Final Feasibility Study Report
Umiat Air Force Station Landfill
Umiat, Alaska

Contract W911KB-08-D-0005, Task Order 0012

Prepared For:

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ACRONYMS AND ABBREVIATIONS

4,4'-DDD	4,4'-dichlorodiphenyldichloroethane
4,4'-DDE	4,4'-dichlorodiphenyldichloroethene
4,4'-DDT	4,4'-dichlorodiphenyltrichloroethane
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ADFG	Alaska Department of Fish and Game
ADOT&PF	Alaska Department of Transportation and Public Facilities
AFS	air force station
ARAR	applicable or relevant and appropriate requirements
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
BLM	U.S. Bureau of Land Management
BMP	Best Management Practice
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	cubic feet per second
CFR	Code of Federal Regulations
COPC	contaminant of potential concern
CRE	cumulative risk evaluation
CSM	conceptual site model
CY	cubic yards
DERP	Defense Environmental Restoration Program
DoD	U.S. Department of Defense
DoI	U.S. Department of the Interior
DRO	diesel range organics
E&E	Ecology and Environment, Inc.
EC	engineering controls
EPA	U.S. Environmental Protection Agency
FAA	U.S. Federal Aviation Administration
FEMA	U.S. Federal Emergency Management Agency
FIRM	flood insurance rate map
FS	feasibility study
FUDS	Formerly Used Defense Site
g/day	grams per day
GRA	general response actions
GRO	gasoline-range organics
HI	hazard index
HTRW	hazardous, toxic, and radioactive waste
IC	institutional controls
mg/kg	milligram per kilogram

ACRONYMS AND ABBREVIATIONS, CONT'D.

NCP	National Oil & Hazardous Substances Pollution Contingency Plan
NOAA	National Oceanic and Atmospheric Administration
NPR	National Petroleum Reserve
NPRA	National Petroleum Reserve – Alaska
NSB	North Slope Borough
O&M	Operations & Maintenance
PCB	polychlorinated biphenyl
POL	petroleum, oil, and lubricant
PP	proposed plan
PRG	preliminary remediation goal
RAO	remedial action objective
RBC	risk-based concentrations
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
ROD	Record of Decision
RRO	residual oil-range organics
SARA	Superfund Amendment & Reauthorization Act
SQuiRT	(NOAA) Screening & Quick Reference Tables
TBC	to be considered
TSCA	Toxics Substances Control Act
TSDF	Treatment, Storage and Disposal Facility
UIC	Ukpeaġvik Iñupiat Corporation
US	United States
USACE	US Army Corps of Engineers
USAF	US Air Force
USGS	US Geological Survey
WWII	World War II

EXECUTIVE SUMMARY

The former Umiat Air Force Station (AFS) is located along the Colville River in the arctic foothills north of the Brooks Range, Alaska, approximately 120 miles southwest of Prudhoe Bay, 170 miles southeast of Barrow, and 65 miles southwest of Nuiqsut. Umiat AFS was used by the United States (US) Navy from 1945 to 1946 and was a major staging area for Department of Defense (DoD) and private oil exploration. Since then, the station has been used as a staging area and base camp by various federal and state agencies to support activities in the National Petroleum Reserve – Alaska (NPRA) and adjacent areas.

The subject of this feasibility study (FS) is the 8-acre landfill about one-half mile east of the main station facilities, within an ephemeral slough of the Colville River, and hot spot sediment contamination downstream of the landfill. Records indicate the landfill may have been used for dumping wastes as early as 1943 and as recently as 1981, including wastes generated during a 1973 site-wide demolition and cleanup effort. The landfill has no surface markers indicating its location or boundaries.

Since 1973, a number of site inspections and investigations have been conducted at the former Umiat AFS and landfill by the US Environmental Protection Agency (EPA), Alaska Department of Environmental Conservation (ADEC), Alaska Department of Transportation and Public Facilities (ADOT&PF), Federal Aviation Administration (FAA), and US Army Corps of Engineers (USACE). Remedial investigations were performed in 1994, 1996, 1997, and 2013. Additional field investigations were performed in 1998 and 1999, and a limited removal action was performed in 2001. Several studies have been conducted to evaluate whether contamination from past activities at the former Umiat AFS may affect human health and ecological receptors. These studies have focused on chemicals detected in fish tissue and their potential effects on recreational and subsistence users.

Environmental media sampled during these investigations included surface and subsurface soil, sediment, groundwater, surface water, and fish tissue. Data generated during those investigations shows the chemicals of potential concern (COPCs) include total polychlorinated biphenyls (PCBs; specifically Aroclor 1254), 4,4'-dichlorodiphenyldichloroethane (4,4'-DDD), 4,4'-dichlorodiphenyldichloroethene (4,4'-DDE), 4,4'-dichlorodiphenyltrichloroethane (4,4'-DDT), diesel-range organics (DRO), naphthalene, methylene chloride, and lead. Based on a cumulative risk evaluation, the carcinogenic risk posed to human health by these contaminants exceeds the carcinogenic risk standard of 1×10^{-5}; the non-carcinogenic hazard index exceeds the risk management standard of 1. This procedure does not change the conclusion that corrective action should be implemented because the risk range of 1×10^{-4} to 1×10^{-6} was exceeded. In addition, PCBs, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT have been detected in fish samples in the vicinity of the Umiat AFS. However, an Agency for Toxic Substances and Disease Registry (ATSDR) health evaluation found that consumption of fish is not expected to cause harmful health effects (ATSDR, 2003).

The Colville River floods the seasonal stream and landfill areas annually, typically in spring and fall. Water velocities during these events can be high. Sand and gravel historically placed covering the landfill has been redeposited exposing landfill debris. These flood events have uncovered hazardous materials and inert solid wastes, and transported contamination off-site to downstream sediments.

Landfill-cover erosion and subsequent exposure of potentially contaminated debris and soil is an on-going process, likely to result in future releases of COPCs to the environment. In 2001, a small transformer and areas containing debris from lead-acid batteries were observed on the surface of the landfill; these objects were subsequently removed by the USACE.

The landfill reportedly contains equipment, scrap metal, and crushed steel drums. Buried debris is also believed to include possible contaminant sources such as lead-acid batteries and transformers, and suspected to include other containers with unknown contents and contaminated soil. Debris observed at the landfill surface during recent site visits included scrap metal, wire, pipe, pipe fittings, drill bits, drum carcasses, and drill-rig tracks. The environmental sampling, geophysical assessments, and historical information Shannon & Wilson reviewed for the Remedial Investigation (RI) report (Shannon & Wilson, 2013) provided comprehensive landfill characterization. Information yielded by these sources has not identified distinct contaminant sources within the landfill that may be targeted for a limited removal.

Hazardous materials are known to be present; contaminants have been detected above acceptable risk levels and regulatory limits in soil, sediment, surface water, and fish tissue; and landfill-cover erosion is an on-going process. For these reasons, interim and/or permanent remedial actions were recommended in the RI Report to reduce the potential for contaminant exposure to humans and ecological receptors.

This FS report was prepared to identify and evaluate a range of remedial alternatives to mitigate risks posed by the landfill area to human health and the environment. The remedial alternatives subjected to detailed analysis include:

- Alternative 1: No Action
- Alternative 2: Land Use Controls
- Alternative 3: Land Use Controls and Hot Spot Sediment Removal
- Alternative 4: Containment and Capping
- Alternative 5: Excavation and On-Site Disposal
- Alternative 6: Excavation and Off-Site Treatment/Disposal
- Alternative 7: Excavation, On-Site Disposal of Clean Material, and Off-Site Disposal/Treatment of Contaminated Material
- Alternative 8: Step-wise Implementation of Interim Actions

Alternatives 1, 2, and 3 do not meet the two threshold evaluation criteria (Overall Protection of Human Health and the Environment and Compliance with ARARs) and should not be considered for final remedy selection.

