E-02	6.6E-04	3.6E-03	0.025	0.03
Lead	112	4,590	400				na [b]	na [b]	na [b]	na [b]	na [b]	na [b]	na [b]	na [b]	na [b]	na [b]	
Manganese	1,589	970	1,680	1.7E+03	5.3E+04	3.4E+03	1.1E-02	3.4E-04	5.3E-07	1.4E-01	1.4E-01	1.4E-05	7.6E-02	2.4E-03	3.8E-02	0.116	0.13
Mercury	0.43	5.6	6.9	6.9E+00	2.2E+02	1.4E+05	6.1E-05	1.9E-06	3.0E-09	3.0E-04	3.0E-04	3.0E-04	2.0E-01	6.5E-03	1.0E-05	0.210	0.25
Nickel	59	280	366	3.7E+02	1.2E+04	7.4E+06	3.1E-03	9.7E-05	1.5E-07	2.0E-02	2.0E-02	2.0E-02	1.5E-01	4.8E-03	7.6E-06	0.158	0.20
Thallium	1.6	1.2	1.3	1.3E+00	4.0E+01	2.6E+04	1.3E-05	4.2E-07	6.5E-10	7.0E-05	7.0E-05	7.0E-05	1.9E-01	5.9E-03	9.3E-06	0.19	0.20
VOLATILE ORGANIC COMPOUNDS																	
1,1,1-Trichloroethane		0.28	2.6	2.6E+00	8.1E+00	1.2E+05	3.1E-06	9.7E-07	1.5E-10	2.8E-01	2.8E-01	6.3E-01	1.1E-05	3.5E-06	2.4E-10	0.000014	0.0001
Acetone		1.6	8.2	8.2E+00	2.6E+01	1.7E+05	1.7E-05	5.5E-06	8.7E-10	9.0E-01	9.0E-01	9.0E-01	1.9E-05	6.1E-06	9.6E-10	0.000026	0.0001
m,p-Xylene		0.066	1.8	1.8E+00	5.8E+00	5.4E+03	7.2E-07	2.3E-07	3.6E-11	2.0E-01	2.0E-01	2.9E-02	3.6E-06	1.1E-06	1.2E-09	0.0000047	0.0001
Methylene chloride		0.13	1.65	1.6E+00	5.2E+00	4.8E+05	1.4E-06	4.5E-07	7.0E-11	6.0E-02	6.0E-02	8.6E-01	2.4E-05	7.5E-06	8.2E-11	0.000031	0.0003
SEMIVOLATILE ORGANIC COMPOUNDS																	
Naphthalene		220	92	9.2E+01	2.9E+02	7.9E+04	2.4E-03	7.6E-04	1.2E-07	2.0E-02	2.0E-02	8.6E-04	1.2E-01	3.8E-02	1.4E-04	0.158	0.05
POLYCHLORINATED BIPHENYLS																	
PCB-1260 (Aroclor 1260)		37	2	1.8E+00	4.1E+00	3.7E+04	4.0E-04	1.8E-04	2.0E-08	2.0E-05	2.0E-05	2.0E-05	2.0E+01	9.0E+00	1.0E-03	29.2	1.0
															HI		**3**
PETROLEUM HYDROCARBONS [c]													**HI excluding PCBs, aluminum, arsenic**				**1**
Diesel Range Organics		150,000	9,200				na [d]	na [d]	na [d]	na [d]	na [d]	na [d]	na [d]	na [d]	na [d]	na [d]	
Diesel Range Organics, Aliphatic		120,000	9,158	9.2E+03	Inc	5.4E+08	1.3E+00	Inc	6.5E-05	1.0E-01	na	2.9E-01	1.3E+01	Inc	2.2E-04	13.1	1
Diesel Range Organics, Aromatic		60,000	3,663	3.7E+03	Inc	1.1E+09	6.6E-01	Inc	3.3E-05	4.0E-02	na	5.7E-01	1.6E+01	Inc	5.7E-05	16.4	1
Residual Range Organics		14,000	9,200				na [e]	na [e]	na [e]	na [e]	na [e]	na [e]	na [e]	na [e]	na [e]	na [e]	
Residual Range Organics, Aliphatic		12,600	183,154	1.8E+05	Inc	na	1.4E-01	Inc	6.8E-06	2.0E+00	na	na	6.9E-02	Inc	Inc	0.069	1
Residual Range Organics, Aromatic		4,200	2,747	2.7E+03	Inc	na	4.6E-02	Inc	2.3E-06	3.0E-02	na	na	1.5E+00	Inc	Inc	1.53	1
															HI		**4**

APPENDIX B
TABLE B2 - SCENARIO A ALTERNATE CLEANUP LEVELS
NONCANCER HAZARD CALCULATIONS FOR A FUTURE PERMANENT RESIDENT
SOIL

Constituent	Ambient Soil Conc. (mg/kg)	Maximum Soil Conc. [a] (mg/kg)	Alternate Cleanup Level (mg/kg)	CS Ingestion (mg/kg)	CS Dermal (mg/kg)	CS Inhalation (mg/kg)	Soil Ingestion Dose (mg/kg-d)	Dermal Dose (mg/kg-d)	Dust Inhalation Dose (mg/kg-d)	Reference Dose (mg/kg-d) Oral	Reference Dose (mg/kg-d) Dermal	Reference Dose (mg/kg-d) Inhalation	Pathway-Specific Hazard Soil Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Dust Inhalation	Maximum Chemical-Specific HQ	ACL Target HQ

Notes:

[a] Based on the maximum or 95 percent upper confidence limit (95% UCL) on the mean concentration detected at the site.
[b] Consistent with EPA policy, lead is not evaluated in the cumulative HI estimate.
[c] Risks associated with indicator compounds are included in cumulative risk and hazard estimates for each site. However, the health hazards associated with petroleum mixtures are evaluated and reported separately.
[d] Exposure dose and noncancer hazards were calculated for petroleum hydrocarbons measured as DRO (method 8100) by segregating total DRO concentrations into aliphatic and aromatic fractions, assuming 80% aliphatic hydrocarbons and 40% aromatic hydrocarbons (ADEC, 2000c).
[e] Exposure dose and noncancer hazards were calculated for petroleum hydrocarbons measured as RRO (method) by segregating total RRO concentrations into aliphatic and aromatic fractions, assuming 90% aliphatic hydrocarbons and 30% aromatic hydrocarbons (ADEC, 2000c).
[f] ACL is site background concentration

1) Doses and noncancer hazards shown only for noncarcinogenic chemicals with available toxicity values.
2) Absorbed doses were calculated for dermal contact with the medium, and intakes were calculated for ingestion or inhalation of a medium
3) Noncancer hazards are unitless values which represent the probability of incurring an adverse health effect.
They are calculated using the following formula: Noncancer HI = Exposure Dose/Reference dose

CS	Concentration in soil
HI	Hazard index
HQ	Hazard quotient
Inc	Incomplete pathway
mg/kg	Milligrams per kilogram
mg/kd-d	Milligrams per kilogram per day
na	not available

ACL = minimum of TargetHQ*RfD_oral/((IRsoil_a*EFsi_a*ED_a*10^-6)/(BW_a*ATnoncarc_a)+(IRsoil_c*EFsi_c*ED_c*10^-6)/(BW_c*ATnoncarc_c))
or TargetHQ*RfD_dermal/(((SAsoil_a*AF_a*ABS_inorg*EFsd_a*ED_a*10^-6)/(BW_a*ATnoncarc_a))+((SAsoil_c*AF_c*ABS_inorg*EFsd_c*ED_c*10^-6)/(BW_c*ATnoncarc_c)))
or TargetHQ*RfD_inh/(((1/PEF)*InhR_a*EFsinh_a*ED_a)/(BW_a*ATnoncarc_a)+((1/PEF)*InhR_c*EFsinh_c*ED_c)/(BW_c*ATnoncarc_c))

APPENDIX B
TABLE B3 - Exposure Parameters
Future Resident

Parameter	Units	Adult			Child	
		Symbol	Value		Symbol	Value
General						
Body weight	kg	BW_a	70		BW_c	15
Averaging time						
carcinogens	days	ATcarc_a	25,550		ATcarc_c	25,550
noncarcinogens	days	ATnoncarc_a	8,760		ATnoncarc_c	2,190
Exposure time	hr/day	ET_a	0.25		ET_c	0.25
Exposure Duration	yrs	ED_a	24		ED_c	6
Inhalation rate	m^3/day	InhR_a	20		InhR_c	10
Ingestion of soil/sediment/dust						
Soil ingestion rate	mg/day	IRsoil_a	100		IRsoil_c	200
Exposure frequency	day/yr	EFsi_a	270		EFsi_c	270
Dermal contact with soil/sediment/dust						
Dermal surface area	cm^2/event	SAsoil_a	3,300		SAsoil_c	2,800
Skin adherence factor	mg/cm^2	AF_a	0.2		AF_c	0.2
Skin absorption factor	unitless	ABS	chemical specific		ABS	chemical specific
Exposure frequency	day/yr	EFsd_a	270		EFsd_c	270
Inhalation of particulates for indoor dust			.			
Particulate Emission Factor	m^3/kg	PEF	1.30E+09		PEF	1.30E+09
Exposure frequency	day/yr	EFsinh_a	270		EFsinh_c	270
Ingestion of sufrace water/groundwater						
Groundwater ingestion rate	L/day	IRwater_a	2		IRwater_c	1
Exposure frequency	day/yr	EFwi_a	350		EFwi_c	350
Inhalation of constituents volatilizing from surface water/groundwater						
Volatility factor	m^3/kg	VF	chemical specific		VF	chemical specific
Exposure frequency	day/yr	EFwinh_a	350		EFwinh_c	350
Dermal contact with surface water/groundwater						
Dermal surface area	cm^2/event	SAwater_a	20,000		SAwater_c	20,000
Dermal permeability constant	cm/hr	PC	Chemical specific		PC	Chemical specific
Exposure frequency	day/yr	EFwd_a	350		EFwd_c	350

APPENDIX B
TABLE B4 - SCENARIO B ALTERNATE CLEANUP LEVELS
MIGRATION TO GROUNDWATER PATHWAY INPUT VALUES
SOIL

				SITE-SPECIFIC INPUT VALUES						
PARAMETER	**DESCRIPTION**	**UNITS**	**DEFAULT**	**All Sites**	**Main Ops**	**Site 28**	**Site 31**	**Tundra**	**Gravel**	**Site 29**
Cw	target soil leachate concentration	mg/L	chemical-specific							
Koc	soil organic carbon/water partition coefficient	L/kg	chemical-specific							
foc	fraction organic carbon in soil	g/g	0.001	0.008101	0.00317	0.05	0.00593	0.185	0.010501	0.0548
pb	dry soil bulk density	kg/L	1.5					0.341	1.62	
ps	soil particle density	kg/L	2.65							
n	total soil porosity	Lpore/Lsoil	0.434					0.871	0.389	
Ow	water-filled soil porosity	Lwater/Lsoil	0.3	0.135	0.135		0.135	0.5115	0.1296	0.135
Oa	air-filled soil porosity	Lair/Lsoil	0.13	0.299	0.299		0.299	0.360	0.259	0.299
w	average soil moisture content	kgwater/kgsoil	0.2	0.114	0.09		0.114	1.5	0.08	0.078
H	Henry's law constant	unitless	chemical-specific							
DF	dilution factor	unitless	3.3	4.2	4.2	4.2	4.2	4.2	4.2	4.2
K	aquifer hydraulic conductivity	m/yr	876							
I	hydraulic gradient	m/m	0.002							
D	mixing zone depth	m	5.50	4.77	4.77	4.77	4.77	4.77	4.77	4.77
Inf	infiltration rate	m/yr	0.13	0.08	0.08	0.08	0.08	0.08	0.08	0.08
L	source length parallel to GW flow	m	32							
da	aquifer thickness	m	10							

APPENDIX B
TABLE B5 - SCENARIO B ALTERNATE CLEANUP LEVELS
MIGRATION TO GROUNDWATER PATHWAY CHEMICAL-SPECIFIC INPUT VALUES
SOIL

CHEMICAL-SPECIFIC INPUT VALUES				SITE-SPECIFIC INPUT VALUES *	
PARAMETER	**DESCRIPTION**	**UNITS**	**DEFAULT**	**Northeast Cape**	**Table C**
Cw_DROali	target soil leachate concentration - DRO aliphatics	mg/L	1.3	1.4	0.1
Cw_DROaro	target soil leachate concentration - DRO aromatics	mg/L	20.0	21.3	1.5
Cw_RROaro	target soil leachate concentration - RRO aromatics	mg/L	14.6	15.6	1.1
Cw_benzene	target soil leachate concentration - benzene	mg/L	0.067	0.1	0.005
Cw_toluene	target soil leachate concentration - toluene	mg/L	13.316	14.2	1
Cw_ethylbenz	target soil leachate concentration - ethylbenzene	mg/L	9.321	9.9	0.7
Cw_xylene	target soil leachate concentration - xylene	mg/L	133.164	142.1	10
Cw_naphthl	target soil leachate concentration - naphthl	mg/L	9.321	9.9	0.7
Koc_DROali	soil organic carbon/water partition coefficient - DRO ali	g/g	5.37E+06		
Koc_DROaro	soil organic carbon/water partition coefficient - DRO aro	g/g	5.01E+03		
Koc_RROaro	soil organic carbon/water partition coefficient - RRO aro	g/g	2.24E+05		
Koc_benzene	soil organic carbon/water partition coefficient - benzene	g/g	5.89E+01		
Koc_toluene	soil organic carbon/water partition coefficient - toluene	g/g	1.82E+02		
Koc_ethylbenz	soil organic carbon/water partition coefficient - ethylbenzene	g/g	3.63E+02		
Koc_xylene	soil organic carbon/water partition coefficient - xylene	g/g	3.63E+02		
Koc_naphthl	soil organic carbon/water partition coefficient - naphthl	g/g	2.00E+03		
H_DROali	Henry's law constant - DRO aliphatics	unitless	7.59E+01		
H_DROaro	Henry's law constant - DRO aromatics	unitless	3.02E-02		
H_RROaro	Henry's law constant - RRO aromatics	unitless	4.86E-06		
H_benzene	Henry's law constant - benzene	unitless	2.28E-01		
H_toluene	Henry's law constant - toluene	unitless	2.72E-01		
H_ethylbenz	Henry's law constant - ethylbenzene	unitless	3.23E-01		
H_xylene	Henry's law constant - xylene	unitless	2.13E-01		
H_naphthl	Henry's law constant - naphthalene	unitless	1.98E-02		

*using site-specific Infiltration rate of 0.08 m/yr based on mean annual precipitation of 16 inches for St. Lawrence Island

APPENDIX B
TABLE B6 - SCENARIO B ALTERNATE CLEANUP LEVELS
MIGRATION TO GROUNDWATER PATHWAY CALCULATIONS
SOIL

MIGRATION TO GROUNDWATER PATHWAY				SITE-SPECIFIC ALTERNATE CLEANUP LEVELS							
PARAMETER	**DESCRIPTION**	**UNITS**	**DEFAULT METHOD 2**	**All Sites**	**Main Ops**	**Site 28 Tundra Soil**	**Site 31**	**Background - Tundra**	**Background - Gravel**	**Site 29**	**Default Percentages**
CS_DROali	Concentration in soil	mg/kg	7,160	61,841	24,212	381,562	45,274	1,411,857	80,151	391,890	80%
CS_DROaro	Concentration in soil	mg/kg	104	867	341	5,344	635	19,789	1,123	5,486	40%
CS_DRO Total	Concentration in soil	**mg/kg**	**260**	**2,200**	**850**	**13,400**	**1,600**	**49,500**	**2,800**	**13,700**	
CS_RROali	Concentration in soil	mg/kg	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	90%
CS_RROaro	Concentration in soil	mg/kg	3,284	28,367	11,101	175,076	20,765	647,795	36,770	3,282	30%
CS_RRO Total	Concentration in soil	**mg/kg**	**11,000**	**95,000**	**37,000**	**584,000**	**69,000**	**2,200,000**	**123,000**	**11,000**	
CS_benzene	Concentration in soil	mg/kg	0.02		0.02			0.8	0.05		
CS_toluene	Concentration in soil	mg/kg	5.4		10			472	27		
CS_ethylbenz	Concentration in soil	mg/kg	5.5		13			643	37		
CS_xylenes	Concentration in soil	mg/kg	78		182			9,172	523		
CS_naphthal	Concentration in soil	mg/kg	21		64			3,463	197		

Example equations for Main Ops:
CS_DROali = Cw_DROali_NEC*((Koc_DROali*foc_mainops)+((Ow_mainops+Oa_mainops*H_DROali)/pb))
CS_DROaro = Cw_DROaro_NEC*((Koc_DROaro*foc_mainops)+((Ow_mainops+Oa_mainops*H_DROaro)/pb))
CS_DRO Total = CS_DROaro/0.4

CS_RROaro = Cw_RROaro_NEC*((Koc_RROaro*foc_mainops)+((Ow_mainops+Oa_mainops*H_RROaro)/pb))
CS_RRO Total = CS_RROaro/0.3

APPENDIX C – RACER COST ESTIMATES

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APPENDIX D – RESPONSE TO COMMENTS

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USACE Responses to ADEC Comments on Northeast Cape Feasibility Study
October 16, 2006

1. The alternative analysis appears thorough and objective. As you know there will be a number of sites where in choosing the best alternative the cleanup team will end up deciding on a combination approach. For example in the drainage basin it may be best to do limited removal of impacted sediment (Scenario A or B) in combination with monitored natural attenuation and institutional controls. Please discuss this approach in the document so that the reader knows this combination approach is likely to happen or a viable choice. Costs for these combination options will of course then have to be modified.

An overview statement describing the process for selecting between alternatives and/or combining multiple approaches will be added to Section 4.3, the generic discussion of the detailed analysis of alternatives. The costs as presented under each group of sites will not be modified for the feasibility study since a breakdown of costs by phases (mob/demob/removal/reporting) is already specified.

2. Section 3.1: Please include TSCA in the table for chemical specific ARARs. Please remove the word "Potential" from the table heading.

Concur.

3. Section 3.1: Please include the "Identification and Listing of Hazardous Waste (40 CFR Part 261; 18 AAC 62) in the ARARs table.

Added to Action-specific ARARs section.

4. Section 3.5: At the end of the first paragraph please briefly explain why lead and the petroleum compounds aren't included in cumulative risk.

Additional text added, based on ADEC Cumulative Risk Guidance (2002):

> *Alternate cleanup levels must also be protective from a cumulative risk perspective. Cumulative risk is defined as the sum of risks resulting from multiple sources and pathways to which humans are exposed. Cancer and non-cancer cumulative risks are calculated separately. When more than one hazardous substance is present at a site or multiple exposure pathways exist, calculated cleanup levels may need to be adjusted downward. Lead contamination in soil or groundwater is not included in cumulative risk calculations, because cancer slope factor and non-cancer reference dose values are not applied to this chemical. Lead is evaluated separately using a model predicting integrated uptake of lead in children. For petroleum hydrocarbons, each fraction is a mixture of many different chemicals. Risks from individual petroleum constituents (i.e. indicator compounds) such as BTEX or PAHs are included in the cumulative risk calculations. However, the bulk petroleum hydrocarbons mixtures (e.g. DRO, GRO, RRO) are assessed using toxicity and chemical parameters for the three*

total petroleum ranges (e.g. surrogate approach). Using toxicological data for the mixture itself is the USEPA's preferred method for evaluating the risk to chemical mixtures. The risk from bulk hydrocarbons is not included in the cumulative risk calculations because the risk from indicator compounds is considered protective of the cumulative risk to petroleum exposure.

5. Section 3.6.3: The DEC doesn't typically endorse alternative cleanup levels for groundwater. It appears that the calculated ACL values are close to or below the published Table C values. Perhaps it would be a cleaner approach to just use Table C.

The presentation of groundwater cleanup levels (or ACLs) followed the Cumulative Risk Guidance published by ADEC, which states groundwater ingestion must be considered a completed pathway, unless it is shown the groundwater is not used for human consumption. Chemicals found at $1/10^{th}$ the Table C values need to be included in the cumulative risk calculations. Table C groundwater cleanup levels are expected to be protective of the ingestion of groundwater. All Table C values, regardless of how they were developed, are assumed to be protective of human health. For some chemicals, the cleanup level in Table C exceeds the cumulative risk standard. In these cases, the cumulative risk at the site should be calculated by both including these chemicals and not including these chemicals. Thus, the Tables 3-6a and 3-6c illustrate the cumulative risk calculations for noncarcinogens and carcinogens. The Table C cleanup values were adjusted to minimize the cumulative risk hazard quotient for non-carcinogens.

6. Table 3-6B: Please clarify the use of the aliphatic/aromatic split for groundwater. The DEC has not approved the AA methods. Most of our historic data is in totals.

Table 3-6b was meant to illustrate the basis for the groundwater cleanup levels. The cleanup levels are calculated by ADEC using the aliphatic/aromatic split, but instead of assigning a proportion of either fraction to compute a total hydrocarbon concentration, the most conservative number is used by default. If more specific laboratory data is obtained to document the actual breakdown/composition of petroleum hydrocarbons in the groundwater, different cleanup levels may apply. The default cleanup levels for petroleum hydrocarbons are overly protective and assume 100% of the carbon is available as aromatic compounds, whereas in reality, a portion of the hydrocarbon will be present as the less toxic, aliphatic carbon chains.

The ADEC promulgates the total DRO, total GRO, and total RRO cleanup levels based on surrogate toxicity information for aliphatic or aromatic fractions, as shown in the Cleanup Levels Guidance, Appendix C. The ADEC Cleanup Levels Guidance (2004), Appendix C, provides a table of chemical-specific parameters for petroleum hydrocarbons. Surrogate toxicity information for these mixtures is *only* provided for the aliphatic/aromatic fractions of three carbon ranges (C6-C10 GRO, C10-C25 GRO, C25-C36 RRO). For soil, the ADEC recommends assuming a default breakdown (percentage) of total petroleum hydrocarbon data into the aliphatic and aromatic fractions (e.g. 80/40% for DRO). Because fuel constituents vary considerably, the default composition of the percent aliphatic and percent aromatics was set at 120% of the total.

7. Section 3.6.4: Surface water standards are promulgated in 18 AAC 70. For petroleum the cleanup levels are 10 parts per billion total aromatic hydrocarbons (TAH) and 15 parts per billion total aqueous hydrocarbons (TaqH). Please include.

Concur. Text will be modified to clarify that the water quality criteria for petroleum hydrocarbons, oil, and grease are set out in a table in regulation at 18 AAC 70.020 (b). Laboratory analysis is needed to determine surface water column concentrations of total aromatic hydrocarbons (TAH) and total aqueous hydrocarbons (TAqH). TAH is the sum of concentrations of benzene, toluene, ethylbenzene, and xylene isomers, commonly called BTEX. TAqH is the sum of concentrations of TAH (BETX) plus the polynuclear aromatic hydrocarbons (PAH) in the water column.

8. Table 3-7: We should discuss the sediment cleanup levels. It will be difficult to justify using numbers above the NOAA screening tables, Probable Effects Level (PEL) as the cleanup criteria for sediment especially for PCBs. Please clarify the use of the Washington State criteria. Are these levels adjusted for carbon?

The Washington State criteria are normalized based on organic carbon content. The proposed cleanup levels are shown on a dry-weight basis and assume the sediments contain 1% total organic carbon. For example, the Washington Administrative Code (WAC) criteria listed in Table III is 65 mg/kgOC for PCBs. This value was converted to a dry weight basis, by multiplying by the decimal fraction % TOC in sediment. Thus, 65 mg/kg OC is 0.65 mg/kg PCBs (dry weight basis). The consensus-based probable effects concentration (PEC), an upper effects level or threshold for PCBs, in freshwater sediment is 0.676 mg/kg (dry weight basis, assumes 1% TOC). The proposed sediment cleanup level was thus rounded up to 0.7 mg/kg PCBs (dry weight basis). If a higher percent total organic carbon is assumed, the applicable cleanup level would be correspondingly higher. For example, if you assume 2% TOC, the cleanup level for PCBs would be 65 mg/kgOC * 0.02 = 1.3 mg/kg (dry weight). The TOC in sediments across Northeast Cape area ranges higher than 2%, thus the proposed cleanup level is conservative.

The sediment data for Northeast Cape are reported on a dry weight basis. Corresponding total organic carbon data are not available for every data point. Total organic carbon also varies considerably between samples. An average TOC concentration for the Suqi River is 5.5%, based on the most recent (2004) data collected by Shannon & Wilson. Historical data indicates a range of organic carbon content in sediments throughout Northeast Cape, such as 2.5% in the Suqi River, 10% from background locations, 14% in the Drainage Basin, and 23% at the Site 9 Landfill.

Regarding the use of numbers above the NOAA screening tables, Probable Effects Level (PEL), the PEL numbers are **not** meant to be used as default *cleanup* levels. Screening levels are purposely conservative, rely on generic assumptions, and are meant to help focus investigations and identify areas of contamination. Thus, it is unreasonable for the ADEC to assume cleanup levels cannot vary from a range of available *screening* values. The PEL for PCBs in freshwater sediment from the SQuiRT Table is 0.277 mg/kg (dry weight basis). The consensus-based PEC (an upper effects level or threshold) for PCBs in freshwater sediment is 0.676 mg/kg (dry weight basis, assumes 1%TOC). The State of Washington also defines the Sediment Impact Zone maximum contaminant level and the Puget Sound Marine Sediment Cleanup Screening Level and Minimum Cleanup Level for PCBs as 0.65 mg/kg (dry weight basis, assumes 1% TOC).

The organic carbon content of sediment is an important factor influencing the movement and bioavailability of nonpolar organic compounds (e.g., PAHs, PCBs, and chlorinated pesticides) between the organic carbon content in bulk sediments and the sediment pore water and overlying surface water. The consensus-based SQGs for organic compounds are expressed on a dry weight concentration at 1% TOC in sediments. However, unlike the organic compounds, the consensus-based SQG and study site metals concentrations can be compared on a bulk chemistry basis and do not need to be adjusted to a 1% TOC basis to do the comparison. TOC does not play the same role in determining metals availability as it does in determining organic compound availability.

The NOAA SQuiRT Table was last updated in September 1999. Subsequent advances in scientific understanding of sediment contamination should be applied to the development of sediment cleanup levels. One of the recent developments in defining sediment quality guidelines (SQGs) is the consensus-based SQGs in which the geometric mean of several sets of SQGs of similar narrative intent have been integrated to yield "consensus based" lower (threshold effect concentration - TEC) and upper (probable effect concentration - PEC) effect levels.

Given the number of guidelines available, selection of any one as the most appropriate and most reliable for ability to predict toxicity and impacts to benthic species at a study site is difficult. However, recent evaluations based on combining several sets of guidelines into one to yield "consensus-based" guidelines have shown that such guidelines can substantially increase the reliability, predictive ability, and level of confidence in using and applying the guidelines (Crane *et al*. 2000; MacDonald *et al*. 2000 a, 2000 b; Ingersoll *et al*. 2000). The agreement of guidelines derived from a variety of theoretical and empirical approaches helps to establish the validity of the consensus-based values. Use of values from multiple guidelines that are similar for a contaminant provides a weight-of evidence for relating to actual biological effects.

Based on MacDonald *et al*. (2000a), the consensus-based SQGs can be used for or considered for the following:

- To provide a reliable basis for assessing sediment quality conditions in freshwater ecosystems.
- To identify hot spots with respect to sediment contamination.
- To determine the potential for and spatial extent of injury to sediment-dwelling organisms.
- To evaluate the need for sediment remediation.
- To support the development of monitoring programs to further assess the extent of contamination and the effects of contaminated sediment on sediment-dwelling organisms.

It is important to note, however, the intent of the consensus-based SQGs, as well. According to the Wisconsin DNR, the consensus-based SQGs should not be used on a stand-alone basis to establish cleanup levels or for sediment management decision making. However, in certain situations, with the agreement of all parties involved in overseeing remediation and those responsible for remediating a contaminated sediment site, the consensus-based SQG values deemed to be protective of the site receptors can be used as the remediation objective for a site (at or approaching the lower effect or threshold effect levels for the contaminant of concern).

Using consensus-based SQGs to drive cleanup of some sites may be preferable under certain conditions (based on considerations of size of site and defined boundaries of contamination) rather than spending a large amount of time and resources for additional studies and risk assessments that may lead to considerable costs with little benefit. At larger, more complex sites, the costs associated with detailed studies may be warranted to reduce uncertainties and focus resources on the remedial actions that provide the greatest benefits (MacDonald et al. 1999).

In addition, the WDNR guidance makes an interesting point, in that there may be contaminated sediment sites and situations where a numerical chemical concentration related to effects may not be the primary driver in a sediment cleanup. Based on a number of balancing factors (e.g., technical feasibility of remediation methods, considerations of natural attenuation factors specific to the site, remedial implementability, human health and ecological risks, stakeholder input, and costs) performance-based standards based on the removal of an established mass of contaminant or removal of visual contamination (applicable to coal tars and petroleum oils) from a site may be the remediation action objective rather than a numerical concentration. There may be situations where the above balancing factors will also be considered to derive a factored cleanup concentration that will not initially achieve the science-based protective sediment concentration but may after an established time period (e.g., when factors such as natural attenuation are considered).

9. Section 8.0: Please clarify if there will be an interim action to address the screening for and removal/disposal of possible additional drums of product in the landfill. We could also include a screening process in the selected alternative to be implemented at a later date.

The landfill does not pose an imminent threat to human health and the environment. Thus, an interim removal action is not recommended. The landfill drums will be further evaluated in an Engineering Evaluation/Cost Analysis (EECA), to determine the appropriate course of action. The existing groundwater monitoring data demonstrates/supports the conclusion that contaminants are not migrating from the landfill into the surrounding area. Furthermore, too many unknowns exist to start an interim removal action at the landfill.

10. Section 8.0: Please note depending on the selected remedy for the Landfill 7 additional screening for PCBs may be necessary.

Field/lab screening for PCBs can be incorporated into the design phase of the final selected remedy.

11. Section 11.1.3.1: Please explain that the reason higher trophic level species are generally not affected by elevated levels of petroleum or other contaminants is due to the brief time duration of interaction with the impacted media (they move around a lot).

Text added:

Higher trophic level receptors do not spend as much time in one particular location, have a larger home range relative to the impacted area, and thus are not exposed for a long enough duration to predict potential impacts.

12. Section 11.1.5, page 140 Sediment ACLs: Please correct the sentence that says the sediment cleanup levels are based on ADEC Table C standards. They are based on criteria listed in 18 AAC 70.

Text does not indicate such.

13. Section 11.3.8: Please discuss if the reactive matting has been tested in frozen conditions and level of possible flooding it can handle.

The manufacturer was contacted and provided a brief technical memorandum summarizing results from a series of laboratory tests conducted on their organoclay product which was exposed to freeze-thaw cycling. CETCO recommended sufficient cover and armoring (e.g., rip rap or articulating concrete block) of the reactive core matting (RCM) to protect it from flooding and ice scouring. The amount of covering is always site specific.

The objective of the laboratory study was to investigate the impact of freeze-thaw conditions on the organoclay particle integrity and their oil removal performance under the laboratory conditions. A series of laboratory tests were conducted on a CETCO organoclay which was exposed to freeze-thaw cycling. The results showed there was no detrimental impact on their particle size distribution and oil removal capability. The conditions of freeze-thaw cycling had minimal impact on CETCO granular organoclay's particle integrity in term of its particle size distribution. The frozen-thawed organoclay media performed efficiently on removing oil in the process of column study. The manufacturer expects that the CETCO proprietary organoclay supplied to field applications either in the bulk format or in the matting will deliver similar performance results to those discovered in this study.

14. Figure 4-1: Please include the ecological conceptual site model diagram.

Ecological CSM added as Figure 4-2.

15. Figure 11-1: The drainage basin area has red squares over the DRO cleanup level within the Scenario B cleanup zone. Please explain the criteria to determine the decision unit surrounding these red squares.

Clarifying text will be added to the feasibility study. Figure 11-1 has been updated to reflect the proper locations of the sediment transect data from 2001, and Figure 11-2 will be added to show the subsurface sediment sampling results separately (see below for revised Figures). The sediment/tundra soil concentrations above the Scenario A DRO cleanup level of 9,200 mg/kg are distributed throughout the Drainage Basin. The DRO exceedances downgradient of the polygons identified for excavation under Scenario A are intermixed between sampling results that are significantly below the proposed cleanup levels. The Scenario A proposed excavation area was delineated based on considerations which included ease of access using heavy equipment from the main gravel pad area, standing water levels (e.g. ponds), and causing less disturbance to the entire wetland ecosystem.

A comprehensive study of the Drainage Basin sediments was conducted in 2001 by MWH. This involved sampling across transects at 12 locations in the basin, which stretches 2,000 linear feet from the edge of the gravel pad to the confluence with the Suqitughneq River. If you look at the 2001 sediment sampling results by themselves, as distance from the source increased, the number of locations in a particular transect with DRO levels above 9,200 mg/kg decreased.

For example:
CS-1 (furthest downgradient from Main Complex)
  DRO 180 – 680 mg/kg
CS-2
  DRO 74 – 36,000 mg/kg, 1 of 6 samples exceeded 9,200 mg/kg; 1 of 6 above 3,500 mg/kg
CS-3
  DRO 650 – 15,000 mg/kg, 1 of 6 samples exceeded 9,200 mg/kg; 2 of 6 above 3,500 mg/kg
CS-4
  DRO 2,500 – 150,000 mg/kg, 3 of 6 samples exceeded 9,200 mg/kg (2 locations, one sample at depth of 1.5 feet); 5 of 6 above 3,500 mg/kg
CS-5
  DRO 170 – 40,000 mg/kg, 1 of 6 samples above 9,200 mg/kg, 1 of 6 above 3,500 mg/kg
CS-6
  DRO 280 – 66,000 mg/kg, 2 of 6 samples above 9,200 mg/kg; 3 of 6 above 3,500 mg/kg
CS-7
  DRO 4,600 – 19,000 mg/kg, 4 of 6 above 9,200 mg/kg, 6 of 6 above 3,500 mg/kg
CS-8
  DRO 3,800 – 88,000 mg/kg, 6 of 6 above 9,200 and 3,500 mg/kg
CS-9
  DRO 56,000 – 75,000 mg/kg, 5 of 5 above 9,200 and 3,500 mg/kg
CS-10
  DRO 65 – 60,000 mg/kg, 4 of 6 above 9,200 and 3,500 mg/kg
CS-11
  DRO 280 – 5,700 mg/kg, 0 of 5 above 9,200; 1 of 5 above 3,500 mg/kg
CS-12
  DRO 79 – 45,000 mg/kg, 4 of 7 above 9,200 mg/kg; 5 of 7 above 3,500 mg/kg

Thus, the worst cross sections, CS-7 and CS-8 are covered by the Western polygon, CS-9 and CS-10 by the Middle polygon and CS-12 is covered by the Eastern polygon (Scenario A). The proposed removal areas could be modified under Scenario A to address an additional limited source area near CS-4, however access could still be problematic in terms of getting equipment across the wetland/tundra.

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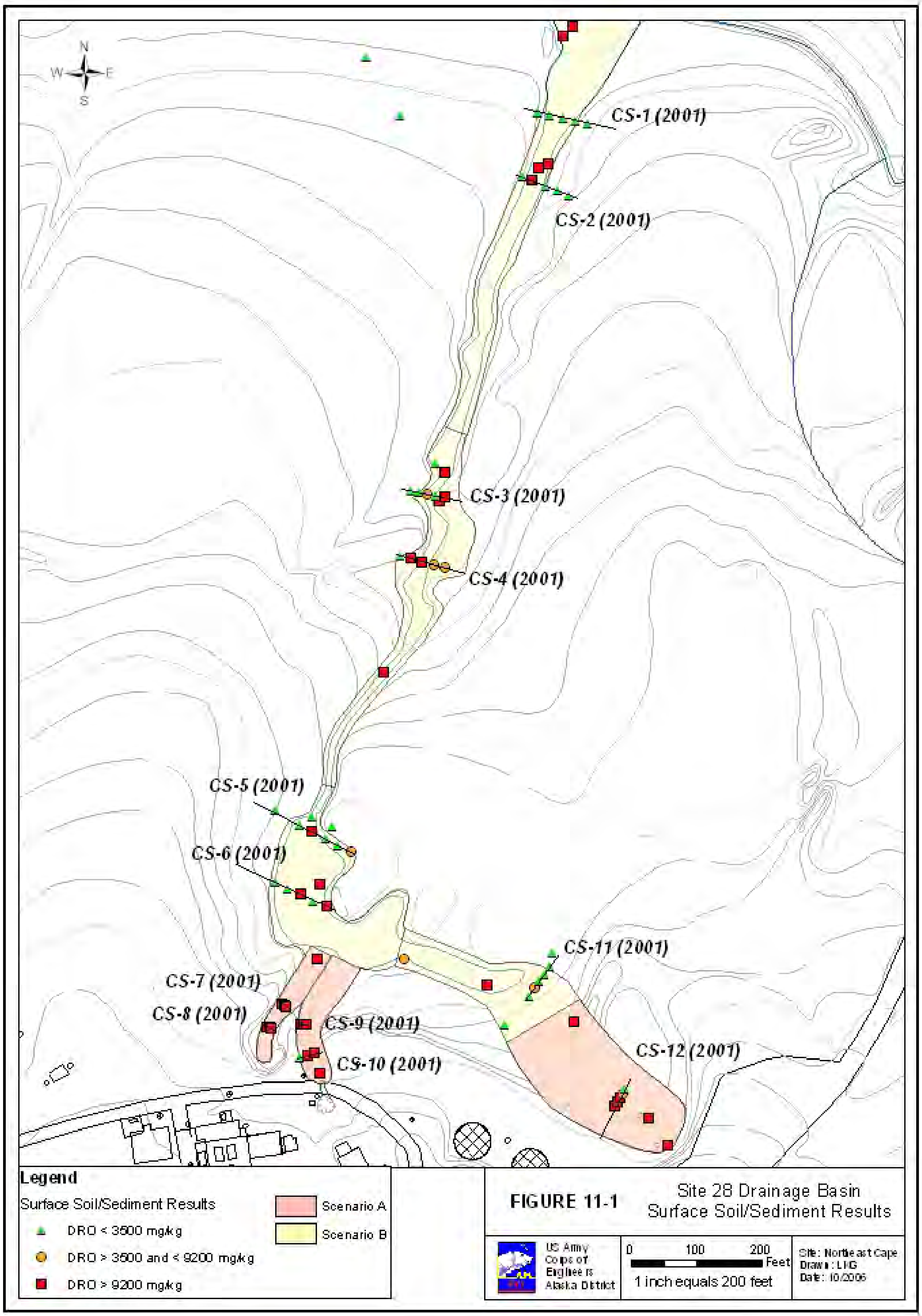
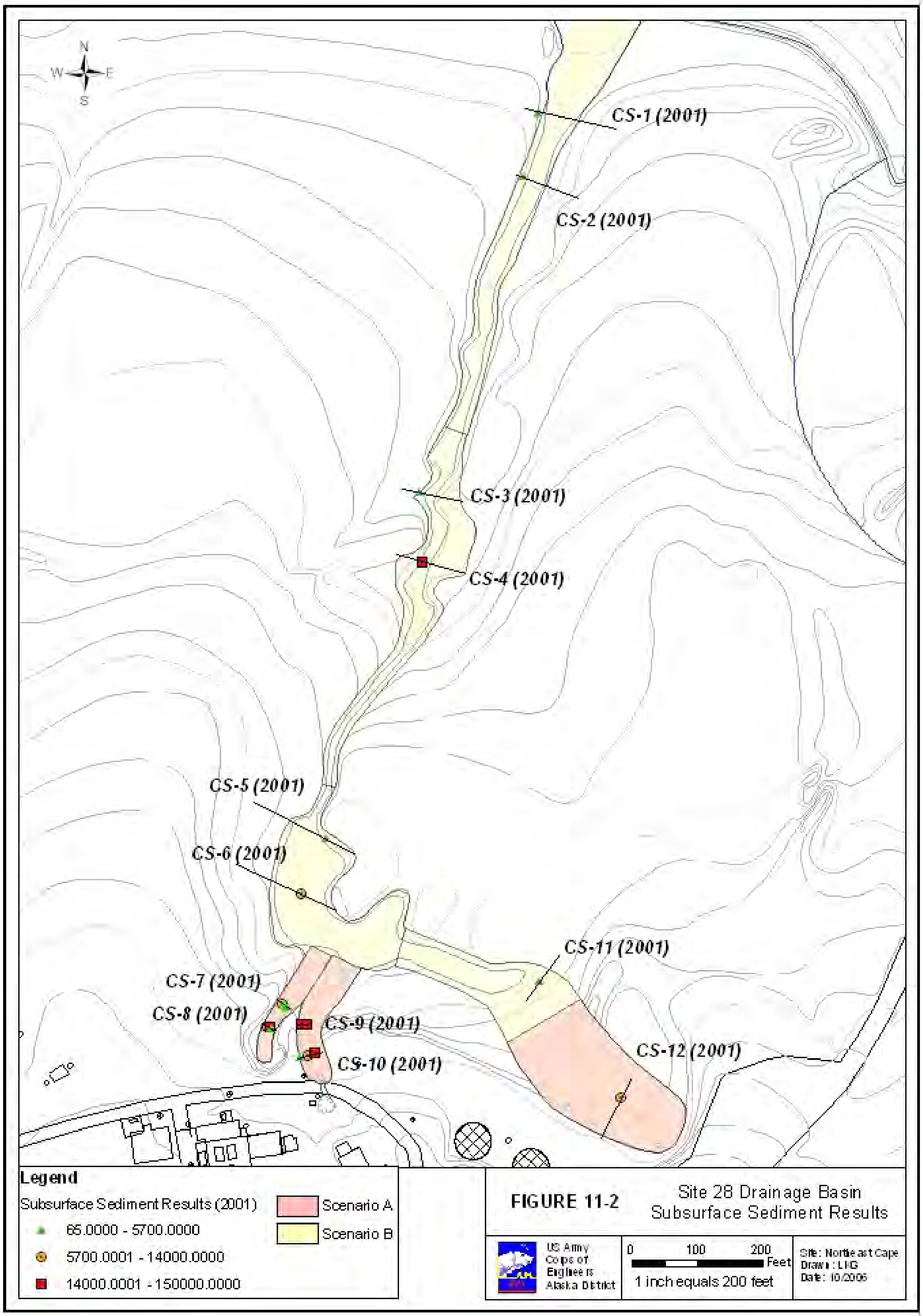

N
W
E
S
CS-1 (2001)
CS-2 (2001)
CS-3 (2001)
CS-4 (2001)
CS-5 (2001)
CS-6 (2001)
CS-7 (2001)
CS-8 (2001)
CS-9 (2001)
CS-10 (2001)
CS-11 (2001)
CS-12 (2001)
Legend
Surface Soil/Sediment Results
DRO < 3500 mg/kg
DRO > 3500 and < 9200 mg/kg
DRO > 9200 mg/kg
Scenario A
Scenario B
FIGURE 11-1
Site 28 Drainage Basin
Surface Soil/Sediment Results
US Army
Corps of
Engineers
Alaska District
0
100
200
Feet
1 inch equals 200 feet
Site: Northeast Cape
Drawn: LHG
Date: 10/2006


N
S
W
E
CS-1 (2001)
CS-2 (2001)
CS-3 (2001)
CS-4 (2001)
CS-5 (2001)
CS-6 (2001)
CS-7 (2001)
CS-8 (2001)
CS-9 (2001)
CS-10 (2001)
CS-11 (2001)
CS-12 (2001)
Legend
Subsurface Sediment Results (2001)
65.0000 - 5700.0000
5700.0001 - 14000.0000
14000.0001 - 150000.0000
Scenario A
Scenario B
FIGURE 11-2
Site 28 Drainage Basin
Subsurface Sediment Results
US Army Corps of Engineers Alaska District
0 100 200 Feet
1 inch equals 200 feet
Site: Northeast Cape
Drawn: LHG
Date: 10/2006

1. **Site History and Document Background.** Ancestors of the current residents of St. Lawrence likely arrived on the island from neighboring parts of Siberia many hundreds, if not thousands of years ago. The location of St. Lawrence Island is such that it had strategic importance during the Cold War and the United State's Government for nearly twenty years, from 1954-1972, operated the former military surveillance installation at Northeast Cape. During this time, numerous contaminants were used, spilt, buried, disposed of, or otherwise released into the environment. From government records, eyewitness accounts, and a variety of investigations conducted from 1994 until the present time, 33 individual sites of potential concern have been identified. This draft Feasibility Study provides information on the remedial alternatives under consideration for sites that are deemed significant enough for further action. Based on available data, 17 sites are proposed for no further action and will be left as is.