Alternative 4 generally meets the threshold criteria without excavating the landfill contents (hot spot sediments would be removed). Implementing this alternative would result in a permanent, protected structure within the existing slough channel. Implementing land use controls and long-term maintenance of this structure could pose significant challenges.

Alternatives 5, 6, and 7 each comprise excavation of the landfill area but differ by their proposed disposition of excavated materials. On-site (i.e., near the Umiat facility) disposal options reduce the overall material handling costs but incur long-term maintenance liabilities. Off-site (i.e., at permitted facilities elsewhere in Alaska or the Lower 48 states) disposal options increase material handling costs but eliminate post-remedy site exposures and maintenance liabilities.

Alternative 8 would allow for immediate implementation of land use controls such as deed restrictions and informational signage around the landfill to be followed by more protective (and more costly) remedies as funding allows.

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1.0 INTRODUCTION

This Feasibility Study (FS) report presents the results of an evaluation of remedial alternatives for the landfill associated with the Umiat Air Force Station (AFS), Alaska. Umiat is located along the Colville River in the arctic foothills north of the Brooks Range, Alaska, approximately 120 miles southwest of Prudhoe Bay, 170 miles southeast of Barrow, and 65 miles southwest of the Village of Nuiqsut on the north slope of Alaska (Figure 1-1). Umiat AFS was used by the United States (US) Navy or its civilian contractors for petroleum exploration purposes from 1945 to 1954, at which time ownership returned to the Air Force. The station has been used as a staging area and base camp by various federal and state agencies and private entities to support a variety of activities in the National Petroleum Reserve – Alaska (NPRA) and adjacent areas. Environmental studies have been performed at several sites at the AFS. The subject of this FS is the facility's former landfill, about one-half mile east of the station's main gravel pad and hot spot sediment contamination identified downstream of the landfill (Figure 1-2).

This FS report was developed using information collected by others during several site investigations and removal actions dating to the mid-1970s and evaluated and summarized in a Remedial Investigation (RI) report prepared by Shannon & Wilson, Inc. (Shannon & Wilson) in March 2013. The RI and this FS were prepared by Shannon & Wilson under Hazardous, Toxic, and Radioactive Waste (HTRW) Contract W911KB-08-D-0005, Task Order 0012.

This FS was prepared in accordance with the US Army Corps of Engineers (USACE) Formerly Used Defense Site (FUDS) Program Policy Manual (ER 200-3-1). As prescribed by the FUDS regulation, response activities undertaken by the USACE as part of the FUDS program that address hazardous substances, pollutants, or contaminants shall be conducted in accordance with the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The work followed the process outlined in the US Environmental Protection Agency's (EPA's) Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA, 1988).

1.1 Purpose and Organization

1.1.1 Project Objectives

The objectives of this FS are to:

- identify and screen remedial response actions that address the risks posed by known and suspected contamination remaining at the landfill; and
- provide a detailed evaluation of feasible remedial alternatives to allow decision makers to select an appropriate remedial alternative.

This FS report presents an evaluation of remedial action alternatives for addressing the risks to human health and the environment identified in the RI report (Shannon & Wilson, 2013).

1.1.2 FS Report Organization

This FS is organized into six sections, including this introduction. Section 2.0 describes the Preliminary Remediation Goals (PRGs). Section 3.0 includes a discussion of remedial action objectives (RAOs) and general response actions (GRAs). Section 4.0 includes the remedial action alternatives developed and screened against project RAOs. Section 5.0 provides a detailed analysis of selected remedial action alternatives. Section 6.0 lists the references cited in this report. Tables and figures follow their corresponding section. Appendices A through C to this report contain supporting information. Lastly, Appendix D contains Alaska Department of Environmental Conservation (ADEC) and US Bureau of Land Management (BLM) comments to the Interim Final Feasibility Study.

1.2 Background Information

1.2.1 Site Location

The former Umiat AFS is at 69 degrees 22 minutes North Latitude, 152 degrees 08 minutes West Longitude. The geographical location of the station is within Sections 9, 10, and 15, Township 1 South, Range 1 West, Umiat Meridian. The Umiat AFS is shown on the US Geological Survey (USGS) Umiat (B-4) Alaska quadrangle map. Umiat lies within the Colville River valley north of the Brooks Range in northern Alaska, within the NPRA. It is about 120 miles southwest of Prudhoe Bay and 300 miles northwest of Fairbanks, as shown in Figure 1-1. The nearest community is Nuiqsut, approximately 65 overland miles and 85 river miles northeast of the station.

For the purposes of this report, “Umiat AFS” is defined as a FUDS property based on former military use and real estate records and includes the areas formerly occupied by the U.S. Air Force (USAF) Station (main gravel pad and airstrip). The “Umiat Site” is defined as a project within the Umiat AFS property and includes the landfill area associated with and southeast of the Umiat AFS (Figure 1-2) as well as contaminated sediments downstream of the landfill, for which the landfill is the presumed source.

1.2.2 Umiat AFS Description, History, and Ownership

The Umiat area was designated a part of the 22.8-million-acre Naval Petroleum Reserve (NPR) on February 27, 1923, by Executive Order 3797-A. Umiat was developed in 1945 by the U.S. Navy within Naval Petroleum Reserve Number 4 (NPR-4; now known as the NPRA). A series of land orders issued during World War II (WWII) opened the area to coal mining and oil and gas exploration. The airfield was originally constructed as an emergency airstrip during WWII. In 1945, Umiat became a supply and operation base for petroleum exploration conducted by the Navy in NPR-4. Between 1945 and 1954, the Navy or its contractors installed 11 oil-exploration wells near Umiat; six of the 11 wells were within the USAF Station boundary and five wells were outside the boundary. The Umiat AFS, comprising 8,000 acres, was obtained by transfer letter (May 13, 1953) from the Department of the Navy to the Department of the Air Force (USACE, 2009).

The Air Force planned an Aircraft Control and Warning Station at Umiat; however, the facility was never constructed. The USAF used the station intermittently until 1959, when it was transferred back to the Navy. In 1977, the site was transferred to the U.S. Department of the Interior (DoI) as a result of Public Law 94-258, the Naval Petroleum Reserve Act of 1976. The DoI later transferred a portion of the site, including the airfield and buildings, to the State of Alaska.

Ownership and management jurisdiction over Umiat is currently divided between the Alaska Department of Transportation & Public Facilities (ADOT&PF) and BLM. The ADOT&PF owns 115 acres of the former Umiat military property, including the airfield, and grants leases for buildings and space to the US Federal Aviation Administration (FAA), and private interests. The BLM manages lands surrounding the former Umiat AFS, including the Colville River (as part of the public lands within the NPRA). The Arctic Slope Regional Corporation also owns land west of the Umiat AFS and has selected other land as part of their regional entitlement. These areas include lands along the Colville River based on the high water level mark. As shown on Figure 1-3, the ownership boundary between BLM and the ADOT&PF crosses the former landfill, with the southern portion on BLM land and the northern portion on ADOT&PF land. The Umiat main camp area includes an east/west trending, 5,400-foot gravel airstrip and operations complex. The operations complex historically comprised a number of Quonset huts and other structures used for housing and dining, material and equipment storage, maintenance, and power generation. Ukpeaġvik Iñupiat Corporation (UIC) UMIAQ leases and operates a seasonal camp (lodge and dining facility), commercial aviation-fueling facilities, and a diesel-powered generator. Other agencies, including the BLM, USGS, Alaska Department of Fish & Game (ADFG), and FAA, operate facilities at Umiat.