Comment noted.

2. The Northeast Cape (NEC) has been used intensely by Island residents in the past for seasonal subsistence activities, although due to fear of contamination, the site is currently only sporadically visited during transit. In recognition of past abundance of fish and game, and in anticipation of the restoration of the area to its original state, the residents have designated the Northeast Cape as the next permanent community on the island.

The Risk Assessment completed in 2004 did proceed with a scenario that a viable community would exist at the Fish Camp and other areas at the former Northeast Cape installation.

3. **Site Characterization**. A series of remedial investigations mentioned above have been used to characterize the NEC sites in terms of select contaminants and environmental media. These efforts have been limited by a number of endemic factors including site history, the size and complexity of the sites, the large size of the NEC, the climate and occurrence of permafrost, the topography, the geology and hydrology, limited field seasons, the remote location of the Northeast Cape, and the amount of time that has past since military occupation. External limitations include costs, schedules, analytical and technological limitations, Corps of Engineers (COE) guidelines and operating procedures, differences between various investigations and contractors, and other factors imposed by the context of the investigation.

   As a consequence, a number of serious limitations exist in the characterization of various sites at Northeast Cape. These include inadequate sample numbers, analytical protocols, limited analyte lists, elevated detection or reporting limits, inadequate sample sites or placement, biases in interpretation, and other problems noted during the review of previous remedial investigations. In particular, the characterization of landfills, the origin of petroleum in sediments and soils in the Suqi drainage, groundwater on site, and even the general geology of the sites have not been adequately investigated.

The Corps has addressed concerns related to inadequate site characterization on numerous occasions in the past and has conducted additional investigations specifically to address some of those concerns. We feel that the best course of action is to move forward with cleanup efforts, and not get bogged down with more study. It is anticipated that certain aspects of site cleanup will be revealed during actual remediation efforts and would most efficiently be dealt with at that time.

4. Poor site characterization will inevitably leave significant amounts of contaminants in place and the poorly characterized sites will remain sources of contamination to the local region and Bering Sea for generations

   Part of the problem lies in the site based approach of the various studies. Little or no attempt has been made to understand aquifer flow or characterize the various aquifers on site, nor have meaningful hydrogeological cross-sections been constructed on a site wide basis. In many cases, landfill soil samples have come from cover materials rather than actual fill. Given these limitations, it is difficult if not impossible, to evaluate the results of draft feasibility study or proposed alternatives on the long-term status of the site and the appropriateness of remedies selected.

Regarding the more specific comment that the site has not undergone a meaningful hydrogeological assessment, the Corps believes that the costs and time associated with such a potentially complex issue, in this harsh and remote region, would not yield a justifiable return. There are more practical solutions to good drinking water.

5. This, however, is not an indictment of individuals involved in the remedial process. We are convinced that everyone involved wants the same outcome, i.e. that is a cleanup that is complete as possible and protective of human health and the environment and a process that can be held up as a model of the commitment and ability of our government agencies and representatives to live up to their environmental and human responsibilities.

   Our critiques predominantly question the rigidity and policies of the system followed by the COE, the inadequacies of remedial investigations at such complex and large sites, the lack of understanding of designated site interrelationships, the lack of effective and feasible options for cold climate sites, and the lack of funding for the FUDS program.

   These factors combine to create a sense of defeatism given the limited funding, incomplete environmental investigations, and the inevitability that stores of contaminants will remain in the soils, sediments, surface and groundwater as a consequence of an inadequate remediation of the Northeast Cape sites.

   Given these constraints, as technical advisors to the RAB, we are left with no other option than to try to guide available funding to efforts and areas that will have the greatest impact on the environmental health of the site, while still disagreeing with the limitations and choices presented in the Draft Feasibility Study. Therefore, we present the following comments with the realization that the remediation will be severely under funded, limited in scope, and based on insufficient data.

Comments noted. The FUDS program goals and objectives require the Corps to implement cost-effective response actions.

6. **Generic Concerns.** There are a number of potential insitu and ex-situ remedial technologies discussed in the Northeast Cape Feasibility Study that have questionable utility in Arctic/tundra regions including: Enhanced Biodegradation, Bioslurping, use of Bioreactors, Phytoremediation, Constructed Wetlands, Bioventing, Landfarming/ Composting, and Air Stripping due to climatic and soil/sediment constraints.

The primary purpose of the Feasibility Study phase is to evaluate potential remedial alternatives to eliminate or reduce an exposure pathway. This evaluation develops a list of alternatives, screens those alternatives, and then takes a more detailed analysis of possible alternatives. The screenings of alternatives are evaluated against three primary criteria: Effectiveness, Implementability, and Cost.

7. Remedial technologies designed to utilize microbial degradation is dependent on temperature of the soil, sediments and/or groundwater. Phytoremediation, Constructed Wetlands, Bioventing, Landfarming/Composting involve microbial processes and are therefore temperature dependent and require a significant degree of maintenance to work effectively including maintaining moisture and perhaps plant harvesting and effective disposal of the vegetation if contaminants are to be prevented from recycling back to the impacted soils.

The temperature of soil, sediments and/or groundwater is a factor to consider for remedial technologies that use microbial degradation. The costs are reflective of the additional maintenance and mobilization requirements to implement this type of technology.   Plant harvesting is primarily only performed when the vegetation uptakes inorganic material like heavy metals.   Plant harvesting is not necessary for hydrocarbon remediation.

8. Natural Attenuation processes are also affected by site temperature and soil/sediment type. Microbes can significantly enhance the degradation of organic compounds including POL, GRO and DRO. However, local temperature, soil/sediment composition, moisture, availability of dissolved oxygen, the acidity of the soils and/or groundwater and particle size also play a major role on natural attenuation processes and are likely to be less effective in degrading the contaminants of concern in Arctic, tundra regions including sites located at the Northeast Cape.

Every site that requires remediation presents a unique situation.   A contractor would have to take the local conditions into account and adjust the selected remedy to be as effective as possible for the local conditions. The University of Saskatchewan recently performed a field-scale assessment of phytotechnology and applied it to sites impacted with weathered hydrocarbons. The site in Canada appeared to be very similar to those of interior Alaska with a growing season of June through August. The university excavated 2,400 m^3 of highly weathered petroleum (diesel and oil) from a former fire pit. The soils were a clay-loam. The field trial successfully showed that phytoremediation is effective, especially using native plants in extreme arctic climates. The test cells achieved cleanup levels in less than 2 field seasons.

9. Other suggested remedial technologies involve the transfer of soil, sediment and groundwater contaminants to the atmosphere. Transfer to the atmosphere technologies include Soil Vapor Extraction (SVE), Thermally Enhanced SVE, Thermal Desorption, Air Stripping, Air Sparging, Thermal Desorption and although not intended, Landfarming/Composting also results in the transfer of contaminants to the air.

Any "active" remediation of hydrocarbons will transfer the contaminants to the air. The goal for complete destruction of hydrocarbons is to form water and carbon dioxide. Bioremediation (such as landfarming/composting) typically will transfer much less to the air as microbes will use the available hydrocarbons as an energy source for their activity and the resulting carbon dioxide would remain in the soil. Phytoremediation on the other hand would remove additional carbon dioxide from the air, while providing a good environment in the rhizosphere for microbial activity to occur.

10. If these technologies are not combined with some form of destructive process after the contaminants of concern are separated from the impacted solids and liquids, the contaminants will be released to the atmosphere and contribute to local and global air contamination.

The FS process is to evaluate potential remedial alternatives to eliminate or reduce an exposure pathway. In this process, the contribution to local/global air contamination is not currently required to be evaluated. The emissions from equipment used to fuel a remediation project and mobilize to the site, for example, would contribute significantly more pollutants to the atmosphere than those released during treatment processes such as soil vapor extraction. If emissions of air pollutants were a consideration in this FS, it is likely the overall global environment would benefit more by leaving the hydrocarbons in place and strictly looking at cutting off the exposure pathway and limiting any hydrocarbon combustion or consumption in the process.

11. **Physical Barriers**. Physical barriers include use of engineered liners, soils or constructed structures including impermeable caps commonly used on landfills to prevent contaminants from migrating offsite. Capping is a form of a physical barrier proposed as one of the remedial options for landfills used by the military at the Northeast Cape, including the Cargo Beach Landfill at Site 7 and the Housing and Operations Landfill at Site 9.

Comment noted.

12. **Institutional Controls.** This form of site isolation involves establishing guidelines, constraints, including fences or walls and/or warning signs designed to keep humans and animals away from contaminants impacting an area or site. Site isolation does not remove, degrade or immobilize the contaminants of concern to ensure the substances do not come in contact with humans and/or other animals, but physically and/or with the use of signs and publicized restrictions, isolate the sites to prevent humans and animals from coming in contact with the contaminants.

Comment noted. Natural attenuation processes would still continue under an institutional controls alternative.

13. **Contaminants assessed**. There were a range of organic and inorganic contaminants identified in the NIEHS Environmental Justice sampling conducted at the NEC that are ignored in the summary data discussed in the Draft FS including mercury, mirex, Hexachlorobenzene, DDE and PCB Aroclors other than 1254 and/or 1260. Although some or portions of the above listed contaminants may have derived from global transport and deposition, the concentrations and trends with depth in sediment cores indicate these substances derived from former military occupancy at the NEC.

Mirex, hexachlorobenzene, DDE, and PCBs were not found at levels above ADEC regulatory limits in the NIEHS study. A final report on the findings of the NIEHS sampling has not been provided to USACE.

14. Site Specific-No Further Action Recommended. Site 5-Cargo Beach. This site is situated near the hunting/fishing camp. The shallow groundwater and surface water located in proximity to this area is likely to be utilized by visitors utilizing the camp during hunting/fishing seasons**.** The possible use of the Cargo Beach surface and groundwater by visitors will likely increase since they are closest to the camp and the probability of use of these resources will increase with time.

Disagree. The shallow groundwater is not readily accessible or a viable continuous source of drinking water given its potential salinity and difficulty maintaining a well.

15. Site 12-Gasoline Tank Area. Although there was no indicated evidence of leaks at this site, it is evident there was some spillage as indicated by the presence of DRO and RRO in the analyzed soil samples. Because this site was a storage facility for leaded gasoline, there should also be an assessment and summary of the lead concentrations of the soils.

The ADEC reviewed a summary of site characterization data for Northeast Cape and provided the following response via letter dated December 1, 2003: *"This site [Site 12] should have been tested for metals (UST Procedures Manual, Table 2). However, as there appears to have been minor fuel impact on the soil under the tank, it is unlikely that there were any metals contribution from product. The site is adequately characterized to proceed to the FS."*

16. Site 16-Paint and Dope Storage Building. This site has been effected by a range of contaminants including arsenic, antimony, cadmium, lead, PCBs and TCE. Although TCE was ONLY detected in one sample, it represented 33% of the samples collected (1 of 3 representing another example of incomplete site characterization). What was the detection limit for the TCE in the 1998 sampling for TCE? Were only the averaged concentration of a compound (element) used to determine action levels? The use of averaged concentrations is specifically referenced in this document to the 1994 PCB sample results.

TCE was detected in 1 out of the 3 monitoring wells installed in 1994. The TCE concentration did not exceed federal drinking water standards (e.g. maximum contaminant level (MCL) of 0.005 mg/L). Additional groundwater samples were collected in 1998 from 2 of the 3 existing monitoring wells. The third monitoring well was not operable. Two primary, a QA duplicate, and QC triplicate were analyzed for TCE in 1998. The Method Detection Limit for the 1994 and 1998 data was 0.0001 mg/L. The Practical Quantitation Limit was 0.001 mg/L. TCE was not detected in any of the 1998 samples.

Action levels are determined from regulations and/or guidance. For TCE, the maximum concentration was used in the risk assessment evaluation because the number of discrete data points was small (n< 10), and the true average of the data could not be calculated.

The exposure point concentration (EPC) term represents the average exposure contacted by an individual over an exposure area (EA) during a long period of time; therefore, the EPC term should be estimated by using an average value (such as an appropriate 95% UCL of the mean) and not by the maximum observed concentration. The US EPA recommends using the 95%UCL to evaluate potential risk at a site.

17. Although it is well recognize that suspended sediments can add to the concentration of trace metals in water samples, filtering of the samples can also reduce the dissolved phase of detected metals particularly if the pH of the sample has changed. The extrapolation of the lead data based on the elevated cadmium data attributed to the suspended sediment results is not justified since the lead was not analyzed as a filtered sample.

Comment noted that filtering of water samples can reduce the dissolved phase concentration of detected metals. In 1994, groundwater samples were analyzed for both total metals and dissolved phase concentrations. The groundwater samples were filtered in the field using disposable, in-line, 0.45 microgram (ug) filters. Both cadmium and lead were analyzed for total and dissolved phase in 1994. Lead concentrations from the dissolved phase were below cleanup levels. The data indicates that suspended sediments did contribute to the observed concentrations of metals in the groundwater.

18. Site 21-Wastewater Treatment Facility. This site has been impacted by a range of contaminants including PCBs, arsenic and chromium (why is it not hexavalent chromium?). The arsenic may well be related to treated wood and perhaps the chromium is as well. It is not likely though that the 170 mg/kg is background and the elevated concentration is likely related to the treated wood. Why is it stated that the PCB sites at this site are not readily accessible to humans and/or animals, especially if the NEC becomes a third SLI community?

Hexavalent chromium [Cr(VI)] is a very strong oxidizer and very reactive with organics. It is rarely found to exist in nature or on surface soils. Regardless of pH and redox potential, most Cr(VI) in soil is quickly reduced to trivalent chromium [Cr(III)]. Soil organic matter and iron minerals donate the electrons for this reaction to occur.

A source area of arsenic is not supported by the sampling in 1994. The additional soil samples collected to verify the one elevated occurrence of arsenic found in 1994 showed arsenic concentrations ranging from 4.5 to 11.5 mg/kg and are well within the range of ambient levels for the Northeast Cape site.

During the initial investigation that occurred in 1994, PCBs were detected above 1 ppm at one location. This sample was split into three parts and each part analyzed separately. The primary result was 1.9 ppm, a quality control result was 4.2 mg/kg and a quality assurance result of 0.93 mg/kg. Down gradient samples and additional samples collected during the 2001 investigation indicated the detection was an isolated occurrence. Confirmation samples collected after decontamination and decommissioning of the septic tank further demonstrated that PCBs had not migrated through the concrete at significant levels. One sample, collected immediately beneath the outfall piping adjacent to the septic tank (sample 03NE21SB01, collected at 5 feet below ground surface) contained detectable PCBs at 1.7 mg/kg. PCBs were not detected in the 17 other samples collected from beneath the concrete tank and the wooden utilidor. There is no remaining source of PCBs at this location. While an occasional hit at the site may be just above 1 mg/kg, as a whole, the site does not exhibit any PCB contamination that would pose a risk to human health and the environment.

The PCBs are considered not readily accessible because the soil confirmation samples were collected from beneath the concrete foundation of the tank, 5 to 11.5 feet below the current ground surface. The cleaned, broken up concrete was demolished in place and used as fill, thus covering the low level PCBs detected at the one sampling location. The ground immediately surrounding Site 21 and the former wastewater tank consists of wet rolling tundra and would be unlikely to support permanent houses without gravel fill or piling construction.

19. Site 22-Water Wells and Water Supply Building. Because this site location is underlain by recoverable groundwater and may have the potential of serving as a source of municipal drinking water, a monitoring period of the monitoring wells should be integrated into future remedial actions.

This will be considered in the proposed plan.

20. Site 24-Receiver Building Area. Invoking biogenic origins to DRO and RRO.

We acknowledge there is significant disagreement regarding the potential for naturally occurring organic matter or biogenic compounds to cause interferences with established State of Alaska soil sampling methods for petroleum hydrocarbons. However, it is reasonable to state that reported DRO concentrations from samples collected as recently as 2001 may include some proportion of biogenic compounds. The observed concentrations of DRO at Site 24 do not pose a risk to humans from incidental ingestion of soil/sediment.

21. Site 24 (con't) Was the reporting limit (10 mg/kg) for antimony in water samples as well?

The reporting limit for antimony in the groundwater samples and surface water samples collected in 1994 ranged from 0.03 to 0.1 mg/L. Additional surface water samples were collected in 2001 and the method reporting limit was 0.05 mg/L, with a method detection limit of 0.014 mg/L.

22. Site 24 (con't) Why do the migration to groundwater cleanup levels not apply?

The migration to groundwater cleanup levels are not applicable at Site 24 because the observed groundwater at this location is shallow, near surface water that cannot be reasonably expected to serve as a potential drinking water source. The primary human exposure pathway is ingestion or dermal contact with soil/sediment. Furthermore, sampling has demonstrated that even if the water was utilized for drinking water purposes, contaminants were not detected above ADEC drinking water standards in the groundwater or surface water. The migration to groundwater pathway cleanup levels are calculated based on the assumption that groundwater underlying a source of contaminants soils is utilized as a drinking water supply.

The primary source of contamination has been removed from Site 24, thus any residual soil contamination will continue to naturally attenuate. See photos (below) from before and after the removal actions completed in 2005.

Photo 1 Site 24 BEFORE cleanup (2001)

Photo 2 Site 24 AFTER cleanup (2005)

Photo 3 Site 24 BEFORE cleanup (2001)

Photo 4 Site 24 AFTER cleanup (2005)

Photo 5 Site 24 BEFORE cleanup

Photo 6 Site 24 AFTER cleanup

23. Site 34-Upper Camp. Was the PCB cleanup level of 1.0 mg/kg applied to this site? When visited, this site's building walls and immediate surrounding areas (floor) were extensively oil stained.

A cleanup level of 1 mg/kg PCBs was applied at the Upper Camp. A risk assessment evaluated the existing site characterization data and exposure scenarios and concluded no potential risk to human health at this location. The building was removed, thus the primary source of contamination has been eliminated.

Three soil borings were completed by Bristol at Site 34 former septic system outfall at depths of 1 – 2 feet bgs. PCBs were not detected (PQL of 0.0534 - 0.058 mg/kg). The concrete slabs (CTP-3 and the Building 124 Upper Quarters floor slab) were also tested for PCBs using field screening kits (EnSys) by Bristol during the 2003 removal action. PCBs were below action levels at all locations except one portion of the transformer pad CTP-3. Three composite samples were collected from CTP-3 and field screened. Two of the samples had field screening results less than 1 mg/kg PCBs. Analytical samples were then collected from these two locations and submitted for laboratory analysis. The lab results confirmed that PCBs were less than 1 mg/kg (0.124 and 0.189 mg/kg). The field screening results from one composite sample covering the northwestern portion of the transformer pad indicated PCB concentrations greater than 1 mg/kg. No discrete laboratory confirmation analytical samples were collected from the concrete to verify the field screening results. The original source of contamination has been removed and the limited amount of contaminated concrete does not pose a potential threat to human health or the environment.

Historical photos of concrete transformer pad in 2002 (prior to demolition work) and the surrounding area during 2003 and 2005 demolition work do not show evidence of heavy oil staining.

24. **Areas of Concern.** **Sites 3 and 4 Combined.** Based on the groundwater and soil data collected to date, additional sampling is required to assess the effects of salinity, turbidity, detected analytes in the blank samples and cause of the low dissolved oxygen concentrations of the groundwater (likely due to stagnant and organics) in the analyzed samples. The proximity to the Native Fishing Camp will likely expose seasonal camp users to the shallow groundwater and soils. Impacts to soils and groundwater are evident at these two sites and selective source removal and disposal or treatment should be considered as part of the remedial options.

We don't understand the comment regarding the effects of salinity, turbidity, and detected analytes in the blank samples. Blank samples are typically analyzed at the laboratory to ensure cross-contamination is not present. Field parameters such as salinity and turbidity would not be recorded for a blank sample. Additional sampling to determine the cause of low dissolved oxygen concentrations in the groundwater seems superfluous, since the cause has already been inferred by the existing site conditions and general knowledge of tundra hydrologic properties. The low dissolved oxygen content noted in well point 03WP06 was mentioned because the drinking water criteria for DO is 4 mg/L (even though not applicable to groundwater). Thus, this confirms the assumption that shallow groundwater in the immediate vicinity of Site 3 is unlikely to be a reliable source of drinking water for reasons other than chemical contaminants. Dissolved oxygen content, oxygen reduction potential, and turbidity were measured in the field prior to collecting groundwater samples at Sites 3 and 4. We agree that further information on salinity content of the near surface water could be useful to evaluate the potential for use as a drinking water source. However, this is not necessary to define the nature and extent of contamination from fuels, nor would the presence of such contaminants influence the salinity of the shallow groundwater. Soil removal and groundwater treatment are evaluated in the Feasibility Study and will be considered in the Proposed Plan.

25. **Site 6-Cargo Beach Road Drum Field**. At this stage, it is not known whether the drum field contains only "empty" drums. Based on the collected samples of soils and groundwater, there was and likely is, at a minimum, considerable quantities of "residual" petroleum in the field of drums at Site 6. The elevated metal concentrations defined in the soils and groundwater suggests other forms of metal-contained substances were disposed at the landfill. Mercury is mentioned as an analyte although no mercury data is referenced in this report. Was mercury an analyte at Site 6 and if so, what were the detection limits and results?

Site 6 was not a landfill. All drums have been removed from this Site. The drums were removed during the 2000 field season by Nugget Construction. Although exact numbers collected at Site 6 were not recorded, out of all the drums processed during 2000 field season, only 5% had fluid contents.

Sites – Various (3, 4, 5, 6, 7, 9, 24, 25)	Total Drums collected	6,099
	Empty Drums	5,640
	Drums with fluids	347
	Drums with solids	112
Site 6 AST 6-1	500	Gallons

The elevated metals could be from batteries disposed at this location. Several batteries were removed during 2000 field work.

Based on community concerns and input, mercury was added to the analyte list at Site 6 during the 2001 remedial investigation. Mercury was analyzed for but not detected in two sediment samples (MRL 0.06-0.2 mg/kg) and detected at the MRL of 0.0001mg/L in one shallow groundwater sample.

26. The capping alternative should be eliminated for this site considering the shallow groundwater. Although effective capping could be accomplished, the cap would require long term maintenance and the surrounding areas of the site will also require long term monitoring to ensure the cap is effective in restricting off-site migration of contaminants. Capping will not prevent the drums from continuing to deteriorate releasing liquids to the drum field and downgradient regions in proximity to the field. Additionally, the shallow groundwater will introduce water to the drum field from below the field of drums due to capillary action of the fluctuating groundwater thereby introducing contaminants contained in the drum field to the downgradient environments.

    Caps work more effectively at sites that have been lined with a clay/geotexture material to prevent water from migrating vertically into the mass of overlying drums and impacted fill material. Since this site is not lined, there is significant potential for the upward migration of shallow groundwater into the overlying mass of wastes.

Note – there are not any drums remaining at Site 6. The media of concern is residual contaminated soil from underneath the former drum piles.

Long term maintenance of a cap is considered as one of the criteria evaluating this alternative (e.g. short term versus long term effectiveness).

We agree that shallow groundwater levels fluctuate over time and seasonally. The original source of contamination (e.g. leaking drums) has been removed. Since the drums have been removed, the residual soil contamination cannot increase. The residual soil contamination has experienced the fluctuating shallow groundwater site conditions over the years and these continuing conditions are unlikely to cause increased migration to shallow groundwater.

27. Site 7-Cargo Beach Road Landfill. Because this site was operated as a landfill (dump) that operated for an approximate ten year period (1965-1974), little is actually known about the range and concentration of contaminants contained in the fill material although a wide range of organic and inorganic substances have been identified within the landfill and offsite soils and groundwater. Drums containing liquid waste materials have also been reported. The waste material at Site 7 has been covered with a thin cover of local soil material and although sampling of site soils has identified PCBs and a range of organic and inorganic contaminants, not all of the sampling has been conducted of the actual waste materials, but of the cover material which is not reflective of the material disposed in the landfill.

The Corps has not completed the landfill investigation at Northeast Cape. We agree that this warrants additional study given the most recent findings of intact barrels of waste oil. Our investigation to date has addressed the current spread of contaminants. Our sampling has included soils that are intimately co-mingled with landfill debris, and has included water samples within the logical, down gradient effluent pathway.

28. As described above (Site 6), this site was used as a waste management facility by the military and used to dispose of a range of co-mingled municipal and hazardous wastes. The site will continue to pose a threat to the local environment as long as waste materials exist within the landfill. Because the landfill does not have a liner, wastes contained in partially filled drums and other containers and other soluble materials will be able to migrate from the mass of buried wastes to the surrounding soils and groundwater. Capping of landfills to prevent the infiltration of water can be only partially effective. Although caps are partially effective in preventing offsite migration of wastes as long as the capping material is well maintained, areas with high, fluctuating water tables are not ideal sites to minimize water infiltration since the shallow groundwater will be able to migrate upward into the waste materials providing a source of contaminated leachate that can migrate offsite to surrounding soils and groundwater.

Comment noted regarding the effectiveness of capping. Capping does prevent exposure of people and animals to subsurface materials containing within a landfill. Capping also prevents downward infiltration of water which can create leachates. We agree that high, fluctuating water tables are not ideal sites to minimize water movement <u>within</u> the landfill mass by capping. However, existing monitoring well/well point information suggests contaminants are not leaching from the landfill. Long term monitoring of the selected alternative can be included in the final remedy to ensure changed future conditions are evaluated.

29. **Site 9-Housing and Operations Landfill**. This site was used as a mixed waste landfill for the period of 1952-1965. This site contains a range of organic and inorganic contaminants including DRO, dioxins and furans and trace metals. The site is also situated upgradient of the Suqi River posing a potential source of contamination to the river and estuary. This landfill (dump) was not designed or constructed with a basal liner and the waste materials, therefore, rest directly on top and in contact with the native soils.

Site 9 is located within a wetland environment and portions of the landfill have been eroded exposing wastes.

As discussed above for the landfills at Sites 6 and 7, capping of unlined landfills provides limited effect in preventing the formation and offsite migration of landfill leachate. Because Site 9 is located in a very wet environment, capping will have only limited effect in preventing the formation and migration of leachate to the surrounding environments.

See response, above. We agree that the wet environment of Site 9 adds more complexity to the design of any remedial actions for this location.

30. **Site 8-POL Spill Site**. It appears there is not sufficient information to develop a proposed remedial action on this site. The limited sampling conducted on this site indicates elevated DRO (19,500 mg/kg) concentrations in sediments; yet despite the elevated concentrations in the sediments, non detect of DRO in surface waters. This site also drains to the Suqi River and therefore has a potential effect on the water quality of the River and Estuary. Because there is limited understanding of the concentrations and sources of the DRO at this site, additional sampling should be conducted to gain the additional information needed to develop effective remedial options.

The high organic content of the tundra/sediment environment suggests the soils have tightly bound any petroleum-based organic compounds such as diesel fuel. Thus, this wetland environment may already be functioning as a natural filter for the detected contaminants and preventing migration to surface water. However, the existing sampling indicates DRO above cleanup levels, and the FS evaluates a range of alternatives to address this contamination. The volume estimates in the study assume the entire wetland area is impacted. The Proposed Plan will identify any additional sampling necessary to implement the selected alternative.

31. **Area of Concern E (AOC E) Sites 10, 11, 13, 15, 19, and 27. Main Operations Complex.** The sites listed above are situated in areas that are significantly different from the areas downgradient and north of the Main Complex. The sites included in the AOC E area are significantly different geologically and hydrologically from the shallow groundwater and clayey soils of the downgradient areas to the north that are dominated by fine grained, organic, tundra soils.

    As the higher elevations of the Main Complex area are approached from the north, the soils become coarser grained, the groundwater is more uniform and deeper and found in coarser grained sediments. If permafrost is encountered near and south of the Main Complex, it is deeper than found in the northern areas of the NEC series of military sites. Surface and groundwater drainage is to the north and the majority of the drainage north of the Main Complex will intersect the Suqi drainage, including the section of the Suqi tributary that has been classified as the Main Drainage. Spills, leaks, landfills, discharges from impacted soils and any other potential contaminant releases near or south of the Main Complex will either move into the groundwater and/or migrate toward the north and therefore likely intersect the Suqi River drainage.

    Toward the south of the NEC, the elevation increases quickly above the Main Complex as the mountain is approached. The White Alice site was situated on glacial outwash material which overlies the very coarse grained, highly permeable talus deposits that flank the mountain. The tramway is built on the steep slope of the mountain on the bolder strewn talus deposits and undisturbed granitic bedrock.

    Because the surface and underlying deposits of soils and sediments differ significantly from the deposits north of the Main Complex, remedial technologies designed to degrade or retain contaminants at the sites located near the Main Complex will therefore be different for the coarser grained soils and sediments found near and south of the Main Complex including the deeper, more uniform groundwater resources underlying these areas.

The transition from the tundra soils north of the Main Complex and the coarser grained soils to the south also included the use of gravel fill material by the military that was used to establish slabs for Main Complex buildings and support structures as well for road materials.

Large volume spills were reported from storage tanks including a 30,000 to180,000 gallon spill from one of the 400,000 gallon diesel fuel tanks (site 11), a 40,000 gallon spill of diesel fuel from Site 13. These spills and other unreported smaller releases contributed to the contamination of the groundwater underlying the Main Complex as well as the soils and sediments immediately downgradient including the sediments of the Suqi drainage basin.

In addition to the petroleum based compounds, PCBs and other chlorinated compounds as well as a range of trace metals have been identified in the soils and sediments at the NEC. The shallow groundwater at the Main Complex contains elevated concentrations of arsenic, lead, benzene, toluene, ethylbenzene, DRO, GRO, and RRO. The contaminated groundwater is a continuing source of contamination of the downgradient regions of the NEC including the soils, sediments and groundwater to the north of the Main Complex.

Comments noted.

32. Additionally, the presence and elevated concentrations of volatile compounds including the GRO, benzene, ethylbenzene and other volatile compounds suggests these compounds have been isolated from the surface since being spilled and further that biodegradation or natural attenuation has not been effective since these more volatile and more biodegradeable materials have persisted in the environment for more than 50 years. The natural attenuation parameters of the Main Complex groundwater is not the most conducive to active biodegradation or other forms of Natural Attenuation and may be cause for the presence of the more volatile and biodegradeable, organic compounds.

Natural attenuation was considered at all locations in the Feasibility Study. Natural attenuation is slower in arctic climates. However, natural attenuation processes can be enhanced using techniques such as injecting oxygen or microbes.

33. Although PCBs have been identified in the Main Complex soils, the method detection limits used by the COE contractors for soluble phase PCBs is too high to detect the presence of these compounds in water. PCB water concentrations at highly impacted sites (Hudson River, NY; Anniston, AL) are in the range of 100-150 ng/L; more than an order of magnitude lower than the analytical protocols used by COE contracted analytical laboratories. The presence of aqueous phase PCBs within the Main Complex groundwater and downgradient surface and/or groundwater is, therefore, not known.

Surface water samples were analyzed for PCBs in the Suqi River (Site 29) and the former Drum Field (Site 6) during the 2004 remedial investigation based on comments and input from the community. PCBs were not detected, and the detection limits ranged from 105 to 115 nanograms per liter at the primary lab, and 500 ng/L at the QA lab. The ADEC drinking water standard for PCBs is 500 ng/L (i.e. 0.5 micrograms per liter (ug/L)). The sample detection limits for the most recent data collected were thus below the applicable cleanup criteria. Samples collected and analyzed for PCBs in surface/groundwater in previous investigation (1994, 1996, 1998, 2001) had detection limits ranging from 500 to 1300 ng/L, and PCBs were not detected.

34. Chemical oxidation can be used effectively to degrade contaminants in soils. If reagents can be infused through the soils and/or sediments, chemical oxidation can be used effectively to degrade organic compounds including refractory compounds. Additionally, this technology can immobilize trace metals. Additionally, use of dilute (<10%) reagents, significantly reduces adverse effects including impacts to subsurface infrastructure (not an issue at NEC) as well as operations personnel.

    The Main Complex site area is a source of contamination to the downgradient regions of the NEC. Remedial technologies must be used to degrade and immobilize the contaminants impacting the soils, sediments and groundwater of the sites within the complex as well as to the impacted areas to the north and downgradient of the large source of contaminants stored in the soils and groundwater of the Main Complex sites. In order to reduce the organic and inorganic contaminants in the soils and groundwater, a proactive remedial program is required to effectively degrade the contaminants of concern (COCs) which will likely require processes to reduce and eventually eliminate the organic and inorganic substances impacting this area. The subsurface area of the Main Complex and areas immediately to the south provide a viable source of groundwater which could provide sufficient quantities for municipal use. In order to utilize this source of groundwater, the contaminants must be removed likely requiring a mix of technologies.

Comments noted and will be considered in preparation of the Proposed Plan.

35. **Area of Concern F-Drainage Basin-Site 28.** Three discrete drainages flow from the Main Complex north to the Suqi River and then to the Estuary. This drainage is a tributary of the Suqi River and because this branch of the river receives its waters from areas above and within the Main Complex, the tributary has been significantly impacted by the large volume spills and release of contaminants originating from the impacted soils as well as the affected surface and groundwater. Sections of this drainage are narrow (<1') and deep (~ 2') where it is incised into the tundra soils.

    Sampling within the narrow regions of the Main Drainage (Suqi Tributary) must be done carefully to avoid the sampling the incised tundra soils. The poorly consolidated tundra soils can be easily mistaken for Main Drainage and Suqi drainage sediments and because the tundra soils are likely centuries old, they will be essentially unaffected by any of the near term contaminants derived from military activities. Similarly, during dry periods or shortly after extensive river flow, the Main Complex Drainage will have little sediment accumulated in the small drainage.

    Where sediments do accumulate in the Main Drainage, there is often an evident oil sheen that is released to the water column when the bottom sediments are disturbed. Because the river is narrow and deepened where its width is reduced, flooding that takes place during the spring melt and times of extensive precipitation, re-suspends the fine grained sediments and transports the material downgradient to the Suqi River and then to the Estuary where the sediments and associated contaminants accumulate.

The Main Drainage, therefore, has and currently serves as a conduit for the contaminants being released to the downgradient regions of the NEC by the Main Complex store of organic and inorganic contaminants residing in and being released by the upgradient soils and groundwater.

The reservoir of contaminants being released to the Main Drainage of the Suqi will diminish when the Main Complex area is effectively remediated. However, as long as there are contaminated soils and groundwater within the Main Complex area, the Main Drainage and the Suqi River and Estuary will continue to be impacted. This section of the Suqi River drainage needs to be effectively monitored during and after remediation of the Main Complex to ensure contaminants are no longer being released to the Main Drainage. When contaminated sediments accumulate in sections of the Main Drainage, they should be removed and disposed even though this remedial phase will damage the system's ecology.

Comments noted. A mix of technologies will likely be needed to address both source area contamination at the Main Complex and downgradient monitoring. The concerns identified will be considered during preparation of the Proposed Plan.

36. **Area of Concern G-Suqitughneq (Suqi) River and Estuary-Site 29**. This section of the Suqi drainage was likely affected by the large spills reported from the above ground fuel storage facilities located upgradient of the river. Comments made above relative to the Main Drainage section (Site 28) of the Suqi are relevant as it relates to the accumulation of impacted sediments during periods of low flow, scouring and transport and remobilization of the sediments during high flow. It also emphasizes the need for careful sampling to ensure sediments and not tundra soils are being sampled. The relative high variation in the DRO sampling results suggests sampling may not have been consistent and may have included tundra and not the contaminated sediments derived from impacted upgradient sources. Tundra soils will also contain large quantities of biogenic organics and low concentrations of petrogenic materials.

To ensure Site 29 sediments are not impacted, additional sampling and analysis needs to be conducted to ensure sediments are sampled and that the sediments represent material recently accumulated which would be reflective of the effects of the upgradient sources of the sampled material.

Comment noted. Additional sampling will be considered as part of the remedy selection process. The intent of previous sampling events, especially the 2004 investigation, was to target depositional areas of sediment in the Suqi River and Estuary.

37. As with Site 28, designating the Suqi River (Site 29) as a suitable alternative drinking water source is based on insufficient data including detection limits of PCBs and presence of aqueous phase contaminants during various flow regimes including PAHs, DRO and trace metals. Subtle changes in pH, Eh, dissolved oxygen, water flow, organic acids and other physicochemical parameters have profound effects on contaminant solubility and mobility. Because it is known that a range of organic and inorganic contaminants exist in the Suqi River drainage and upgradient soils and groundwater, these same materials are also present in the aqueous phase within the Suqi system.