1.2.3 Landfill History and Description

The following summary of the landfill's history and description is a condensed version of information presented in the final RI report. The landfill is in a slough of the Colville River; it has no surface features indicating its location or boundaries. The slough runs about a half-mile before rejoining the Colville River. Water may be present in the slough for about four months of the year, mainly after spring ice breakup and during heavy rain events. This is referred to as the seasonal stream (Agency for Toxic Substances and Disease Registry [ATSDR], 2003).

Solid-waste disposal practices at Umiat prior to 1946 are unknown. However the earliest indication of disposal at the landfill appears to be 1944. Between 1944 and 1973, raw sewage was collected in 55-gallon drums for disposal at what was called the "east landfill" along the water haul road east of the camp to the Colville River, believed to be the subject landfill. From 1946 to at least 1981, the landfill appears to have been used for disposal of solid waste (Ecology and Environment, Inc. [E&E], 1996).

In 1973, the Naval Petroleum Oil Shale Reserves contracted Pacific Architects and Engineers, Inc., to clean up the Umiat camp. Four-hundred and nine tons of junk equipment and scrap metal and approximately 86,600 crushed drums were reportedly buried in "stable areas of the flood plain." Most of the drums were buried at the east landfill, including 7,091 drums hauled from the surrounding exploratory-well sites (E&E, 1996).

Debris observed at the landfill during recent site visits included scrap metal, wire, pipe, pipe fittings, drill bits, at least a half-dozen drum carcasses, and drill-rig tracks (USACE, 2010). In late May/early June 2011, a representative from the BLM photographed flooding of the Colville River over the Umiat landfill area and observed areas of erosion and exposed debris (USACE, 2011b). A transformer was exposed by flooding in 2001 and was removed along with approximately one-third cubic yard of polychlorinated biphenyl (PCB)-contaminated soil.

Debris that may have been buried at the landfill during site demolition activities in 1973 include 55-gallon drums, oil drums, lead-acid batteries, transformers, cable pipe, and equipment tracks. The remaining wastes at the landfill are assumed to consist of a heterogeneous mix of inert solid waste (including construction debris), potentially contaminated soil, and potential contaminant sources such as drums and other containers, batteries, and transformers.

Geophysical investigations performed at the landfill identified six cells of buried debris and estimated the horizontal extent of the debris cells to be about 4.2 acres. Including the area between the cells, the overall extent is about 8 acres. The approximate extents of the six cells of buried debris are shown in Figure 1-4.

Geophysical investigations and reported observations by persons involved with the landfill estimated the waste depth to range from about 8 feet to 43 feet below ground surface (bgs). A geophysical investigation performed by GeoTek (GeoTek 2011) was considered to be more reliable and estimated the basal depths of debris burial at the landfill to range between 8 feet and 17 feet bgs. However, the variations in landfill waste depth estimates results in a degree of uncertainty

1.2.4 Environmental Setting

1.2.4.1 Climate

Umiat is in an area defined as part of the Arctic Climatic Region. Due to the length of daylight hours and extreme northern latitude, summer and winter temperatures vary greatly. The average temperature for July is 53.2 degree Fahrenheit (ºF), and the average temperature in February drops to -24.4 ºF. The average annual temperature is 10.7 ºF.

The average annual precipitation for Umiat is 5.4 inches, about 1 inch of which typically falls in August, classifying the region as arid. Umiat averages 33.7 inches of snowfall annually. Prevailing winds blow from the west November through April, and from the east May to October. The average annual wind speed is 6.9 miles per hour (USACE, 2009).

1.2.4.2 Physiography

Umiat is in the northern foothills of Alaska's Brooks Range. The foothills generally slope to the north, with elevations ranging from 3,500 feet in the south to 400 feet in the north. Regionally, Umiat is located along the Colville River Valley. Major streams and rivers, such as the Colville River, have downcut through the sandstone and shale, creating high vertical bluffs. Umiat AFS is built on alluvial deposits; there are no sandstone or shale outcrops near the landfill.

1.2.4.3 Geology

Unconsolidated deposits within the Colville River floodplain near Umiat primarily consist of interbedded alluvial gravel, sand, and silt of Quaternary Age. These deposits are estimated to be 20 feet to 70 feet thick. In some areas, the Quaternary alluvium is overlain by an organic mat of unknown thickness and underlain by late Cretaceous sandstones, shales, and conglomerates associated with the uplift of the Brooks Range. The active layer (the interval of soil that freezes and thaws each year) is assumed to be approximately 2 feet to 3 feet thick in the undisturbed tundra; however, it is estimated to vary from 4 feet to 6 feet thick in gravel-pad areas. At the former Umiat AFS, permafrost is ubiquitous in the subsurface and believed to extend to depths of 1,000 feet or more bgs. The gravel pad and airstrip at Umiat consist mostly of poorly graded sandy gravels excavated from the river floodplain with a maximum size of about 6 inches. In the undeveloped wetland areas adjacent to the gravel pads and roadways, the main sediment type exposed at the surface is organic-rich silt. This silt varies in thickness up to approximately 8 feet and overlies the sandy gravels of the Colville River floodplain (E&E, 1997a-c).

1.2.4.4 Surface-Water Hydrology

Surface water occurs as rivers, streams, shallow ponds, and lakes near the former Umiat AFS. The major surface-water feature in the Umiat area is the Colville River, which drains the north slope of the Brooks Range and has a drainage area of 13,830 square miles. The river flows to the east (and eventually north), discharging into the Arctic Ocean. Flooding commonly occurs in the lower reaches of the river because of snowmelt, rainfall, and ice damming. The mean annual surface-water runoff for the Umiat vicinity is about 0.72 cubic foot per second per square mile of drainage basin above the point of measurement. Runoff into the Colville River is at a minimum during the winter months.

The landfill is on a gravelly inside meander within the active floodplain of the Colville River. During spring snowmelt, the high water of the Colville River overflows into a seasonal stream between the former Umiat AFS and Colville River. The seasonal stream runs across the landfill surface. There is another stream west of the landfill, which merges with the seasonal stream north of the landfill. During high water, the landfill is surrounded by the western stream and Colville River. Except during high-flow periods of spring runoff, the upper end of the seasonal stream is typically cut off from the Colville River, and the lower reaches of this channel act as a backwater. The size of this backwater area expands and contracts throughout the summer in response to changing levels of the Colville River (Jacobs, 2003).

The USGS measured discharge data for the Colville River at Umiat from August 2002-2009. The water gauge is on the left bank of the river, at the upstream end of the landfill and seasonal slough. Peak flows in May and June have been measured from 173,000 to 261,000 cubic feet per second (cfs; USACE, 2011a). Peak flows from 2002 to 2015 have been measured from 108,000 to 271,000 cfs.

1.2.4.5 Groundwater and Permafrost

Groundwater occurs in three zones in the Umiat area: suprapermafrost, thaw bulbs beneath lakes and rivers, and deep bedrock aquifers beneath permafrost (USACE, 2009). Groundwater occurring in unconsolidated sediments above permafrost is called suprapermafrost, and groundwater that occurs below continuous permafrost is subpermafrost. Shallow suprapermafrost groundwater occurs within the unconsolidated alluvial deposits at Umiat. The thickness of this suprapermafrost alluvial aquifer is variable because thaw bulbs form beneath lakes and rivers preventing freezing to the bottom during winter. Additionally, suprapermafrost groundwater occurs beneath developed areas such as the gravel pad and roadways.

Permafrost was observed in 29 of the 259 soil borings advanced in the Umiat landfill area. Groundwater extends from the water table to the top of permafrost. It is commonly 2 feet to 3 feet bgs in wetlands and undeveloped areas, and as deep as 15 feet bgs, but is highly variable in developed and gravel-pad areas. This permafrost is believed to have limited the possible depth of excavation and waste burial at the landfill. Previous investigations measured the active layer between 5.5 feet and 17.5 feet bgs. The active layer refers to ground that freezes in winter and thaws in summer, the base of which usually coincides with the top of permafrost.

The 1996 remedial investigation results indicated the groundwater gradient in the suprapermafrost alluvial aquifer is fairly flat, generally flowing toward the north and east. The flow direction is altered locally by depth to permafrost, stratigraphy, surface-water bodies, and water uptake by vegetation.

Suprapermafrost groundwater is assumed to be hydrologically connected to the nearby Colville River. The water-table elevation probably fluctuates in response to the stage of the river and depth of permafrost. River flooding probably has the greatest influence on groundwater elevation, flow direction, and gradient. Based on soil-boring logs from the 1994 and 1996 RIs, E&E determined the top of the shallow suprapermafrost groundwater near Umiat is commonly found between 2 feet and 5 feet bgs.

Deep subpermafrost groundwater at Umiat has been encountered at 3,303 feet and 6,212 feet bgs in deep bedrock aquifers and is brackish or saline (USACE, 2009).

At Umiat, no wells are known to have been drilled into suprapermafrost or subpermafrost aquifers to obtain potable water. No evidence was found that groundwater in the Umiat area has been investigated as a potential drinking-water source (E&E, 1997a).

1.3 Nature and Extent of Contamination

As described in the 2013 RI report, the heterogeneous mixture of wastes buried in the landfill is the presumed source of contamination detected in soil, sediment, surface water, and groundwater there. The following sections describe the methodology for identifying contaminants of potential concern (COPCs) and estimating cumulative risk for the landfill. Risk-based PRGs for the identified COPCs are further developed in Section 2.0.

1.3.1 Methodology for Identifying COPCs and Estimating Cumulative Risk

Historical analytical results were evaluated and COPCs identified using two basic approaches. Soil, sediment, surface-water, and groundwater results were compared to potential cleanup levels (PCLs) from Alaska statutes (Appendix A, Table A-1). Additionally, the highest results for soil and sediment were compared to one-tenth the Method Two Table B1 soil cleanup levels for the Arctic Zone, and surface-water and groundwater results to one-tenth the Table C groundwater cleanup levels, in accordance with the ADEC's 2008 *Cumulative Risk Guidance*. Fish-sample results were compared to calculated site-specific risk-based fish-screening levels (see Section 1.3.5).

Results were also compared to "to-be-considered" (TBC) criteria, namely the National Oceanic and Atmospheric Administration (NOAA) Screening and Quick Reference Table (SQuiRT) values. Though TBCs have no enforceable requirements, they may be relevant for consideration by stakeholders or other interested parties reviewing the accumulated chemical data. The PCLs and risk-based screening levels used to identify COPCs are listed in Tables A-2 through A-6 along with the highest detected analyte concentrations for each media.

1.3.2 Soil and Sediment

Soil and sediment were considered in the same manner for purposes of comparing to PCLs and incorporating the results into the cumulative risk evaluation. Given that the landfill is within a hyporheic zone (the interface between groundwater and surface water) and is periodically flooded during spring snowmelt events, soil may be considered sediment and sediment considered soil depending on the time of year. For purposes of assessing the potential for exposure to contaminants, sediment is conservatively compared to soil PCLs and risk-based screening levels.

The primary soil/sediment PCLs were derived from 18 Alaska Administrative Code (AAC) 75, specifically Method Two cleanup levels for the Arctic Zone and migration to groundwater. Method Two cleanup levels are based on a cancer risk-management standard of 1 in 100,000 (1×10^{-5}) and a noncarcinogenic risk standard or hazard index (HI) of 1.0, set forth in 18 AAC 75.325(h). ADEC Method Two cleanup levels for the Arctic Zone are based on exposure frequency values of 200 days (160 days non-exposure time per year). The remaining exposure parameters used to develop Method Two cleanup levels are standardized default values developed by the EPA (ADEC, 2002). The exposure scenarios are essentially residential scenarios for children or adults involving exposure duration of six and 30 years, respectively.

Organic and inorganic analyte results were compared to the more stringent of the Method Two direct-contact and outdoor-air inhalation pathway Arctic-Zone cleanup levels and migration-to-groundwater cleanup levels. Method Two soil-cleanup levels are considered to be protective of human health with respect to the carcinogenic risk standard and non-carcinogenic HI for individual analytes in a residential setting under long-term exposure. Migration-to-groundwater soil-cleanup levels are considered protective of groundwater as a drinking-water source. Analytical results were also screened for potential contributions to cumulative risk by comparing the highest result to one-tenth the relevant human-health based cleanup level, or in the case of fish-tissue results, the calculated risk-based screening level (see Section 1.3.4).

Groundwater is present in the landfill area. The ADEC considers sites north of Latitude 68° North to be in the Arctic Zone, where groundwater is not typically considered an exposure medium of concern. It is assumed groundwater and surface water at Umiat are closely connected. During the summer, the majority of the groundwater in the landfill likely originates from surface water from the river, to re-emerge into the seasonal slough. Because of the close hydrologic connection between surface and groundwater at this site, the groundwater is protected for use as drinking water, and migration-to-groundwater soil cleanup levels apply.

For the same reason (interrelatedness of groundwater and surface water), suprapermafrost groundwater is considered a transport medium for contaminant migration from soil in the landfill to the adjacent slough.

The use of the Method Two cleanup levels is considered a conservative and protective screening tool to assess the need for actions at the site. Method Two soil-cleanup levels were used when appropriate for petroleum hydrocarbons (gasoline-range organics [GRO], diesel-range organics [DRO], and residual oil-range organics [RRO]). The use of Method Two cleanup levels for petroleum hydrocarbons requires a responsible person to demonstrate Arctic Zone soil cleanup level level is protective of migration to surface water (18 AAC 75.340 [c]).

The NOAA SQuiRTs include medium-specific screening values for soil and sediment. Soil results were also compared to the NOAA SQuiRT values for soil, and sediment results compared to the NOAA SQuiRT values for freshwater sediment, using the most stringent screening criteria available for a given analyte. The SQuiRTs were developed for internal use by the Coastal Protection and Restoration Division of NOAA. The Division identifies potential impacts to coastal resources and habitats likely affected by hazardous waste sites. The SQuiRT values are TBCs intended for preliminary screening purposes only. They represent no official NOAA policy or actionable cleanup levels.

> The NOAA SQuiRTs' preface notes:
>
> This set of NOAA Screening Quick Reference Tables, or SQuiRTs, presents screening concentrations for inorganic and organic contaminants in various environmental media….NOAA identifies potential impacts to coastal resources and habitats likely to be affected by hazardous waste. To screen for substances which may threaten natural resources of concern to NOAA, environmental concentrations are compared to these screening levels. These tables are intended for preliminary screening purposes only. NOAA does not endorse their use for any other purposes.

However, SQuiRT data were included in the screening effort as TBC criteria that may be relevant for consideration by stakeholders or other interested parties reviewing accumulated chemical data.

1.3.3 Surface Water and Groundwater

As noted in Section 1.3.2, surface water and groundwater are closely connected hydrologically at the site. At certain times of the year the landfill is within the hyporheic zone of the seasonal stream. Regulation 18 AAC 75.345(f) requires, "groundwater that is closely connected hydrologically to nearby surface water may not cause a violation of the water quality standards in 18 AAC 70 for surface water or sediment." Likewise, no surface water may exceed Table C Groundwater cleanup levels, as surface water in Alaska is protected for all uses (including drinking water). Therefore, 18 AAC 75.345 Table C groundwater and 18 AAC 70 Water Quality Standards apply to both surface water and groundwater.