The detection limits for PCBs in the Suqi River surface water sampling conducted in 2004 were sufficiently low to meet ADEC drinking water standards.

38. **Area of Concern H-White Alice Complex-Site 31**. The organic contaminants identified in the White Alice soils are comprised of DRO and PCBs. It is evident from the more than 50 year history of the persistence of the DRO that Natural Attenuation is not effective in degrading DRO at the NEC.

Natural attenuation processes in the arctic are typically slower when compared directly with temperate climates. It is not unreasonable to expect the natural attenuation process to take more time to reach cleanup goals. The original concentrations of DRO and PCBs at the White Alice site are unknown, so the true rate of natural attenuation is unknown, thus it is speculative to state natural attenuation processes are completely ineffective.

39. Chemical oxidation is not restricted to groundwater and has been used to degrade contaminated sediments including PCB-contaminated, relatively permeable, soils/sediments. The use of dilute oxidizing reagents can also stimulate biodegradation of the DRO compounds.

Chemical oxidation could be considered in the FS for the DRO-impacted soils at the White Alice complex. The relatively small area impacted, however, may preclude this as a viable option. PCB-contaminated soils are evaluated separately, however, under Area I.

40. What data was used to determine the groundwater at Site 31 is not impacted? The FS should summarize this statement to complete the record.

Groundwater samples have not been collected at Site 31. The area is underlain by fractured bedrock. Two surface water samples were collected and analyzed for petroleum hydrocarbons, PAHs, BTEX, and metals during the 2001 remedial investigation. All analytes were below action levels; some were not even detected.

41. The preferred action would be to remove all contaminated soils from the White Alice site followed by off-island disposal. Clean fill should be used to replace the removed soils.

Further evaluation of chemical oxidation and dilute oxidizing reagents seems to contradict your preference for the excavation and off-site disposal alternative.

42. **Area of Concern I-PCB Contaminated Soils (Sites 13, 31).** PCBs are highly resistant to changes in the natural environment. However, although considered highly refractory, depending which of the approximate 200+ congeners is involved, this compound can be volatile, soluble and, therefore, highly mobile. In general, the lower the chlorine content, the more soluble and volatile the congener. Land farming, composting, constructed wetlands and other remedial alternative that affect the chlorine content of the compound can have a profound effect on the mobility of this contaminant.

Typically in a highly organic environment, the mobility of contaminants is greatly reduced using technologies such as land farming, composting and wetlands. Research articles have demonstrated that phytoremediation is effective at low level PCB remediation and long term polishing.

43. It is also well recognized that PCBs can be partially altered by anaerobic, microbial degradation. This involves the selective loss of chlorines on the biphenyl ring creating PCBs that are less chlorinated than the parent compound and are therefore more soluble and more volatile and subsequently more mobile than the parent compound.

The PCB contaminated soils can be isolated by capping and which can then partially degrade creating more mobile compounds. PCBs can also be degraded by chemical oxidation, particularly effective on coarse-grained, low organic, non-carbonate soils.

Comment noted.

44. The preferred remedial option is to ensure these compounds do not become more mobile due to the partial loss of chlorine. The PCB contaminated soils should be removed off-island to be treated and disposed in approved facilities.

Comment noted.

USACE Responses to Alaska Community Action on Toxics (ACAT) and Saint Lawrence Island RAB members Vi Waghiyi and Pamela Miller
Comments on Northeast Cape Feasibility Study
October 16, 2006

1. Over the past several years, as RAB members and through our work with the people of Saint Lawrence Island, we have heard the concerns and observations of respected community elders and health aides about adverse health outcomes in families and individuals that have lived and/or worked at Northeast Cape. We have heard the deep sense of loss and justifiable doubts about the health of the waters and traditional foods that were once an immeasurably important and safe source of sustenance to the people of Saint Lawrence Island. These concerns and observations have been too easily dismissed by the Corps and ADEC. The limited perspectives of the Corps and ADEC are based on inadequate site characterizations, poor understanding of the underlying hydrology, risk assessment models that rely on spurious assumptions, and bureaucratic policies that are not current with the latest peer-reviewed science.

Concerns regarding adverse health impacts are noted. The Corps has addressed concerns related to inadequate site characterization on numerous occasions in the past and has conducted additional investigations specifically to address some of those concerns. We feel that the best course of action is to move forward with cleanup efforts, and not get bogged down with more study. It is anticipated that certain aspects of site cleanup will be revealed during actual remediation efforts and would most efficiently be dealt with at that time. Regarding the more specific comment that the site has not undergone a meaningful hydrogeological assessment, the Corps believes that the costs and time associated with such a potentially complex issue, in this harsh and remote region, would not yield a justifiable return. There are more practical solutions to good drinking water.

2. The people of the Island and we believe that the military is obliged to do the utmost possible to return Northeast Cape to the clean, safe place that it once was. People of the Island believe that cost should not be an obstacle when they have lost so many lives, suffered illnesses, treatment and travel away from home, and the hardships of those who remain. Cost should not be an obstacle to restoring the watershed of the Suqi River so that it can once again support an abundant, healthy population of salmon and other fish. Contamination within the Suqi River is preventing the recovery of the anadromous and resident fish populations. The Feasibility Study must carefully consider the full range of options for the restoration of the Suqi River. The Feasibility Study does not provide the people of Saint Lawrence Island with viable alternatives that will ensure the protection of the environment and health.

The FUDS program goals and objectives require the Corps to implement cost-effective response actions. We do not understand what additional alternatives could be included in the FS, if other technology could be considered viable, please let us know.

3. The people of Saint Lawrence Island intend to establish a permanent community at Northeast Cape. The Corps has vastly underestimated current uses and importance of the area year round as a base for hunting and fishing, for rest and during periods of inclement weather, and to replenish water. Yet, the military occupation and concerns about contamination have also diminished use of the area compared with times prior to 1950.

The Risk Assessment completed in 2004 did proceed with a scenario that a viable community would exist at the Fish Camp and other areas at the former Northeast Cape installation.

4. Costs should not prohibit cleanup and restoration of Northeast Cape given the tremendous losses suffered by the people of Saint Lawrence Island resulting from military contamination. The Corps of Engineers and the Alaska Department of Environmental Conservation are negligent if the agencies do not ensure complete characterization and removal of landfills; restoration of the Suqi River and all potential surface and groundwater sources of drinking water. Capping will not isolate contamination that will inevitably leach and volatilize.

Comments noted. The Corps has not completed the landfill investigation at Northeast Cape. We agree that this warrants additional study given the most recent findings of intact barrels of waste oil. Our investigation to date has addressed the current spread of contaminants. Our sampling has included soils that are intimately co-mingled with landfill debris, and has included water samples within the logical, down gradient effluent pathway. Capping prevents exposure of people and animals to subsurface materials containing within a landfill. Capping also prevents downward infiltration of water which can create leachates.

5. We reject institutional controls as inadequate because they are not protective of health and safety.

Comment noted.

6. We also reject those technologies that would only serve to re-mobilize contaminants and increase the possibility of exposure, such as soil vapor extraction and thermal desorption.

Comment noted.

7. Other proposed technologies have not sufficiently been demonstrated as effective under Arctic conditions, such as enhanced biodegradation and phytoremediation. In fact, the Feasibility Study does not provide credible evidence of the efficacy of most of the proposed in situ remedial technologies. Source characterization and excavation and removal of contaminated soils and sediments, oxidation technologies, and off-island removal of landfill wastes are the most viable and protective options.

Comment noted. A contractor would have to take the arctic environment into account and adjust the selected remedy to be as effective as possible for the local conditions. The University of Saskatchewan recently performed a field-scale assessment of phytotechnology and applied it to sites impacted with weathered hydrocarbons. The site in Canada appeared to be very similar to those of interior Alaska with a growing season of June through August. The university excavated 2,400 m^3 of highly weathered petroleum (diesel and oil) from a former fire pit. The soils were a clay-loam. The field trial successfully showed that phytoremediation is effective, especially using native plants in extreme arctic climates. The test cells achieved cleanup levels in less than 2 field seasons.

Regarding the reactive matting technology, the manufacturer was contacted and provided a brief technical memorandum summarizing results from a series of laboratory tests conducted on their organoclay product which was exposed to freeze-thaw cycling. CETCO recommended sufficient cover and armoring (e.g., rip rap or articulating concrete block) of the reactive core matting (RCM) to protect it from flooding and ice scouring. The amount of covering is always site specific. The objective of the laboratory study was to investigate the impact of freeze-thaw conditions on the organoclay particle integrity and their oil removal performance under the laboratory conditions. A series of laboratory tests were conducted on a CETCO organoclay which was exposed to freeze-thaw cycling. The results showed there was no detrimental impact on their particle size distribution and oil removal capability. The conditions of freeze-thaw cycling had minimal impact on CETCO granular organoclay's particle integrity in term of its particle size distribution. The frozen-thawed organoclay media performed efficiently on removing oil in the process of column study. The manufacturer expects that the CETCO proprietary organoclay supplied to field applications either in the bulk format or in the matting will deliver similar performance results to those discovered in this study.

8. We note that risk assessment models used to justify no further action determinations and minimal remediation at Northeast Cape have not taken into consideration that there is a growing body of peer-reviewed science demonstrating adverse health outcomes with proximity to hazardous waste sites, municipal landfills, and open dumps. Research demonstrates that there are increased risks of adverse birth outcomes and other reproductive health outcomes associated with living near landfill sites. Low birth weight, pre-term births, congenital malformations, and a range of endocrine disorders are associated with living near solid and hazardous waste landfills (see references provided in footnote).[1] Health aides have noted these health outcomes in the families most closely associated with NE Cape. The science certainly justifies precautionary and protective measures –complete removal actions especially in light of the intention of Saint Lawrence Island people to establish a permanent community at NE Cape.

The complete removal of all sources of contamination must be balanced using the criteria defined in the National Contingency Plan (NCP), including protection of human health, compliance with regulations, cost, short and long term effectiveness, implementability, state agency and community acceptance. Whereas risk assessments are not an exact science, the risk assessment did factor in actual analytical chemistry. The modeling was carried out by a disinterested third party, and the study has withstood outside peer review.

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[1] See for example, Gilbreath, S. and PH Kass. 2006. Adverse birth outcomes associated with open dumpsites in Alaska Native villages. Am J Epidemiology July 13, 2006; and Elliot, P. et.al 2001. Risk of adverse birth outcomes in populations living near landfill sites. BMJ 323:363-8.

9. Page 9 – petroleum and lead should be included in cumulative risk calculations

Disagree. The ADEC Cumulative Risk Guidance (2002) document clearly states that petroleum and lead are excluded from the cancer and non-cancer cumulative risk calculations. However, this does not mean that petroleum and lead are not evaluated for potential risks. Constituents of petroleum are already included in the cumulative risk calculations (e.g. BTEX, PAHs, metals) and inclusion of the petroleum mixture itself would be duplicative. Lead is evaluated separately using a model to predict integrated uptake of lead in children. Clarifying text added to the Feasibility Study (see below).

> *Alternate cleanup levels must also be protective from a cumulative risk perspective. Cumulative risk is defined as the sum of risks resulting from multiple sources and pathways to which humans are exposed. Cancer and non-cancer cumulative risks are calculated separately. When more than one hazardous substance is present at a site or multiple exposure pathways exist, calculated cleanup levels may need to be adjusted downward. Lead contamination in soil or groundwater is not included in cumulative risk calculations, because cancer slope factor and non-cancer reference dose values are not applied to this chemical. Lead is evaluated separately using a model predicting integrated uptake of lead in children. For petroleum hydrocarbons, each fraction is a mixture of many different chemicals. Risks from individual petroleum constituents (i.e. indicator compounds) such as BTEX or PAHs are included in the cumulative risk calculations. However, the bulk petroleum hydrocarbons mixtures (e.g. DRO, GRO, RRO) are assessed using toxicity and chemical parameters for the three total petroleum ranges (e.g. surrogate approach). Using toxicological data for the mixture itself is the USEPA's preferred method for evaluating the risk to chemical mixtures. The risk from bulk hydrocarbons is not included in the cumulative risk calculations because the risk from indicator compounds is considered protective of the cumulative risk to petroleum exposure.*

10. Page 10—characterization of the complexity of the subsistence diet has not been done in order to properly assess consumption risks of a diet that includes berries, greens, fish, and reindeer and marine mammals.

The risk assessment conducted by MWH quantified human exposure to contaminants in the food chain through consumption of plant (including greens and berries) and animal tissues (fish). Average daily rates of native plants and fish consumption by island residents were derived from survey information obtained by Montgomery Watson and the USACE. Exposure concentrations were calculated from remedial investigation data obtained in 2001. The plant tissue data used in the risk assessment consisted of four greens/willow samples and one black crowberry sample. Eight fish tissue samples were used to determine exposure concentrations. The risk assessment was not meant to evaluate every possible food chain pathway, but instead focused on food items most likely to be impacted by the Northeast Cape Installation contaminants and those commonly consumed by potentially exposed individuals. ATSDR (2001) independently evaluated consumption of reindeer meat. The report concluded that no health problems would be expected in individuals consuming a diet containing large quantities of reindeer meat and fat related to the group of chemicals analyzed in this exposure investigation (PCBs, PAH, pesticides). Based on the analysis of PCB, PAH, and pesticide levels from the 2000 reindeer roundup, detectable health effects are not expected in individuals consuming reindeer muscle and fat on St. Lawrence Island.

Marine mammals, including seals, walruses, and polar bears, are present in the Northeast Cape Installation and are harvested by subsistence hunters for human consumption. However, potential exposures associated with this pathway are anticipated to be low because marine mammals: (1) have very wide foraging ranges, (2) are migratory species and are present at the Northeast Cape Installation for only a portion of the year, and (3) do not use inland areas or the lagoon for foraging or breeding. In addition, attributing chemical concentrations in these wide-ranging species to potential exposures from the Northeast Cape Installation would be extremely difficult.

11. ATSDR assessment relied on limited analysis of small fish and composite samples and is therefore incomplete.

ATSDR conducted a second assessment[2] (2006) based on the more recent fish tissue data obtained in 2001 in response to recommendations contained in their first Health Consultation (2000). The ATSDR Health Consultation concluded that:

- The available data indicate that the low PCB levels in the Dolly Varden and pink salmon in waters at the NE Cape are similar to, or less than, PCB levels in fish from other Alaska waters.
- Consumption of PCBs in the Dolly Varden and pink salmon from the waters at the NE Cape is not likely to result in adverse health effects.
- The levels of PAHs in the Dolly Varden in the Suqitughneq River are similar to those found in commercially available smoked fish and are similar to, or less than, PAH levels in fish from the Chesapeake Bay fishery.
- Consumption of the PAHs in the fish from the Suqitughneq River is not likely to result in adverse health effects.

12. Page 11—the Suqi River should not be considered “uncontaminated” as per comments of Drs. Scrudato and Chiarenzelli.

Comment noted.

13. Page 11—the shallow groundwater should not be considered isolated from deeper groundwater and also surface waters that are potential drinking water sources.

The alternate cleanup level scenarios were meant to illustrate a range of potential options for cleanup. The shallow groundwater was considered to not be a viable drinking water source at

[2] ATSDR Health Consultation - Polyaromatic Hydrocarbons and Polychlorinated Biphenyls in Fish From the Suqitughneq River — St. Lawrence Island, Alaska, March 24, 2006.

most locations under Scenario A. This assumption is not tied to any isolation between shallow and deeper aquifers. However, Scenario B assumes a potential connection between any existing aquifers and includes a drinking water exposure pathway.

14. Page 28—natural attenuation has not significantly diminished contamination over the 50 years in soils and sediments of NE Cape.

The original concentrations of DRO and PCBs across Northeast Cape are unknown, so the true rate of natural attenuation cannot be determined. Assertions that natural attenuation processes have not significantly diminished contaminant levels cannot be verified. Natural attenuation processes in the arctic are typically slower when compared directly with temperate climates.

15. Page 28—Institutional controls should not be considered as an option because they cannot be properly maintained and do not prevent off-site contamination and exposures.

Comment noted. Institutional controls are included as an alternative for evaluation. The inclusion of any particular alternative in the feasibility study does not mean it will be the selected or preferred alternative, the FS is a means for comparing alternatives prior to development of the Proposed Plan.

16. Page 41—Site 21 requires remediation and cleanup because of the presence of arsenic and PCBs.

A source area of arsenic is not supported by the sampling in 1994. The additional soil samples collected to verify the one elevated occurrence of arsenic found in 1994 showed arsenic concentrations ranging from 4.5 to 11.5 mg/kg and are well within the range of ambient levels for the Northeast Cape site.

During the initial investigation that occurred in 1994, PCBs were detected above 1 ppm at one location. This sample was split into three parts and each part analyzed separately. The primary result was 1.9 ppm, a quality control result was 4.2 mg/kg and a quality assurance result of 0.93 mg/kg. Down gradient samples and additional samples collected during the 2001 investigation indicated the detection was an isolated occurrence. Confirmation samples collected after decontamination and decommissioning of the septic tank further demonstrated that PCBs had not migrated through the concrete at significant levels. One sample, collected immediately beneath the outfall piping adjacent to the septic tank (sample 03NE21SB01, collected at 5 feet below ground surface) contained detectable PCBs at 1.7 mg/kg. PCBs were not detected in the 17 other samples collected from beneath the concrete tank and the wooden utilidor. There is no remaining source of PCBs at this location. While an occasional hit at the site may be just above 1 mg/kg, as a whole, the site does not exhibit any PCB contamination that would pose a risk to human health and the environment.

17. Page 71 (section 7.1.6)—volume of contaminated soil must be determined and removed.

The soil volume estimate is based on all the available data. An exact figure is never known until after a removal action is completed, if excavation is the selected alternative.

18. Page 78—no justification to show that landfarming would significantly or effectively decrease petroleum hydrocarbons in conditions found on St. Lawrence Island.

A Feasibility Study is not meant to summarize technical literature demonstrating the successful or unsuccessful application of a particular technology at other specific sites. Landfarming/landspreading is an accepted practice in the State of Alaska, and a proven technology for remediating contaminated soils. Landspreading has been approved at other remote sites by the ADEC. Studies in Alaska have shown that typical landspread soils remain aerobic and have moisture contents suitable for biodegradation, and that leachate has not caused deleterious effects on native soils or groundwater. Landfarming faces the same concerns as other alternatives evaluated, such that logistics and the ability to ship materials to the site are relatively difficult in remote Alaska. The site conditions themselves (i.e. arctic climate) are not a significant obstacle to normal degradation processes.

19. Page 79—Phytoremediation is not a proven technique in conditions found on St. Lawrence Island.

Every site that requires remediation presents a unique situation. A contractor would have to take the local conditions into account and adjust the selected remedy to be as effective as possible for the local conditions. The University of Saskatchewan recently performed a field-scale assessment of phytotechnology and applied it to sites impacted with weathered hydrocarbons. The site in Canada appeared to be very similar to those of interior Alaska with a growing season of June through August. The university excavated 2,400 m^3 of highly weathered petroleum (diesel and oil) from a former fire pit. The soils were a clay-loam. The field trial successfully showed that phytoremediation is effective, especially using native plants in extreme arctic climates. The test cells achieved cleanup levels in less than 2 field seasons.

20. Additional landfills have been discovered at NE Cape that have not yet been adequately characterized or included in the feasibility analysis. These include but not necessarily limited to a landfill at the top of the mountain and another approximately 1000 ft. E-SE of the main complex. Reports also include landfill about 500 yards south of the main complex used by contractors that built NE Cape infrastructure. Debris is surfacing in areas throughout NE Cape. The first main Air Force landfill must be characterized and cleaned up as with the other landfills established at NE Cape.

We are unaware of any additional landfills or sites that require characterization. If you have data which indicates more landfills are present at Northeast Cape, please share those reports. We acknowledge that some minimal near-surface debris may remain near the top of the mountain at the debris fields. Bristol removed scattered debris consisting of wood and metals pieces from the steep mountain slopes near Site 34. However, Bristol was given the option to not dig up certain pipes and similar debris out of the ground, and instead cut off the debris at the ground surface. It is highly unlikely this miscellaneous debris would produce any leachate.

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1. These are the comments of Sivuqaq, Inc., an Alaska corporation formed pursuant to the Alaska Natives Claims Settlement Act (43 U.S.C. 1601, *et. seq.*), co--landowner of St. Lawrence Island. Most significantly Sivuqaq, Inc. joins in the comments prepared by the Technical Advisor for Public Participation to the St. Lawrence Island Restoration Advisory Board, Dr. Ronald J. Scrudato, and his associate, Jeffrey R. Chiarenzelli. Dr. Scrudato's commentary reflects the concerns of Sivuqaq, Inc., and Sivuqaq's commentary is intended to supplement the comments of Dr. Scrudato and to particularly comment on those areas of the feasibility study that appear deficient, and that do not require a technical background to discuss.

Comments noted.

2. **Site Characterization** It is a matter of concern that the sampling at Site 6, Cargo Beach Road Drum Field, Site 7, Cargo Beach Road Land Fill, and Site 9, Housing and Operations Landfill, has not been adequate. There has been little effort to get beneath the landfill "caps" to sample the material that was placed in the drum field or either landfill. Given the 20-odd year presence of the military at the site, and the lack of readily disposal alternatives, these sites are a likely continuing and future source of toxins entering into the environment. Steel barrels rust and rot over time, and their contents seep into the surrounding environment.

Comment noted. Site 6 is not considered a landfill. The drums were present in piles and were removed during the 2000 field season. The material of concern is residual petroleum-contaminated soils and shallow groundwater at Site 6. The Corps has not completed the Site 7 landfill investigation at Northeast Cape. We agree that this warrants additional study given the most recent findings of intact barrels of waste oil. Our investigation to date has addressed the current spread of contaminants. Our sampling has included soils that are intimately co-mingled with landfill debris, and has included water samples within the logical, down gradient effluent pathway.

3. The Corps' contractors have found highly elevated diesel range organics and soils that are contaminated to an estimated depth of 7 feet (Site 6) and 5 feet (Site 7). There are also elevated concentrations of metal in the shallow ground water. The risk assessment's assumption that the shallow ground water at Site 6 was not a complete exposure pathway is unjustifiable. The Corps' assumption, made throughout, that shallow ground water does not migrate into the underlying aquifer is without adequate support.

Comment noted. The alternate cleanup level scenarios were meant to illustrate a range of potential options for cleanup. The shallow groundwater was considered to not be a viable drinking water source at most locations under Scenario A. In particular at Site 6, the shallow groundwater is extremely difficult to extract and thus unlikely to support a permanent drinking water well. The elimination of the shallow groundwater exposure pathway in terms of its use as a drinking water source is not tied to any isolation between shallow and deeper aquifers.

However, until further information regarding the potential connection between a shallow and deeper source of groundwater is obtained, Scenario B is adequately protective and includes a drinking water exposure pathway.

4. Sivuqaq advocates using Scenario B (7.1.6 Site Parameters, page 71) as the only effective means of eliminating a continuing source of contamination.

Comment noted. Scenario B stipulates a cleanup level, not an actual remedial alternative.

5. **Buried Drums** Sites 7, 9 & 10 contain buried drums that have accumulated over the life of the installation. No one knows for certain what the drums contain aside from waste oil. There are numerous possibilities given the presence of pcbs, dioxin, mirex, heavy metals and other toxic and hazardous waste around the installation. It is possible, perhaps even likely, that the landfills contain all the hazardous and toxic materials used anywhere on the site at any time.

   Unless they are removed, these buried drums will deteriorate, release their contents and further degrade the environment. A cap of impermeable material will not prevent the contents of the buried drums from seeping into the ground and into the aquifer. In order to be effective, the remedial action must remove the sources of the contamination. The drum fields must be excavated and the drums removed in order to prevent contamination to Northeast Cape in the future. Northeast Cape is intended for resettlement and the site should not become a source of contamination for future residents.

Comment noted. A cap does prevent migration of water through the landfill materials and will reduce the potential for seepage or leachate to migrate into the underlying aquifer.

6. **Site 9 – Housing and Operation Landfill** All of the samplings from this landfill show the presence of many metals above screening levels. The feasibility study suggests that at the presence of bentonite at the bottom of a monitoring well may be due to interference from well construction material. The report then writes off the large number of other metals detected in the water column as suspect, and concludes that the monitoring well does "not provide a strong line of evidence for contaminants migrating from the solid wastes disposed in the vicinity." The presence of each contaminant is dismissed for a variety of reasons. Sivuqaq does not believe that any alternative, other than the removal, can be effective.

Comment noted. The Feasibility Study acknowledged that the presence of lead in shallow groundwater was consistently above cleanup levels and could be related to materials deposited within the landfill. Filtered water samples are necessary to determine if the observed lead concentrations represent a dissolved phase problem in water, or a suspended sediment problem. Surface water samples have also been collected from ephemeral ponds surrounding the landfill and lead has either not been detected or did not exceed the drinking water criteria. Although metals are commonly detected in poorly developed monitoring well samples, lead was consistently detected over time and will be considered a primary driver for cleanup decisions. Sampling of the shallow groundwater is problematic at Site 9 due to the tundra/wetland environment, shallow saturated soils, the difficulty installing good sampling points, achieving low turbidity in the water column, and obtaining high quality water samples. Installation of several additional well points was attempted during the 2001 investigation, but the well points did not yield water.

7. **Remedies** Sivuqaq rejects the notion of institutional controls as an unjustified and uncompensated burden on Sivuqaq's ownership interest in the property. Natural attenuation does not address the reality that these contaminants have already been in place for 40 years and still exceed clean up levels. Long-term monitoring does not address the problem of contamination, it only reports on it. Capping does not address the slow deterioration of the containers containing toxic materials and their eventual migration into the soil and migration into the environment.

Comments noted.

8. For those proposed remedies that are dependent on thermal action, Sivuqaq seeks evidence that these techniques have been successful in sub-arctic environments underlain with continuous and discontinuous permafrost such as that found at NE Cape.

Landfarming/landspreading is an accepted practice in the State of Alaska, and a proven technology for remediating contaminated soils. Landspreading has been approved at other remote sites by the ADEC. Studies in Alaska have shown that typical landspread soils remain aerobic and have moisture contents suitable for biodegradation, and that leachate has not caused deleterious effects on native soils or groundwater. Landfarming faces the same concerns as other alternatives evaluated, such that logistics and the ability to ship materials to the site are relatively difficult in remote Alaska. The site conditions themselves (i.e. arctic climate) are not a significant obstacle to normal degradation processes.

Every site that requires remediation presents a unique situation. A contractor would have to take the local conditions into account and adjust the selected remedy to be as effective as possible for the local conditions. The University of Saskatchewan recently performed a field-scale assessment of phytotechnology and applied it to sites impacted with weathered hydrocarbons. The site in Canada appeared to be very similar to those of interior Alaska with a growing season of June through August. The university excavated 2,400 m^3 of highly weathered petroleum (diesel and oil) from a former fire pit. The soils were a clay-loam. The field trial successfully showed that phytoremediation is effective, especially using native plants in extreme arctic climates. The test cells achieved cleanup levels in less than 2 field seasons.

9. **Site 28 & 29 Suqitughneq (Suqi) River Drainage Basin and Estuary** The Suqi River is one of the main geological features and the most important drainage at the NE Cape site. The people of St. Lawrence Island have known about very large oil spills in the fuel tank area for decades because some of them were present when the spills occurred. There has never been any sort of recovery or remediation of these spills totaling as much as 200,000 gallons. The Suqi River and its tributary provide drainage for the spill site at Site 11. Eye witness accounts report that a sheen of oil still appears when the sediments are disturbed. The sediments in the estuary and the drainage basin should be tested further.

Sampling may be considered as part of the overall remedial strategy selected. The ADEC agreed that additional sampling was not necessary to proceed with the FS.

10. The Suqi River no longer supports a salmon run suggesting that the river is not healthy. Meaningful remediation of the NE Cape Site requires returning the Suqi River to a condition that will support a salmon run. The restoration of a salmon run will be the clearest most meaningful demonstration to the people of St. Lawrence Island that the NE Cape Site has been restored.

Comment noted. Corps of Engineers biologists have observed conditions at Northeast Cape and collected fish specimens in 2001 and 1999. The Corps biologist noted that the Suqitughneq River normally lacks the discharge to breach the berm during northerly winds and probably has never been able to support viable spawning runs of pink salmon because of it.

1. Thermal remediation was skipped for AOC F Drainage Basin. On page 141 thermal treatment was retained for further evaluation. It was omitted from discussion in the detailed analysis of alternatives.

The text incorrectly stated that thermal treatment was retained. The primary media of concern is contaminated sediments in the Drainage Basin. Thermal treatment of sediment/soils was eliminated from further consideration at the Drainage Basin due to the dewatering requirements for wet sediment/soils.

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USACE Responses to HTRW – Center of Expertise Comments
February 12, 2007

Reviewer Name:	Grimm, Jennifer
Discipline	Geologist
CX Project Review No.	998-70205
Date:	29 January 2007
Project Location	St. Lawrence Island, Alaska
Document Name:	Feasibility Study, Northeast Cape FUDS, Final

Comment # 1: General. How Chemicals of Concern (COCs) for each media of concern were designated is unclear. Please consider including this information in the Introduction and Executive Summary. In addition, suggest clearly listing COCs designated in each media for each Area of Concern (AOC) in Sections 6 through 14. Currently, COCs designated for each AOC are unclear and evaluating whether RAOs and proposed alternatives are appropriate is difficult.

Response # 1:
Agree. Text throughout the document has been clarified to indicate contaminants of concern.

Comment # 2: Sections 3.4, 3.5, and 3.6. It appears that the Chemicals of Potential Concern (COPCs) and alternate clean-up levels identified in this section are all inclusive with respect to the 33 sites investigated during the referenced Remedial Investigations. If this is the case, consider clarifying this at the beginning of Section 3 and include a statement that indicates alternate clean-up levels will only apply to COPCs designated as COCs for each AOC.

Response # 2:
Tables have been modified to only include alternate cleanup level for chemical designated as COCs.

Comment # 3: Sections 6 through 14. Each site includes a section titled, Nature and Extent of Contamination. This section includes a discussion of nature and extent and also includes a discussion of risk. Please consider breaking the risk discussion out of Nature and Extent of Contamination and including it in a new section. At the beginning of this new section, suggest including all COPCs in each media determined during the risk assessment. (Please note, in some sections, COPCs are clearly identified; however, this is not consistent throughout the document.) This is suggested because it is difficult to differentiate between discussions of detected constituents and discussions of COPCs determined through the risk assessment. A bulleted list might be helpful for clarity. If a specific media was not evaluated at a site or if no COPCs were determined in a specific media, suggest including this information.

Response # 3:
Document reorganized to include a separate section for Risk Assessment under each AOC. Text clarified throughout to indicate which COPCs were designated as COCs.

Comment # 4: General. Please review this document and verify that applicable tables and figures have been referenced as appropriate within the body of the text. Revise the text as necessary.

Response # 4:
Document reviewed and text revised. Figure 1-2 and Figure 5-3 were deleted. All other tables and figures referenced in text.

Comment # 5: Sections 6 through 14. Each AOC includes a section titled, Remedial Action Objectives. In this section, recommend focusing on the development of specific Remedial Action Objectives (RAOs) based on COCs and media of concern, exposure routes and receptors, and cleanup levels. Current RAOs are open to interpretation and could easily be misinterpreted if taken out of context.

Suggest clearly identifying the following in the RAO section for each AOC:

1. The designated COCs and media of concern. 2. The exposure routes and receptors. 3. The preliminary remediation goals (cleanup levels) for each COC.

In some cases, this information is provided throughout the text, but it can be difficult to find. Cleary summarizing this information in the RAO section would help clarify the justification for each RAO.

After these 3 items are clearly identified, consider developing RAOs that encompass all three elements. For example, the following hypothetical RAO is specific and contains all three elements: Prevent future resident ingestion, inhalation, and dermal absorption of soils containing DRO greater than 9,200 mg/kg. This hypothetical RAO leaves little open to interpretation. More than one RAO may be necessary at each AOC to cover all COCs in each media.

Response # 5:
COCs more clearly identified for each AOC in the new Risk Assessment subsections.

Comment # 6: Figure 3-1. Based on Figure 3-1 the following are complete exposure pathways for future seasonal resident receptors and future permanent resident receptors: soils, sediment, surface water (lakes/streams/wetlands), and groundwater. A distinction between shallow groundwater and deep groundwater is not made. Throughout this document shallow groundwater and deep groundwater are treated as distinct media; however, this is not reflected on Figure 3-1. In addition, at individual AOCs, shallow groundwater is sometimes considered a complete pathway and sometimes considered an incomplete pathway. If Figure 3-1 is not applicable to every AOC, suggest clarifying this in the text of Section 3 and including an AOC-specific human-health CSM (similar to figure 3-1) with each AOC described in Sections 6 through 14.

Response # 6:
Clarifying text added to Section 3 as follows:

The CSM depicts complete exposure pathways for a future permanent resident and soils, *sediment, surface water, and groundwater. Groundwater exposure pathways are evaluated on a site-specific basis and discussed in more detail in Sections 3.6.3, and 6 through 14. The shallow groundwater within specific areas of the Northeast Cape installation is not a current or reasonably expected potential future drinking water source. These areas are characterized by low-lying tundra; including the vicinity of Cargo Beach (Sites 3, 4, 5), the landfills (Sites 7, 9) and other areas away from the main operations complex (Sites 1, 2, 6, 8, 23, 24, 25). The groundwater exposure pathway is only applicable to Area of Concern E – Main Operations Complex and H – White Alice Complex.*

Comment # 7: General. At AOCs where groundwater is considered a media of concern, the extent of groundwater contamination targeted for potential remediation is not always clear. Suggest clarifying this on a figure for each applicable AOC. It would be helpful for the figure to show a distinct boundary for the area of attainment where the groundwater RAO(s) may apply.

Response # 7:
Groundwater is only considered a media of concern at the Main Operations Complex. Delineation of a distinct boundary of contamination is not possible.

Reviewer Name:	VanCleef, Beverly
Discipline	Regulatory Specialist
CX Project Review No.	70205
Date:	08 January 2007
Project Location	NE Cape Installation, St Lawrence Island, Alaska
Document Name:	Final FS

Comment # 1: General comment. Though this is titled as a final document, according to my records, we did not received a previous draft of this FS for review. We did receive a document back in 1999 referred to as a pre-final Phase II RI/FS, but it only contained RI information.

Response # 1:
The HTRW-CX did participate in and review the Northeast Cape Human Health and Ecological Risk Assessment. Although titled a FINAL document, transmittal was delayed until CX comments were received and addressed through additional modifications to the document.

Comment # 2: General comment. Some of the AOCs in this FS involve hazardous substances and others are strictly petroleum response actions. Feasibility Study requirements specified in CERCLA hazardous substance response process within 40 CFR 300 Subpart E do not apply to releases which are strictly petroleum because petroleum is neither a CERCLA "hazardous substance" nor "pollutant or contaminant". If the CERCLA process is being followed for petroleum responses for programmatic reasons, this should be explained in the document. Petroleum response actions should be limited to attaining applicable requirements only.

Response # 2:
Additional text added to Section 1.1 Purpose and Organization of Report as follows:

Although petroleum is not defined as a hazardous substance, pollutant, or contaminant under CERCLA, for administrative convenience the same process was utilized to evaluate potential remedial alternatives. The state of Alaska defines (A.S 46.03.826) hazardous substance to mean (A) an element or compound which, when it enters into the atmosphere or in or upon the water or surface or subsurface land of the state, presents an imminent and substantial danger to the public health or welfare, including but not limited to fish, animals, vegetation, or any part of the natural habitat in which they are found; (B) oil; or (C) a substance defined as a hazardous substance under 42 U.S.C. 9601(14). Oil is defined by statute to mean a derivative of a liquid hydrocarbon and includes crude oil, lubricating oil, sludge, oil refuse or another petroleum-related product or by-product;

Comment # 3: Page xiii, Executive Summary. This states, "The information presented in this feasibility study will be used to develop proposed alternatives for the Northeast Cape site in a future Proposed Plan document."

Recommend rewording the above quoted sentence to "The information within this FS will be used as the basis for proposing remedial alternatives for the North Cape site" since alternatives are developed in the FS, not the PP.

Response # 3:
Accepted, text revised.

Comment # 4: Page 1, section 1.1. The second paragraph states, "In accordance with Environmental Protection Agency (EPA) guidance, this FS is presented as a three-phase process to develop, screen, and analyze corrective measures for the site."

To be consistent with CERCLA terminology, it is recommended that the term "corrective measures" be replaced with "remedial action". This is recommended because "corrective measures" is a RCRA corrective action term, not CERCLA terminology.

Response # 4:
Accepted, text revised.

Comment # 5: Page 6, section 3.0. Regarding ARARs this states, "ARARs are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria or limitations, established under federal or state law, that specifically address or regulate a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance associated with the planned remedial actions"

This paraphrases the definition of an ARAR and in doing so changes it by not including state facility siting requirements and by incorrectly expanding ARARs to include associated circumstances. The actual definition of an ARAR uses the phrase "circumstances found at a CERCLA site" to limit ARARs to onsite circumstances, not "associated circumstances" which could be construed to include offsite activities. It is recommended that the above quoted sentence be replaced with the definitions from the NCP. Per 40 CFR 300.5, applicable

requirement means "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than Federal requirements may be applicable."
Relevant and appropriate requirement means "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate."

Response # 5:
Accepted, text revised.

Comment # 6: Page 6, section 3.0. This states, " If existing ARARs do not ensure protectiveness in all situations or site conditions, then advisories, criteria, or guidelines will be used as TBCs to set cleanup targets."

Delete the above quoted sentence. Cleanup levels should never default to TBCs because they are not enforceable standards. Because remedial action selection criteria require the selected remedy to be both protective of human health and the environment and to attain (or waive) ARARs, if ARARs are not protective, cleanup levels will be set based on risk assessment, not TBCs. TBCs may be considered, but should their status should not be elevated to a cleanup standard unless deemed necessary for protectiveness.

Response # 6:
Accepted, text revised.

Comment # 7: Page 6, section 3. This states, "ARARs and TBCs can be divided into three categories: (1) chemical-specific, (2) location-specific, and (3) action-specific."

Delete "and TBCs".

Response # 7:
Accepted, text revised.

Comment # 8: Page 6, section 3 and page 9, section 3.3. The discussion regarding action-specific ARARs lists "Identification and Listing of Hazardous Wastes (40 CFR Part 261 and 18 AAC 62)".

It appears from Appendix D, that this was added in response to a comment from the State. In the future, if similar comments are received from the State, the response should be that 40 CFR 261 is not an action-specific ARAR since it merely defines what constitutes a hazardous waste and therefore is not a substantive standard nor an ARAR. On the other hand, 18 AAC 62 includes substantive standards and is a potential ARAR, but only if hazardous waste is encountered.

Response # 8:
Comment noted.

Comment # 9: Page 19, Tables 3-6a, b, and c. These are tables regarding cleanup levels for ground water. Though not directly stated in the table, it is presumed these cleanup levels only apply where ground water is reasonably expected to be a potential source of drinking water (not to the shallow ground water). Since the referenced 18 AAC 75.345 only applies where it is reasonably expected that potential future use is drinking water, it is not clear why the State arsenic standard of 0.05 mg/kg, is being used instead of the more stringent MCL of 0.010 mg/kg..

Response # 9:
Tables revised. Arsenic is not considered a COC, therefore references to groundwater cleanup levels have been deleted and the discussion of state vs federal standard is not applicable.

Comment # 10: Page 24, Table 3-7. This proposes an alternate cleanup level for PCBs in sediment of 0.7 mg/kg based on a State of Washington reference. From an ARARs perspective, since this is an Alaska project, this is not relevant. I defer to Risk Assessors as to whether it is an appropriate use this reference on the basis of protectiveness.

Response # 10:
Comment noted.

Comment #11: Page 70, Table 7-2. This table refers to "contaminants of potential concern" and lists ACLs for the constituents. Related discussion implies some of the metals are likely background concentrations.

The document discusses COPCs, but not COCs. It is not clear whether CoCs are limited to petroleum or also include some or all of the metals. Document should clearly state CoCs and only establish cleanup levels for COCs.

Response # 11:
Table revised. Nature and extent of contamination discussed with respect to COPCs. New section on risk assessment clarifies COCs. Cleanup levels only established for COCs.

Comment #12: Page 71. Section 7.1.3 regarding nature and extent of contamination makes statements such as "Aluminum, arsenic, lead, nickel, and zinc in shallow groundwater were elevated in relation to the alternate cleanup levels. The most likely source of the detected metals is natural background". This implies these are not COCs, however, Table 7-2 lists ACLs for these constituents. Then section 7.1.7 only contains remedial action objectives for DROs and RROs. This is confusing. If metals are not CoCs, this should be clearly stated in the document.

Response # 12:
Metals were eliminated as COCs. Text revised to clarify.

Comment #13: Page 75. Regarding AOC B compliance with ARARs, this states, "The metals in shallow groundwater do not readily naturally attenuate" however in the protectiveness section is states, "The metals in shallow groundwater do not readily naturally attenuate, but may be due to naturally occurring levels in soil."

It is not clear whether metals are a factor when evaluating compliance with ARARs because it is not clear whether these are CoC. If they are not CoC's, there is no need to discuss them with respect to ARARs. Same comment applies to other alternative discussions.

Response # 13:
Text clarified to indicate metals not COCs, and shallow groundwater not a potential drinking water source at AOC B.

Comment #14: Page 97. Regarding AOC C and the natural attenuation alternative, this states "The metals in shallow groundwater would not comply with ARARs." It is not clear whether there are any ARARs for the shallow aquifer. Elsewhere in the document it implied that future use of shallow ground water is not drinking water. State standards in 18 ADEC 75 only apply if ground water is reasonably anticipated to become drinking water. Clarify if there are any ARARs for the shallow ground water. In the absence of ARARs, the alternative complies with ARARs. This same comment applies to other alternatives.

Response # 14:
Text clarified to indicate shallow groundwater not a complete exposure pathway at particular sites.

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PROJECT: Northeast Cape - FUDS **DOCUMENT:** Draft Feasibility Study , June 2006 **REVIEW COMMENTS** **LOCATION:** Northeast Cape, St. Lawrence Island, Alaska				
DATE: 09/21/06 **REVIEWER:** Morgan Apatiki **PHONE:** (907) 985-5011				
Item No.	**Location (page, par., sen.)**	**COMMENTS**	**Review** **A – Comment Accepted** **W – Comment Withdrawn** **N - Noted**	**Alaska District Response**
1.	xiii	In accordance with the Gambell Information Repository, provided by: Army Corps of Engineers (ACOE) Alaska District, the initial performances of Feasibility Studies, conducted by several Independent Contracting Companies, hired by ACOE's were actually began in between the Years of 1985-1994.		You are correct that there were environmental investigations beginning in 1985. The text will be corrected to reflect the occurrence of preliminary reconnaissance and Preliminary Assessment reports.
2.	Pg. 3, Sec. 1.2.3	The summaries of DATA Collections, regarding Analytical Sampling Results, performed by the Contractors mentioned above normally have the comparison (COPEC) analytical sampling-protocol results and in which have the indication of High Level of Contaminants Reports, and also were not listed or included in the History of Investigations, REF 1.2.3, Page 3, 1.1 Page 1, (16.0, Page 177-180).		Agreed, see response to comment 1.
3.	xiii	Criteria is the indication of the High/Wide Range of Contaminant Component and other compound elements stated in this Volume 1 section of documents and most of the accumulated organics are still intact and continued to be the Human Health Risk Factor. REF 6. Page 33.		Sorry, we do not understand the comment.
4.	Para 2	Of the seventeen Sites that are proposed for no further remedial action; I have no further information regarding the condition of the Sites, wherther they are on ground surface or subsurface. There are several of the controversial questions and statements listed in the following subsequent sections:		Comment noted.
5.	xiii. Para 2	-Did you ensure that the technical aspects of the RI/FS performances are thorough and logic to meet the standards and requirements of the ADEC CLEANUP LEVEL. REF 3.0 Page 2; 3.0 P-6.		We believe that we have.

PROJECT: Northeast Cape - FUDS **DOCUMENT:** Draft Feasibility Study , June 2006 **REVIEW COMMENTS** **LOCATION:** Northeast Cape, St. Lawrence Island, Alaska				
DATE: 09/21/06 **REVIEWER:** Morgan Apatiki **PHONE:** (907) 985-5011				
Item No.	**Location (page, par., sen.)**	**COMMENTS**	**Review** **A – Comment Accepted** **W – Comment Withdrawn** **N - Noted**	**Alaska District Response**
6.		What are the sites containments? It is questionable if some of the sites remain unidentified anomalies, due to inadequate characterization of the RI/FS performances in the past and come to the point where uncertainties remain. REF-3.4, Page 9. (5.0, Page 34)		The contaminants for each of the sites that are proposed for no further action are discussed beginning on page 34, Section 5.0.
7.		As I have work with Montgomery Watson Harza (MWH), CONDUCTING the RI/FS, during the Years 2000-2003, Their work performances were impertinent. I have more information in my previous review comments regarding their work perfomances during the years of my work with Army Corps of Engineers (ACOE), Alaska District, and-Sivuqaq Incorperated, Gambell, Alaska.		We recall some of your dissatisfaction with the work of MWH. We're sorry you feel this way, but we believe that MWH did a fine job for the most part.
8.		I'm sure some of the proposed for "NO FURTHER ACTION" be continued for monotering during your long term evaluation of the Environmental Impact Statement caused by Formerly Used Defense Sites, Hazardous Toxic Radioactive Waste-(HTRW), and I'm sure this Remedial Technology in next Phase will work things out well to determine the teleology of the RI/FS Analytical Sampling Protocol Results. REF 3.0, Page 6 and 3.1, Page 7.		For those sites where we have proposed no further action, there will be no further action if that remains the decision in the Proposed Plan and the subsequent Decision Document.
9.	5.1.2 Page 34	During the previous removal actions discussed in REF 5.1.2, Page 34 thru REF 14.2.2 Page 168, I don't know which Independent Contractor was conducting the remedial removal action, one of local hire from Savoonga was about to remove some material for containerizing, he was told not to, because the material was not on the list of removal and leave it there.		We cannot comment on this without knowing what was left behind.

PROJECT: Northeast Cape - FUDS **DOCUMENT:** Draft Feasibility Study , June 2006
REVIEW COMMENTS **LOCATION:** Northeast Cape, St. Lawrence Island, Alaska
DATE: 09/21/06 **REVIEWER:** Morgan Apatiki **PHONE:** (907) 985-5011

Item No.	Location (page, par., sen.)	COMMENTS	Review A – Comment Accepted W – Comment Withdrawn N - Noted	Alaska District Response
10.	5.1.3 Page 34	The Nature and Extent of Contamination on each Sites of Anomalies indicated duration of this VOLUME 1 DRAFT DOCUMENTS may have specific science and remedial technology to minimize some of the contaminants and also have the same version of measures and figures developed and pub-lised by (ACOE) in 1994.		We have not seen contamination at Site 1 that warrants further action.
11.	10.1.3 Page 116	In regards to noncancer risk estimate stated in this section; What about the Sites that have PCB and other highly Contaminant Components stated in Section 11.0,REF 11.3.1 thru 11.3.8, Pages 142-149; Sec. 12.0, REF 12.1, PAGE 152; SEC. 14.0, REF 14.3 thru 14.5.3, PAGES 168-172; and specifically FIGURE 11-1, viii.		The non-cancer risk in the Main Operations Complex and the Site 28 Drainage Basin remains at high levels. It appears that something needs to be done at these sites.
12.	3.1 Page 7	If the references listed in item 4, page 2 of this report, have been promulgated at the State of Alaska Level; Why could'nt the state expedite the Remedial Removal Action? Further stated in REF 3.0, Page 6.		Sorry, we do not understand the comment. The State doesn't have funding to conduct environmental cleanups.
13.	11.1.1 Page 135	Would you be more specific describing this heavy staining? What are the analysis results? Could it be the accumulation of petroleum products that are composed of DRO,GRO, RRO, kerosene, transformer fluid, benzine, benzene hexachloride, and other substance associated with military activities, and not to mention the U.S. Army vehicles and heavy equipment waste-oil.		The staining mentioned is describe color and analytical range of analyses

PROJECT: Northeast Cape - FUDS **DOCUMENT:** Draft Feasibility Study , June 2006 **REVIEW COMMENTS** **LOCATION:** Northeast Cape, St. Lawrence Island, Alaska				
DATE: 09/21/06 **REVIEWER:** Morgan Apatiki **PHONE:** (907) 985-5011				
Item No.	**Location (page, par., sen.)**	**COMMENTS**	**Review** **A – Comment Accepted** **W – Comment Withdrawn** **N - Noted**	**Alaska District Response**
14.	11.1.4 11.1.5 Page 139	The other form of potential human exposure pathways direct contact would be the inhalant volatile. The contamination can be activated during the extreme cold weather and can be radiant throughout the whole year. NOTE: LEGEND, FIGURE 4-1.		DRO, especially old DRO, is not very volatile and shouldn't be an inhalation concern (see Note 2, Figure 4-1)
15.	11.3.3 Page 144	How well can you conduct the natural attenuation? Will it be like a chemical oxidation, described on page 30?		Natural attenuation is described on page 28. It is, essentially, letting Mother Nature run its course. You don't really do anything. Chemical oxidation is a more involved action in which you actually introduce new components to the environment to speed remediation up.
16.		How can you possibly analyze the contribution from biogenic compounds?		By comparing the change in analytical chemistry over time, you can determine the effectiveness of natural remediation. The contribution of biogenic compounds in that remedial process could be estimated using certain modeling. But if natural attenuation became the selected remedy, we would likely just monitor the cleanup progress without getting too specific as to what is doing the cleaning.
17.	11.3.2 Page 143	Can this be publicized as well?		Sorry, we do not understand the comment.
18.	NOTE:	Review Comments time period should be appropriated according to its size or thickness. I assume this two (2) volume set should be reviewed for sixty (60) days.		The FS was released June 29. The original comment period was to close on August 17, roughly 45 days. The comment period was extended to September 15, making the total period roughly 75 days.
19.	GENERAL:	Continuous remedial action is promising. It is truly a long term progress of the RI/FS. I appreciate your concern. Thank You!		Comment noted.

United States Army
Corps of Engineers

Formerly Used Defense Sites Program

Feasibility Study

Northeast Cape FUDS
F10AK096903
St. Lawrence Island, Alaska

Final

Volume 2
Appendix C

March 2007

Prepared By:
U.S. Army Corps of Engineers - Alaska District
Environmental Engineering Branch
P.O. Box 6898
Elmendorf AFB, Alaska 99506-0898

Appendix C – RACER Cost Estimates

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Area of Concern A

Sites 3 and 4
Fuel Pumphouse and Pipeline

Folder Cost Summary Report

Note: This report shows first year costs.

Folder Cost Summary Report

System:

Version: 8.1.0
Database Location: C:\Documents and Settings\J4ENENJF\Application Data\Earth Tech\RACER 8.1\NE Cape FS.mdb

Folder:

Folder Name: NE Cape HTRW

FUDS Property:

FUDS Property ID: Sites 3 and 4 (Fuel Pumphouse and Pipeline)
FUDS Property Name: Fuel Pumphouse and Pipeline Alt. A
FUDS Property Category: None

Location
State / Country: ALASKA
City: SAVOONGA

Location Modifiers	Default	User
Material:	*1.929*	1.929
Labor:	*1.461*	1.461
Equipment:	*1.161*	1.161

Options
Database: Modified System
Cost Database Date: 2006
Report Option: Fiscal

Description

Northeast Cape is located on St. Lawrence Island in the Bering Sea, approximately 135 miles southwest of Nome, Alaska. The Village of Savoonga is the closest community, and is located approximately 60 miles northwest of Northeast Cape. The Northeast Cape site was acquired by the Air Force in 1952, and served as an Aircraft Control and Warning, and White Alice Communications System site. The former military installation operated from about 1954 until 1972. The site is currently owned by two Native corporations.

Site 3
The site is located just south of Cargo Beach on Kitnagak Bay. A 4-inch welded pipeline was used to transfer diesel fuel from the pumphouse to the bulk storage facilities at the housing and operations areas (Main Complex). The pumphouse is roughly 1.5 miles north of the main operating complex, and was situated on a gravel pad estimated to be approximately 2 feet thick. Three seasonal dwellings with associated fuel containers, all-terrain vehicles, and scrap machinery are located within 100 feet of the former pumphouse location. The site topography generally

Note: This report shows first year costs.

slopes north-northeast towards the beach. The area between the pumphouse and the beach consists of former dunes covered with tundra. The area south of the gravel pad appears to contain unconsolidated deposits, likely of glacial origin, with a thick tundra mat cover. Permafrost and ice-rich soil underlie the tundra.

Site 4
A native fishing and hunting camp is located southwest of the Cargo Beach barge landing area. The site includes wood frame structures originally constructed as housing for the native civilian employees of the base. Three structures are currently used by local residents for part of the year, the other structures are in disrepair due to inclement weather. Former sources of contamination at the site include two ASTs and abandoned vehicles.

Folder Cost Summary Report

Project:

Project ID: Alternative 2 (Institutional Controls)
Project Name: Alternative 2 (Institutional Controls)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Institutional controls are intended to limit and reduce impacts to human health and the environment. Institutional controls are usually land use restrictions that address the future use of the sites. Typical examples of institutional controls include deed, building, excavation and/or groundwater restrictions.

Institutional controls such as land use restrictions and the placement of warning signs at exposure areas are considered potentially applicable and may be implemented to protect human health from these exposures.

Institutional controls retained for further evaluation include the following:
Controls to prevent excavation in potentially contaminated soil.
Controls to prevent construction of buildings on top of potentially contaminated soil.
Placing signs at access points to the site to alert site residents and visitors to the presence of contaminants that could pose health risks.

The need for, and likelihood of, landowner acceptance and compliance with ICs is a consideration for those alternatives requiring them.

Support Team: NA
References: NA

Estimator Information

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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase allows for Institutional control planning, implementation, and enforcement.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
ADMINISTRATIVE LAND USE CONTROLS	Yes	100	0

Technologies:

Technology: ADMINISTRATIVE LAND USE CONTROLS (#1)

Comments: This Technology includes:
Institutional Control Planning
Institutional Control Implementation (Includes deed restrictions, access control signs, updating the city plan, etc.)
Institutional Control Enforcement (Includes a site visit every five years to verify that the site access control signs are in place)

	Direct Cost	Marked Up Cost
Total ADMINISTRATIVE LAND USE CONTROLS (#1)	**68,444**	**185,951**
Total Phase:	**68,444**	**185,951**
Total Project:	**68,444**	**185,951**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 3 (Natural Attenuation)
Project Name: Alternative 3 (Natural Attenuation)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Natural attenuation allows the natural subsurface process to continue to reduce contaminant concentration to acceptable levels. Natural attenuation can significantly limit the migration of contaminants resulting from releases of petroleum hydrocarbons. Biodegradation by indigenous subsurface microorganisms appears to be on the primary mechanisms for natural attenuation.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Signature: ______________________ **Date:** __________

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes Natural Attenuation to address the contamination at this site.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Natural Attenuation	Yes	100	0

Technologies:

Technology: Natural Attenuation (#1)

Comments: This technology allows for preliminary natural attenuation sampling (20 samples) and a natural attenuation report.

Groundwater and soil sampling is required.

All sampling to be performed by hand. Mobilization of a drill rig is not required.

	Direct Cost	Marked Up Cost
Total Natural Attenuation (#1)	84,893	211,813
Total Phase:	84,893	211,813
Total Project:	**84,893**	**211,813**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 4 (Long Term Monitoring)
Project Name: Alternative 4 (Long Term Monitoring)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☐
Operations & Maintenance: ☐
Long Term Monitoring: ☑
Site Closeout: ☐

Documentation

Description: Long term monitoring includes collecting soil and/or water samples from the impacted sites and analyzing for the contaminants of concern on an established time schedule. Analytical results are used to evaluate the contaminant degradation or check on the mobility.
Support Team: NA
References: NA

Estimator Information

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Estimate Prepared Date: 12/19/2005

Estimator Signature: ____________________ **Date:** __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ____________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Long Term Monitoring
Phase Name: LTM
Description: This phase utilizes long term monitoring to address the contamination at the site.

LTM will be performed for 25 years. One sampling event will be performed every five years.

No new monitoring wells will be installed. Existing wells will be sampled during this phase.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0

Technologies:

Technology: Monitoring (#1)
Comments: Year 1
This technology allows for the first round of sampling.

Three groundwater and three soil samples will be collected during this sampling event.

All sampling to be performed by hand. Mobilization of a drill rig is not required.

Direct Cost **Marked Up Cost**

Note: This report shows first year costs.

	Direct Cost	Marked Up Cost
Total Monitoring (#1)	**29,872**	**73,113**

Technology: Monitoring (#2)

Comments: Year 5

This technology allows for the second round of sampling.

Three groundwater samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#2)	**25,603**	**65,213**

Technology: Monitoring (#3)

Comments: Year 10

This technology allows for the third round of sampling.

Three groundwater samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#3)	**25,603**	**65,213**

Technology: Monitoring (#4)

Comments: Year 15

This technology allows for the fourth round of sampling.

Three groundwater samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#4)	**25,603**	**65,213**

Technology: Monitoring (#5)

Comments: Year 20

This technology allows for the fifth round of sampling.

Three groundwater samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#5)	**25,603**	**65,213**

Technology: Monitoring (#6)

Comments: Year 25

This technology allows for the sixth round of sampling.

Three groundwater and three soil samples will be collected during this sampling event.

All sampling to be performed by hand. Mobilization of a drill rig is not required.

	Direct Cost	Marked Up Cost
Total Monitoring (#6)	**29,872**	**73,113**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Phase:	**162,156**	**407,078**
Total Project:	**162,156**	**407,078**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 5 (Landfarming)
Project Name: Alternative 5 (Landfarming)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Landfarming aerates contaminated soil, sediment, or sludge by placing the excavated soil into lined beds, and periodically turning or tilling the soil. Soil conditions are often controlled to optimize the rate of contaminant degradation. Conditions normally controlled include:

Moisture content (usually by irrigation or spraying).
Aeration (by tilling and mixing).
pH (buffered near neutral pH by adding crushed limestone or agricultural lime).
Other amendments (e.g., Soil bulking agents, nutrients, etc.)

Contaminated media is usually treated in lifts that are up to 18 inches thick. When the desired level of treatment is achieved, the lift is removed and a new lift is constructed. The site would be managed properly to prevent both on-site and off-site problems with ground water, surface water, air, or food chain contamination. Adequate monitoring and environmental safeguards would be required.

Support Team: NA
References: NA

Estimator Information

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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ____________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes exsitu landfarming to address the contamination at this site.

A total of 60 CY will be excavated, treated, and backfilled.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MOBILIZATION/DEMOBILIZATION	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Excavation	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Note: This report shows first year costs.

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the landfarming activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 32 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Anchorage to NE Cape.

Includes airfare to mobilize a 5 person crew for the excavation and landfarming cell construction activities. Includes airfare to mobilize a 2 person crew every two weeks to perform the land farming activities. Perdiem is not shown here. It is included in field overhead technology.

Assume mobilization from Anchorage.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**693,020**	**893,647**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#2)

Comments: This technology allows for maintenance of a remote camp for a five person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#2)	**9,000**	**11,586**

Technology: Ex Situ Land Farming (#1)

Comments: This technology allows for the treatment of the contaminated soil by landfarming. The landfarming treatment duration will be 10 weeks. Tilling will be performed every two weeks.

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#1)	**45,790**	**64,389**

Technology: Excavation (#1)

Comments: This technology allows for the excavation of the contaminated soil at sites 3 and 4 (60 CY total) and backfill of treated soil.

The excavated soil will be placed in the landfarming treatment cells.

	Direct Cost	Marked Up Cost
Total Excavation (#1)	**5,140**	**6,922**

Technology: Site Close-Out Documentation (#2)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

Direct Cost **Marked Up Cost**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Site Close-Out Documentation (#2)	**11,549**	**34,867**

Technology: Professional Labor Management (#2)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#2)	**103,398**	**312,161**
Total Phase:	**867,897**	**1,323,571**
Total Project:	**867,897**	**1,323,571**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 7 (Thermal Treatment)
Project Name: Alternative 7 (Thermal Treatment)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Thermal Treatment processes use heat to increase the volatility (separation); burn, decompose, destruct; or melt the contaminants. Separation technologies include thermal desorption and hot gas decontamination. Destruction technologies include incineration, and pyrolysis. Vitrification immobilizes inorganics and destroys some organics. Thermal treatments offer quick cleanup times but are typically the most costly treatment group. This difference, however, is less in ex situ applications than in in situ applications. Cost is driven by energy and equipment costs and is both capital and O&M-intensive.

Support Team: NA
References: NA

Estimator Information

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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
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Business Address:
Telephone Number:

Note: This report shows first year costs.

Folder Cost Summary Report

Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes low temperature thermal desorption to address the contamination at this site.

A total of 60 CY will be excavated, treated, and backfilled.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Excavation	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
On-site Low Temp. Thermal Desorption	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#1)

Comments: This technology allows for maintenance of a remote camp for a 4 person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#1)	**4,800**	**6,179**

Folder Cost Summary Report

Technology: Excavation (#1)

Comments: This technology allows for the excavation of the contaminated soil at sites 3 and 4 (60 CY total) and backfill of treated soil.

	Direct Cost	Marked Up Cost
Total Excavation (#1)	**5,140**	**6,922**

Technology: MOBILIZATION/DEMOBILIZATION (#2)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the thermal treatment activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes one unit of barge at 32 days per round trip and 12 days standby at a lease rate based on communication with barging companies and contractors. This assumes 1 round trip Anchorage to NE Cape.

Includes airfare to mobilize a 4 person crew for the excavation and thermal treatment activities. Perdiem is not shown here. It is included in field overhead technology.

A small soil burner will be mobilized out of Anchorage due to the limited quantity of soil.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#2)	**617,190**	**796,027**

Technology: On-site Low Temp. Thermal Desorption (#1)

Comments: This technology allows for the thermal treatment of the contaminated soil. It is assumed that 1 CY = 1.5 tons.

	Direct Cost	Marked Up Cost
Total On-site Low Temp. Thermal Desorption (#1)	**48,104**	**61,927**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**92,887**	**280,428**
Total Phase:	**779,671**	**1,186,350**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Project:	**779,671**	**1,186,350**

Folder Cost Summary Report

Project:

Project ID: Alternative 6 (Phytoremediation)
Project Name: Alternative 6 (Phytoremediation)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Phytoremediation is a process that uses plants to remove, transfer, stabilize, and destroy contaminants in soil, sludge, sediment, and groundwater. Growing and, in some cases, harvesting plants grown on contaminated soil is a remediation method that can be used to clean sites with shallow contamination. Phytoremediation of deeper soils may be performed by excavation and building phytoremediation cells. Phytoremediation may be applicable for the remediation of metals, pesticides, solvents, petroleum products, PAHs, and landfill leachates.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

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Telephone Number:
Email Address:

Note: This report shows first year costs.

Folder Cost Summary Report

Date Reviewed:

Reviewer Signature: ______________________________ **Date:** ______________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes ex situ phytoremediation to address the contamination at this site.

A total of 60 CY will be excavated, treated, and backfilled.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Excavation	Yes	100	0
Phytoremediation	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Note: This report shows first year costs.

Folder Cost Summary Report

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the phytoremediation activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 32 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Anchorage to NE Cape.

Includes airfare to mobilize a 5 person crew for the excavation and phytoremediation cell construction activities. Perdiem is not shown here. It is included in field overhead technology.

Assume mobilization from Anchorage.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**686,720**	**885,537**

Technology: Ex Situ Land Farming (#1)

Comments: This technology allows for the construction of the phytoremediation cells.

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#1)	**29,634**	**41,143**

Technology: Excavation (#1)

Comments: This technology allows for the excavation of the contaminated soil at sites 3 and 4 (60 CY total) and backfill of treated soil.

The excavated soil will be placed in the phytoremediation treatment cells.

	Direct Cost	Marked Up Cost
Total Excavation (#1)	**5,140**	**6,922**

Technology: Phytoremediation (#1)

Comments: This technology allows for phytoremediation to treat the contaminated soil at this site.

Assume mobilization from Anchorage.

	Direct Cost	Marked Up Cost
Total Phytoremediation (#1)	**21,770**	**26,664**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#3)

Comments: This technology allows for maintenance of a remote camp for a five person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#3)	**3,000**	**3,862**

Folder Cost Summary Report

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**102,494**	**309,431**
Total Phase:	**860,308**	**1,308,426**
Total Project:	**860,308**	**1,308,426**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 8 (Off-site Treatment/Disposal)
Project Name: Alternative 8 (Off-site Treatment/Disposal)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Excavation using conventional earthmoving equipment is the common method of extracting contaminated soil at and below the ground surface. Off-site treatment or disposal includes transferring the contaminated soil to a facility that is capable of treating or disposing of the soil.
Support Team: NA
References: NA

Estimator Information

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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes off-site treatment/disposal to address the contamination at this site.

A total of 60 CY will be excavated and disposed of off site .

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Off-site Transportation and Waste Disposal	Yes	100	0
CONTAINER RENTAL	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Excavation	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#1)
Comments: This technology allows for maintenance of a remote camp for a four person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#1)	**2,400**	**3,090**

Folder Cost Summary Report

Technology: Off-site Transportation and Waste Disposal (#1)

Comments: This technology includes loading the contaminated soil into gaylord boxes, staging the gaylord boxes, transporting the boxes from the dock in Seattle to the disposal facility, and tipping fees at the facility. The barge transportation of the waste is accounted for in the Mob/Demod technology.

	Direct Cost	Marked Up Cost
Total Off-site Transportation and Waste Disposal (#1)	**8,867**	**11,436**

Technology: CONTAINER RENTAL (#2)

Comments: This technology allows for the rental of the gaylord boxes that the waste streams will be shipped in. The typical gaylord box has a capacity of 20 tons and rents for $10/day.

60 CY = 5 containers

A total of 5 boxes will be rented over the duration of the project.

	Direct Cost	Marked Up Cost
Total CONTAINER RENTAL (#2)	**2,400**	**3,090**

Technology: MOBILIZATION/DEMOBILIZATION (#3)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the removal action at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes one unit of barge at 46 days per round trip and 5 days standby at a lease rate based on communication with barging companies and contractors. This assumes 1 round trip Seattle to NE Cape.

This technology allows for the round trip transportation of the waste containers between Seattle and NE Cape. The standard barge has a 12,000 ton or 500 container capacity.

Includes airfare to mobilize a 4 person crew . Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#3)	**564,320**	**727,965**

Technology: Excavation (#2)

Comments: This technology allows for the excavation of the contaminated soil at sites 3 and 4 (60 CY total) and backfill.

Direct Cost **Marked Up Cost**

Note: This report shows first year costs.

Folder Cost Summary Report

	Direct Cost	Marked Up Cost
Total Excavation (#2)	**5,827**	**7,763**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**80,523**	**243,099**
Total Phase:	**675,886**	**1,031,309**
Total Project:	**675,886**	**1,031,309**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 9 (Chemical Oxidation)
Project Name: Alternative 9 (Chemical Oxidation)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Chemical oxidation is an in-situ treatment option for either soil and/or groundwater. This option chemically converts hazardous contaminants to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. The oxidizing agents most commonly used are ozone, hydrogen peroxide, hypochlorites, chlorine, and chlorine dioxide. The Chemical oxidants most commonly employed to date include peroxide, ozone, and permanganate. These oxidants have been able to cause the rapid and complete chemical destruction of many toxic organic chemicals; other organics are amenable to partial degradation as an aid to subsequent bioremediation. Field applications have clearly affirmed that matching the oxidant and in situ delivery system to the contaminants of concern (COCs) and the site conditions is the key to successful implementation and achieving performance goals.

Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
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Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:

Note: This report shows first year costs.

Folder Cost Summary Report

Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ____________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes chemical oxidation to address the contamination at this site.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Injection Wells	Yes	100	0
Permeable Barriers	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#1)

Comments: This technology allows for maintenance of a remote camp for a 4 person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#1)	**3,200**	**4,120**

Folder Cost Summary Report

Technology: Injection Wells (#1)

Comments: 25 injection wells will be installed for this alternative.

This technology allows for the installation of the wells and injection of the chemical oxidant.

	Direct Cost	Marked Up Cost
Total Injection Wells (#1)	**187,062**	**252,786**

Technology: Permeable Barriers (#1)

Comments: This technology allows for purchasing and shipping the chemical oxidant to Anchorage Alaska.

	Direct Cost	Marked Up Cost
Total Permeable Barriers (#1)	**41,753**	**54,225**

Technology: MOBILIZATION/DEMOBILIZATION (#2)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform chemical oxidation at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes one unit of barge at 32 days per round trip and 8 days standby at a lease rate based on communication with barging companies and contractors. This assumes 1 round trip Anchorage to NE Cape.

Includes airfare to mobilize a 4 person crew . Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#2)	**465,320**	**600,517**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**95,876**	**289,452**

Folder Cost Summary Report

Total Phase:	**804,760**	**1,235,966**
Total Project:	**804,760**	**1,235,966**
Total FUDS Property:	**4,304,015**	**6,890,465**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Folder:	**4,304,015**	**6,890,465**

Note: This report shows first year costs.

Area of Concern B

Site 6
Cargo Beach Road Former Drum Field

Scenario A

Folder Cost Summary Report

Note: This report shows first year costs.

Folder Cost Summary Report

System:

Version: 8.1.0
Database Location: C:\Documents and Settings\J4ENENJF\Application Data\Earth Tech\RACER 8.1\NE Cape FS.mdb

Folder:

Folder Name: NE Cape HTRW

FUDS Property:

FUDS Property ID: Site 6 (Drum Dump)
FUDS Property Name: Drum Dump Alt. A
FUDS Property Category: None

Location
State / Country: ALASKA
City: SAVOONGA

Location Modifiers	Default	User
Material:	*1.929*	1.929
Labor:	*1.461*	1.461
Equipment:	*1.161*	1.161

Options
Database: Modified System
Cost Database Date: 2006
Report Option: Fiscal

Description

Northeast Cape is located on St. Lawrence Island in the Bering Sea, approximately 135 miles southwest of Nome, Alaska. The Village of Savoonga is the closest community, and is located approximately 60 miles northwest of Northeast Cape. The Northeast Cape site was acquired by the Air Force in 1952, and served as an Aircraft Control and Warning, and White Alice Communications System site. The former military installation operated from about 1954 until 1972. The site is currently owned by two Native corporations.

Site 6
The Cargo Beach Road Drum Field is located west of Cargo Beach Road, approximately 0.6 mile south of the former fuel pumphouse, and north of the Cargo Beach Road landfill. The drum field was used primarily for the disposal of empty drums containing petroleum-oil-liquid (POL) products generated during the operation of the former installation. The surface deposits at the site resemble lodgment till, with relatively fine soils with cobbles exposed in the center of the site. The area to the west-northwest and south contain only boulders and large cobbles. Field observations

Note: This report shows first year costs.

indicated the area is subject to frost segregation, resulting in areas of uplifted fines and areas of rock. Soil staining has been observed in an area with fines and smaller particles, and most likely migrates with runoff to the west.

Folder Cost Summary Report

Project:

Project ID: Alternative 2 (Institutional Controls)
Project Name: Alternative 2 (Institutional Controls)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Institutional controls are intended to limit and reduce impacts to human health and the environment. Institutional controls are usually land use restrictions that address the future use of the sites. Typical examples of institutional controls include deed, building, excavation and/or groundwater restrictions.

Institutional controls such as land use restrictions and the placement of warning signs at exposure areas are considered potentially applicable and may be implemented to protect human health from these exposures.

Institutional controls retained for further evaluation include the following:
Controls to prevent excavation in potentially contaminated soil.
Controls to prevent construction of buildings on top of potentially contaminated soil.
Placing signs at access points to the site to alert site residents and visitors to the presence of contaminants that could pose health risks.

The need for, and likelihood of, landowner acceptance and compliance with ICs is a consideration for those alternatives requiring them.

Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
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Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase allows for Institutional control planning, implementation, and enforcement.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
ADMINISTRATIVE LAND USE CONTROLS	Yes	100	0

Technologies:

Technology: ADMINISTRATIVE LAND USE CONTROLS (#1)

Comments: This Technology includes:
Institutional Control Planning
Institutional Control Implementation (Includes deed restrictions, access control signs, updating the city plan, etc.)
Institutional Control Enforcement (Includes a site visit every five years to verify that the site access control signs are in place)

	Direct Cost	Marked Up Cost
Total ADMINISTRATIVE LAND USE CONTROLS (#1)	**68,444**	**185,951**
Total Phase:	**68,444**	**185,951**
Total Project:	**68,444**	**185,951**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 3 (Natural Attenuation)
Project Name: Alternative 3 (Natural Attenuation)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Natural attenuation allows the natural subsurface process to continue to reduce contaminant concentration to acceptable levels. Natural attenuation can significantly limit the migration of contaminants resulting from releases of petroleum hydrocarbons. Biodegradation by indigenous subsurface microorganisms appears to be on the primary mechanisms for natural attenuation.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
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Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ____________________ **Date:** __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Signature: ______________________ **Date:** __________

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes Natural Attenuation to address the contamination at this site.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Natural Attenuation	Yes	100	0

Technologies:

Technology: Natural Attenuation (#1)

Comments: This technology allows for preliminary natural attenuation sampling (20 samples) and a natural attenuation report.

Groundwater and soil sampling is required.

All sampling to be performed by hand. Mobilization of a drill rig is not required.

	Direct Cost	Marked Up Cost
Total Natural Attenuation (#1)	**84,893**	**211,813**
Total Phase:	**84,893**	**211,813**
Total Project:	**84,893**	**211,813**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 4 (Long Term Monitoring)
Project Name: Alternative 4 (Long Term Monitoring)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☐
Operations & Maintenance: ☐
Long Term Monitoring: ☑
Site Closeout: ☐

Documentation

Description: Long term monitoring includes collecting soil and/or water samples from the impacted sites and analyzing for the contaminants of concern on an established time schedule. Analytical results are used to evaluate the contaminant degradation or check on the mobility.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ____________________ **Date:** __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ____________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Long Term Monitoring
Phase Name: LTM
Description: This phase utilizes long term monitoring to address the contamination at the site.

LTM will be performed for 25 years. One sampling event will be performed every five years.

No new monitoring wells will be installed. Existing wells will be sampled during this phase.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0

Technologies:

Technology: Monitoring (#1)
Comments: Year 1
This technology allows for the first round of sampling.

Three groundwater and three soil samples will be collected during this sampling event.

All sampling to be performed by hand. Mobilization of a drill rig is not required.

Direct Cost **Marked Up Cost**

Note: This report shows first year costs.

Folder Cost Summary Report

	Direct Cost	Marked Up Cost
Total Monitoring (#1)	**29,872**	**73,113**

Technology: Monitoring (#2)

Comments: Year 5

This technology allows for the second round of sampling.

Three groundwater samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#2)	**25,603**	**65,213**

Technology: Monitoring (#3)

Comments: Year 10

This technology allows for the third round of sampling.

Three groundwater samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#3)	**25,603**	**65,213**

Technology: Monitoring (#4)

Comments: Year 15

This technology allows for the fourth round of sampling.

Three groundwater samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#4)	**25,603**	**65,213**

Technology: Monitoring (#5)

Comments: Year 20

This technology allows for the fifth round of sampling.

Three groundwater samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#5)	**25,603**	**65,213**

Technology: Monitoring (#6)

Comments: Year 25

This technology allows for the sixth round of sampling.

Three groundwater and three soil samples will be collected during this sampling event.

All sampling to be performed by hand. Mobilization of a drill rig is not required.

	Direct Cost	Marked Up Cost
Total Monitoring (#6)	**29,872**	**73,113**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Phase:	**162,156**	**407,078**
Total Project:	**162,156**	**407,078**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 6 (Phytoremediation)
Project Name: Alternative 6 (Phytoremediation)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Phytoremediation is a process that uses plants to remove, transfer, stabilize, and destroy contaminants in soil, sludge, sediment, and groundwater. Growing and, in some cases, harvesting plants grown on contaminated soil is a remediation method that can be used to clean sites with shallow contamination. Phytoremediation of deeper soils may be performed by excavation and building phytoremediation cells. Phytoremediation may be applicable for the remediation of metals, pesticides, solvents, petroleum products, PAHs, and landfill leachates.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:

Note: This report shows first year costs.

Folder Cost Summary Report

Date Reviewed:

Reviewer Signature: ________________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes ex situ Phytoremediation to address the contamination at this site.

A total of 1050 CY will be excavated, treated, and backfilled.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Phytoremediation	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Excavation	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: Phytoremediation (#1)

Comments: This technology allows for phytoremediation to treat the contaminated soil at this site.

	Direct Cost	Marked Up Cost
Total Phytoremediation (#1)	**26,614**	**33,298**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the phytoremediation activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 32 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Anchorage to NE Cape.

Includes airfare to mobilize a 5 person crew for the excavation and phytoremediation cell construction activities. Perdiem is not shown here. It is included in field overhead technology.

Assume mobilization from Anchorage.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**686,720**	**885,537**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#3)

Comments: This technology allows for maintenance of a remote camp for a 5 person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#3)	**5,000**	**6,437**

Technology: Excavation (#2)

Comments: This technology allows for the excavation of the contaminated soil at site 6 (1050CY total) and backfill of treated soil.

The excavated soil will be placed in the phytoremediation cells.

	Direct Cost	Marked Up Cost
Total Excavation (#2)	**27,138**	**37,041**

Technology: Ex Situ Land Farming (#2)

Comments: This technology allows for the construction of the phytoremediation cells.

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#2)	**172,431**	**234,949**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost

Note: This report shows first year costs.

Folder Cost Summary Report

Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**125,708**	**379,515**
Total Phase:	**1,055,160**	**1,611,644**
Total Project:	**1,055,160**	**1,611,644**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 5 (Landfarming)
Project Name: Alternative 5 (Landfarming)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Landfarming aerates contaminated soil, sediment, or sludge by placing the excavated soil into lined beds, and periodically turning or tilling the soil. Soil conditions are often controlled to optimize the rate of contaminant degradation. Conditions normally controlled include:

Moisture content (usually by irrigation or spraying).
Aeration (by tilling and mixing).
pH (buffered near neutral pH by adding crushed limestone or agricultural lime).
Other amendments (e.g., Soil bulking agents, nutrients, etc.)

Contaminated media is usually treated in lifts that are up to 18 inches thick. When the desired level of treatment is achieved, the lift is removed and a new lift is constructed. The site would be managed properly to prevent both on-site and off-site problems with ground water, surface water, air, or food chain contamination. Adequate monitoring and environmental safeguards would be required.

Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes exsitu landfarming to address the contamination at this site.

A total of 1050 CY will be excavated, treated, and backfilled.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MOBILIZATION/DEMOBILIZATION	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Excavation	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Note: This report shows first year costs.

Folder Cost Summary Report

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the landfarming activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 32 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Anchorage to NE Cape.

Includes airfare to mobilize a 5 person crew for the excavation and landfarming cell construction activities. Includes airfare to mobilize a 2 person crew every two weeks to perform the land farming activities. Perdiem is not shown here. It is included in field overhead technology.

Assume mobilization from Anchorage.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**693,920**	**894,806**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#2)

Comments: This technology allows for maintenance of a remote camp for a 5 person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#2)	**11,000**	**14,161**

Technology: Ex Situ Land Farming (#1)

Comments: This technology allows for the treatment of the contaminated soil by landfarming. The landfarming treatment duration will be 10 weeks. Tilling will be performed every two weeks.

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#1)	**193,001**	**264,174**

Technology: Excavation (#1)

Comments: This technology allows for the excavation of the contaminated soil at site 6 (1050CY total) and backfill of treated soil.

The excavated soil will be placed in the landfarming treatment cells.

	Direct Cost	Marked Up Cost
Total Excavation (#1)	**27,138**	**37,041**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost

Note: This report shows first year costs.

Folder Cost Summary Report

Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**126,676**	**382,437**
Total Phase:	**1,063,284**	**1,627,485**
Total Project:	**1,063,284**	**1,627,485**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 7 (Thermal Treatment)
Project Name: Alternative 7 (Thermal Treatment)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Thermal Treatment processes use heat to increase the volatility (separation); burn, decompose, destruct; or melt the contaminants. Separation technologies include thermal desorption and hot gas decontamination. Destruction technologies include incineration, and pyrolysis. Vitrification immobilizes inorganics and destroys some organics. Thermal treatments offer quick cleanup times but are typically the most costly treatment group. This difference, however, is less in ex situ applications than in in situ applications. Cost is driven by energy and equipment costs and is both capital and O&M-intensive.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:

Note: This report shows first year costs.