To screen water-sample data and identify COPCs, surface-water and groundwater-sample results were compared to the most stringent values (where available) for the following:

- 18 AAC 75.345 Table C groundwater cleanup levels (June 2015);
- 18 AAC 70 Water Quality Standards (April 2012) for fresh-water uses; and
- *Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances* (December 2008), Water Quality Criteria for Toxics and Other Deleterious Substances (Aquatic Life Criteria for Fresh Water), which also includes criteria for pesticides and inorganic analytes.

The water-quality standards regulate human activities that result in alterations to waters within the state's jurisdiction. The water data were compared with standards provided for "Petroleum Hydrocarbons, Oils and Grease, for Fresh Water Uses." The water-quality standards further state surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discolorations.

The NOAA SQuiRTs include media-specific screening values for surface water and groundwater. Surface-water results were also compared to the NOAA SQuiRT values for freshwater, and groundwater results compared to the NOAA SQuiRT values for groundwater, using the most stringent screening criteria available for a given analyte.

1.3.4 Fish Tissue

Fish tissue results were screened against risk-based screening levels calculated with the EPA "Regional Screening Levels for Chemical Contaminants at Superfund Sites" online calculator (see reference in Section 6.0), using a cancer-risk management level of 1 in 1,000,000 ($1x10^{-6}$), a hazard index of 0.1, and fish-consumption rates estimated for subsistence users (390 grams per day (g/day); 2003 ATSDR citing ADFG 2000 Community Profile Database for Nuiqsut). Analytes exceeding risk-based screening levels were included in the cumulative risk evaluation and considered COPCs.

1.3.5 Cumulative-Risk Evaluation

Cumulative risk is defined as the sum of risks resulting from multiple sources and pathways to which humans are exposed. When applying Method Two cleanup levels to a site, 18 AAC 75.325(g) states risk from hazardous substances must not exceed a cumulative carcinogenic risk standard of 1 in 100,000, and a cumulative noncarcinogenic risk standard at a HI of 1.0 across all exposure pathways. Cumulative risk evaluation (CRE) is a means of determining whether the risk to human health from multiple contaminants at a given site exceed these risk standards, and is typically conducted following site cleanup. Given that multiple analytes were present at greater than one-tenth the Method Two cleanup levels, a CRE was conducted to assess baseline (pre-cleanup) cumulative risk at the site. The CRE was then used in Section 2.0 to develop PRGs that are protective of exposure to multiple contaminants as part of the FS. This procedure does not change the conclusion that corrective action should be implemented because the risk range of 1×10^{-4} to 1×10^{-6} was exceeded.

Some chemicals may pose exposure risks through more than one pathway (e.g., PCBs in soil via direct contact and inhalation). When more than one exposure pathway was possible for a given analyte found at the site, each pathway was included in the CRE to evaluate the incremental risk associated with that contaminant and its exposure routes.

In accordance with the ADEC's 2008 *Cumulative Risk Guidance*, the highest analytical results for soil/sediment were compared to one-tenth the Method Two cleanup levels for the Arctic Zone, and maximum analytical results for water (surface water and groundwater) to one-tenth the Table C groundwater cleanup levels. As noted above, fish-sample results were compared to site-specific fish risk-based screening levels to determine which analytes to include in the CRE. No petroleum hydrocarbons (i.e. GRO, DRO, and RRO) or lead were included in the CRE, in accordance with ADEC regulations and the *Cumulative Risk Guidance*.

Once analytes were selected for inclusion in the CRE, pathway-specific carcinogenic and non-carcinogenic risk was calculated for each analyte using the procedures specified in the ADEC's 2008 *Cumulative Risk Guidance*. Carcinogenic risk was calculated by dividing the highest site concentration by the risk-based concentrations (RBC), then multiplying by the risk-management standard of 1×10^{-5}. Non-carcinogenic risk is calculated by dividing the highest site concentration by the appropriate RBC and multiplying by the HI of 1.0. The CRE is included as Table A-7.

Soil RBCs in the *Cumulative Risk Guidance* were used for calculating risk from soil and sediment, and groundwater RBCs (also listed in the *Guidance*) for calculating risk from surface water and groundwater. Fish-tissue RBCs were calculated using the EPA calculator referenced in Section 1.3.4 using a cancer risk-management level of $1x10^{-5}$, a HI of 1.0, and fish-consumption rates estimated for subsistence users (390 g/day). Certain analytes present risk through a limited number of exposure pathways (i.e. inhalation of arsenic is not considered a potential exposure pathway); the CRE includes only those pathways for which an RBC is listed or calculable for a given analyte.

A list of COPCs, including the highest result and frequency of exceedance, are provided in Table A-8.

1.4 Summary of Remedial Investigation Findings

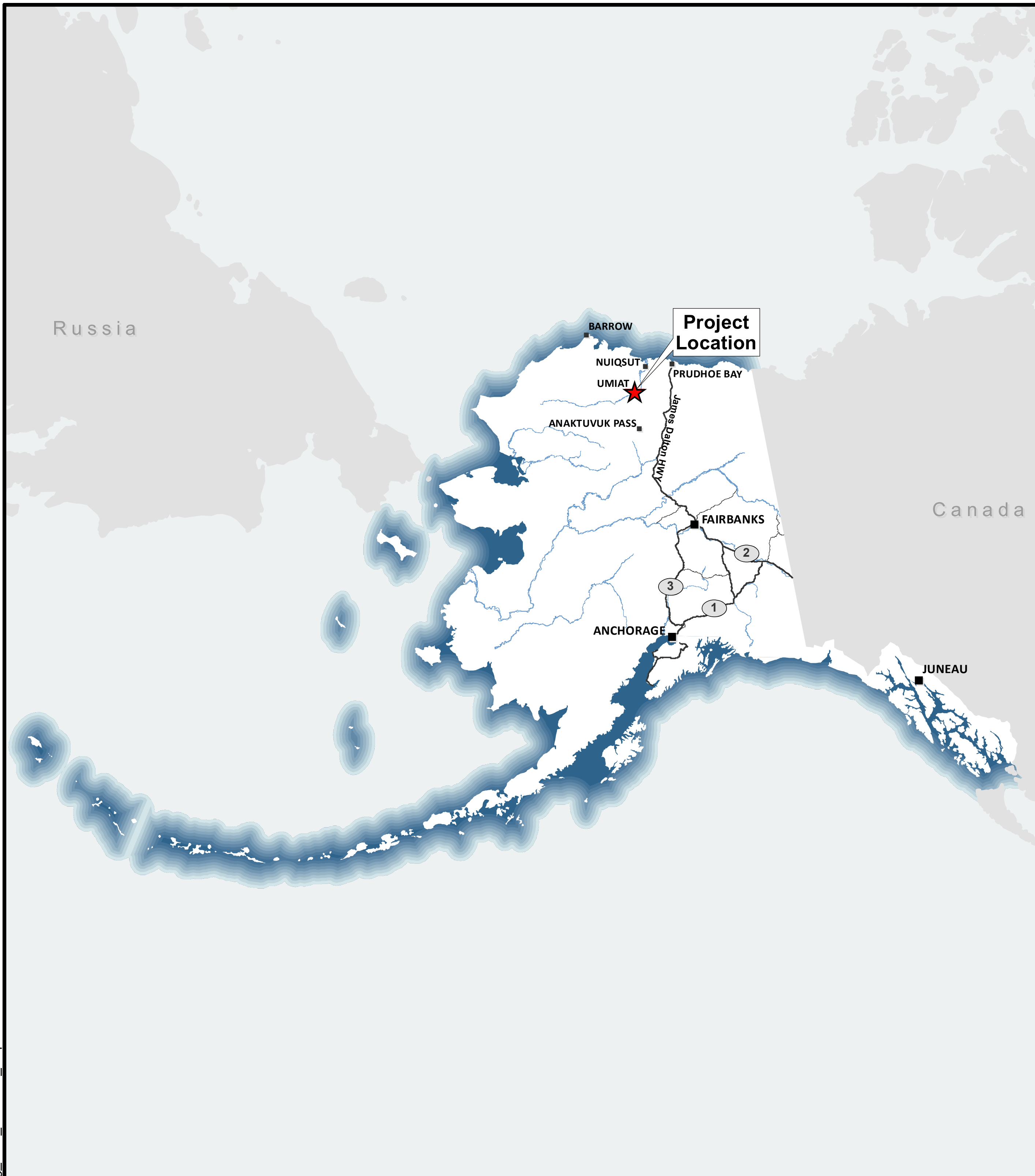
Shannon & Wilson's 2013 RI Report was based on data collected and previously reported by others. The RI report describes the nature and extent of chemical contamination in soil, groundwater, surface water, sediment, and fish. It discusses the risks to human health and the environment posed by remaining contamination at the landfill.