Folder Cost Summary Report

Email Address:
Date Reviewed:

Reviewer Signature: ____________________________ **Date:** ______________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes low temperature thermal desorption to treat the contaminated soil at this site.

A total of 1050 CY will be excavated, treated, and backfilled.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MOBILIZATION/DEMOBILIZATION	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
On-site Low Temp. Thermal Desorption	Yes	100	0
Excavation	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Note: This report shows first year costs.

Folder Cost Summary Report

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the thermal treatment activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes one round trip of barge (32 days) and standby at a lease rate based on communication with barging companies and contractors. This assumes 1 round trip Anchorage to NE Cape and 18 days of standby at NE Cape while the work is being performed.

Includes airfare to mobilize a 4 person crew for the excavation and thermal treatment activities. Perdiem is not shown here. It is included in field overhead technology.

Soil burner will be mobilized out of Seattle

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**1,121,501**	**1,445,253**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#2)

Comments: This technology allows for maintenance of a remote camp for a four person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#2)	**8,000**	**10,299**

Technology: On-site Low Temp. Thermal Desorption (#1)

Comments: This technology allows for the thermal treatment of the contaminated soil. It is assumed that 1 CY = 1.5 tons.

	Direct Cost	Marked Up Cost
Total On-site Low Temp. Thermal Desorption (#1)	**294,431**	**379,036**

Technology: Excavation (#2)

Comments: This technology allows for the excavation of the contaminated soil at site 6 (1050CY total) and backfill of treated soil.

	Direct Cost	Marked Up Cost
Total Excavation (#2)	**27,138**	**37,041**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

Direct Cost **Marked Up Cost**

Note: This report shows first year costs.

Folder Cost Summary Report

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**139,461**	**421,033**
Total Phase:	**1,602,079**	**2,327,529**
Total Project:	**1,602,079**	**2,327,529**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 8 (Off-site Treatment/Disposal)
Project Name: Alternative 8 (Off-site Treatment/Disposal)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Excavation using conventional earthmoving equipment is the common method of extracting contaminated soil at and below the ground surface. Off-site treatment or disposal includes transferring the contaminated soil to a facility that is capable of treating or disposing of the soil.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
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Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes off-site treatment/disposal to address the contamination at this site.

A total of 1050 CY will be excavated and disposed of off site

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Excavation	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Off-site Transportation and Waste Disposal	Yes	100	0
CONTAINER RENTAL	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: Excavation (#1)
Comments: This technology allows for the excavation of the contaminated soil at site 6 (1050CY total) and backfill.

	Direct Cost	Marked Up Cost
Total Excavation (#1)	**37,988**	**50,333**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#2)

Comments: This technology allows for maintenance of a remote camp for a five person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#2)	**4,000**	**5,149**

Technology: Off-site Transportation and Waste Disposal (#1)

Comments: This technology includes loading the contaminated soil into gaylord boxes, staging the gaylord boxes, transporting the boxes from the dock in Seattle to the disposal facility, and tipping fees at the facility. The barge transportation of the waste is accounted for in the Mob/Demod technology.

	Direct Cost	Marked Up Cost
Total Off-site Transportation and Waste Disposal (#1)	**156,014**	**201,199**

Technology: CONTAINER RENTAL (#3)

Comments: This technology allows for the rental of the gaylord boxes that the waste streams will be shipped in. The typical gaylord box has a capacity of 20 tons and rents for $10/day.

1050 CY = 79 containers

A total of 79 boxes will be rented over the duration of the project.

	Direct Cost	Marked Up Cost
Total CONTAINER RENTAL (#3)	**42,976**	**55,325**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: MOBILIZATION/DEMOBILIZATION (#4)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the removal action at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes one unit of barge at 46 days per round trip and 8 days standby at a lease rate based on communication with barging companies and contractors. This assumes 1 round trip Seattle to NE Cape.

This technology allows for the round trip transportation of the waste containers between Seattle and NE Cape. The standard barge has a 12,000 ton or 500 container capacity.

Includes airfare to mobilize a 5 person crew . Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#4)	**592,220**	**763,882**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**114,252**	**344,928**
Total Phase:	**958,998**	**1,455,684**
Total Project:	**958,998**	**1,455,684**
Total FUDS Property:	**4,995,014**	**7,827,183**

Folder Cost Summary Report

Total Folder:	**4,995,014**	**7,827,183**

Note: This report shows first year costs.

Area of Concern B

Site 6
Cargo Beach Road Former Drum Field

Scenario B

Folder Cost Summary Report

Folder Cost Summary Report

System:

Version: 8.1.0
Database Location: C:\Documents and Settings\J4ENENJF\Application Data\Earth Tech\RACER 8.1\NE Cape FS.mdb

Folder:

Folder Name: NE Cape HTRW

FUDS Property:

FUDS Property ID: Site 6 (Drum Dump)
FUDS Property Name: Drum Dump Alt. B
FUDS Property Category: None

Location
State / Country: ALASKA
City: SAVOONGA

Location Modifiers	Default	User
Material:	*1.929*	1.929
Labor:	*1.461*	1.461
Equipment:	*1.161*	1.161

Options
Database: Modified System
Cost Database Date: 2006
Report Option: Fiscal

Description

Northeast Cape is located on St. Lawrence Island in the Bering Sea, approximately 135 miles southwest of Nome, Alaska. The Village of Savoonga is the closest community, and is located approximately 60 miles northwest of Northeast Cape. The Northeast Cape site was acquired by the Air Force in 1952, and served as an Aircraft Control and Warning, and White Alice Communications System site. The former military installation operated from about 1954 until 1972. The site is currently owned by two Native corporations.

Site 6
The Cargo Beach Road Drum Field is located west of Cargo Beach Road, approximately 0.6 mile south of the former fuel pumphouse, and north of the Cargo Beach Road landfill. The drum field was used primarily for the disposal of empty drums containing petroleum-oil-liquid (POL) products generated during the operation of the former installation. The surface deposits at the site resemble lodgment till, with relatively fine soils with cobbles exposed in the center of the site. The area to the west-northwest and south contain only boulders and large cobbles. Field observations

Note: This report shows first year costs.

indicated the area is subject to frost segregation, resulting in areas of uplifted fines and areas of rock. Soil staining has been observed in an area with fines and smaller particles, and most likely migrates with runoff to the west.

Folder Cost Summary Report

Project:

Project ID: Alternative 2 (Institutional Controls)
Project Name: Alternative 2 (Institutional Controls)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Institutional controls are intended to limit and reduce impacts to human health and the environment. Institutional controls are usually land use restrictions that address the future use of the sites. Typical examples of institutional controls include deed, building, excavation and/or groundwater restrictions.

Institutional controls such as land use restrictions and the placement of warning signs at exposure areas are considered potentially applicable and may be implemented to protect human health from these exposures.

Institutional controls retained for further evaluation include the following:
Controls to prevent excavation in potentially contaminated soil.
Controls to prevent construction of buildings on top of potentially contaminated soil.
Placing signs at access points to the site to alert site residents and visitors to the presence of contaminants that could pose health risks.

The need for, and likelihood of, landowner acceptance and compliance with ICs is a consideration for those alternatives requiring them.

Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ______________

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** __________

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase allows for Institutional control planning, implementation, and enforcement.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
ADMINISTRATIVE LAND USE CONTROLS	Yes	100	0

Technologies:

Technology: ADMINISTRATIVE LAND USE CONTROLS (#1)

Comments: This Technology includes:
Institutional Control Planning
Institutional Control Implementation (Includes deed restrictions, access control signs, updating the city plan, etc.)
Institutional Control Enforcement (Includes a site visit every five years to verify that the site access control signs are in place)

	Direct Cost	Marked Up Cost
Total ADMINISTRATIVE LAND USE CONTROLS (#1)	**68,444**	**185,951**
Total Phase:	**68,444**	**185,951**
Total Project:	**68,444**	**185,951**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 3 (Natural Attenuation)
Project Name: Alternative 3 (Natural Attenuation)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Natural attenuation allows the natural subsurface process to continue to reduce contaminant concentration to acceptable levels. Natural attenuation can significantly limit the migration of contaminants resulting from releases of petroleum hydrocarbons. Biodegradation by indigenous subsurface microorganisms appears to be on the primary mechanisms for natural attenuation.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Signature: ______________________ **Date:** __________

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes Natural Attenuation to address the contamination at this site.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Natural Attenuation	Yes	100	0

Technologies:

Technology: Natural Attenuation (#1)

Comments: This technology allows for preliminary natural attenuation sampling (20 samples) and a natural attenuation report.

Groundwater and soil sampling is required.

All sampling to be performed by hand. Mobilization of a drill rig is not required.

	Direct Cost	Marked Up Cost
Total Natural Attenuation (#1)	**84,893**	**211,813**
Total Phase:	**84,893**	**211,813**
Total Project:	**84,893**	**211,813**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 4 (Long Term Monitoring)
Project Name: Alternative 4 (Long Term Monitoring)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☐
Operations & Maintenance: ☐
Long Term Monitoring: ☑
Site Closeout: ☐

Documentation

Description: Long term monitoring includes collecting soil and/or water samples from the impacted sites and analyzing for the contaminants of concern on an established time schedule. Analytical results are used to evaluate the contaminant degradation or check on the mobility.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ____________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ____________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Long Term Monitoring
Phase Name: LTM
Description: This phase utilizes long term monitoring to address the contamination at the site.

LTM will be performed for 25 years. One sampling event will be performed every five years.

No new monitoring wells will be installed. Existing wells will be sampled during this phase.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0

Technologies:

Technology: Monitoring (#1)
Comments: Year 1
This technology allows for the first round of sampling.

Three groundwater and three soil samples will be collected during this sampling event.

All sampling to be performed by hand. Mobilization of a drill rig is not required.

Direct Cost **Marked Up Cost**

Note: This report shows first year costs.

	Direct Cost	Marked Up Cost
Total Monitoring (#1)	**29,872**	**73,113**

Technology: Monitoring (#2)

Comments: Year 5
This technology allows for the second round of sampling.

Three groundwater samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#2)	**25,603**	**65,213**

Technology: Monitoring (#3)

Comments: Year 10
This technology allows for the third round of sampling.

Three groundwater samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#3)	**25,603**	**65,213**

Technology: Monitoring (#4)

Comments: Year 15
This technology allows for the fourth round of sampling.

Three groundwater samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#4)	**25,603**	**65,213**

Technology: Monitoring (#5)

Comments: Year 20
This technology allows for the fifth round of sampling.

Three groundwater samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#5)	**25,603**	**65,213**

Technology: Monitoring (#6)

Comments: Year 25
This technology allows for the sixth round of sampling.

Three groundwater and three soil samples will be collected during this sampling event.

All sampling to be performed by hand. Mobilization of a drill rig is not required.

	Direct Cost	Marked Up Cost
Total Monitoring (#6)	**29,872**	**73,113**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Phase:	**162,156**	**407,078**
Total Project:	**162,156**	**407,078**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 6 (Phytoremediation)
Project Name: Alternative 6 (Phytoremediation)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Phytoremediation is a process that uses plants to remove, transfer, stabilize, and destroy contaminants in soil, sludge, sediment, and groundwater. Growing and, in some cases, harvesting plants grown on contaminated soil is a remediation method that can be used to clean sites with shallow contamination. Phytoremediation of deeper soils may be performed by excavation and building phytoremediation cells. Phytoremediation may be applicable for the remediation of metals, pesticides, solvents, petroleum products, PAHs, and landfill leachates.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
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Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:

Note: This report shows first year costs.

Folder Cost Summary Report

Date Reviewed:

Reviewer Signature: ____________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes ex situ Phytoremediation to address the contamination at this site.

A total of 7600 CY will be excavated. It is assumed that 75% of the excavated soil will require treatment (5700 CY).

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Phytoremediation	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Excavation	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Folder Cost Summary Report

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the phytoremediation activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 32 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Anchorage to NE Cape.

Includes airfare to mobilize a 7 person crew for the excavation and phytoremediation cell construction activities. Perdiem is not shown here. It is included in field overhead technology.

Assume mobilization from Anchorage.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**690,320**	**890,171**

Technology: Phytoremediation (#1)

Comments: This technology allows for phytoremediation to treat the contaminated soil at this site.

	Direct Cost	Marked Up Cost
Total Phytoremediation (#1)	**55,378**	**72,242**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#3)

Comments: This technology allows for maintenance of a remote camp for a seven person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#3)	**11,000**	**14,161**

Technology: Ex Situ Land Farming (#2)

Comments: This technology allows for the construction of the phytoremediation cells.

A total of 7600 CY will be excavated. It is assumed that 75% of the excavated soil will require treatment (5700 CY).

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#2)	**729,213**	**981,303**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Excavation (#2)

Comments: This technology allows for the excavation of the contaminated soil at site 6 (7600 CY total) and backfill of treated soil.

A total of 7600 CY will be excavated. It is assumed that 75% of the excavated soil will require treatment (5700 CY).

	Direct Cost	Marked Up Cost
Total Excavation (#2)	**171,862**	**234,847**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**159,170**	**480,536**
Total Phase:	**1,828,491**	**2,708,126**
Total Project:	**1,828,491**	**2,708,126**

Folder Cost Summary Report

Project:

Project ID: Alternative 5 (Landfarming)
Project Name: Alternative 5 (Landfarming)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Landfarming aerates contaminated soil, sediment, or sludge by placing the excavated soil into lined beds, and periodically turning or tilling the soil. Soil conditions are often controlled to optimize the rate of contaminant degradation. Conditions normally controlled include:

Moisture content (usually by irrigation or spraying).
Aeration (by tilling and mixing).
pH (buffered near neutral pH by adding crushed limestone or agricultural lime).
Other amendments (e.g., Soil bulking agents, nutrients, etc.)

Contaminated media is usually treated in lifts that are up to 18 inches thick. When the desired level of treatment is achieved, the lift is removed and a new lift is constructed. The site would be managed properly to prevent both on-site and off-site problems with ground water, surface water, air, or food chain contamination. Adequate monitoring and environmental safeguards would be required.

Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes exsitu landfarming to address the contamination at this site.

A total of 7600 CY will be excavated. It is assumed that 75% of the excavated soil will require treatment (5700 CY).

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MOBILIZATION/DEMOBILIZATION	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Excavation	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Note: This report shows first year costs.

Folder Cost Summary Report

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the landfarming activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 32 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Anchorage to NE Cape.

Includes airfare to mobilize a 7 person crew for the excavation and landfarming cell construction activities. Includes airfare to mobilize a 2 person crew every two weeks to perform the land farming activities. Perdiem is not shown here. It is included in field overhead technology.

Assume mobilization from Anchorage.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**695,720**	**897,123**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#2)

Comments: This technology allows for maintenance of a remote camp for a seven person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#2)	**17,000**	**21,885**

Technology: Ex Situ Land Farming (#1)

Comments: This technology allows for the treatment of the contaminated soil by landfarming. The landfarming treatment duration will be 10 weeks. Tilling will be performed every two weeks.

A total of 7600 CY will be excavated. It is assumed that 75% of the excavated soil will require treatment (5700 CY).

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#1)	**729,213**	**981,303**

Technology: Excavation (#1)

Comments: This technology allows for the excavation of the contaminated soil at site 6 (7600 CY total) and backfill of treated soil.

A total of 7600 CY will be excavated. It is assumed that 75% of the excavated soil will require treatment (5700 CY).

	Direct Cost	Marked Up Cost
Total Excavation (#1)	**171,862**	**234,847**

Folder Cost Summary Report

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**154,977**	**467,876**
Total Phase:	**1,780,321**	**2,637,901**
Total Project:	**1,780,321**	**2,637,901**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 7 (Thermal Treatment)
Project Name: Alternative 7 (Thermal Treatment)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Thermal Treatment processes use heat to increase the volatility (separation); burn, decompose, destruct; or melt the contaminants. Separation technologies include thermal desorption and hot gas decontamination. Destruction technologies include incineration, and pyrolysis. Vitrification immobilizes inorganics and destroys some organics. Thermal treatments offer quick cleanup times but are typically the most costly treatment group. This difference, however, is less in ex situ applications than in in situ applications. Cost is driven by energy and equipment costs and is both capital and O&M-intensive.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
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Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:

Note: This report shows first year costs.

Folder Cost Summary Report

Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes low temperature thermal desorption to treat the contaminated soil at this site.

A total of 7600 CY will be excavated. It is assumed that 75% of the excavated soil will require treatment (5700 CY).

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MOBILIZATION/DEMOBILIZATION	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
On-site Low Temp. Thermal Desorption	Yes	100	0
Excavation	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Folder Cost Summary Report

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the thermal treatment activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 32 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Anchorage to NE Cape.

Includes airfare to mobilize a 7 person crew for the excavation and thermal treatment activities. Perdiem is not shown here. It is included in field overhead technology.

Soil burner will be mobilized out of Seattle

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**1,247,501**	**1,607,460**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#2)

Comments: This technology allows for maintenance of a remote camp for a seven person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#2)	**33,000**	**42,483**

Technology: On-site Low Temp. Thermal Desorption (#1)

Comments: This technology allows for the thermal treatment of the contaminated soil. It is assumed that 1 CY = 1.5 tons.

	Direct Cost	Marked Up Cost
Total On-site Low Temp. Thermal Desorption (#1)	**977,565**	**1,258,470**

Technology: Excavation (#2)

Comments: This technology allows for the excavation of the contaminated soil at site 6 (7600 CY total) and backfill of treated soil.

A total of 7600 CY will be excavated. It is assumed that 75% of the excavated soil will require treatment (5700 CY).

	Direct Cost	Marked Up Cost
Total Excavation (#2)	**171,862**	**234,847**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

Direct Cost **Marked Up Cost**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Site Close-Out Documentation (#1)	11,549	34,867

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	232,795	702,810
Total Phase:	2,674,271	3,880,937
Total Project:	**2,674,271**	**3,880,937**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 8 (Off-site Treatment/Disposal)
Project Name: Alternative 8 (Off-site Treatment/Disposal)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Excavation using conventional earthmoving equipment is the common method of extracting contaminated soil at and below the ground surface. Off-site treatment or disposal includes transferring the contaminated soil to a facility that is capable of treating or disposing of the soil.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ____________________ **Date:** __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ____________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes off-site treatment/disposal to address the contamination at this site.

A total of 7600 CY will be excavated. It is assumed that 75% of the excavated soil will require treatment/disposal (5700 CY).

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Off-site Transportation and Waste Disposal	Yes	100	0
CONTAINER RENTAL	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Excavation	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#1)

Comments: This technology allows for maintenance of a remote camp for a five person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#1)	**9,000**	**11,586**

Folder Cost Summary Report

Technology: Off-site Transportation and Waste Disposal (#1)

Comments: This technology includes loading the contaminated soil into gaylord boxes, staging the gaylord boxes, transporting the boxes from the dock in Seattle to the disposal facility, and tipping fees at the facility. The barge transportation of the waste is accounted for in the Mob/Demod technology.

	Direct Cost	Marked Up Cost
Total Off-site Transportation and Waste Disposal (#1)	**842,412**	**1,086,407**

Technology: CONTAINER RENTAL (#2)

Comments: This technology allows for the rental of the gaylord boxes that the waste streams will be shipped in. The typical gaylord box has a capacity of 20 tons and rents for $10/day.

5700 CY = 428 containers

A total of 428 boxes will be rented over the duration of the project.

	Direct Cost	Marked Up Cost
Total CONTAINER RENTAL (#2)	**273,920**	**352,632**

Technology: MOBILIZATION/DEMOBILIZATION (#3)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the removal action at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 46 days per round trip and 8 days standby (each) at a lease rate based on communication with barging companies and contractors. This assumes 2 round trip Seattle to NE Cape.

This technology allows for the round trip transportation of the waste containers between Seattle and NE Cape. The standard barge has a 12,000 ton or 500 container capacity.

Includes airfare to mobilize a 5 person crew . Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#3)	**1,078,220**	**1,389,535**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Excavation (#2)

Comments: This technology allows for the excavation of the contaminated soil at site 6 (7600 CY total) and backfill.

A total of 7600 CY will be excavated. It is assumed that 75% of the excavated soil will require treatment (5700 CY).

	Direct Cost	Marked Up Cost
Total Excavation (#2)	**248,526**	**328,763**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**234,907**	**709,187**
Total Phase:	**2,698,534**	**3,912,976**
Total Project:	**2,698,534**	**3,912,976**
Total FUDS Property:	**9,297,111**	**13,944,781**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Folder:	**9,297,111**	**13,944,781**

Note: This report shows first year costs.

Area of Concern C

Sites 7 and 9
Landfills

Folder Cost Summary Report

Note: This report shows first year costs.

Folder Cost Summary Report

System:

Version: 8.1.0
Database Location: C:\Documents and Settings\J4ENENJF\Application Data\Earth Tech\RACER 8.1\NE Cape FS.mdb

Folder:

Folder Name: NE Cape HTRW

FUDS Property:

FUDS Property ID: Sites 7 and 9 (Landfills)
FUDS Property Name: Landfills
FUDS Property Category: None

Location
State / Country: ALASKA
City: SAVOONGA

Location Modifiers	Default	User
Material:	*1.929*	1.929
Labor:	*1.461*	1.461
Equipment:	*1.161*	1.161

Options
Database: Modified System
Cost Database Date: 2006
Report Option: Fiscal

Description

Northeast Cape is located on St. Lawrence Island in the Bering Sea, approximately 135 miles southwest of Nome, Alaska. The Village of Savoonga is the closest community, and is located approximately 60 miles northwest of Northeast Cape. The Northeast Cape site was acquired by the Air Force in 1952, and served as an Aircraft Control and Warning, and White Alice Communications System site. The former military installation operated from about 1954 until 1972. The site is currently owned by two Native corporations.

Site 7
The Cargo Beach Road Landfill is located approximately 0.8 mile south of the Cargo Beach, midway between the main operations complex and the beach. The unpermitted landfill was used at the installation's solid waste disposal area from 1965 until closure in 1974 and contains a wide variety of materials. The landfill appears to have been created by dumping debris off the sides of a large glacial drumlin. The debris was apparently covered by frequently grading soil out from the top of the drumlin.

Note: This report shows first year costs.

Folder Cost Summary Report

Site 9
Site 9 is located approximately 500 feet northeast of the main complex. The landfill was a waste disposal area from 1952 until 1965 and contains miscellaneous metal debris, drums and other trash.

Folder Cost Summary Report

Project:

Project ID: Alternative 2 (Institutional Controls)
Project Name: Alternative 2 (Institutional Controls)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Institutional controls are intended to limit and reduce impacts to human health and the environment. Institutional controls are usually land use restrictions that address the future use of the sites. Typical examples of institutional controls include deed, building, excavation and/or groundwater restrictions.

Institutional controls such as land use restrictions and the placement of warning signs at exposure areas are considered potentially applicable and may be implemented to protect human health from these exposures.

Institutional controls retained for further evaluation include the following:
Controls to prevent excavation in potentially contaminated soil.
Controls to prevent construction of buildings on top of potentially contaminated soil.
Placing signs at access points to the site to alert site residents and visitors to the presence of contaminants that could pose health risks.

The need for, and likelihood of, landowner acceptance and compliance with ICs is a consideration for those alternatives requiring them.

Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________________ **Date:** ______________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type:	Remedial Action
Phase Name:	RA-C
Description:	This phase allows for Institutional control planning, implementation, and enforcement. This phase also includes site access controls at both landfill sites.

Media/Waste Type

Primary:	Soil
Secondary:	Groundwater

Contaminant

Primary:	Fuels
Secondary:	Metals
Approach:	None
Start Date:	October, 2006

Rate Groups

Labor:	System Labor Rate
Analysis:	System Analysis Rate
Phase Markups:	System Defaults

Technology Markups	Markup	% Prime	% Sub.
ADMINISTRATIVE LAND USE CONTROLS	Yes	100	0
Fencing	Yes	100	0
Fencing	Yes	100	0

Technologies:

Technology: ADMINISTRATIVE LAND USE CONTROLS (#1)

Comments: This Technology includes:
Institutional Control Planning
Institutional Control Implementation (Includes deed restrictions, access control signs, updating the city plan, etc.)
Institutional Control Enforcement (Includes a site visit every five years to verify that the site access control signs are in place)

	Direct Cost	Marked Up Cost
Total ADMINISTRATIVE LAND USE CONTROLS (#1)	**68,444**	**183,960**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Fencing (#1)

Comments: This technology allows for the installation of a security fence around the perimeter of the Site 7 landfill.

Perimeter = 2,500 feet

	Direct Cost	Marked Up Cost
Total Fencing (#1)	**136,009**	**190,303**

Technology: Fencing (#2)

Comments: This technology allows for the installation of a security fence around the perimeter of the Site 9 landfill.

Perimeter = 1,400 feet

	Direct Cost	Marked Up Cost
Total Fencing (#2)	**76,140**	**106,536**
Total Phase:	**280,593**	**480,798**
Total Project:	**280,593**	**480,798**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 3 (Natural Attenuation)
Project Name: Alternative 3 (Natural Attenuation)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Natural attenuation allows the natural subsurface process to continue to reduce contaminant concentration to acceptable levels. Natural attenuation can significantly limit the migration of contaminants resulting from releases of petroleum hydrocarbons. Biodegradation by indigenous subsurface microorganisms appears to be on the primary mechanisms for natural attenuation.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
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Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ____________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Signature: ______________________ **Date:** ____________

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes Natural Attenuation to address the contamination at this site.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Natural Attenuation	Yes	100	0

Technologies:

Technology: Natural Attenuation (#1)

Comments: This technology allows for preliminary natural attenuation sampling (30 samples) and a natural attenuation report.

Groundwater, soil, and sediment sampling is required.

All sampling to be performed by hand. Mobilization of a drill rig is not required.

	Direct Cost	Marked Up Cost
Total Natural Attenuation (#1)	**101,119**	**235,791**
Total Phase:	**101,119**	**235,791**
Total Project:	**101,119**	**235,791**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 4 (Long Term Monitoring)
Project Name: Alternative 4 (Long Term Monitoring)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☐
Operations & Maintenance: ☐
Long Term Monitoring: ☑
Site Closeout: ☐

Documentation

Description: Long term monitoring includes collecting soil and/or water samples from the impacted sites and analyzing for the contaminants of concern on an established time schedule. Analytical results are used to evaluate the contaminant degradation or check on the mobility.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Long Term Monitoring
Phase Name: LTM
Description: This phase utilizes long term monitoring to address the contamination at the site.

LTM will be performed for 25 years. One sampling event will be performed every five years.

Eight new monitoring wells will be installed. The eight new wells and two existing wells will be sampled during this phase.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Groundwater Monitoring Well	Yes	100	0
Residual Waste Management	Yes	100	0

Technologies:

Technology: Monitoring (#1)

Note: This report shows first year costs.

Folder Cost Summary Report

Comments: Year 1
This technology allows for the first round of sampling.

Ten groundwater and Ten soil samples will be collected during this sampling event.

All sampling to be performed by hand. Mobilization of a drill rig is not required.

	Direct Cost	Marked Up Cost
Total Monitoring (#1)	**63,337**	**151,595**

Technology: Monitoring (#2)

Comments: Year 5
This technology allows for the second round of sampling.

Ten groundwater samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#2)	**36,055**	**81,963**

Technology: Monitoring (#3)

Comments: Year 10
This technology allows for the third round of sampling.

Ten groundwater samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#3)	**36,055**	**81,963**

Technology: Monitoring (#4)

Comments: Year 15
This technology allows for the fourth round of sampling.

Ten groundwater samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#4)	**36,055**	**81,963**

Technology: Monitoring (#5)

Comments: Year 20
This technology allows for the fifth round of sampling.

Ten groundwater samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#5)	**36,055**	**81,963**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Monitoring (#6)

Comments: Year 25

This technology allows for the sixth round of sampling.

Ten groundwater and Ten soil samples will be collected during this sampling event.

All soil sampling to be performed by hand. Mobilization of a drill rig is not required.

	Direct Cost	Marked Up Cost
Total Monitoring (#6)	**63,337**	**151,595**

Technology: Groundwater Monitoring Well (#1)

Comments: This technology allows for the installation of 8 monitoring wells at the landfill sites.

	Direct Cost	Marked Up Cost
Total Groundwater Monitoring Well (#1)	**38,627**	**60,126**

Technology: Residual Waste Management (#1)

Comments: This technology allows for the transportation and disposal of the drill cuttings generated during the monitoring well installation.

	Direct Cost	Marked Up Cost
Total Residual Waste Management (#1)	**11,384**	**12,999**
Total Phase:	**320,904**	**704,167**
Total Project:	**320,904**	**704,167**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 5 (Capping)
Project Name: Alternative 5 (Capping)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Capping provides containment by minimizing vertical movement of contamination and reducing the likelihood of human and animal contact with contamination. Capping consists of covering the contaminated area with a low-permeability cover to prevent the infiltration of surface water, a drain layer above the cap to direct precipitation, and a vegetative covering that prevents erosion and restores the area's native vegetation.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ____________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Signature: ______________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes capping to address the contamination at the two landfill sites.

The capped landfills will be inspected every 5 years for 25 years.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Capping	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Monitoring	No	0	0
Monitoring	No	0	0
Monitoring	No	0	0
Monitoring	No	0	0
Monitoring	No	0	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Note: This report shows first year costs.

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the capping activities at the landfill sites. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 46 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Seattle to Anchorage to NE Cape.

Includes airfare to mobilize a 10 person crew to site. Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**938,720**	**1,209,950**

Technology: Capping (#1)

Comments: This technology allows for capping the site 7 and 9 landfills.

The combined landfill surface area is 14 acres.

All capping materials will be from an offsite source.

	Direct Cost	Marked Up Cost
Total Capping (#1)	**4,989,165**	**6,635,958**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#2)

Comments: This technology allows for maintenance of a remote camp for a ten person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#2)	**76,000**	**97,839**

Technology: Monitoring (#1)

Comments: Year 5
This technology estimates the cost to perform the first inspection of the landfill caps and prepare an inspection report.

The landfill caps will be inspected every 5 years for 25 years.

	Direct Cost	Marked Up Cost
Total Monitoring (#1)	**30,268**	**30,268**

Folder Cost Summary Report

Technology: Monitoring (#2)

Comments: Year 10

This technology estimates the cost to perform the second inspection of the landfill caps and prepare an inspection report.

The landfill caps will be inspected every 5 years for 25 years.

	Direct Cost	Marked Up Cost
Total Monitoring (#2)	**30,268**	**30,268**

Technology: Monitoring (#3)

Comments: Year 15

This technology estimates the cost to perform the third inspection of the landfill caps and prepare an inspection report.

The landfill caps will be inspected every 5 years for 25 years.

	Direct Cost	Marked Up Cost
Total Monitoring (#3)	**30,268**	**30,268**

Technology: Monitoring (#4)

Comments: Year 20

This technology estimates the cost to perform the fourth inspection of the landfill caps and prepare an inspection report.

The landfill caps will be inspected every 5 years for 25 years.

	Direct Cost	Marked Up Cost
Total Monitoring (#4)	**30,268**	**30,268**

Technology: Monitoring (#5)

Comments: Year 25

This technology estimates the cost to perform the fifth inspection of the landfill caps and prepare an inspection report.

The landfill caps will be inspected every 5 years for 25 years.

	Direct Cost	Marked Up Cost
Total Monitoring (#5)	**30,268**	**30,268**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Folder Cost Summary Report

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**442,466**	**1,335,810**
Total Phase:	**6,609,239**	**9,465,763**
Total Project:	**6,609,239**	**9,465,763**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 6 (Off-site Treatment/Disposal)
Project Name: Alternative 6 (Off-site Treatment/Disposal)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Excavation using conventional earthmoving equipment is the common method of extracting contaminated soil at and below the ground surface. Off-site treatment or disposal includes transferring the contaminated soil to a facility that is capable of treating or disposing of the soil.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes off-site treatment/disposal to address the contamination at this site.

The landfills contain 290,000 cubic yards of debris.

It is assumed that:
70% of the debris is non-hazardous solid waste (203,000 CY).
15% of the debris is clean soil (43,500 CY).
10% of the debris is POL contaminated soil (29,000 CY).
5% of the debris is a regulated waste (14,500 CY).

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Excavation	Yes	100	0
Off-site Transportation and Waste Disposal	Yes	100	0
Off-site Transportation and Waste Disposal	Yes	100	0
Off-site Transportation and Waste Disposal	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
CONTAINER RENTAL	Yes	100	0
BARGING	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0
Cleanup and Landscaping	Yes	100	0

Technologies:

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#2)

Folder Cost Summary Report

Comments: This technology allows for maintenance of a remote camp for a 20 person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#2)	**362,500**	**466,665**

Technology: Excavation (#1)

Comments: This technology allows for the excavation of the landfills (290,000 CY). The excavated material will be separated into 4 catagories (non-hazardous solid waste, clean soil, POL soil, and regulated wastes). The clean soil will be used as backfill.

	Direct Cost	Marked Up Cost
Total Excavation (#1)	**5,253,353**	**7,301,105**

Technology: Off-site Transportation and Waste Disposal (#1)

Comments: It is assumed that 70% of the debris excavated from the landfill will be non-hazardous solid waste (203,000 CY). This technology includes loading the solid waste into gaylord boxes, staging the gaylord boxes, transporting the boxes from the dock in Seattle to the disposal facility, and tipping fees at the facility. The barge transportation of the waste is accounted for in the Barging technology.

	Direct Cost	Marked Up Cost
Total Off-site Transportation and Waste Disposal (#1)	**24,421,236**	**31,507,295**

Technology: Off-site Transportation and Waste Disposal (#2)

Comments: It is assumed that 10% of the debris excavated from the landfill will be POL contaminated soil (29,000 CY). This technology includes loading the soil into gaylord boxes, staging the gaylord boxes, transporting the boxes from the dock in Seattle to the disposal facility, and tipping fees at the facility. The barge transportation of the waste is accounted for in the barging technology.

	Direct Cost	Marked Up Cost
Total Off-site Transportation and Waste Disposal (#2)	**4,285,958**	**5,527,333**

Technology: Off-site Transportation and Waste Disposal (#3)

Comments: It is assumed that 5% of the debris excavated from the landfill will be a regulated waste (14,500 CY). This technology includes loading the waste into gaylord boxes, staging the gaylord boxes, transporting the boxes from the dock in Seattle to the disposal facility, and tipping fees at the facility. The barge transportation of the waste is accounted for in the Barging technology.

	Direct Cost	Marked Up Cost
Total Off-site Transportation and Waste Disposal (#3)	**3,786,554**	**4,879,527**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: MOBILIZATION/DEMOBILIZATION (#3)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the excavation activities at the landfill sites. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 46 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Seattle to Anchorage to NE Cape.

The asssembly includes 90 days for a smaller landing craft to assist getting materials, equipment, and waste streams on and off the beach.

Includes airfare to mobilize a 20 person crew to site. Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#3)	**1,789,460**	**2,305,153**

Technology: CONTAINER RENTAL (#4)

Comments: This technology allows for the rental of the gaylord boxes that the waste streams will be shipped in. The typical gaylord box has a capacity of 20 tons and rents for $10/day.

non-hazardous solid waste (203,000 CY) = 10150 boxes
POL contaminated soil (29,000 CY) = 2175 boxes
regulated waste (14,500 CY) = 1088 boxes

A total of 13413 boxes will be rented over the duration of the project.

	Direct Cost	Marked Up Cost
Total CONTAINER RENTAL (#4)	**8,584,320**	**11,051,046**

Technology: BARGING (#5)

Comments: This technology allows for the round trip transportation of the waste containers between Seattle and NE Cape. The waste containers will be shipped by barge. The standard barge has a 12,000 ton or 500 container capacity.

Each barge trip will include 46/days per round trip.

A total of 13,413 containers would require 27 barge trips.

Direct Cost	Marked Up Cost

Note: This report shows first year costs.

Folder Cost Summary Report

Total BARGING (#5)	**11,178,000**	**14,390,026**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**2,152,623**	**6,498,797**

Technology: Cleanup and Landscaping (#1)

Comments: This technology allows for the revegetation of the landfill sites

	Direct Cost	Marked Up Cost
Total Cleanup and Landscaping (#1)	**39,229**	**51,087**
Total Phase:	**61,864,782**	**84,012,899**
Total Project:	**61,864,782**	**84,012,899**
Total FUDS Property:	**69,176,637**	**94,899,419**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Folder:	**69,176,637**	**94,899,419**

Note: This report shows first year costs.

Area of Concern D

Site 8
Pipeline Break

Folder Cost Summary Report

Note: This report shows first year costs.

Folder Cost Summary Report

System:

Version: 8.1.0
Database Location: C:\Documents and Settings\J4ENENJF\Application Data\Earth Tech\RACER 8.1\NE Cape FS.mdb

Folder:

Folder Name: NE Cape HTRW

FUDS Property:

FUDS Property ID: Site 8 POL Spill
FUDS Property Name: POL Spill
FUDS Property Category: None

Location

State / Country: ALASKA
City: SAVOONGA

Location Modifiers	Default	User
Material:	*1.929*	1.929
Labor:	*1.461*	1.461
Equipment:	*1.161*	1.161

Options

Database: Modified System

Cost Database Date: 2006

Report Option: Fiscal

Description

Northeast Cape is located on St. Lawrence Island in the Bering Sea, approximately 135 miles southwest of Nome, Alaska. The Village of Savoonga is the closest community, and is located approximately 60 miles northwest of Northeast Cape. The Northeast Cape site was acquired by the Air Force in 1952, and served as an Aircraft Control and Warning, and White Alice Communications System site. The former military installation operated from about 1954 until 1972. The site is currently owned by two Native corporations.

Site 8
The POL Spill Site is located near the intersection of Cargo Beach Road and the Airport Access Road. The site is a wetland with thick surface vegetation, typical of locations along roads and the airstrip where a thick tundra mat was removed before construction. The roughly 40-foot wide wetland slopes southward for approximately 300 feet toward the Suqi. River. The wetland narrows as it approaches the river. A fuel pipeline extended from the pumphouse at Cargo beach to the bulk storage tanks at the main operations complex. A reported break in the pipeline was located

Note: This report shows first year costs.

on the west side of the main road embankment south of the Cargo Beach Road and north of the Suqitughneq River. The area downgradient of this location is a wetland with thick surface vegetation that drains to the Suqitughneq River. The vegetation in the wetland did not appear to be stressed or petroleum stained according to field observations.

Folder Cost Summary Report

Project:

Project ID: Alternative 2 (Institutional Controls)
Project Name: Alternative 2 (Institutional Controls)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Institutional controls are intended to limit and reduce impacts to human health and the environment. Institutional controls are usually land use restrictions that address the future use of the sites. Typical examples of institutional controls include deed, building, excavation and/or groundwater restrictions.

Institutional controls such as land use restrictions and the placement of warning signs at exposure areas are considered potentially applicable and may be implemented to protect human health from these exposures.

Institutional controls retained for further evaluation include the following:
Controls to prevent excavation in potentially contaminated soil.
Controls to prevent construction of buildings on top of potentially contaminated soil.
Placing signs at access points to the site to alert site residents and visitors to the presence of contaminants that could pose health risks.

The need for, and likelihood of, landowner acceptance and compliance with ICs is a consideration for those alternatives requiring them.

Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
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Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase allows for Institutional control planning, implementation, and enforcement.

Media/Waste Type
Primary: Sediment/Sludge
Secondary: N/A

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
ADMINISTRATIVE LAND USE CONTROLS	Yes	100	0

Technologies:

Technology: ADMINISTRATIVE LAND USE CONTROLS (#1)

Comments: This Technology includes:
Institutional Control Planning
Institutional Control Implementation (Includes deed restrictions, access control signs, updating the city plan, etc.)
Institutional Control Enforcement (Includes a site visit every five years to verify that the site access control signs are in place)

	Direct Cost	Marked Up Cost
Total ADMINISTRATIVE LAND USE CONTROLS (#1)	**68,444**	**185,951**
Total Phase:	**68,444**	**185,951**
Total Project:	**68,444**	**185,951**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 3 (Natural Attenuation)
Project Name: Alternative 3 (Natural Attenuation)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Natural attenuation allows the natural subsurface process to continue to reduce contaminant concentration to acceptable levels. Natural attenuation can significantly limit the migration of contaminants resulting from releases of petroleum hydrocarbons. Biodegradation by indigenous subsurface microorganisms appears to be on the primary mechanisms for natural attenuation.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Signature: ______________________ **Date:** ____________

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes Natural Attenuation to address the contamination at this site.

Media/Waste Type
Primary: Sediment/Sludge
Secondary: N/A

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Natural Attenuation	Yes	100	0

Technologies:

Technology: Natural Attenuation (#1)
Comments: This technology allows for preliminary natural attenuation sampling (10 samples) and a natural attenuation report.

Sediment sampling is required.

All sampling to be performed by hand. Mobilization of a drill rig is not required.

	Direct Cost	Marked Up Cost
Total Natural Attenuation (#1)	**46,007**	**126,203**
Total Phase:	**46,007**	**126,203**
Total Project:	**46,007**	**126,203**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 4 (Long Term Monitoring)
Project Name: Alternative 4 (Long Term Monitoring)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☐
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☑
- **Site Closeout:** ☐

Documentation

Description: Long term monitoring includes collecting soil and/or water samples from the impacted sites and analyzing for the contaminants of concern on an established time schedule. Analytical results are used to evaluate the contaminant degradation or check on the mobility.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ____________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ____________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Long Term Monitoring
Phase Name: LTM
Description: This phase utilizes long term monitoring to address the contamination at the site.

LTM will be performed for 20 years. One sampling event will be performed every ten years.

Media/Waste Type
Primary: Sediment/Sludge
Secondary: N/A

Contaminant
Primary: Fuels
Secondary: Metals

Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0

Technologies:

Technology: Monitoring (#1)
Comments: Year 1
This technology allows for the first round of sampling.

Three sediment samples will be collected during this sampling event

	Direct Cost	Marked Up Cost
Total Monitoring (#1)	**23,136**	**62,567**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Monitoring (#3)

Comments: Year 10

This technology allows for the second round of sampling.

Three sediment samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#3)	**23,136**	**62,567**

Technology: Monitoring (#5)

Comments: Year 20

This technology allows for the third round of sampling.

Three sediment samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#5)	**23,136**	**62,567**
Total Phase:	**69,409**	**187,700**
Total Project:	**69,409**	**187,700**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 5 (Landfarming)
Project Name: Alternative 5 (Landfarming)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Landfarming aerates contaminated soil, sediment, or sludge by placing the excavated soil into lined beds, and periodically turning or tilling the soil. Soil conditions are often controlled to optimize the rate of contaminant degradation. Conditions normally controlled include:

Moisture content (usually by irrigation or spraying).
Aeration (by tilling and mixing).
pH (buffered near neutral pH by adding crushed limestone or agricultural lime).
Other amendments (e.g., Soil bulking agents, nutrients, etc.)

Contaminated media is usually treated in lifts that are up to 18 inches thick. When the desired level of treatment is achieved, the lift is removed and a new lift is constructed. The site would be managed properly to prevent both on-site and off-site problems with ground water, surface water, air, or food chain contamination. Adequate monitoring and environmental safeguards would be required.

Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
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Estimator Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
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Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes exsitu landfarming to address the contamination at this site.

A total of 90 CY will be excavated, treated, and backfilled.

Media/Waste Type
Primary: Sediment/Sludge
Secondary: N/A

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MOBILIZATION/DEMOBILIZATION	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Excavation	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the landfarming activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 32 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Anchorage to NE Cape.

Includes airfare to mobilize a 5 person crew for the excavation and landfarming cell construction activities. Includes airfare to mobilize a 2 person crew every two weeks to perform the land farming activities. Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**691,220**	**891,330**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#2)

Comments: This technology allows for maintenance of a remote camp for a five person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#2)	**9,000**	**11,586**

Technology: Ex Situ Land Farming (#1)

Comments: This technology allows for the treatment of the contaminated soil by landfarming. The landfarming treatment duration will be 10 weeks. Tilling will be performed every two weeks.

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#1)	**45,790**	**64,389**

Technology: Excavation (#1)

Comments: This technology allows for the excavation of the contaminated soil at site 8 (90 CY total) and backfill of treated soil.

The excavated soil will be placed in the landfarming treatment cells.

	Direct Cost	Marked Up Cost
Total Excavation (#1)	**6,004**	**8,103**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost

Note: This report shows first year costs.

Folder Cost Summary Report

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**103,272**	**311,779**
Total Phase:	**866,834**	**1,322,053**
Total Project:	**866,834**	**1,322,053**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 6 (Phytoremediation)
Project Name: Alternative 6 (Phytoremediation)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Phytoremediation is a process that uses plants to remove, transfer, stabilize, and destroy contaminants in soil, sludge, sediment, and groundwater. Growing and, in some cases, harvesting plants grown on contaminated soil is a remediation method that can be used to clean sites with shallow contamination. Phytoremediation of deeper soils may be performed by excavation and building phytoremediation cells. Phytoremediation may be applicable for the remediation of metals, pesticides, solvents, petroleum products, PAHs, and landfill leachates.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:

Note: This report shows first year costs.

Folder Cost Summary Report

Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes ex situ phytoremediation to address the contamination at this site.

A total of 90 CY will be excavated, treated, and backfilled.

Media/Waste Type
Primary: Sediment/Sludge
Secondary: N/A

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Phytoremediation	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Excavation	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the phytoremediation activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 32 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Anchorage to NE Cape.

Includes airfare to mobilize a 5 person crew for the excavation and treatment cell construction activities. Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**686,720**	**885,537**

Technology: Ex Situ Land Farming (#1)

Comments: This technology allows for the construction of the phytoremediation cells.

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#1)	**29,634**	**41,143**

Technology: Phytoremediation (#1)

Comments: This technology allows for phytoremediation to treat the contaminated soil at this site.

	Direct Cost	Marked Up Cost
Total Phytoremediation (#1)	**22,011**	**26,998**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#3)

Comments: This technology allows for maintenance of a remote camp for a five person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#3)	**4,000**	**5,149**

Technology: Excavation (#2)

Comments: This technology allows for the excavation of the contaminated soil at site 8 (90 CY total) and backfill of treated soil.

The excavated soil will be placed in the treatment cells.

	Direct Cost	Marked Up Cost
Total Excavation (#2)	**6,004**	**8,103**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**102,779**	**310,290**
Total Phase:	**862,696**	**1,312,087**
Total Project:	**862,696**	**1,312,087**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 7 (Off-site Treatment/Disposal)
Project Name: Alternative 7 (Off-site Treatment/Disposal)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Excavation using conventional earthmoving equipment is the common method of extracting contaminated soil at and below the ground surface. Off-site treatment or disposal includes transferring the contaminated soil to a facility that is capable of treating or disposing of the soil.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes off-site treatment/disposal to address the contamination at this site.

A total of 90 CY will be excavated and disposed of off site .

Media/Waste Type
Primary: Sediment/Sludge
Secondary: N/A

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Off-site Transportation and Waste Disposal	Yes	100	0
CONTAINER RENTAL	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Excavation	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#1)

Comments: This technology allows for maintenance of a remote camp for a four person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#1)	**2,400**	**3,090**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Off-site Transportation and Waste Disposal (#1)

Comments: This technology includes loading the contaminated soil into gaylord boxes, staging the gaylord boxes, transporting the boxes from the dock in Seattle to the disposal facility, and tipping fees at the facility. The barge transportation of the waste is accounted for in the Mob/Demod technology.

	Direct Cost	Marked Up Cost
Total Off-site Transportation and Waste Disposal (#1)	**14,134**	**18,226**

Technology: CONTAINER RENTAL (#2)

Comments: This technology allows for the rental of the gaylord boxes that the waste streams will be shipped in. The typical gaylord box has a capacity of 20 tons and rents for $10/day.

90 CY = 7 containers

A total of 7 boxes will be rented over the duration of the project.

	Direct Cost	Marked Up Cost
Total CONTAINER RENTAL (#2)	**3,472**	**4,470**

Technology: MOBILIZATION/DEMOBILIZATION (#3)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the removal action at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes one unit of barge at 46 days per round trip and 5 days standby at a lease rate based on communication with barging companies and contractors. This assumes 1 round trip Seattle to NE Cape.

This technology allows for the round trip transportation of the waste containers between Seattle and NE Cape. The standard barge has a 12,000 ton or 500 container capacity.

Includes airfare to mobilize a 4 person crew . Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#3)	**564,320**	**727,965**

Technology: Excavation (#2)

Comments: This technology allows for the excavation of the contaminated soil at site 8 (90 CY total) and backfill.

Direct Cost **Marked Up Cost**

Note: This report shows first year costs.

Folder Cost Summary Report

	Direct Cost	Marked Up Cost
Total Excavation (#2)	**6,964**	**9,279**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**81,534**	**246,152**
Total Phase:	**684,373**	**1,044,048**
Total Project:	**684,373**	**1,044,048**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 8 (Reactive Matting)
Project Name: Alternative 8 (Reactive Matting)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: A reactive core mat is an aqueous permeable composite of geotextiles and reactive core materials that reliably adsorb oils and similar organics, heavy metals, and other inorganic materials from water and contaminated sediment.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes reactive matting to address the contamination at this site.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Capping	Yes	100	0
REACTIVE MAT	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#1)

Comments: This technology allows for maintenance of a remote camp for a 4 person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#1)	**2,000**	**2,575**

Folder Cost Summary Report

Technology: MOBILIZATION/DEMOBILIZATION (#2)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to install the reactive mat at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes one unit of barge at 32 days per round trip and 5 days standby at a lease rate based on communication with barging companies and contractors. This assumes 1 round trip Anchorage to NE Cape.

Includes airfare to mobilize a 4 person crew . Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#2)	**429,320**	**554,172**

Technology: Capping (#1)

Comments: This technology allows for the installation of the reactive mat. The reactive mat system consists of 6 inches of sand, the reactive mat, six inches of sand, and an 8 inch layer of rock (6 inch minus).

	Direct Cost	Marked Up Cost
Total Capping (#1)	**10,843**	**14,453**

Technology: REACTIVE MAT (#3)

Comments: This technology accounts for purchasing the reactive mat and shipping it to Anchorage, Alaska.

The reactive mat costs are based on a programming level cost provided by CETCO.

	Direct Cost	Marked Up Cost
Total REACTIVE MAT (#3)	**3,750**	**4,828**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**75,024**	**226,498**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Phase:	**532,485**	**837,392**
Total Project:	**532,485**	**837,392**
Total FUDS Property:	**3,130,248**	**5,015,434**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Folder:	**3,130,248**	**5,015,434**

Note: This report shows first year costs.

Area of Concern E

Sites 10, 11, 13, 15, 19, and 27
Main Operations Complex

Folder Cost Summary Report

Note: This report shows first year costs.

Folder Cost Summary Report

System:

Version: 8.1.0
Database Location: C:\Documents and Settings\J4ENENJF\Application Data\Earth Tech\RACER 8.1\NE Cape FS.mdb

Folder:

Folder Name: NE Cape HTRW

FUDS Property:

FUDS Property ID: Sites 10, 11, 13, 15, 19, 20, 22, and 27 (Main Com
FUDS Property Name: Main Complex
FUDS Property Category: None

Location
State / Country: ALASKA
City: SAVOONGA

Location Modifiers	Default	User
Material:	*1.929*	1.929
Labor:	*1.461*	1.461
Equipment:	*1.161*	1.161

Options
Database: Modified System
Cost Database Date: 2006
Report Option: Fiscal

Description

Northeast Cape is located on St. Lawrence Island in the Bering Sea, approximately 135 miles southwest of Nome, Alaska. The Village of Savoonga is the closest community, and is located approximately 60 miles northwest of Northeast Cape. The Northeast Cape site was acquired by the Air Force in 1952, and served as an Aircraft Control and Warning, and White Alice Communications System site. The former military installation operated from about 1954 until 1972. The site is currently owned by two Native corporations.

Site 10
Site 10 is located approximately 400 feet northeast of the main operations complex, on the northwest side of the main access road that leads to Cargo Beach.. The site is a wide gravel area that is level with the road. The gravel extends westward and drops off approximately 8 feet with a shallow wetland basin at the base of the embankment. The embankment on the northwest side has a few pieces of decomposing drums exposed. The site was reportedly used as a drum storage area for a variety of petroleum products. A large stained area exists at both the surface and

Note: This report shows first year costs.

along the bermed west edge of the site. The gravel pad consists of compacted fine to medium gravels with sand. The transition between fill material (gravel) and native soil is likely between 1.5 and 5 feet below ground surface. Frozen ground is suspected between 10 and 11 feet bgs, and strongly indicated at 16 feet bgs.

Site 11
Three large fuel storage tanks (400,000 gallons each) were formerly located on the northeast corner of the main operations complex, between the perimeter access road and Site 10. The tanks were situated on a constructed gravel pad, and the gravel embankment drops to a shallow tundra drainage basin to the northeast. The center tank was punctured during snow removal activities in the late 1960s and reportedly released 180,000 gallons of diesel fuel to the surrounding area.

Site 13
This site contained Building 110 and the immediately surrounding area of the main operating complex. Several ASTs and USTs were located near the building. The site also included three transformer banks and diesel generators.

Site 15
This site includes the area east of the former UST at Site 13 to the diesel fuel pump island at Site 27. A break in this fuel line resulted in a reported 40,000 gallon diesel fuel spill.

Site 19
This site includes the former auto maintenance facility (Building 109), and the auto storage facility (Building 108). These buildings were constructed with concrete floors and floor drains.

Site 20
Site 20 included Building 103 at the housing and operations complex.

Site 22
This site includes the water storage building, the pumphouse, and the four water wells. The water storage building held four 20-foot diameter and 26-foot high water storage tanks. An UST was located adjacent to the pumphouse.

Site 27
The diesel fuel pump island was originally used to refuel heavy equipment and vehicles. The site included a small shed and cement valve box, and buried pipeline from the bulk fuel storage tanks.

Folder Cost Summary Report

Project:

Project ID: Alternative 2 (Institutional Controls)
Project Name: Alternative 2 (Institutional Controls)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Institutional controls are intended to limit and reduce impacts to human health and the environment. Institutional controls are usually land use restrictions that address the future use of the sites. Typical examples of institutional controls include deed, building, excavation and/or groundwater restrictions.

Institutional controls such as land use restrictions and the placement of warning signs at exposure areas are considered potentially applicable and may be implemented to protect human health from these exposures.

Institutional controls retained for further evaluation include the following:
Controls to prevent excavation in potentially contaminated soil.
Controls to prevent construction of buildings on top of potentially contaminated soil.
Placing signs at access points to the site to alert site residents and visitors to the presence of contaminants that could pose health risks.

The need for, and likelihood of, landowner acceptance and compliance with ICs is a consideration for those alternatives requiring them.

Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase allows for Institutional control planning, implementation, and enforcement.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
ADMINISTRATIVE LAND USE CONTROLS	Yes	100	0

Technologies:

Technology: ADMINISTRATIVE LAND USE CONTROLS (#1)

Comments: This Technology includes:
Institutional Control Planning
Institutional Control Implementation (Includes deed restrictions, access control signs, updating the city plan, etc.)
Institutional Control Enforcement (Includes a site visit every five years to verify that the site access control signs are in place)

	Direct Cost	Marked Up Cost
Total ADMINISTRATIVE LAND USE CONTROLS (#1)	**68,444**	**185,951**
Total Phase:	**68,444**	**185,951**
Total Project:	**68,444**	**185,951**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 3 (Natural Attenuation)
Project Name: Alternative 3 (Natural Attenuation)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Natural attenuation allows the natural subsurface process to continue to reduce contaminant concentration to acceptable levels. Natural attenuation can significantly limit the migration of contaminants resulting from releases of petroleum hydrocarbons. Biodegradation by indigenous subsurface microorganisms appears to be on the primary mechanisms for natural attenuation.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Signature: ______________________ **Date:** ____________

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes Natural Attenuation to address the contamination at this site.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Natural Attenuation	Yes	100	0

Technologies:

Technology: Natural Attenuation (#1)

Comments: This technology allows for preliminary natural attenuation sampling (20 samples) and a natural attenuation report.

Groundwater and soil sampling is required.

All sampling to be performed by hand. Mobilization of a drill rig is not required.

	Direct Cost	Marked Up Cost
Total Natural Attenuation (#1)	**84,893**	**211,813**
Total Phase:	**84,893**	**211,813**
Total Project:	**84,893**	**211,813**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 4 (Long Term Monitoring)
Project Name: Alternative 4 (Long Term Monitoring)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☐
Operations & Maintenance: ☐
Long Term Monitoring: ☑
Site Closeout: ☐

Documentation

Description: Long term monitoring includes collecting soil and/or water samples from the impacted sites and analyzing for the contaminants of concern on an established time schedule. Analytical results are used to evaluate the contaminant degradation or check on the mobility.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ____________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ____________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Long Term Monitoring
Phase Name: LTM
Description: This phase utilizes long term monitoring to address the contamination at the site.

LTM will be performed for 25 years. One sampling event will be performed every five years.

No new monitoring wells will be installed. Existing wells will be sampled during this phase.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0

Technologies:

Technology: Monitoring (#1)
Comments: Year 1
This technology allows for the first round of sampling.

Ten groundwater and Ten soil samples will be collected during this sampling event.

All sampling to be performed by hand. Mobilization of a drill rig is not required.

Direct Cost **Marked Up Cost**

Note: This report shows first year costs.

Folder Cost Summary Report

	Direct Cost	Marked Up Cost
Total Monitoring (#1)	**63,337**	**151,595**

Technology: Monitoring (#2)

Comments: Year 5
This technology allows for the second round of sampling.

Ten groundwater samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#2)	**36,055**	**81,963**

Technology: Monitoring (#3)

Comments: Year 10
This technology allows for the third round of sampling.

Ten groundwater samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#3)	**36,055**	**81,963**

Technology: Monitoring (#4)

Comments: Year 15
This technology allows for the fourth round of sampling.

Ten groundwater samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#4)	**36,055**	**81,963**

Technology: Monitoring (#5)

Comments: Year 20
This technology allows for the fifth round of sampling.

Ten groundwater samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#5)	**36,055**	**81,963**

Technology: Monitoring (#6)

Comments: Year 25
This technology allows for the sixth round of sampling.

Ten groundwater and Ten soil samples will be collected during this sampling event.

All soil sampling to be performed by hand. Mobilization of a drill rig is not required.

	Direct Cost	Marked Up Cost
Total Monitoring (#6)	**63,337**	**151,595**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Phase:	**270,892**	**631,042**
Total Project:	**270,892**	**631,042**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 5 (Landfarming)
Project Name: Alternative 5 (Landfarming)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Landfarming aerates contaminated soil, sediment, or sludge by placing the excavated soil into lined beds, and periodically turning or tilling the soil. Soil conditions are often controlled to optimize the rate of contaminant degradation. Conditions normally controlled include:

Moisture content (usually by irrigation or spraying).
Aeration (by tilling and mixing).
pH (buffered near neutral pH by adding crushed limestone or agricultural lime).
Other amendments (e.g., Soil bulking agents, nutrients, etc.)

Contaminated media is usually treated in lifts that are up to 18 inches thick. When the desired level of treatment is achieved, the lift is removed and a new lift is constructed. The site would be managed properly to prevent both on-site and off-site problems with ground water, surface water, air, or food chain contamination. Adequate monitoring and environmental safeguards would be required.

Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes exsitu landfarming to address the contamination at this site.

A total of 31000 CY will be excavated. It is assumed that 75% of the excavated soil will require treatment (23250 CY).

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MOBILIZATION/DEMOBILIZATION	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Excavation	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Note: This report shows first year costs.

Folder Cost Summary Report

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the landfarming activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 32 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Anchorage to NE Cape.

Includes airfare to mobilize a 15 person crew for the excavation and landfarming cell construction activities. Includes airfare to mobilize a 2 person crew every two weeks to perform the land farming activities. Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**700,220**	**902,916**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#2)

Comments: This technology allows for maintenance of a remote camp for a 15 person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#2)	**50,000**	**64,368**

Technology: Ex Situ Land Farming (#1)

Comments: This technology allows for the treatment of 10000 CY of contaminated soil by landfarming. The landfarming treatment duration will be 10 weeks. Tilling will be performed every two weeks.

31000 CY of soil will be excavated. It is assumed that 75% of this soil will require treatment (23250 CY). This technology allows for the treatment of 10000 CY.

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#1)	**1,185,609**	**1,588,579**

Technology: Excavation (#1)

Comments: This technology allows for the excavation of the soil at the main complex area (31000 CY total) and backfill of treated soil.

The excavated soil that is contaminated will be placed in the landfarming treatment cells.

	Direct Cost	Marked Up Cost
Total Excavation (#1)	**635,409**	**876,304**

Folder Cost Summary Report

Technology: Ex Situ Land Farming (#2)

Comments: This technology allows for the treatment of 10000 CY of contaminated soil by landfarming. The landfarming treatment duration will be 10 weeks. Tilling will be performed every two weeks.

31000 CY of soil will be excavated. It is assumed that 75% of this soil will require treatment (23250 CY). This technology allows for the treatment of 10000 CY.

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#2)	**1,185,609**	**1,588,579**

Technology: Ex Situ Land Farming (#3)

Comments: This technology allows for the treatment of 3250 CY of contaminated soil by landfarming. The landfarming treatment duration will be 10 weeks. Tilling will be performed every two weeks.

31000 CY of soil will be excavated. It is assumed that 75% of this soil will require treatment (23250 CY). This technology allows for the treatment of 3250 CY.

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#3)	**426,501**	**576,147**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**399,984**	**1,207,555**
Total Phase:	**4,594,882**	**6,839,315**
Total Project:	**4,594,882**	**6,839,315**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 9 (Reactive Walls)
Project Name: Alternative 9 (Reactive Walls)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: A permeable reaction wall is installed across the flow path of a contaminant plume, allowing the water portion of the plume to passively move through the wall. These barriers allow the passage of water while prohibiting the movement of contaminants by employing such agents as zero-valent metals, chelators (ligands selected for their specificity for a given metal), sorbents, microbes, and others.

The contaminants will either be degraded or retained in a concentrated form by the barrier material. The wall could provide permanent containment for relatively benign residues or provide a decreased volume of the more toxic contaminants for subsequent treatment. Passive treatment walls are generally intended for long-term operation to control migration of contaminants in ground water.

Target contaminant groups for passive treatment walls are VOCs, SVOCs, and inorganics. The technology can be used, but may be less effective, in treating some fuel hydrocarbons.

Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes reactive walls to address the groundwater contamination at this site. The treatment system will constist of sheet pilings to direct the contaminated water to reactive walls.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Permeable Barriers	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#2)

Comments: This technology allows for maintenance of a remote camp for a 7 person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#2)	**62,500**	**80,460**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Permeable Barriers (#1)

Comments: This technology allows for 900 feet of sheet piling to direct the contaminated groundwater towards 300' of reactive/permeable wall for treatment. The reactive wall will contain a mixture of activated carbon, proprietary oxidizing powder, and pea gravel.

	Direct Cost	Marked Up Cost
Total Permeable Barriers (#1)	**4,624,183**	**6,024,623**

Technology: MOBILIZATION/DEMOBILIZATION (#4)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to construct the reactive wall treatment system at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 32 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Anchorage to NE Cape.

Includes airfare to mobilize a 7 person crew. Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#4)	**684,020**	**882,061**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**386,177**	**1,165,872**
Total Phase:	**5,768,428**	**8,187,881**
Total Project:	**5,768,428**	**8,187,881**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 6 (Phytoremediation)
Project Name: Alternative 6 (Phytoremediation)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Phytoremediation is a process that uses plants to remove, transfer, stabilize, and destroy contaminants in soil, sludge, sediment, and groundwater. Growing and, in some cases, harvesting plants grown on contaminated soil is a remediation method that can be used to clean sites with shallow contamination. Phytoremediation of deeper soils may be performed by excavation and building phytoremediation cells. Phytoremediation may be applicable for the remediation of metals, pesticides, solvents, petroleum products, PAHs, and landfill leachates.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ____________________ **Date:** __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:

Note: This report shows first year costs.

Folder Cost Summary Report

Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes ex situ phytoremediation to address the contamination at this site.

A total of 31000 CY will be excavated. It is assumed that 75% of the excavated soil will require treatment (23250 CY).

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Phytoremediation	Yes	100	0
Excavation	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Note: This report shows first year costs.

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the phytoremediation activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 32 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Anchorage to NE Cape.

Includes airfare to mobilize a 15 person crew for the excavation and phytoremediation cell construction activities. Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**704,720**	**908,709**

Technology: Ex Situ Land Farming (#1)

Comments: This technology allows for the construction of the phytoremediation cells for the first 10,000 CY of contaminated soil.

31000 CY of soil will be excavated. It is assumed that 75% of this soil will require treatment (23250 CY).

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#1)	**1,152,336**	**1,541,968**

Technology: Ex Situ Land Farming (#2)

Comments: This technology allows for the construction of the phytoremediation cells for the second 10,000 CY of contaminated soil.

A total of 31000 CY will be excavated. It is assumed that 75% of the excavated soil will require treatment (23250 CY).

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#2)	**1,152,336**	**1,541,968**

Technology: Ex Situ Land Farming (#3)

Comments: This technology allows for the construction of the phytoremediation cells for remaining 3250 CY of contaminated soil.

A total of 31000 CY will be excavated. It is assumed that 75% of the excavated soil will require treatment (23250 CY).

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#3)	**404,859**	**545,390**

Folder Cost Summary Report

Technology: Phytoremediation (#1)

Comments: This technology allows for phytoremediation to treat the contaminated soil at this site.

	Direct Cost	Marked Up Cost
Total Phytoremediation (#1)	**165,729**	**221,610**

Technology: Excavation (#2)

Comments: This technology allows for the excavation of the soil at the main complex area (31000 CY total) and backfill of treated soil.

The excavated soil that is contaminated will be placed in the treatment cells.

	Direct Cost	Marked Up Cost
Total Excavation (#2)	**635,409**	**876,304**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#3)

Comments: This technology allows for maintenance of a remote camp for a 15 person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#3)	**40,000**	**51,494**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**406,852**	**1,228,293**
Total Phase:	**4,673,789**	**6,950,601**
Total Project:	**4,673,789**	**6,950,601**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 8 (Off-site Treatment/Disposal)
Project Name: Alternative 8 (Off-site Treatment/Disposal)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Excavation using conventional earthmoving equipment is the common method of extracting contaminated soil at and below the ground surface. Off-site treatment or disposal includes transferring the contaminated soil to a facility that is capable of treating or disposing of the soil.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes off-site treatment/disposal to address the contamination at this site.

A total of 31000 CY will be excavated. It is assumed that 75% of the excavated soil will require treatment/disposal (23250 CY).

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Off-site Transportation and Waste Disposal	Yes	100	0
CONTAINER RENTAL	Yes	100	0
Excavation	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#1)

Comments: This technology allows for maintenance of a remote camp for a seven person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#1)	**42,000**	**54,069**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Off-site Transportation and Waste Disposal (#1)

Comments: This technology includes loading the contaminated soil into gaylord boxes, staging the gaylord boxes, transporting the boxes from the dock in Seattle to the disposal facility, and tipping fees at the facility. The barge transportation of the waste is accounted for in the Mob/Demod technology.

	Direct Cost	Marked Up Cost
Total Off-site Transportation and Waste Disposal (#1)	**3,436,989**	**4,432,468**

Technology: CONTAINER RENTAL (#2)

Comments: This technology allows for the rental of the gaylord boxes that the waste streams will be shipped in. The typical gaylord box has a capacity of 20 tons and rents for $10/day.

23250 CY = 1744 containers

A total of 1744 boxes will be rented over the duration of the project.

	Direct Cost	Marked Up Cost
Total CONTAINER RENTAL (#2)	**1,115,680**	**1,436,273**

Technology: Excavation (#2)

Comments: This technology allows for the excavation of the soil at the main complex area (31000 CY total) and backfill.

	Direct Cost	Marked Up Cost
Total Excavation (#2)	**951,469**	**1,263,490**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: MOBILIZATION/DEMOBILIZATION (#4)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the removal action at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes 3 units of barge at 46 days per round trip and 16 days standby (each) at a lease rate based on communication with barging companies and contractors. This assumes 3 round trips Seattle to NE Cape.

This technology allows for the round trip transportation of the waste containers between Seattle and NE Cape. The standard barge has a 12,000 ton or 500 container capacity.

Includes airfare to mobilize a 7 person crew . Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#4)	**1,782,020**	**2,295,574**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**526,624**	**1,589,884**
Total Phase:	**7,866,330**	**11,106,624**
Total Project:	**7,866,330**	**11,106,624**

Folder Cost Summary Report

Project:

Project ID: Alternative 7 (Thermal Treatment)
Project Name: Alternative 7 (Thermal Treatment)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Thermal Treatment processes use heat to increase the volatility (separation); burn, decompose, destruct; or melt the contaminants. Separation technologies include thermal desorption and hot gas decontamination. Destruction technologies include incineration, and pyrolysis. Vitrification immobilizes inorganics and destroys some organics. Thermal treatments offer quick cleanup times but are typically the most costly treatment group. This difference, however, is less in ex situ applications than in in situ applications. Cost is driven by energy and equipment costs and is both capital and O&M-intensive.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ____________________ **Date:** __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:

Note: This report shows first year costs.

Folder Cost Summary Report

Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes thermal desorption to address the contamination at this site.

A total of 31000 CY will be excavated. It is assumed that 75% of the excavated soil will require treatment (23250 CY).

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
On-site Low Temp. Thermal Desorption	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Excavation	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#1)

Comments: This technology allows for maintenance of a remote camp for a 7 person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#1)	**89,500**	**115,218**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: On-site Low Temp. Thermal Desorption (#1)

Comments: This technology allows for the thermal treatment of the contaminated soil. It is assumed that 1 CY = 1.5 tons.

A total of 31000 CY will be excavated. It is assumed that 75% of the excavated soil will require treatment (23250 CY).

	Direct Cost	Marked Up Cost
Total On-site Low Temp. Thermal Desorption (#1)	**2,535,142**	**3,263,622**

Technology: MOBILIZATION/DEMOBILIZATION (#2)

Comments:

This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the thermal treatment activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 32 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Anchorage to NE Cape.

Includes airfare to mobilize a 7 person crew for the excavation and thermal treatment activities. Perdiem is not shown here. It is included in field overhead technology.

Soil burner will be mobilized out of Seattle

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#2)	**1,247,501**	**1,607,460**

Technology: Excavation (#1)

Comments: This technology allows for the excavation of the soil at the main complex area (31000 CY total) and backfill of treated soil.

	Direct Cost	Marked Up Cost
Total Excavation (#1)	**635,409**	**876,304**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Folder Cost Summary Report

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**430,896**	**1,300,881**
Total Phase:	**4,949,998**	**7,198,351**
Total Project:	**4,949,998**	**7,198,351**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 10 (Chemical Oxidation)
Project Name: Alternative 10 (Chemical Oxidation)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Chemical oxidation is an in-situ treatment option for either soil and/or groundwater. This option chemically converts hazardous contaminants to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. The oxidizing agents most commonly used are ozone, hydrogen peroxide, hypochlorites, chlorine, and chlorine dioxide. The Chemical oxidants most commonly employed to date include peroxide, ozone, and permanganate. These oxidants have been able to cause the rapid and complete chemical destruction of many toxic organic chemicals; other organics are amenable to partial degradation as an aid to subsequent bioremediation. Field applications have clearly affirmed that matching the oxidant and in situ delivery system to the contaminants of concern (COCs) and the site conditions is the key to successful implementation and achieving performance goals.

Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
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Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:

Note: This report shows first year costs.

Folder Cost Summary Report

Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ Date: __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes chemical oxidation to address the soil and groundwater contamination at this site.

Media/Waste Type
Primary: Soil
Secondary: Groundwater

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Injection Wells	Yes	100	0
Permeable Barriers	Yes	100	0
Injection Wells	Yes	100	0
Injection Wells	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#1)

Comments: This technology allows for maintenance of a remote camp for a 5 person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#1)	**20,000**	**25,747**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: MOBILIZATION/DEMOBILIZATION (#2)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform chemical oxidation at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 32/days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Anchorage to NE Cape.

Includes airfare to mobilize a 5 person crew. Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#2)	**682,220**	**879,744**

Technology: Injection Wells (#1)

Comments: This technology allows for the installation of 90 wells and injection of the chemical oxidant.

A total of 205 injection wells will be installed for this alternative (1 well every 400 square feet).

	Direct Cost	Marked Up Cost
Total Injection Wells (#1)	**664,670**	**897,825**

Technology: Permeable Barriers (#1)

Comments: This technology allows for purchasing and shipping the chemical oxidant to Anchorage Alaska.

	Direct Cost	Marked Up Cost
Total Permeable Barriers (#1)	**255,242**	**331,504**

Technology: Injection Wells (#2)

Comments: This technology allows for the installation of 90 wells and injection of the chemical oxidant.

A total of 205 injection wells will be installed for this alternative (1 well every 400 square feet).

	Direct Cost	Marked Up Cost
Total Injection Wells (#2)	**664,670**	**897,825**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Injection Wells (#3)

Comments: This technology allows for the installation of 25 wells and injection of the chemical oxidant.

A total of 205 injection wells will be installed for this alternative (1 well every 400 square feet).

	Direct Cost	Marked Up Cost
Total Injection Wells (#3)	**187,062**	**252,786**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**236,984**	**715,458**
Total Phase:	**2,722,396**	**4,035,754**
Total Project:	**2,722,396**	**4,035,754**
Total FUDS Property:	**31,000,053**	**45,347,333**

Folder Cost Summary Report

Total Folder:	**31,000,053**	**45,347,333**

Note: This report shows first year costs.

Area of Concern F

Site 28
Drainage Basin

Scenario A

Folder Cost Summary Report

Note: This report shows first year costs.

Folder Cost Summary Report

System:

Version: 8.1.0
Database Location: C:\Documents and Settings\J4ENENJF\Application Data\Earth Tech\RACER 8.1\NE Cape FS.mdb

Folder:

Folder Name: NE Cape HTRW

FUDS Property:

FUDS Property ID: Sites 28 and 29 (Drainage Basin and Suqi River)
FUDS Property Name: Drainage Basin and Suqi River Alt. A
FUDS Property Category: None

Location

State / Country: ALASKA
City: SAVOONGA

Location Modifiers	Default	User
Material:	*1.929*	1.929
Labor:	*1.461*	1.461
Equipment:	*1.161*	1.161

Options

Database: Modified System
Cost Database Date: 2006
Report Option: Fiscal

Description

Northeast Cape is located on St. Lawrence Island in the Bering Sea, approximately 135 miles southwest of Nome, Alaska. The Village of Savoonga is the closest community, and is located approximately 60 miles northwest of Northeast Cape. The Northeast Cape site was acquired by the Air Force in 1952, and served as an Aircraft Control and Warning, and White Alice Communications System site. The former military installation operated from about 1954 until 1972. The site is currently owned by two Native corporations.

Site 28
The drainage basin lies north of the main operations complex and receives surface and subsurface flow from Sites 10, 11, 13, 15, 19, 20, and 27. The drainage basin flows north into the Suqitughneq River. This site has been impacted by fuel releases from the bulk fuel storage tanks and other spill/releases at the main complex.

Site 29
The Suqitughneq River flows north from the Kinipaghulghat Mountains,

Note: This report shows first year costs.

originating south of the main complex. The Suqitughneq flows through tundra to a lagoon/estuary located east of the Northeast Cape airstrip where it drains into the Bering Sea. The lagoon/estuary is separated from the Bering Sea by a sand berm that forms at the beach and occasionally breaches. Several smaller tributaries (west and east), as well as the Site 28 drainage basin, contribute flow to the Suqitughneq River.

Folder Cost Summary Report

Project:

Project ID: Alternative 2 (Institutional Controls)
Project Name: Alternative 2 (Institutional Controls)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Institutional controls are intended to limit and reduce impacts to human health and the environment. Institutional controls are usually land use restrictions that address the future use of the sites. Typical examples of institutional controls include deed, building, excavation and/or groundwater restrictions.

Institutional controls such as land use restrictions and the placement of warning signs at exposure areas are considered potentially applicable and may be implemented to protect human health from these exposures.

Institutional controls retained for further evaluation include the following:
Controls to prevent excavation in potentially contaminated soil.
Controls to prevent construction of buildings on top of potentially contaminated soil.
Placing signs at access points to the site to alert site residents and visitors to the presence of contaminants that could pose health risks.

The need for, and likelihood of, landowner acceptance and compliance with ICs is a consideration for those alternatives requiring them.

Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase allows for Institutional control planning, implementation, and enforcement.

Media/Waste Type
Primary: Surface Water
Secondary: Sediment/Sludge

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
ADMINISTRATIVE LAND USE CONTROLS	Yes	100	0

Technologies:

Technology: ADMINISTRATIVE LAND USE CONTROLS (#1)

Comments: This Technology includes:
Institutional Control Planning
Institutional Control Implementation (Includes deed restrictions, access control signs, updating the city plan, etc.)
Institutional Control Enforcement (Includes a site visit every five years to verify that the site access control signs are in place)

	Direct Cost	Marked Up Cost
Total ADMINISTRATIVE LAND USE CONTROLS (#1)	**68,444**	**185,951**
Total Phase:	**68,444**	**185,951**
Total Project:	**68,444**	**185,951**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 4 (Long Term Monitoring)
Project Name: Alternative 4 (Long Term Monitoring)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☑
Removal/Interim Action: ☐
Remedial Action: ☐
Operations & Maintenance: ☐
Long Term Monitoring: ☑
Site Closeout: ☐

Documentation

Description: Long term monitoring includes collecting soil and/or water samples from the impacted sites and analyzing for the contaminants of concern on an established time schedule. Analytical results are used to evaluate the contaminant degradation or check on the mobility.
Support Team: NA
References: NA

Estimator Information

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Estimator Title: Environmental Engineer
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Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Long Term Monitoring
Phase Name: LTM
Description: This phase utilizes long term monitoring to address the contamination at the site.

LTM will be performed for 25 years. One sampling event will be performed every five years.

Media/Waste Type
Primary: Surface Water
Secondary: Sediment/Sludge

Contaminant
Primary: Fuels
Secondary: Metals

Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0

Technologies:

Technology: Monitoring (#1)
Comments: Year 1
This technology allows for the first round of sampling.

Four surface water and four sediment samples will be collected during this sampling event

	Direct Cost	Marked Up Cost
Total Monitoring (#1)	**31,366**	**74,634**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Monitoring (#2)

Comments: Year 5

This technology allows for the second round of sampling.

Four surface water samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#2)	**26,295**	**66,478**

Technology: Monitoring (#3)

Comments: Year 10

This technology allows for the third round of sampling.

Four surface water samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#3)	**26,295**	**66,478**

Technology: Monitoring (#4)

Comments: Year 15

This technology allows for the fourth round of sampling.

Four surface water samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#4)	**26,295**	**66,478**

Technology: Monitoring (#5)

Comments: Year 20

This technology allows for the fifth round of sampling.

Four surface water samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#5)	**26,295**	**66,478**

Technology: Monitoring (#6)

Comments: Year 25

This technology allows for the sixth round of sampling.

Four surface water and four sediment samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#6)	**31,366**	**74,634**
Total Phase:	**167,911**	**415,182**
Total Project:	**167,911**	**415,182**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 3 (Natural Attenuation)
Project Name: Alternative 3 (Natural Attenuation)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Natural attenuation allows the natural subsurface process to continue to reduce contaminant concentration to acceptable levels. Natural attenuation can significantly limit the migration of contaminants resulting from releases of petroleum hydrocarbons. Biodegradation by indigenous subsurface microorganisms appears to be on the primary mechanisms for natural attenuation.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
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Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Signature: ______________________ **Date:** __________

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes Natural Attenuation to address the contamination at this site.

Media/Waste Type
Primary: Surface Water
Secondary: Sediment/Sludge

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Natural Attenuation	Yes	100	0

Technologies:

Technology: Natural Attenuation (#1)
Comments: This technology allows for preliminary natural attenuation sampling (20 samples) and a natural attenuation report.

Sediment and surface water sampling is required.

All sampling to be performed by hand. Mobilization of a drill rig is not required.

	Direct Cost	Marked Up Cost
Total Natural Attenuation (#1)	**82,580**	**206,629**
Total Phase:	**82,580**	**206,629**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Project:	**82,580**	**206,629**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 7 (Off-site Treatment/Disposal)
Project Name: Alternative 7 (Off-site Treatment/Disposal)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Excavation using conventional earthmoving equipment is the common method of extracting contaminated soil at and below the ground surface. Off-site treatment or disposal includes transferring the contaminated soil to a facility that is capable of treating or disposing of the soil.
Support Team: NA
References: NA

Estimator Information

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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes off-site treatment/disposal to address the contamination at this site.

A total of 3400 CY will be excavated and transported off-site for treatment/disposal. It is assumed that 500 CY of the excavated soil will be a regulated waste.