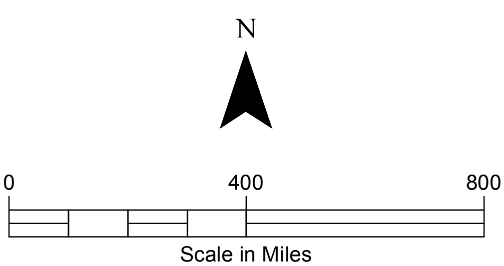
Conclusions from the RI include:

- COPCs are contaminants detected at the site above their respective PCL and include PCBs (specifically Aroclor 1254); 4,4'-dichlorodiphenyldichloroethane (4,4'-DDD), 4,4'-dichlorodiphenyldichloroethene (4,4'-DDE), 4,4'-dichlorodiphenyltrichloroethane (4,4'-DDT), DRO, naphthalene, methylene chloride, and lead.
- Because the contents of the landfill are unknown, additional contaminants may be present and could become COPCs if released to the environment.
- Based on a cumulative risk evaluation (CRE) of contaminants detected above one-tenth of their respective ADEC cleanup level, the carcinogenic risk posed to human health by these COPCs exceeds the risk management standard of 1×10^{-5} (and range of 1×10^{-4} to 1×10^{-6}) and the non-carcinogenic hazard index exceeds the risk management standard of 1.
- The landfill area is adequately defined, occupying about 8 acres.
- Landfill depth estimates vary, and resultant volume calculations vary.
- Buried debris is known to include contaminant sources such as lead-acid batteries and transformers. The landfill is suspected to contain drums and other containers with unknown contents and may include contaminated soil.
- Contaminants have migrated from the landfill to surface soil, sediment, surface water, and groundwater.
- Contaminants are present in fish tissue, including PCB Aroclors 1260 and 1016/1242.

- Data suggest no defined contaminant sources in the landfill that can be targeted for removal.
- Episodic channel flooding with water velocities high enough to cause surface erosion and contaminant transport occurs annually.

A conceptual site model (CSM) for human health and ecological receptors is presented in Figures 1-5 and 1-6, respectively. The CSMs depict potential sources of chemicals, release mechanisms, means of retention in or migration to exposure media, and receptor exposure routes.





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LOCATION MAP

September 2015 31-1-11544-006

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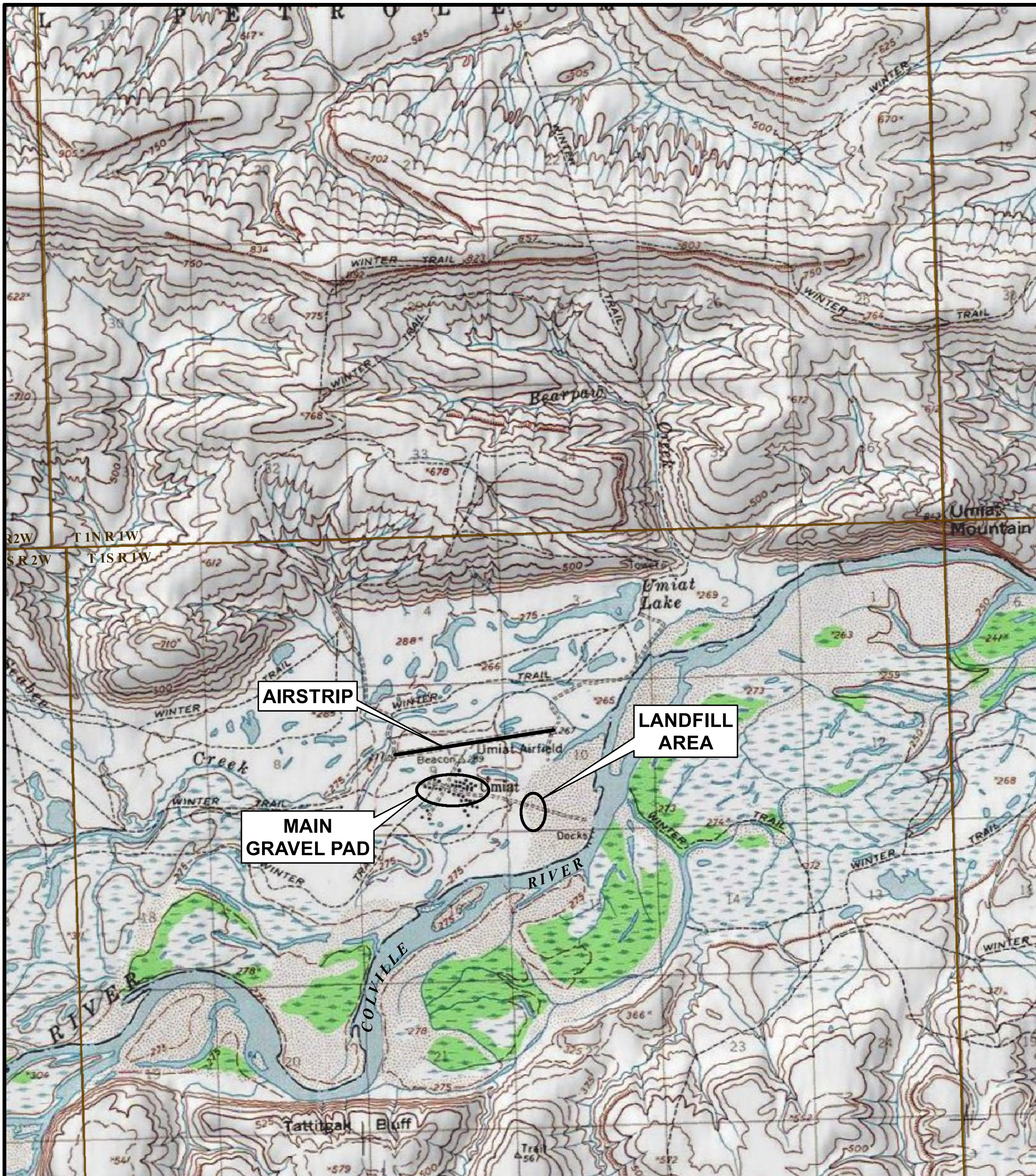
FIG. 1-1

Filename: T:\31-1\11544_Umiat\AV_mxd\Fig_1-01_Location_Map.mxd Date: 9/16/2015 brl



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Basemap from ESRI ArcGIS Online, Copyright: © 2011 National Geographic Society, i-cubed. Basemap includes the National Geographic TOPO! 1:1:250,000 and 1:63,000-scale maps for Alaska. The TOPO! maps are seamless, scanned images of United States Geological Survey (USGS) paper topographic maps, dated 1955.