Media/Waste Type
Primary: Surface Water
Secondary: Sediment/Sludge

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Excavation	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Passive Water Treatment	Yes	100	0
Access Roads	Yes	100	0
Off-site Transportation and Waste Disposal	Yes	100	0
Off-site Transportation and Waste Disposal	Yes	100	0
CONTAINER RENTAL	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Note: This report shows first year costs.

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the removal action at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes one unit of barge at 46 days per round trip and 12 days standby at a lease rate based on communication with barging companies and contractors. This assumes 1 round trip Seattle to NE Cape.

This technology allows for the round trip transportation of the waste containers between Seattle and NE Cape. The standard barge has a 12,000 ton or 500 container capacity.

Includes airfare to mobilize a 7 person crew . Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**630,020**	**812,544**

Technology: Excavation (#1)

Comments: This technology allows for the excavation of the sediment at sites 28 and 29 (3400 CY total) and backfill.

This work will be difficult. Involves excavation from a wetland. Temporary road construction is needed along the drainage to access the excavation areas.

	Direct Cost	Marked Up Cost
Total Excavation (#1)	**121,080**	**160,176**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#2)

Comments: This technology allows for maintenance of a remote camp for a seven person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#2)	**8,400**	**10,814**

Technology: Passive Water Treatment (#1)

Comments: When sediment at Site 28 is removed, it will stir up contaminated suspended sediment in the water, which will flow downstream. Treatment of the water will be needed before it reaches the Suqi River.

This technology allows for the use of a compost filter .

	Direct Cost	Marked Up Cost
Total Passive Water Treatment (#1)	**60,990**	**84,543**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Access Roads (#1)

Comments: This technology allows for an access road to access the Site 28 excavation areas.

	Direct Cost	Marked Up Cost
Total Access Roads (#1)	**48,178**	**66,878**

Technology: Off-site Transportation and Waste Disposal (#1)

Comments: It is assumed that 500 CY of the excavated soil will be a regulated waste. This technology includes loading the waste into gaylord boxes, staging the gaylord boxes, transporting the boxes from the dock in Seattle to the disposal facility, and tipping fees at the facility. The barge transportation of the waste is accounted for in the Mob/Demod technology.

	Direct Cost	Marked Up Cost
Total Off-site Transportation and Waste Disposal (#1)	**130,571**	**168,260**

Technology: Off-site Transportation and Waste Disposal (#2)

Comments: This technology includes loading the contaminated soil (2900 CY) into gaylord boxes, staging the gaylord boxes, transporting the boxes from the dock in Seattle to the disposal facility, and tipping fees at the facility. The barge transportation of the waste is accounted for in the Mob/Demod technology.

	Direct Cost	Marked Up Cost
Total Off-site Transportation and Waste Disposal (#2)	**428,596**	**552,733**

Technology: CONTAINER RENTAL (#3)

Comments: This technology allows for the rental of the gaylord boxes that the waste streams will be shipped in. The typical gaylord box has a capacity of 20 tons and rents for $10/day.

3400 CY = 255 containers

A total of 255 boxes will be rented over the duration of the project.

	Direct Cost	Marked Up Cost
Total CONTAINER RENTAL (#3)	**146,880**	**189,086**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**151,250**	**456,626**
Total Phase:	**1,737,513**	**2,536,527**
Total Project:	**1,737,513**	**2,536,527**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 5 (Landfarming)
Project Name: Alternative 5 (Landfarming)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Landfarming aerates contaminated soil, sediment, or sludge by placing the excavated soil into lined beds, and periodically turning or tilling the soil. Soil conditions are often controlled to optimize the rate of contaminant degradation. Conditions normally controlled include:

Moisture content (usually by irrigation or spraying).
Aeration (by tilling and mixing).
pH (buffered near neutral pH by adding crushed limestone or agricultural lime).
Other amendments (e.g., Soil bulking agents, nutrients, etc.)

Contaminated media is usually treated in lifts that are up to 18 inches thick. When the desired level of treatment is achieved, the lift is removed and a new lift is constructed. The site would be managed properly to prevent both on-site and off-site problems with ground water, surface water, air, or food chain contamination. Adequate monitoring and environmental safeguards would be required.

Support Team: NA
References: NA

Estimator Information

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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes exsitu landfarming to address the contamination at this site.

A total of 3400 CY will be excavated.

Media/Waste Type
Primary: Surface Water
Secondary: Sediment/Sludge

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MOBILIZATION/DEMOBILIZATION	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Excavation	Yes	100	0
Passive Water Treatment	Yes	100	0
Access Roads	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Note: This report shows first year costs.

Folder Cost Summary Report

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the landfarming activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 32 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Anchorage to NE Cape.

Includes airfare to mobilize a 7 person crew for the excavation and landfarming cell construction activities. Includes airfare to mobilize a 2 person crew every two weeks to perform the land farming activities. Perdiem is not shown here. It is included in field overhead technology.

Assume mobilization from Anchorage.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**695,720**	**897,123**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#2)

Comments: This technology allows for maintenance of a remote camp for a seven person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#2)	**16,500**	**21,241**

Technology: Ex Situ Land Farming (#1)

Comments: This technology allows for the treatment of 3400 CY of contaminated soil by landfarming. The landfarming treatment duration will be 10 weeks. Tilling will be performed every two weeks.

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#1)	**443,703**	**599,142**

Technology: Excavation (#1)

Comments: This technology allows for the excavation of the sediment at sites 28 and 29 (3400 CY total) and backfill of treated soil.

The excavated sediment that is contaminated will be placed in the landfarming treatment cells.

This work will be difficult. Involves excavation from a wetland. Temporary road construction needed along drainage to access the excavation areas.

Direct Cost **Marked Up Cost**

Folder Cost Summary Report

	Direct Cost	Marked Up Cost
Total Excavation (#1)	**86,672**	**118,025**

Technology: Passive Water Treatment (#1)

Comments: When sediment at Site 28 is removed, it will stir up contaminated suspended sediment in the water, which will flow downstream. Treatment of the water will be needed before it reaches the Suqi River.

This technology allows for the use of a compost filter .

	Direct Cost	Marked Up Cost
Total Passive Water Treatment (#1)	**60,990**	**84,543**

Technology: Access Roads (#1)

Comments: This technology allows for an access road to access the Site 28 excavation areas.

	Direct Cost	Marked Up Cost
Total Access Roads (#1)	**48,178**	**66,878**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**129,992**	**392,447**
Total Phase:	**1,493,303**	**2,214,265**
Total Project:	**1,493,303**	**2,214,265**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 6 (Phytoremediation)
Project Name: Alternative 6 (Phytoremediation)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Phytoremediation is a process that uses plants to remove, transfer, stabilize, and destroy contaminants in soil, sludge, sediment, and groundwater. Growing and, in some cases, harvesting plants grown on contaminated soil is a remediation method that can be used to clean sites with shallow contamination. Phytoremediation of deeper soils may be performed by excavation and building phytoremediation cells. Phytoremediation may be applicable for the remediation of metals, pesticides, solvents, petroleum products, PAHs, and landfill leachates.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:

Note: This report shows first year costs.

Folder Cost Summary Report

Date Reviewed:

Reviewer Signature: ______________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes ex situ phytoremediation to address the contamination at this site.

A total of 3400 CY will be excavated, treated, and backfilled.

Media/Waste Type
Primary: Surface Water
Secondary: Sediment/Sludge

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Phytoremediation	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Passive Water Treatment	Yes	100	0
Access Roads	Yes	100	0
Excavation	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Note: This report shows first year costs.

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the phytoremediation activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 32 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Anchorage to NE Cape.

Includes airfare to mobilize a 7 person crew for the excavation and phytoremediation cell construction activities. Perdiem is not shown here. It is included in field overhead technology.

Assume mobilization from Anchorage.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**690,320**	**890,171**

Technology: Phytoremediation (#1)

Comments: This technology allows for phytoremediation to treat the contaminated soil at this site.

	Direct Cost	Marked Up Cost
Total Phytoremediation (#1)	**37,935**	**48,785**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#4)

Comments: This technology allows for maintenance of a remote camp for a seven person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#4)	**10,000**	**12,874**

Technology: Ex Situ Land Farming (#3)

Comments: This technology allows for the construction of the phytoremediation cells for the 3400 CY of contaminated soil.

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#3)	**420,373**	**566,123**

Folder Cost Summary Report

Technology: Passive Water Treatment (#2)

Comments: When sediment at Site 28 is removed, it will stir up contaminated suspended sediment in the water, which will flow downstream. Treatment of the water will be needed before it reaches the Suqi River.

This technology allows for the use of a compost filter .

	Direct Cost	Marked Up Cost
Total Passive Water Treatment (#2)	**60,990**	**84,543**

Technology: Access Roads (#2)

Comments: This technology allows for an access road to access the Site 28 excavation areas.

	Direct Cost	Marked Up Cost
Total Access Roads (#2)	**48,178**	**66,878**

Technology: Excavation (#2)

Comments: This technology allows for the excavation of the sediment at sites 28 and 29 (3400 CY total) and backfill of treated soil.

The excavated sediment that is contaminated will be placed in the phytoremediation treatment cells.

This work will be difficult. Involves excavation from a wetland. Temporary road construction is needed along drainage to access the excavation areas.

	Direct Cost	Marked Up Cost
Total Excavation (#2)	**86,672**	**118,025**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**130,250**	**393,225**
Total Phase:	**1,496,266**	**2,215,490**
Total Project:	**1,496,266**	**2,215,490**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 8 (Constructed Wetland)
Project Name: Alternative 8 (Constructed Wetland)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: The constructed wetlands-based treatment technology uses natural geochemical and biological processes inherent in an artificial wetland ecosystem to accumulate and remove metals, explosives, and other contaminants from influent waters. The process can use a filtration or degradation process.

Although the technology incorporates principal components of wetland ecosystems; including organic soils, microbial fauna, algae, and vascular plants; microbial activity is responsible for most of the remediation.

Influent waters with high metal concentrations and low pH flow through the aerobic and anaerobic zones of the wetland ecosystem. Metals are removed through ion exchange, adsorption, absorption, and precipitation with geochemical and microbial oxidation and reduction. Ion exchange occurs as metals in the water contact humic or other organic substances in the wetland. Wetlands constructed for this purpose often have little or no soil instead they have straw, manure or compost. Oxidation and reduction reactions catalyzed by bacteria that occur in the aerobic and anaerobic zones, respectively, play a major role in precipitating metals as hydroxides and sulfides. Precipitated and adsorbed metals settle in quiescent ponds or are filtered out as water percolates through the medium or the plants.
Influent water with explosive residues or other contaminants flows through and beneath the gravel surface of a gravel-based wetland. The wetland, using emergent plants, is a coupled anaerobic-aerobic system. The anaerobic cell uses plants in concert with natural microbes to degrade the contaminant. The aerobic, also known as the reciprocating cell, further improves water quality through continued exposure to the plants and the movement of water between cell compartments.

Wetland treatment is a long-term technology intended to operate continuously for years.

Support Team: NA
References: NA

Note: This report shows first year costs.

Folder Cost Summary Report

Estimator Information

Estimator Name:	EN-EE
Estimator Title:	Environmental Engineer
Agency/Org./Office:	CEPOA EN-EE
Business Address:	P.O. Box 6898 Elmendorf AFB, Alaska 99506
Telephone Number:	(907) 753-5667
Email Address:	en-ee@poa02.usace.army.mil
Estimate Prepared Date:	12/19/2005

Estimator Signature: ______________________ **Date:** __________

Reviewer Information

Reviewer Name:	
Reviewer Title:	
Agency/Org./Office:	
Business Address:	
Telephone Number:	
Email Address:	
Date Reviewed:	

Reviewer Signature: ______________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes constructed wetlands to address the contamination at this site.

Media/Waste Type
Primary: Surface Water
Secondary: Sediment/Sludge

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MOBILIZATION/DEMOBILIZATION	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Access Roads	Yes	100	0
Passive Water Treatment	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Folder Cost Summary Report

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to construct the wetlands at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes one unit of barge at 32 days per round trip and 12 days standby at a lease rate based on communication with barging companies and contractors. This assumes 1 round trip Anchorage to NE Cape.

Includes airfare to mobilize a 4 person crew . Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**501,320**	**646,862**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#2)

Comments: This technology allows for maintenance of a remote camp for a 5 person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#2)	**6,500**	**8,368**

Technology: Access Roads (#1)

Comments: This technology allows for an access road to access the Site 28 impacted area.

	Direct Cost	Marked Up Cost
Total Access Roads (#1)	**48,178**	**66,878**

Technology: Passive Water Treatment (#1)

Comments: This technology allows for the construction of a 2.5 acre wetland. A 650 foot long 3 foot high dike will have to be constructed to create the wetland. The wetland will treat the surface water from the most heavily contaminated area.

Wetland size was determined based on site topography.

	Direct Cost	Marked Up Cost
Total Passive Water Treatment (#1)	**76,836**	**104,476**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**87,153**	**263,115**
Total Phase:	**731,536**	**1,124,566**
Total Project:	**731,536**	**1,124,566**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 9 (Reactive Matting)
Project Name: Alternative 9 (Reactive Matting)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: A reactive core mat is an aqueous permeable composite of geotextiles and reactive core materials that reliably adsorb oils and similar organics, heavy metals, and other inorganic materials from water and contaminated sediment.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes reactive matting to address the contamination at this site.

Media/Waste Type
Primary: Surface Water
Secondary: Sediment/Sludge

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Capping	Yes	100	0
REACTIVE MAT	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#1)

Comments: This technology allows for maintenance of a remote camp for a 5 person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#1)	**7,500**	**9,655**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: MOBILIZATION/DEMOBILIZATION (#2)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to install the reactive mat at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes one unit of barge at 32 days per round trip and 15 days standby at a lease rate based on communication with barging companies and contractors. This assumes 1 round trip Anchorage to NE Cape.

Includes airfare to mobilize a 4 person crew . Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#2)	**528,320**	**681,620**

Technology: Capping (#1)

Comments: This technology allows for the installation of the reactive mat. The reactive mat system consists of 6 inches of sand, the reactive mat, six inches of sand, and an 8 inch layer of rock (6 inch minus).

	Direct Cost	Marked Up Cost
Total Capping (#1)	**423,933**	**560,537**

Technology: REACTIVE MAT (#3)

Comments: This technology accounts for purchasing the reactive mat and shipping it to Anchorage, Alaska.

The reactive mat costs are based on a programming level cost provided by CETCO.

	Direct Cost	Marked Up Cost
Total REACTIVE MAT (#3)	**202,500**	**260,689**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**111,922**	**337,894**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Phase:	**1,285,724**	**1,885,261**
Total Project:	**1,285,724**	**1,885,261**
Total FUDS Property:	**7,063,277**	**10,783,872**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Folder:	**7,063,277**	**10,783,872**

Note: This report shows first year costs.

Area of Concern F

Site 28
Drainage Basin

Scenario B

Folder Cost Summary Report

Note: This report shows first year costs.

Folder Cost Summary Report

System:

Version:	8.1.0
Database Location:	C:\Documents and Settings\J4ENENJF\Application Data\Earth Tech\RACER 8.1\NE Cape FS.mdb

Folder:

Folder Name: NE Cape HTRW

FUDS Property:

FUDS Property ID:	Sites 28 and 29 (Drainage Basin and Suqi River)
FUDS Property Name:	Drainage Basin and Suqi River Alt. B
FUDS Property Category:	None

Location

State / Country:	ALASKA
City:	SAVOONGA

Location Modifiers	**Default**	**User**
Material:	*1.929*	1.929
Labor:	*1.461*	1.461
Equipment:	*1.161*	1.161

Options

Database:	Modified System
Cost Database Date:	2006
Report Option:	Fiscal

Description

Northeast Cape is located on St. Lawrence Island in the Bering Sea, approximately 135 miles southwest of Nome, Alaska. The Village of Savoonga is the closest community, and is located approximately 60 miles northwest of Northeast Cape. The Northeast Cape site was acquired by the Air Force in 1952, and served as an Aircraft Control and Warning, and White Alice Communications System site. The former military installation operated from about 1954 until 1972. The site is currently owned by two Native corporations.

Site 28
The drainage basin lies north of the main operations complex and receives surface and subsurface flow from Sites 10, 11, 13, 15, 19, 20, and 27. The drainage basin flows north into the Suqitughneq River. This site has been impacted by fuel releases from the bulk fuel storage tanks and other spill/releases at the main complex.

Site 29
The Suqitughneq River flows north from the Kinipaghulghat Mountains,

Note: This report shows first year costs.

originating south of the main complex. The Suqitughneq flows through tundra to a lagoon/estuary located east of the Northeast Cape airstrip where it drains into the Bering Sea. The lagoon/estuary is separated from the Bering Sea by a sand berm that forms at the beach and occasionally breaches. Several smaller tributaries (west and east), as well as the Site 28 drainage basin, contribute flow to the Suqitughneq River.

Folder Cost Summary Report

Project:

Project ID: Alternative 2 (Institutional Controls)
Project Name: Alternative 2 (Institutional Controls)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Institutional controls are intended to limit and reduce impacts to human health and the environment. Institutional controls are usually land use restrictions that address the future use of the sites. Typical examples of institutional controls include deed, building, excavation and/or groundwater restrictions.

Institutional controls such as land use restrictions and the placement of warning signs at exposure areas are considered potentially applicable and may be implemented to protect human health from these exposures.

Institutional controls retained for further evaluation include the following:
Controls to prevent excavation in potentially contaminated soil.
Controls to prevent construction of buildings on top of potentially contaminated soil.
Placing signs at access points to the site to alert site residents and visitors to the presence of contaminants that could pose health risks.

The need for, and likelihood of, landowner acceptance and compliance with ICs is a consideration for those alternatives requiring them.

Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil

Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase allows for Institutional control planning, implementation, and enforcement.

Media/Waste Type
Primary: Surface Water
Secondary: Sediment/Sludge

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
ADMINISTRATIVE LAND USE CONTROLS	Yes	100	0

Technologies:

Technology: ADMINISTRATIVE LAND USE CONTROLS (#1)
Comments: This Technology includes:
Institutional Control Planning
Institutional Control Implementation (Includes deed restrictions, access control signs, updating the city plan, etc.)
Institutional Control Enforcement (Includes a site visit every five years to verify that the site access control signs are in place)

	Direct Cost	Marked Up Cost
Total ADMINISTRATIVE LAND USE CONTROLS (#1)	**68,444**	**185,951**
Total Phase:	**68,444**	**185,951**
Total Project:	**68,444**	**185,951**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 4 (Long Term Monitoring)
Project Name: Alternative 4 (Long Term Monitoring)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☐
Operations & Maintenance: ☐
Long Term Monitoring: ☑
Site Closeout: ☐

Documentation

Description: Long term monitoring includes collecting soil and/or water samples from the impacted sites and analyzing for the contaminants of concern on an established time schedule. Analytical results are used to evaluate the contaminant degradation or check on the mobility.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ____________________ **Date:** __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ____________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Long Term Monitoring
Phase Name: LTM
Description: This phase utilizes long term monitoring to address the contamination at the site.

LTM will be performed for 25 years. One sampling event will be performed every five years.

Media/Waste Type
Primary: Surface Water
Secondary: Sediment/Sludge

Contaminant
Primary: Fuels
Secondary: Metals

Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0

Technologies:

Technology: Monitoring (#1)
Comments: Year 1
This technology allows for the first round of sampling.

Four surface water and four sediment samples will be collected during this sampling event

	Direct Cost	Marked Up Cost
Total Monitoring (#1)	**31,366**	**74,634**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Monitoring (#2)

Comments: Year 5

This technology allows for the second round of sampling.

Four surface water samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#2)	**26,295**	**66,478**

Technology: Monitoring (#3)

Comments: Year 10

This technology allows for the third round of sampling.

Four surface water samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#3)	**26,295**	**66,478**

Technology: Monitoring (#4)

Comments: Year 15

This technology allows for the fourth round of sampling.

Four surface water samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#4)	**26,295**	**66,478**

Technology: Monitoring (#5)

Comments: Year 20

This technology allows for the fifth round of sampling.

Four surface water samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#5)	**26,295**	**66,478**

Technology: Monitoring (#6)

Comments: Year 25

This technology allows for the sixth round of sampling.

Four surface water and four sediment samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#6)	**31,366**	**74,634**
Total Phase:	**167,911**	**415,182**
Total Project:	**167,911**	**415,182**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 3 (Natural Attenuation)
Project Name: Alternative 3 (Natural Attenuation)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Natural attenuation allows the natural subsurface process to continue to reduce contaminant concentration to acceptable levels. Natural attenuation can significantly limit the migration of contaminants resulting from releases of petroleum hydrocarbons. Biodegradation by indigenous subsurface microorganisms appears to be on the primary mechanisms for natural attenuation.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Signature: ______________________ **Date:** ____________

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes Natural Attenuation to address the contamination at this site.

Media/Waste Type
Primary: Surface Water
Secondary: Sediment/Sludge

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Natural Attenuation	Yes	100	0

Technologies:

Technology: Natural Attenuation (#1)

Comments: This technology allows for preliminary natural attenuation sampling (20 samples) and a natural attenuation report.

Sediment and surface water sampling is required.

All sampling to be performed by hand. Mobilization of a drill rig is not required.

	Direct Cost	Marked Up Cost
Total Natural Attenuation (#1)	**82,580**	**206,629**
Total Phase:	**82,580**	**206,629**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Project:	**82,580**	**206,629**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 5 (Landfarming)
Project Name: Alternative 5 (Landfarming)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Landfarming aerates contaminated soil, sediment, or sludge by placing the excavated soil into lined beds, and periodically turning or tilling the soil. Soil conditions are often controlled to optimize the rate of contaminant degradation. Conditions normally controlled include:

Moisture content (usually by irrigation or spraying).
Aeration (by tilling and mixing).
pH (buffered near neutral pH by adding crushed limestone or agricultural lime).
Other amendments (e.g., Soil bulking agents, nutrients, etc.)

Contaminated media is usually treated in lifts that are up to 18 inches thick. When the desired level of treatment is achieved, the lift is removed and a new lift is constructed. The site would be managed properly to prevent both on-site and off-site problems with ground water, surface water, air, or food chain contamination. Adequate monitoring and environmental safeguards would be required.

Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ______________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes exsitu landfarming to address the contamination at this site.

A total of 15000 CY will be excavated and treated.

Media/Waste Type
Primary: Surface Water
Secondary: Sediment/Sludge

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MOBILIZATION/DEMOBILIZATION	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Excavation	Yes	100	0
Passive Water Treatment	Yes	100	0
Access Roads	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Note: This report shows first year costs.

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the landfarming activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 32 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Anchorage to NE Cape.

Includes airfare to mobilize a 7 person crew for the excavation and landfarming cell construction activities. Includes airfare to mobilize a 2 person crew every two weeks to perform the land farming activities. Perdiem is not shown here. It is included in field overhead technology.

Assume mobilization from Anchorage.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**695,720**	**897,123**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#2)

Comments: This technology allows for maintenance of a remote camp for a seven person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#2)	**26,000**	**33,471**

Technology: Ex Situ Land Farming (#1)

Comments: This technology allows for the treatment of 10000 CY of contaminated soil by landfarming. The landfarming treatment duration will be 10 weeks. Tilling will be performed every two weeks.

A total of 15000 CY will be excavated and treated.

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#1)	**1,185,609**	**1,588,579**

Technology: Excavation (#1)

Comments: This technology allows for the excavation of the sediment at sites 28 and 29 (15000 CY total) and backfill of treated soil.

The excavated sediment will be placed in the landfarming treatment cells.

This work will be difficult. Involves excavation from a wetland. Temporary road construction needed along drainage to access the excavation areas.

	Direct Cost	Marked Up Cost

Note: This report shows first year costs.

Folder Cost Summary Report

Total Excavation (#1)	**363,192**	**495,854**

Technology: Passive Water Treatment (#1)

Comments: When sediment at Site 28 is removed, it will stir up contaminated suspended sediment in the water, which will flow downstream. Treatment of the water will be needed before it reaches the Suqi River.

This technology allows for the use of a compost filter .

	Direct Cost	Marked Up Cost
Total Passive Water Treatment (#1)	**94,994**	**132,483**

Technology: Access Roads (#1)

Comments: This technology allows for an access road to access the Site 28 excavation areas.

	Direct Cost	Marked Up Cost
Total Access Roads (#1)	**60,654**	**82,459**

Technology: Ex Situ Land Farming (#2)

Comments: This technology allows for the treatment of 5000 CY of contaminated soil by landfarming. The landfarming treatment duration will be 10 weeks. Tilling will be performed every two weeks.

A total of 15000 CY will be excavated and treated.

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#2)	**625,888**	**842,436**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**292,115**	**881,898**
Total Phase:	**3,355,720**	**4,989,169**
Total Project:	**3,355,720**	**4,989,169**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 6 (Phytoremediation)
Project Name: Alternative 6 (Phytoremediation)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Phytoremediation is a process that uses plants to remove, transfer, stabilize, and destroy contaminants in soil, sludge, sediment, and groundwater. Growing and, in some cases, harvesting plants grown on contaminated soil is a remediation method that can be used to clean sites with shallow contamination. Phytoremediation of deeper soils may be performed by excavation and building phytoremediation cells. Phytoremediation may be applicable for the remediation of metals, pesticides, solvents, petroleum products, PAHs, and landfill leachates.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:

Note: This report shows first year costs.

Folder Cost Summary Report

Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes ex situ phytoremediation to address the contamination at this site.

A total of 15000 CY will be excavated and treated.

Media/Waste Type
Primary: Surface Water
Secondary: Sediment/Sludge

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Passive Water Treatment	Yes	100	0
Access Roads	Yes	100	0
Phytoremediation	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Excavation	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Note: This report shows first year costs.

Folder Cost Summary Report

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the phytoremediation activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 32 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Anchorage to NE Cape.

Includes airfare to mobilize a 7 person crew for the excavation and phytoremediation cell construction activities. Perdiem is not shown here. It is included in field overhead technology.

Assume mobilization from Anchorage.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**690,320**	**890,171**

Technology: Passive Water Treatment (#1)

Comments: When sediment at Site 28 is removed, it will stir up contaminated suspended sediment in the water, which will flow downstream. Treatment of the water will be needed before it reaches the Suqi River.

This technology allows for the use of a compost filter .

	Direct Cost	Marked Up Cost
Total Passive Water Treatment (#1)	**94,994**	**132,483**

Technology: Access Roads (#1)

Comments: This technology allows for an access road to access the Site 28 excavation areas.

	Direct Cost	Marked Up Cost
Total Access Roads (#1)	**60,654**	**82,459**

Technology: Phytoremediation (#1)

Comments: This technology allows for phytoremediation to treat the contaminated soil at this site.

	Direct Cost	Marked Up Cost
Total Phytoremediation (#1)	**112,999**	**150,267**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#3)

Comments: This technology allows for maintenance of a remote camp for a seven person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#3)	**19,000**	**24,460**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Ex Situ Land Farming (#3)

Comments: This technology allows for the construction of the phytoremediation cells for the first 10,000 CY of contaminated soil.

A total of 15000 CY will be excavated and treated.

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#3)	**1,154,737**	**1,545,191**

Technology: Excavation (#2)

Comments: This technology allows for the excavation of the sediment at sites 28 and 29 (15000 CY total) and backfill of treated soil.

The excavated sediment that is contaminated will be placed in the phytoremediation treatment cells.

This work will be difficult. Involves excavation from a wetland. Temporary road construction is needed along drainage to access the excavation areas.

	Direct Cost	Marked Up Cost
Total Excavation (#2)	**363,192**	**495,854**

Technology: Ex Situ Land Farming (#4)

Comments: This technology allows for the construction of the phytoremediation cells for 5,000 CY of contaminated soil.

A total of 15000 CY will be excavated and treated.

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#4)	**600,469**	**806,554**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**296,339**	**894,652**
Total Phase:	**3,404,251**	**5,056,958**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Project:	**3,404,251**	**5,056,958**

Folder Cost Summary Report

Project:

Project ID: Alternative 7 (Off-site Treatment/Disposal)
Project Name: Alternative 7 (Off-site Treatment/Disposal)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Excavation using conventional earthmoving equipment is the common method of extracting contaminated soil at and below the ground surface. Off-site treatment or disposal includes transferring the contaminated soil to a facility that is capable of treating or disposing of the soil.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ____________________ **Date:** __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ____________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes off-site treatment/disposal to address the contamination at this site.

A total of 15000 CY will be excavated. It is assumed that 750 CY of the excavated soil will be a regulated waste.

Media/Waste Type
Primary: Surface Water
Secondary: Sediment/Sludge

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Passive Water Treatment	Yes	100	0
Access Roads	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Excavation	Yes	100	0
CONTAINER RENTAL	Yes	100	0
Off-site Transportation and Waste Disposal	Yes	100	0
Off-site Transportation and Waste Disposal	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: Passive Water Treatment (#1)

Comments: When sediment at Site 28 is removed, it will stir up contaminated suspended sediment in the water, which will flow downstream. Treatment of the water will be needed before it reaches the Suqi River.

This technology allows for the use of a compost filter .

Direct Cost **Marked Up Cost**

Note: This report shows first year costs.

Folder Cost Summary Report

	Direct Cost	Marked Up Cost
Total Passive Water Treatment (#1)	**94,994**	**132,483**

Technology: Access Roads (#1)

Comments: This technology allows for an access road to access the Site 28 excavation areas.

	Direct Cost	Marked Up Cost
Total Access Roads (#1)	**60,654**	**82,459**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#2)

Comments: This technology allows for maintenance of a remote camp for a seven person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#2)	**22,500**	**28,965**

Technology: Excavation (#1)

Comments: This technology allows for the excavation of the sediment at sites 28 and 29 (15000 CY total) and backfill.

This work will be difficult. Involves excavation from a wetland. Temporary road construction is needed along the drainage to access the excavation areas.

	Direct Cost	Marked Up Cost
Total Excavation (#1)	**515,139**	**681,995**

Technology: CONTAINER RENTAL (#3)

Comments: This technology allows for the rental of the gaylord boxes that the waste streams will be shipped in. The typical gaylord box has a capacity of 20 tons and rents for $10/day.

15000 CY = 1125 containers

A total of 1125 boxes will be rented over the duration of the project.

	Direct Cost	Marked Up Cost
Total CONTAINER RENTAL (#3)	**234,000**	**301,241**

Technology: Off-site Transportation and Waste Disposal (#1)

Comments: This technology includes loading the contaminated soil (14250 CY) into gaylord boxes, staging the gaylord boxes, transporting the boxes from the dock in Seattle to the disposal facility, and tipping fees at the facility. The barge transportation of the waste is accounted for in the Mob/Demod technology.

Direct Cost **Marked Up Cost**

Note: This report shows first year costs.

Folder Cost Summary Report

	Direct Cost	Marked Up Cost
Total Off-site Transportation and Waste Disposal (#1)	**2,106,864**	**2,717,089**

Technology: Off-site Transportation and Waste Disposal (#2)

Comments: It is assumed that 750 CY of the excavated soil will be a regulated waste. This technology includes loading the waste into gaylord boxes, staging the gaylord boxes, transporting the boxes from the dock in Seattle to the disposal facility, and tipping fees at the facility. The barge transportation of the waste is accounted for in the Mob/Demod technology.

	Direct Cost	Marked Up Cost
Total Off-site Transportation and Waste Disposal (#2)	**196,689**	**253,461**

Technology: MOBILIZATION/DEMOBILIZATION (#4)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the removal action at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 46 days per round trip and 16 days standby (each) at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Seattle to NE Cape.

This technology allows for the round trip transportation of the waste containers between Seattle and NE Cape. The standard barge has a 12,000 ton or 500 container capacity.

Includes airfare to mobilize a 7 person crew . Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#4)	**1,224,020**	**1,577,231**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**425,872**	**1,285,713**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Phase:	**4,892,279**	**7,095,503**
Total Project:	**4,892,279**	**7,095,503**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 8 (Constructed Wetland)
Project Name: Alternative 8 (Constructed Wetland)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: The constructed wetlands-based treatment technology uses natural geochemical and biological processes inherent in an artificial wetland ecosystem to accumulate and remove metals, explosives, and other contaminants from influent waters. The process can use a filtration or degradation process.

Although the technology incorporates principal components of wetland ecosystems; including organic soils, microbial fauna, algae, and vascular plants; microbial activity is responsible for most of the remediation.

Influent waters with high metal concentrations and low pH flow through the aerobic and anaerobic zones of the wetland ecosystem. Metals are removed through ion exchange, adsorption, absorption, and precipitation with geochemical and microbial oxidation and reduction. Ion exchange occurs as metals in the water contact humic or other organic substances in the wetland. Wetlands constructed for this purpose often have little or no soil instead they have straw, manure or compost. Oxidation and reduction reactions catalyzed by bacteria that occur in the aerobic and anaerobic zones, respectively, play a major role in precipitating metals as hydroxides and sulfides. Precipitated and adsorbed metals settle in quiescent ponds or are filtered out as water percolates through the medium or the plants.
Influent water with explosive residues or other contaminants flows through and beneath the gravel surface of a gravel-based wetland. The wetland, using emergent plants, is a coupled anaerobic-aerobic system. The anaerobic cell uses plants in concert with natural microbes to degrade the contaminant. The aerobic, also known as the reciprocating cell, further improves water quality through continued exposure to the plants and the movement of water between cell compartments.

Wetland treatment is a long-term technology intended to operate continuously for years.

Support Team: NA
References: NA

Note: This report shows first year costs.

Folder Cost Summary Report

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes constructed wetlands to address the contamination at this site.

Media/Waste Type
Primary: Surface Water
Secondary: Sediment/Sludge

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Passive Water Treatment	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Access Roads	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: Passive Water Treatment (#1)

Comments: This technology allows for the construction of a 15 acre wetland. A 300 foot long 12 foot high damn will have to be constructed to create the wetland. The damn would be positioned 800 feet downstream of the confluence of the drainage basin and Suqi river. The wetland would treat the surface water from the entire site.

Wetland size was determined based on site topography.

Direct Cost **Marked Up Cost**

	Direct Cost	Marked Up Cost
Total Passive Water Treatment (#1)	**427,149**	**580,899**

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to construct the wetlands at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes one unit of barge at 32 days per round trip and 12 days standby at a lease rate based on communication with barging companies and contractors. This assumes 1 round trip Anchorage to NE Cape.

Includes airfare to mobilize a 4 person crew . Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**501,320**	**646,862**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#2)

Comments: This technology allows for maintenance of a remote camp for a 5 person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#2)	**6,500**	**8,368**

Technology: Access Roads (#2)

Comments: This technology allows for an access road to access the Site 28 excavation areas.

	Direct Cost	Marked Up Cost
Total Access Roads (#2)	**60,654**	**82,459**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

Direct Cost **Marked Up Cost**

Folder Cost Summary Report

Total Professional Labor Management (#1)	**96,034**	**289,927**
Total Phase:	**1,103,205**	**1,643,380**
Total Project:	**1,103,205**	**1,643,380**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 9 (Reactive Matting)
Project Name: Alternative 9 (Reactive Matting)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: A reactive core mat is an aqueous permeable composite of geotextiles and reactive core materials that reliably adsorb oils and similar organics, heavy metals, and other inorganic materials from water and contaminated sediment.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ____________________ **Date:** __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ____________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes reactive matting to address the contamination at this site.

Media/Waste Type
Primary: Surface Water
Secondary: Sediment/Sludge

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Capping	Yes	100	0
REACTIVE MAT	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#1)

Comments: This technology allows for maintenance of a remote camp for a 10 person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#1)	**52,200**	**67,200**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Capping (#1)

Comments: This technology allows for the installation of the reactive mat. The reactive mat system consists of 6 inches of sand, the reactive mat, six inches of sand, and an 8 inch layer of rock (6 inch minus).

	Direct Cost	Marked Up Cost
Total Capping (#1)	**1,252,279**	**1,654,941**

Technology: REACTIVE MAT (#3)

Comments: This technology accounts for purchasing the reactive mat and shipping it to Anchorage, Alaska.

The reactive mat costs are based on a programming level cost provided by CETCO.

	Direct Cost	Marked Up Cost
Total REACTIVE MAT (#3)	**612,500**	**788,503**

Technology: MOBILIZATION/DEMOBILIZATION (#4)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to install the reactive mat at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 32 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Anchorage to NE Cape.

Includes airfare to mobilize a 10 person crew. Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#4)	**686,720**	**885,537**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost

Note: This report shows first year costs.

Folder Cost Summary Report

Total Professional Labor Management (#1)	249,364	752,832
Total Phase:	2,864,611	4,183,879
Total Project:	**2,864,611**	**4,183,879**
Total FUDS Property:	**15,939,002**	**23,776,653**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Folder:	**15,939,002**	**23,776,653**

Note: This report shows first year costs.

Area of Concern H

Sites 31 and 32
White Alice Complex

Scenario A

Folder Cost Summary Report

Note: This report shows first year costs.

Folder Cost Summary Report

System:

Version: 8.1.0
Database Location: C:\Documents and Settings\J4ENENJF\Application Data\Earth Tech\RACER 8.1\NE Cape FS.mdb

Folder:

Folder Name: NE Cape HTRW

FUDS Property:

FUDS Property ID: Sites 31 and 32 (White Alice and Tram)
FUDS Property Name: White Alice and Tram Alt. A
FUDS Property Category: None

Location
State / Country: ALASKA
City: SAVOONGA

Location Modifiers	Default	User
Material:	*1.929*	1.929
Labor:	*1.461*	1.461
Equipment:	*1.161*	1.161

Options
Database: Modified System
Cost Database Date: 2006
Report Option: Fiscal

Description

Northeast Cape is located on St. Lawrence Island in the Bering Sea, approximately 135 miles southwest of Nome, Alaska. The Village of Savoonga is the closest community, and is located approximately 60 miles northwest of Northeast Cape. The Northeast Cape site was acquired by the Air Force in 1952, and served as an Aircraft Control and Warning, and White Alice Communications System site. The former military installation operated from about 1954 until 1972. The site is currently owned by two Native corporations.

Site 31
The White Alice site is located southeast and uphill from the main operations complex in a glacial valley at the base of Mt. Kangukhsam. The site included four large billboard antennas, a central main electronics building, other supporting structures, and seven ASTs.

Site 32
The lower tram terminal was located south of the White Alice Site at the northern base of Mt. Kangukhsam. The site consisted of a tram terminal

Note: This report shows first year costs.

building, substation transformer bank, two ASTs, a water well and anchor pit for the aerial tram line.

Folder Cost Summary Report

Project:

Project ID: Alternative 2 (Institutional Controls)
Project Name: Alternative 2 (Institutional Controls)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Institutional controls are intended to limit and reduce impacts to human health and the environment. Institutional controls are usually land use restrictions that address the future use of the sites. Typical examples of institutional controls include deed, building, excavation and/or groundwater restrictions.

Institutional controls such as land use restrictions and the placement of warning signs at exposure areas are considered potentially applicable and may be implemented to protect human health from these exposures.

Institutional controls retained for further evaluation include the following:
Controls to prevent excavation in potentially contaminated soil.
Controls to prevent construction of buildings on top of potentially contaminated soil.
Placing signs at access points to the site to alert site residents and visitors to the presence of contaminants that could pose health risks.

The need for, and likelihood of, landowner acceptance and compliance with ICs is a consideration for those alternatives requiring them.

Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil

Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________________ **Date:** ______________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase allows for Institutional control planning, implementation, and enforcement.

Media/Waste Type
Primary: Soil
Secondary: N/A

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
ADMINISTRATIVE LAND USE CONTROLS	Yes	100	0

Technologies:

Technology: ADMINISTRATIVE LAND USE CONTROLS (#1)

Comments: This Technology includes:
Institutional Control Planning
Institutional Control Implementation (Includes deed restrictions, access control signs, updating the city plan, etc.)
Institutional Control Enforcement (Includes a site visit every five years to verify that the site access control signs are in place)

	Direct Cost	Marked Up Cost
Total ADMINISTRATIVE LAND USE CONTROLS (#1)	**68,444**	**185,951**
Total Phase:	**68,444**	**185,951**
Total Project:	**68,444**	**185,951**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 3 (Natural Attenuation)
Project Name: Alternative 3 (Natural Attenuation)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Natural attenuation allows the natural subsurface process to continue to reduce contaminant concentration to acceptable levels. Natural attenuation can significantly limit the migration of contaminants resulting from releases of petroleum hydrocarbons. Biodegradation by indigenous subsurface microorganisms appears to be on the primary mechanisms for natural attenuation.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
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Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Signature: ______________________ **Date:** ____________

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes Natural Attenuation to address the contamination at this site.