0 1 2

Scale in Miles

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VICINITY MAP

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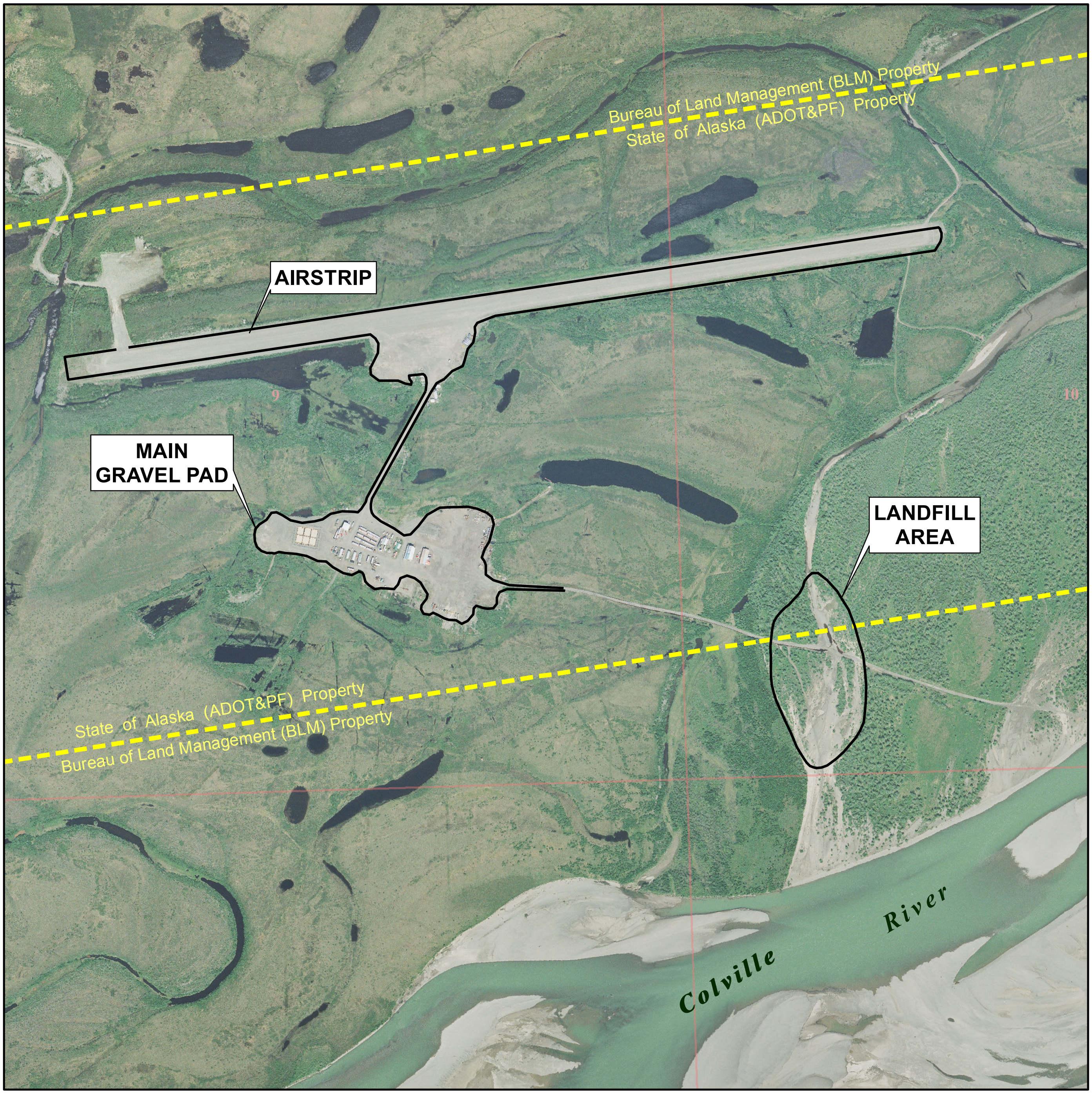
FIG. 1-2

Path: T:\31-1\11544_Umiat\AV_mxd\Fig_1-02_Vicinity_Map_brl.mxd 9/16/2015 brl



ADOT&PF = Alaska Department of Transportation and Public Facilities

Aerial photography dated July 2009. Produced by Kodiak Mapping. Provided by Alaska Department of Transportation and Public Facilities.

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LAND OWNERSHIP MAP

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FIG. 1-3

Filename: T:\31-1\11544_Umiat\AV_mxd\Fig_2-01_Land_Ownership.mxd Date: 9/16/2015 brl

Major Waste Cells

Major waste cells based on USGS, 2006, Geophysical Investigations of Selected Infrastructure Sites within the National Petroleum Reserve, Alaska.

Aerial photography taken July 2009, produced by Kodiak Mapping, recieved from Alaska Department of Transportation & Public Facilities.

N

0 400 800

Scale in Feet

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RESULTS OF GEOPHYSICAL INVESTIGATIONS

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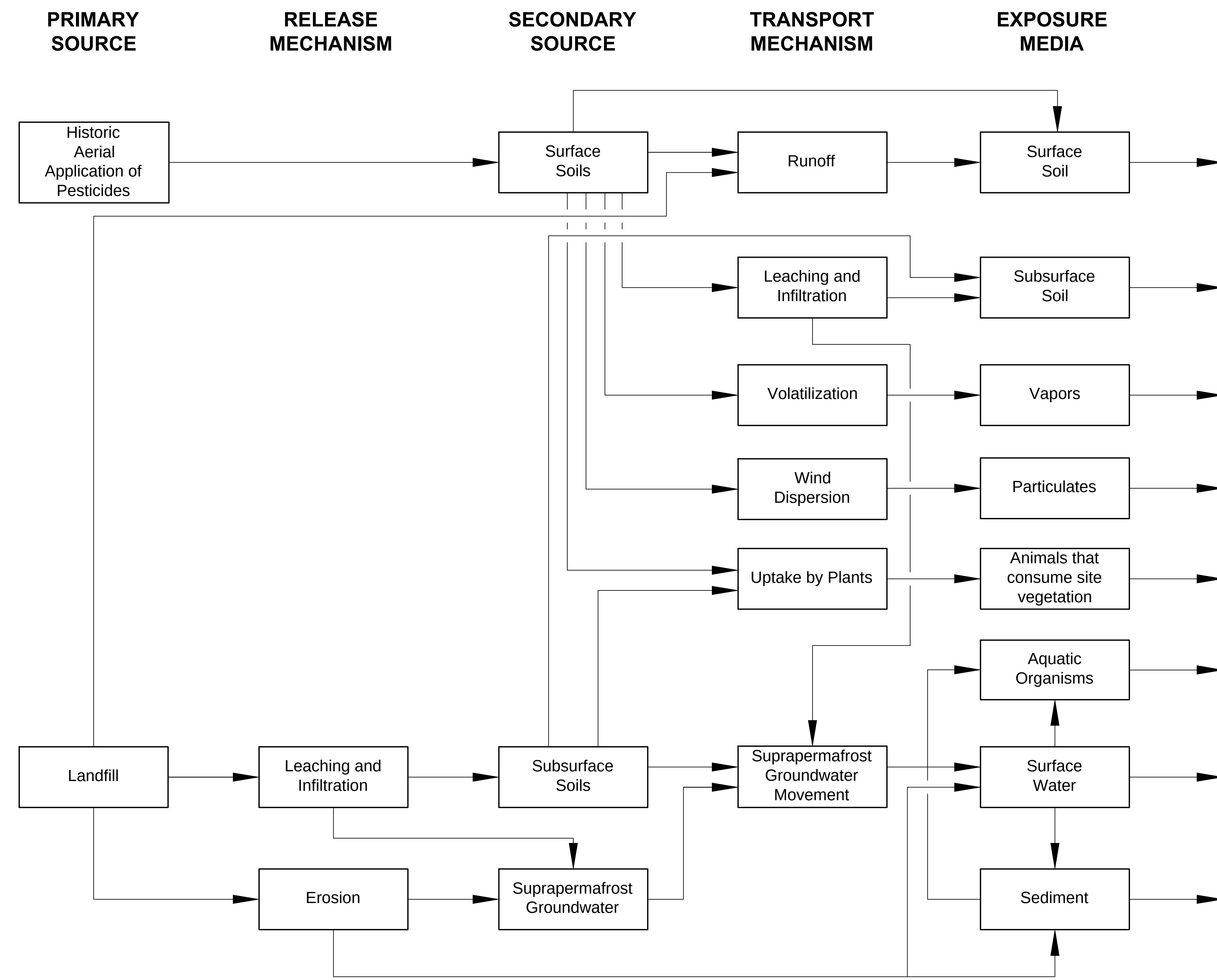
FIG. 1-4