Media/Waste Type
Primary: Soil
Secondary: N/A

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Natural Attenuation	Yes	100	0

Technologies:

Technology: Natural Attenuation (#1)

Comments: This technology allows for preliminary natural attenuation sampling (20 samples) and a natural attenuation report.

Soil sampling is required.

All sampling to be performed by hand. Mobilization of a drill rig is not required.

	Direct Cost	Marked Up Cost
Total Natural Attenuation (#1)	**72,411**	**193,191**
Total Phase:	**72,411**	**193,191**
Total Project:	**72,411**	**193,191**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 4 (Long Term Monitoring)
Project Name: Alternative 4 (Long Term Monitoring)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☐
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☑
- **Site Closeout:** ☐

Documentation

Description: Long term monitoring includes collecting soil and/or water samples from the impacted sites and analyzing for the contaminants of concern on an established time schedule. Analytical results are used to evaluate the contaminant degradation or check on the mobility.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
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Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Long Term Monitoring
Phase Name: LTM
Description: This phase utilizes long term monitoring to address the contamination at the site.

LTM will be performed for 20 years. One sampling event will be performed every ten years.

Media/Waste Type
Primary: Soil
Secondary: N/A

Contaminant
Primary: Fuels
Secondary: Metals

Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0

Technologies:

Technology: Monitoring (#1)
Comments: Year 1
This technology allows for the first round of sampling.

Three soil samples will be collected during this sampling event

	Direct Cost	Marked Up Cost
Total Monitoring (#1)	**22,178**	**61,300**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Monitoring (#2)

Comments: Year 10

This technology allows for the second round of sampling.

Three soil samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#2)	**22,178**	**61,300**

Technology: Monitoring (#3)

Comments: Year 20

This technology allows for the third round of sampling.

Three soil samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#3)	**22,178**	**61,300**
Total Phase:	**66,533**	**183,899**
Total Project:	**66,533**	**183,899**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 5 (Landfarming)
Project Name: Alternative 5 (Landfarming)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Landfarming aerates contaminated soil, sediment, or sludge by placing the excavated soil into lined beds, and periodically turning or tilling the soil. Soil conditions are often controlled to optimize the rate of contaminant degradation. Conditions normally controlled include:

Moisture content (usually by irrigation or spraying).
Aeration (by tilling and mixing).
pH (buffered near neutral pH by adding crushed limestone or agricultural lime).
Other amendments (e.g., Soil bulking agents, nutrients, etc.)

Contaminated media is usually treated in lifts that are up to 18 inches thick. When the desired level of treatment is achieved, the lift is removed and a new lift is constructed. The site would be managed properly to prevent both on-site and off-site problems with ground water, surface water, air, or food chain contamination. Adequate monitoring and environmental safeguards would be required.

Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
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Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil

Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ____________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes exsitu landfarming to address the contamination at this site.

A total of 10 CY will be excavated, treated, and backfilled.

Media/Waste Type
Primary: Soil
Secondary: N/A

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MOBILIZATION/DEMOBILIZATION	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Excavation	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Note: This report shows first year costs.

Folder Cost Summary Report

Comments: This mob/demob technology includes costs for mobilization and demobilization of the materials, personel, and remote camp required to perform the landfarming activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

No barge costs are included in this technology. Due to the limited quantity of soil (10 CY) all landfarming activities will be performed by hand. All mob/demob will be performed by aircraft.

Includes airfare to mobilize a 5 person crew for the excavation and landfarming cell construction activities. Includes airfare to mobilize a 2 person crew every two weeks to perform the land farming activities. Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**115,220**	**154,667**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#2)

Comments: This technology allows for maintenance of a remote camp for a five person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#2)	**11,000**	**14,349**

Technology: Ex Situ Land Farming (#1)

Comments: This technology allows for the treatment of the contaminated soil by landfarming. The landfarming treatment duration will be 10 weeks. Tilling will be performed every two weeks.

Due to the limited quantity of soil (10 CY) all land farming activities will be performed by hand.

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#1)	**45,790**	**65,793**

Technology: Excavation (#1)

Comments: This technology allows for the excavation of the contaminated soil at sites 31 and 32 (10 CY total) and backfill of treated soil.

The excavated soil will be placed in the landfarming treatment cells.

Due to the limited quantity of soil (10 CY) all excavation activities will be performed by hand.

	Direct Cost	Marked Up Cost
Total Excavation (#1)	**8,175**	**11,121**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**31,444**	**94,931**
Total Phase:	**223,178**	**375,727**
Total Project:	**223,178**	**375,727**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 7 (Thermal Treatment)
Project Name: Alternative 7 (Thermal Treatment)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Thermal Treatment processes use heat to increase the volatility (separation); burn, decompose, destruct; or melt the contaminants. Separation technologies include thermal desorption and hot gas decontamination. Destruction technologies include incineration, and pyrolysis. Vitrification immobilizes inorganics and destroys some organics. Thermal treatments offer quick cleanup times but are typically the most costly treatment group. This difference, however, is less in ex situ applications than in in situ applications. Cost is driven by energy and equipment costs and is both capital and O&M-intensive.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:

Note: This report shows first year costs.

Folder Cost Summary Report

Email Address:
Date Reviewed:

Reviewer Signature: ______________________________ **Date:** ______________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes on site thermal desorption to address the contamination at this site.

A total of 10 CY will be excavated, treated, and backfilled.

Media/Waste Type
Primary: Soil
Secondary: N/A

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Excavation	Yes	100	0
On-site Low Temp. Thermal Desorption	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: Excavation (#1)

Comments: This technology allows for the excavation of the contaminated soil at sites 31 and 32 (10 CY total) and backfill of treated soil.

	Direct Cost	Marked Up Cost
Total Excavation (#1)	**3,628**	**4,851**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: On-site Low Temp. Thermal Desorption (#1)

Comments: This technology allows for the thermal treatment of the contaminated soil. It is assumed that 1 CY = 1.5 tons.

	Direct Cost	Marked Up Cost
Total On-site Low Temp. Thermal Desorption (#1)	**35,663**	**45,911**

Technology: MOBILIZATION/DEMOBILIZATION (#3)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the thermal treatment activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes one unit of barge at 32 days per round trip and 8 days standby at a lease rate based on communication with barging companies and contractors. This assumes 1 round trip Anchorage to NE Cape.

Includes airfare to mobilize a 4 person crew for the excavation and thermal treatment activities. Perdiem is not shown here. It is included in field overhead technology.

A small soil burner will be mobilized out of Anchorage due to the limited quantity of soil.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#3)	**581,190**	**749,683**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#4)

Comments: This technology allows for maintenance of a remote camp for a 4 person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#4)	**3,200**	**4,120**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**85,915**	**259,378**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Phase:	**721,145**	**1,098,809**
Total Project:	**721,145**	**1,098,809**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 6 (Phytoremediation)
Project Name: Alternative 6 (Phytoremediation)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Phytoremediation is a process that uses plants to remove, transfer, stabilize, and destroy contaminants in soil, sludge, sediment, and groundwater. Growing and, in some cases, harvesting plants grown on contaminated soil is a remediation method that can be used to clean sites with shallow contamination. Phytoremediation of deeper soils may be performed by excavation and building phytoremediation cells. Phytoremediation may be applicable for the remediation of metals, pesticides, solvents, petroleum products, PAHs, and landfill leachates.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:

Note: This report shows first year costs.

Folder Cost Summary Report

Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes ex situ phytoremediation to address the contamination at this site.

A total of 10 CY will be excavated, treated, and backfilled.

Media/Waste Type
Primary: Soil
Secondary: N/A

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Ex Situ Land Farming	Yes	100	0
Phytoremediation	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Excavation	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: Ex Situ Land Farming (#1)
Comments: This technology allows for the construction of the phytoremediation cells.

Due to the limited quantity of soil (10 CY) all construction activities will be performed by hand (no heavy equipment).

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#1)	**29,634**	**41,969**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Phytoremediation (#1)

Comments: This technology allows for phytoremediation to treat the contaminated soil at this site.

	Direct Cost	Marked Up Cost
Total Phytoremediation (#1)	**22,011**	**27,302**

Technology: MOBILIZATION/DEMOBILIZATION (#3)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the materials, personel, and remote camp required to perform the phytoremediation activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

No barge costs are included in this technology. Due to the limited quantity of soil (10 CY) all landfarming activities will be performed by hand. All mob/demob will be performed by aircraft.

Includes airfare to mobilize a 5 person crew for the excavation and landfarming cell construction activities. Includes airfare to mobilize a 2 person crew every two weeks to perform the land farming activities. Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#3)	**115,220**	**154,667**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#4)

Comments: This technology allows for maintenance of a remote camp for a five person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#4)	**5,000**	**6,522**

Technology: Excavation (#2)

Comments: This technology allows for the excavation of the contaminated soil at sites 31 and 32 (10 CY total) and backfill of treated soil.

The excavated soil that is contaminated will be placed in the treatment cells.

Due to the limited quantity of soil (10 CY) all excavation activities will be performed by hand.

	Direct Cost	Marked Up Cost
Total Excavation (#2)	**8,175**	**11,121**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**31,421**	**94,859**
Total Phase:	**223,009**	**371,306**
Total Project:	**223,009**	**371,306**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 8 (Off-site Treatment/Disposal)
Project Name: Alternative 8 (Off-site Treatment/Disposal)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Excavation using conventional earthmoving equipment is the common method of extracting contaminated soil at and below the ground surface. Off-site treatment or disposal includes transferring the contaminated soil to a facility that is capable of treating or disposing of the soil.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
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Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes off-site treatment/disposal to address the contamination at this site.

A total of 10 CY will be excavated and disposed of off site .

Media/Waste Type
Primary: Soil
Secondary: N/A

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Off-site Transportation and Waste Disposal	Yes	100	0
CONTAINER RENTAL	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Excavation	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#1)

Comments: This technology allows for maintenance of a remote camp for a four person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#1)	**2,400**	**3,090**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Off-site Transportation and Waste Disposal (#1)

Comments: This technology includes loading the contaminated soil into gaylord boxes, staging the gaylord boxes, transporting the boxes from the dock in Seattle to the disposal facility, and tipping fees at the facility. The barge transportation of the waste is accounted for in the Mob/Demod technology.

	Direct Cost	Marked Up Cost
Total Off-site Transportation and Waste Disposal (#1)	**2,310**	**2,978**

Technology: CONTAINER RENTAL (#2)

Comments: This technology allows for the rental of the gaylord boxes that the waste streams will be shipped in. The typical gaylord box has a capacity of 20 tons and rents for $10/day.

10 CY = 1 container

A 1 box will be rented over the duration of the project.

	Direct Cost	Marked Up Cost
Total CONTAINER RENTAL (#2)	**480**	**618**

Technology: MOBILIZATION/DEMOBILIZATION (#3)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the removal action at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes one unit of barge at 46 days per round trip and 5 days standby at a lease rate based on communication with barging companies and contractors. This assumes 1 round trip Seattle to NE Cape.

This technology allows for the round trip transportation of the waste containers between Seattle and NE Cape. The standard barge has a 12,000 ton or 500 container capacity.

Includes airfare to mobilize a 4 person crew . Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#3)	**564,320**	**727,965**

Technology: Excavation (#1)

Comments: This technology allows for the excavation of the contaminated soil and backfill.

	Direct Cost	Marked Up Cost

Note: This report shows first year costs.

Folder Cost Summary Report

	Direct Cost	Marked Up Cost
Total Excavation (#1)	**4,327**	**5,738**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**79,173**	**239,026**
Total Phase:	**664,560**	**1,014,280**
Total Project:	**664,560**	**1,014,280**
Total FUDS Property:	**2,039,279**	**3,423,163**

Folder Cost Summary Report

Total Folder:	**2,039,279**	**3,423,163**

Note: This report shows first year costs.

Area of Concern H

Sites 31 and 32
White Alice Complex

Scenario B

Folder Cost Summary Report

Note: This report shows first year costs.

Folder Cost Summary Report

System:

Version: 8.1.0
Database Location: C:\Documents and Settings\J4ENENJF\Application Data\Earth Tech\RACER 8.1\NE Cape FS.mdb

Folder:

Folder Name: NE Cape HTRW

FUDS Property:

FUDS Property ID: Sites 31 and 32 (White Alice and Tram)
FUDS Property Name: White Alice and Tram Alt. B
FUDS Property Category: None

Location

State / Country: ALASKA
City: SAVOONGA

Location Modifiers	Default	User
Material:	*1.929*	1.929
Labor:	*1.461*	1.461
Equipment:	*1.161*	1.161

Options

Database: Modified System
Cost Database Date: 2006
Report Option: Fiscal

Description

Northeast Cape is located on St. Lawrence Island in the Bering Sea, approximately 135 miles southwest of Nome, Alaska. The Village of Savoonga is the closest community, and is located approximately 60 miles northwest of Northeast Cape. The Northeast Cape site was acquired by the Air Force in 1952, and served as an Aircraft Control and Warning, and White Alice Communications System site. The former military installation operated from about 1954 until 1972. The site is currently owned by two Native corporations.

Site 31
The White Alice site is located southeast and uphill from the main operations complex in a glacial valley at the base of Mt. Kangukhsam. The site included four large billboard antennas, a central main electronics building, other supporting structures, and seven ASTs.

Site 32
The lower tram terminal was located south of the White Alice Site at the northern base of Mt. Kangukhsam. The site consisted of a tram terminal

Note: This report shows first year costs.

building, substation transformer bank, two ASTs, a water well and anchor pit for the aerial tram line.

Folder Cost Summary Report

Project:

Project ID: Alternative 2 (Institutional Controls)
Project Name: Alternative 2 (Institutional Controls)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Institutional controls are intended to limit and reduce impacts to human health and the environment. Institutional controls are usually land use restrictions that address the future use of the sites. Typical examples of institutional controls include deed, building, excavation and/or groundwater restrictions.

Institutional controls such as land use restrictions and the placement of warning signs at exposure areas are considered potentially applicable and may be implemented to protect human health from these exposures.

Institutional controls retained for further evaluation include the following:
Controls to prevent excavation in potentially contaminated soil.
Controls to prevent construction of buildings on top of potentially contaminated soil.
Placing signs at access points to the site to alert site residents and visitors to the presence of contaminants that could pose health risks.

The need for, and likelihood of, landowner acceptance and compliance with ICs is a consideration for those alternatives requiring them.

Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase allows for Institutional control planning, implementation, and enforcement.

Media/Waste Type
Primary: Soil
Secondary: N/A

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
ADMINISTRATIVE LAND USE CONTROLS	Yes	100	0

Technologies:

Technology: ADMINISTRATIVE LAND USE CONTROLS (#1)

Comments: This Technology includes:
Institutional Control Planning
Institutional Control Implementation (Includes deed restrictions, access control signs, updating the city plan, etc.)
Institutional Control Enforcement (Includes a site visit every five years to verify that the site access control signs are in place)

	Direct Cost	Marked Up Cost
Total ADMINISTRATIVE LAND USE CONTROLS (#1)	**68,444**	**185,951**
Total Phase:	**68,444**	**185,951**
Total Project:	**68,444**	**185,951**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 3 (Natural Attenuation)
Project Name: Alternative 3 (Natural Attenuation)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Natural attenuation allows the natural subsurface process to continue to reduce contaminant concentration to acceptable levels. Natural attenuation can significantly limit the migration of contaminants resulting from releases of petroleum hydrocarbons. Biodegradation by indigenous subsurface microorganisms appears to be on the primary mechanisms for natural attenuation.
Support Team: NA
References: NA

Estimator Information

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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Signature: ______________________ **Date:** __________

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes Natural Attenuation to address the contamination at this site.

Media/Waste Type
Primary: Soil
Secondary: N/A

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Natural Attenuation	Yes	100	0

Technologies:

Technology: Natural Attenuation (#1)

Comments: This technology allows for preliminary natural attenuation sampling (20 samples) and a natural attenuation report.

Soil sampling is required.

All sampling to be performed by hand. Mobilization of a drill rig is not required.

	Direct Cost	Marked Up Cost
Total Natural Attenuation (#1)	**72,411**	**193,191**
Total Phase:	**72,411**	**193,191**
Total Project:	**72,411**	**193,191**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 4 (Long Term Monitoring)
Project Name: Alternative 4 (Long Term Monitoring)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☐
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☑
- **Site Closeout:** ☐

Documentation

Description: Long term monitoring includes collecting soil and/or water samples from the impacted sites and analyzing for the contaminants of concern on an established time schedule. Analytical results are used to evaluate the contaminant degradation or check on the mobility.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Long Term Monitoring
Phase Name: LTM
Description: This phase utilizes long term monitoring to address the contamination at the site.

LTM will be performed for 20 years. One sampling event will be performed every ten years.

Media/Waste Type
Primary: Soil
Secondary: N/A

Contaminant
Primary: Fuels
Secondary: Metals

Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Monitoring	Yes	100	0
Monitoring	Yes	100	0
Monitoring	Yes	100	0

Technologies:

Technology: Monitoring (#1)
Comments: Year 1
This technology allows for the first round of sampling.

Three soil samples will be collected during this sampling event

	Direct Cost	Marked Up Cost
Total Monitoring (#1)	**22,178**	**61,300**

Folder Cost Summary Report

Technology: Monitoring (#2)

Comments: Year 10

This technology allows for the second round of sampling.

Three soil samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#2)	**22,178**	**61,300**

Technology: Monitoring (#3)

Comments: Year 20

This technology allows for the third round of sampling.

Three soil samples will be collected during this sampling event.

	Direct Cost	Marked Up Cost
Total Monitoring (#3)	**22,178**	**61,300**
Total Phase:	**66,533**	**183,899**
Total Project:	**66,533**	**183,899**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 5 (Landfarming)
Project Name: Alternative 5 (Landfarming)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Landfarming aerates contaminated soil, sediment, or sludge by placing the excavated soil into lined beds, and periodically turning or tilling the soil. Soil conditions are often controlled to optimize the rate of contaminant degradation. Conditions normally controlled include:

Moisture content (usually by irrigation or spraying).
Aeration (by tilling and mixing).
pH (buffered near neutral pH by adding crushed limestone or agricultural lime).
Other amendments (e.g., Soil bulking agents, nutrients, etc.)

Contaminated media is usually treated in lifts that are up to 18 inches thick. When the desired level of treatment is achieved, the lift is removed and a new lift is constructed. The site would be managed properly to prevent both on-site and off-site problems with ground water, surface water, air, or food chain contamination. Adequate monitoring and environmental safeguards would be required.

Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes exsitu landfarming to address the contamination at this site.

A total of 125 CY will be excavated, treated, and backfilled.

Media/Waste Type
Primary: Soil
Secondary: N/A

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MOBILIZATION/DEMOBILIZATION	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Excavation	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Note: This report shows first year costs.

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the landfarming activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 32 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Anchorage to NE Cape.

Includes airfare to mobilize a 5 person crew for the excavation and landfarming cell construction activities. Includes airfare to mobilize a 2 person crew every two weeks to perform the land farming activities. Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**691,220**	**891,330**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#2)

Comments: This technology allows for maintenance of a remote camp for a five person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#2)	**10,000**	**12,874**

Technology: Ex Situ Land Farming (#1)

Comments: This technology allows for the treatment of the contaminated soil by landfarming. The landfarming treatment duration will be 10 weeks. Tilling will be performed every two weeks.

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#1)	**49,759**	**69,849**

Technology: Excavation (#1)

Comments: This technology allows for the excavation of the contaminated soil at sites 31 and 32 (125 CY total) and backfill of treated soil.

The excavated soil will be placed in the landfarming treatment cells.

	Direct Cost	Marked Up Cost
Total Excavation (#1)	**6,732**	**9,158**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

Direct Cost **Marked Up Cost**

Folder Cost Summary Report

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**104,042**	**314,105**
Total Phase:	**873,301**	**1,332,182**
Total Project:	**873,301**	**1,332,182**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 7 (Thermal Treatment)
Project Name: Alternative 7 (Thermal Treatment)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Thermal Treatment processes use heat to increase the volatility (separation); burn, decompose, destruct; or melt the contaminants. Separation technologies include thermal desorption and hot gas decontamination. Destruction technologies include incineration, and pyrolysis. Vitrification immobilizes inorganics and destroys some organics. Thermal treatments offer quick cleanup times but are typically the most costly treatment group. This difference, however, is less in ex situ applications than in in situ applications. Cost is driven by energy and equipment costs and is both capital and O&M-intensive.

Support Team: NA
References: NA

Estimator Information

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Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
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Business Address:
Telephone Number:

Note: This report shows first year costs.

Folder Cost Summary Report

Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes on site thermal desorption to address the contamination at this site.

A total of 125 CY will be excavated, treated, and backfilled.

Media/Waste Type
Primary: Soil
Secondary: N/A

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
On-site Low Temp. Thermal Desorption	Yes	100	0
Excavation	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#2)

Comments: This technology allows for maintenance of a remote camp for a five person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#2)	**5,200**	**6,694**

Folder Cost Summary Report

Technology: On-site Low Temp. Thermal Desorption (#1)

Comments: This technology allows for the thermal treatment of the contaminated soil. It is assumed that 1 CY = 1.5 tons.

	Direct Cost	Marked Up Cost
Total On-site Low Temp. Thermal Desorption (#1)	**64,692**	**83,281**

Technology: Excavation (#2)

Comments: This technology allows for the excavation of the contaminated soil at sites 31 and 32 (125 CY total) and backfill of treated soil.

	Direct Cost	Marked Up Cost
Total Excavation (#2)	**6,732**	**9,158**

Technology: MOBILIZATION/DEMOBILIZATION (#4)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the thermal treatment activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes one unit of barge at 32 days per round trip and 13 days standby at a lease rate based on communication with barging companies and contractors. This assumes 1 round trip Anchorage to NE Cape.

Includes airfare to mobilize a 4 person crew for the excavation and thermal treatment activities. Perdiem is not shown here. It is included in field overhead technology.

A small soil burner will be mobilized out of Anchorage due to the limited quantity of soil.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#4)	**626,190**	**807,614**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**96,617**	**291,689**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Phase:	**810,980**	**1,233,303**
Total Project:	**810,980**	**1,233,303**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 6 (Phytoremediation)
Project Name: Alternative 6 (Phytoremediation)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Phytoremediation is a process that uses plants to remove, transfer, stabilize, and destroy contaminants in soil, sludge, sediment, and groundwater. Growing and, in some cases, harvesting plants grown on contaminated soil is a remediation method that can be used to clean sites with shallow contamination. Phytoremediation of deeper soils may be performed by excavation and building phytoremediation cells. Phytoremediation may be applicable for the remediation of metals, pesticides, solvents, petroleum products, PAHs, and landfill leachates.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
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Estimate Prepared Date: 12/19/2005

Estimator Signature: ____________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:

Note: This report shows first year costs.

Folder Cost Summary Report

Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes ex situ phytoremediation to address the contamination at this site.

A total of 125 CY will be excavated, treated, and backfilled.

Media/Waste Type
Primary: Soil
Secondary: N/A

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Phytoremediation	Yes	100	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Ex Situ Land Farming	Yes	100	0
Excavation	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: MOBILIZATION/DEMOBILIZATION (#1)

Folder Cost Summary Report

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the phytoremediation activities at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes two units of barge at 32 days per round trip at a lease rate based on communication with barging companies and contractors. This assumes 2 round trips Anchorage to NE Cape.

Includes airfare to mobilize a 5 person crew for the excavation and treatment cell construction activities. Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#1)	**686,720**	**885,537**

Technology: Phytoremediation (#1)

Comments: This technology allows for phytoremediation to treat the contaminated soil at this site.

	Direct Cost	Marked Up Cost
Total Phytoremediation (#1)	**22,102**	**27,120**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#3)

Comments: This technology allows for maintenance of a remote camp for a five person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#3)	**5,000**	**6,437**

Technology: Ex Situ Land Farming (#2)

Comments: This technology allows for the construction of the phytoremediation cells.

	Direct Cost	Marked Up Cost
Total Ex Situ Land Farming (#2)	**33,455**	**46,404**

Technology: Excavation (#2)

Comments: This technology allows for the excavation of the contaminated soil at sites 31 and 32 (125 CY total) and backfill of treated soil.

The excavated soil will be placed in the treatment cells.

	Direct Cost	Marked Up Cost
Total Excavation (#2)	**6,732**	**9,158**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**103,542**	**312,593**
Total Phase:	**869,099**	**1,322,116**
Total Project:	**869,099**	**1,322,116**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 8 (Off-site Treatment/Disposal)
Project Name: Alternative 8 (Off-site Treatment/Disposal)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Excavation using conventional earthmoving equipment is the common method of extracting contaminated soil at and below the ground surface. Off-site treatment or disposal includes transferring the contaminated soil to a facility that is capable of treating or disposing of the soil.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes off-site treatment/disposal to address the contamination at this site.

A total of 125 CY will be excavated and disposed of off site .

Media/Waste Type
Primary: Soil
Secondary: N/A

Contaminant
Primary: Fuels
Secondary: Metals

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Off-site Transportation and Waste Disposal	Yes	100	0
CONTAINER RENTAL	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Excavation	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0

Technologies:

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#1)

Comments: This technology allows for maintenance of a remote camp for a four person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#1)	**2,400**	**3,090**

Folder Cost Summary Report

Technology: Off-site Transportation and Waste Disposal (#1)

Comments: This technology includes loading the contaminated soil into gaylord boxes, staging the gaylord boxes, transporting the boxes from the dock in Seattle to the disposal facility, and tipping fees at the facility. The barge transportation of the waste is accounted for in the Mob/Demod technology.

	Direct Cost	Marked Up Cost
Total Off-site Transportation and Waste Disposal (#1)	**19,723**	**25,432**

Technology: CONTAINER RENTAL (#2)

Comments: This technology allows for the rental of the gaylord boxes that the waste streams will be shipped in. The typical gaylord box has a capacity of 20 tons and rents for $10/day.

125 CY = 10 containers

A total of 10 boxes will be rented over the duration of the project.

	Direct Cost	Marked Up Cost
Total CONTAINER RENTAL (#2)	**4,800**	**6,179**

Technology: MOBILIZATION/DEMOBILIZATION (#3)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the removal action at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes one unit of barge at 46 days per round trip and 5 days standby at a lease rate based on communication with barging companies and contractors. This assumes 1 round trip Seattle to NE Cape.

This technology allows for the round trip transportation of the waste containers between Seattle and NE Cape. The standard barge has a 12,000 ton or 500 container capacity.

Includes airfare to mobilize a 4 person crew . Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#3)	**564,320**	**727,965**

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Excavation (#2)

Comments: This technology allows for the excavation of the contaminated soil at sites 31 and 32 (125 CY total) and backfill.

	Direct Cost	Marked Up Cost
Total Excavation (#2)	**8,175**	**10,927**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**82,633**	**249,471**
Total Phase:	**693,600**	**1,057,930**
Total Project:	**693,600**	**1,057,930**
Total FUDS Property:	**3,454,368**	**5,508,572**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Folder:	**3,454,368**	**5,508,572**

Note: This report shows first year costs.

Area of Concern I

Sites 13 and 31
PCB Contaminated Soils

Folder Cost Summary Report

Note: This report shows first year costs.

Folder Cost Summary Report

System:

Version: 8.1.0
Database Location: C:\Documents and Settings\J4ENENJF\Application Data\Earth Tech\RACER 8.1\NE Cape FS.mdb

Folder:

Folder Name: NE Cape HTRW

FUDS Property:

FUDS Property ID: Sites 13 and 31 (PCBs)
FUDS Property Name: PCB - Contaminated Soils
FUDS Property Category: None

Location
State / Country: ALASKA
City: SAVOONGA

Location Modifiers	Default	User
Material:	*1.929*	1.929
Labor:	*1.461*	1.461
Equipment:	*1.161*	1.161

Options
Database: Modified System
Cost Database Date: 2006
Report Option: Fiscal

Description

Northeast Cape is located on St. Lawrence Island in the Bering Sea, approximately 135 miles southwest of Nome, Alaska. The Village of Savoonga is the closest community, and is located approximately 60 miles northwest of Northeast Cape. The Northeast Cape site was acquired by the Air Force in 1952, and served as an Aircraft Control and Warning, and White Alice Communications System site. The former military installation operated from about 1954 until 1972. The site is currently owned by two Native corporations.

Site 31
The White Alice site is located southeast and uphill from the main operations complex in a glacial valley at the base of Mt. Kangukhsam. The site included four large billboard antennas, a central main electronics building, other supporting structures, and seven ASTs. Only the PCB contaminated soils are being addressed by the following alternatives.

Site 13
This site contained Building 110 and the immediately surrounding area of

the main operating complex. Several ASTs and USTs were located near the building. The site also included three transformer banks and diesel generators. Only the PCB contaminated soils are being addressed by the following alternatives.

Folder Cost Summary Report

Project:

Project ID: Alternative 2 (Institutional Controls)
Project Name: Alternative 2 (Institutional Controls)
Project Type: HTRW

Phase Names

Pre-Study: ☐
Study: ☐
Design: ☐
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☐
Long Term Monitoring: ☐
Site Closeout: ☐

Documentation

Description: Institutional controls are intended to limit and reduce impacts to human health and the environment. Institutional controls are usually land use restrictions that address the future use of the sites. Typical examples of institutional controls include deed, building, excavation and/or groundwater restrictions.

Institutional controls such as land use restrictions and the placement of warning signs at exposure areas are considered potentially applicable and may be implemented to protect human health from these exposures.

Institutional controls retained for further evaluation include the following:
Controls to prevent excavation in potentially contaminated soil.
Controls to prevent construction of buildings on top of potentially contaminated soil.
Placing signs at access points to the site to alert site residents and visitors to the presence of contaminants that could pose health risks.

The need for, and likelihood of, landowner acceptance and compliance with ICs is a consideration for those alternatives requiring them.

Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase allows for Institutional control planning, implementation, and enforcement.

Media/Waste Type
Primary: Soil
Secondary: N/A

Contaminant
Primary: PCBs
Secondary: None

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
ADMINISTRATIVE LAND USE CONTROLS	Yes	100	0

Technologies:

Technology: ADMINISTRATIVE LAND USE CONTROLS (#1)
Comments: This Technology includes:
Institutional Control Planning
Institutional Control Implementation (Includes deed restrictions, access control signs, updating the city plan, etc.)
Institutional Control Enforcement (Includes a site visit every five years to verify that the site access control signs are in place)

	Direct Cost	Marked Up Cost
Total ADMINISTRATIVE LAND USE CONTROLS (#1)	**68,444**	**185,951**
Total Phase:	**68,444**	**185,951**
Total Project:	**68,444**	**185,951**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 4 (Off-site Treatment/Disposal)
Project Name: Alternative 4 (Off-site Treatment/Disposal)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Excavation using conventional earthmoving equipment is the common method of extracting contaminated soil at and below the ground surface. Off-site treatment or disposal includes transferring the contaminated soil to a facility that is capable of treating or disposing of the soil.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ **Date:** __________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes off-site treatment/disposal to address the contamination at this site.

A total of 260 CY will be excavated and disposed of off site (150 CY at site 13 and 110 CY at site 31).

Media/Waste Type
Primary: Soil
Secondary: N/A

Contaminant
Primary: PCBs
Secondary: None

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
Off-site Transportation and Waste Disposal	Yes	100	0
CONTAINER RENTAL	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Excavation	Yes	100	0
Site Close-Out Documentation	Yes	100	0
Professional Labor Management	Yes	100	0
Excavation	Yes	100	0

Technologies:

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#1)

Comments: This technology allows for maintenance of a remote camp for a four person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#1)	**3,200**	**4,120**

Folder Cost Summary Report

Technology: Off-site Transportation and Waste Disposal (#1)

Comments: This technology includes loading the contaminated soil into gaylord boxes, staging the gaylord boxes, transporting the boxes from the dock in Seattle to the disposal facility, and tipping fees at the facility. The barge transportation of the waste is accounted for in the Mob/Demod technology.

	Direct Cost	Marked Up Cost
Total Off-site Transportation and Waste Disposal (#1)	**67,897**	**87,495**

Technology: CONTAINER RENTAL (#2)

Comments: This technology allows for the rental of the gaylord boxes that the waste streams will be shipped in. The typical gaylord box has a capacity of 20 tons and rents for $10/day.

260 CY = 20 containers

20 boxes will be rented over the duration of the project.

	Direct Cost	Marked Up Cost
Total CONTAINER RENTAL (#2)	**9,600**	**12,359**

Technology: MOBILIZATION/DEMOBILIZATION (#3)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the removal action at the site. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes one unit of barge at 46 days per round trip and 7 days standby at a lease rate based on communication with barging companies and contractors. This assumes 1 round trip Seattle to NE Cape.

This technology allows for the round trip transportation of the waste containers between Seattle and NE Cape. The standard barge has a 12,000 ton or 500 container capacity.

Includes airfare to mobilize a 4 person crew . Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#3)	**582,320**	**751,137**

Technology: Excavation (#1)

Comments: This technology allows for the excavation of the contaminated soil and backfill at Site 13.

Direct Cost **Marked Up Cost**

Folder Cost Summary Report

	Direct Cost	Marked Up Cost
Total Excavation (#1)	**10,304**	**13,714**

Technology: Site Close-Out Documentation (#1)

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**93,755**	**283,047**

Technology: Excavation (#2)

Comments: This technology allows for the excavation of the contaminated soil and backfill at Site 31.

	Direct Cost	Marked Up Cost
Total Excavation (#2)	**8,327**	**11,076**
Total Phase:	**786,951**	**1,197,813**
Total Project:	**786,951**	**1,197,813**

Note: This report shows first year costs.

Folder Cost Summary Report

Project:

Project ID: Alternative 3 (Capping)
Project Name: Alternative 3 (Capping)
Project Type: HTRW

Phase Names

- **Pre-Study:** ☐
- **Study:** ☐
- **Design:** ☐
- **Removal/Interim Action:** ☐
- **Remedial Action:** ☑
- **Operations & Maintenance:** ☐
- **Long Term Monitoring:** ☐
- **Site Closeout:** ☐

Documentation

Description: Capping provides containment by minimizing vertical movement of contamination and reducing the likelihood of human and animal contact with contamination. Capping consists of covering the contaminated area with a low-permeability cover to prevent the infiltration of surface water, a drain layer above the cap to direct precipitation, and a vegetative covering that prevents erosion and restores the area's native vegetation.
Support Team: NA
References: NA

Estimator Information

Estimator Name: EN-EE
Estimator Title: Environmental Engineer
Agency/Org./Office: CEPOA EN-EE
Business Address: P.O. Box 6898
Elmendorf AFB, Alaska 99506
Telephone Number: (907) 753-5667
Email Address: en-ee@poa02.usace.army.mil
Estimate Prepared Date: 12/19/2005

Estimator Signature: ______________________ **Date:** ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Note: This report shows first year costs.

Folder Cost Summary Report

Reviewer Signature: ______________________ **Date:** ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: This phase utilizes capping to address the PCB contamination (< 10 ppm) at site 13 and 31.

The capped sites will be inspected every 5 years for 25 years.

10 cubic yards of PCB contaminated soil (>10 ppm) will be excavated and disposed of off site .

Media/Waste Type
Primary: Soil
Secondary: N/A

Contaminant
Primary: PCBs
Secondary: None

Approach: None
Start Date: October, 2006

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Site Close-Out Documentation	Yes	100	0
Capping	Yes	100	0
Monitoring	No	0	0
Professional Labor Management	Yes	100	0
Monitoring	No	0	0
Monitoring	No	0	0
Monitoring	No	0	0
Monitoring	No	0	0
FIELD OVERHEAD EXPENSES NE CAPE	Yes	100	0
MOBILIZATION/DEMOBILIZATION	Yes	100	0
Off-site Transportation and Waste Disposal	Yes	100	0
CONTAINER RENTAL	Yes	100	0
Excavation	Yes	100	0

Technologies:

Technology: Site Close-Out Documentation (#1)

Note: This report shows first year costs.

Folder Cost Summary Report

Comments: This technology allows for the preparation of the work plans and final reports for the remedial action.

	Direct Cost	Marked Up Cost
Total Site Close-Out Documentation (#1)	**11,549**	**34,867**

Technology: Capping (#1)

Comments: This technology allows for capping sites 13 and 31.

The combined surface area is 2000 square feet.

All capping materials will be from an offsite source.

	Direct Cost	Marked Up Cost
Total Capping (#1)	**21,736**	**29,031**

Technology: Monitoring (#1)

Comments: Year 5
This technology estimates the cost to perform the first inspection of the caps and prepare an inspection report.

The caps will be inspected every 5 years for 25 years.

	Direct Cost	Marked Up Cost
Total Monitoring (#1)	**11,674**	**11,674**

Technology: Professional Labor Management (#1)

Comments: The Professional Labor Management technology focuses on professional labor costs incurred by the project. Professional labor includes activities such as project management, project design, construction oversight, site closure activities, and permitting.

	Direct Cost	Marked Up Cost
Total Professional Labor Management (#1)	**49,082**	**148,179**

Technology: Monitoring (#2)

Comments: Year 5
This technology estimates the cost to perform the second inspection of the caps and prepare an inspection report.

The caps will be inspected every 5 years for 25 years.

	Direct Cost	Marked Up Cost
Total Monitoring (#2)	**11,674**	**11,674**

Folder Cost Summary Report

Technology: Monitoring (#3)

Comments: Year 5

This technology estimates the cost to perform the Third inspection of the caps and prepare an inspection report.

The caps will be inspected every 5 years for 25 years.

	Direct Cost	Marked Up Cost
Total Monitoring (#3)	**11,674**	**11,674**

Technology: Monitoring (#4)

Comments: Year 5

This technology estimates the cost to perform the fourth inspection of the caps and prepare an inspection report.

The caps will be inspected every 5 years for 25 years.

	Direct Cost	Marked Up Cost
Total Monitoring (#4)	**11,674**	**11,674**

Technology: Monitoring (#5)

Comments: Year 5

This technology estimates the cost to perform the fifth inspection of the caps and prepare an inspection report.

The caps will be inspected every 5 years for 25 years.

	Direct Cost	Marked Up Cost
Total Monitoring (#5)	**11,674**	**11,674**

Technology: FIELD OVERHEAD EXPENSES NE CAPE (#3)

Comments: This technology allows for maintenance of a remote camp for a four person construction crew. The figure for field overhead is estimated from the prior interim removal action contract at NE Cape.

	Direct Cost	Marked Up Cost
Total FIELD OVERHEAD EXPENSES NE CAPE (#3)	**3,200**	**4,120**

Folder Cost Summary Report

Technology: MOBILIZATION/DEMOBILIZATION (#4)

Comments: This mob/demob technology includes costs for mobilization and demobilization of the equipment, materials, personel, and remote camp required to perform the work at the sites. This technology is structured to reflect competetively procured prices for mobilization/demobilization to this site.

The assembly includes one unit of barge at 46 days per round trip and 7 days standby at a lease rate based on communication with barging companies and contractors. This assumes 1 round trip Seattle to NE Cape.

Includes airfare to mobilize a 4 person crew . Perdiem is not shown here. It is included in field overhead technology.

	Direct Cost	Marked Up Cost
Total MOBILIZATION/DEMOBILIZATION (#4)	**582,320**	**751,137**

Technology: Off-site Transportation and Waste Disposal (#1)

Comments: This technology includes loading the contaminated soil into gaylord boxes, staging the gaylord boxes, transporting the boxes from the dock in Seattle to the disposal facility, and tipping fees at the facility. The barge transportation of the waste is accounted for in the Mob/Demod technology.

	Direct Cost	Marked Up Cost
Total Off-site Transportation and Waste Disposal (#1)	**3,444**	**4,437**

Technology: CONTAINER RENTAL (#5)

Comments: This technology allows for the rental of the gaylord boxes that the waste streams will be shipped in. The typical gaylord box has a capacity of 20 tons and rents for $10/day.

10 CY = 1 container

1 box will be rented over the duration of the project.

	Direct Cost	Marked Up Cost
Total CONTAINER RENTAL (#5)	**480**	**618**

Technology: Excavation (#1)

Comments: This technology allows for the excavation of the PCB contaminated soil (>10 ppm) at Site 13

	Direct Cost	Marked Up Cost
Total Excavation (#1)	**2,973**	**3,994**

Note: This report shows first year costs.

Folder Cost Summary Report

Total Phase:	733,152	1,034,751
Total Project:	**733,152**	**1,034,751**
Total FUDS Property:	**1,588,547**	**2,418,515**

Folder Cost Summary Report

Total Folder:	**1,588,547**	**2,418,515**

Note: This report shows first year costs.