Filename: T:\31-1\11544_Umiat\AV_mxd\Fig_4-11_Results_2005_USGS_Geophysical.mxd Date: 9/16/2015 brl



RECEPTORS AND ROUTES OF EXPOSURE

	SITE RESIDENTS	SITE VISITORS	SUBSISTENCE USERS	CONSTRUCTION WORKER
Incidental Ingestion	●	●	●	●
Dermal Contact	—	—	—	●
Incidental Ingestion	—	—	—	●
Dermal Contact	—	—	—	●
Inhalation [a]	—	—	—	—
Inhalation	●	●	●	●
Ingestion of Game	●	●	●	●
Ingestion of Fish	●	●	●	●
Incidental Ingestion	●	●	●	●
Dermal Contact	●	●	●	●
Incidental Ingestion	●	●	●	●
Dermal Contact	●	●	●	●

KEY

a This exposure pathway is incomplete for the landfill because no volatile COPCs were identified.

→ Complete Contaminant Migration Pathway

● Complete Exposure Pathway

— Incomplete Exposure Pathway

NOTE

Adapted from Ecology & Environment, 1997. Final Risk Assessment Report, Former Umiat Air Force Station, Umiat, Alaska. June.

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HUMAN HEALTH CONCEPTUAL SITE MODEL

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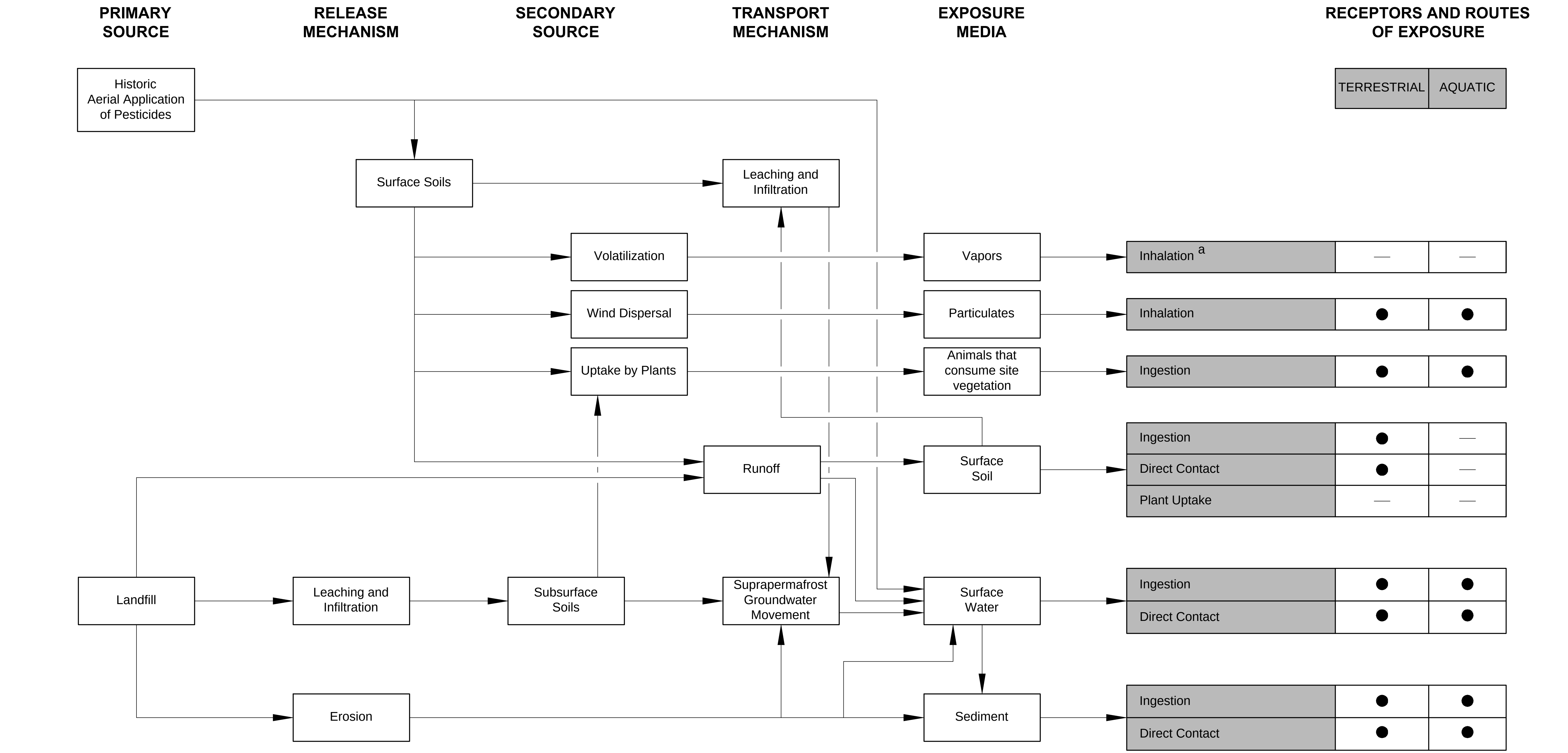
FIG. 1-5

Filename: J:\311\11544-006\FromPDX\31-1-11544-006-ConceptAndAlts.dwg Date: 09-17-2015 Login: bac



KEY

● Complete Exposure Pathway

— Incomplete Exposure Pathway

a This exposure pathway is incomplete for the landfill because no volatile COPCs were identified.

NOTE

Adapted from Ecology & Environment, 1997. Final Risk Assessment Report, Former Umiat Air Force Station, Umiat, Alaska. June.

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ECOLOGICAL CONCEPTUAL SITE MODEL

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FIG. 1-6

Filename: J:\311\11544-006\FromPDX\31-1-11544-006-ConceptAndAlts.dwg Date: 09-17-2015 Login: bac

2.0 DEVELOPMENT OF PRELIMINARY REMEDIATION GOALS

2.1 Methodology for Determining Preliminary Remediation Goals

The methodologies used in the RI for determining COPCs and cumulative risk were presented in Section 1.3.1. The methodology for determining PRGs for these analytes is presented herein.

2.2 COPC and Cumulative Risk Summary

Historical analytical results were evaluated and COPCs identified using two basic approaches:

- Soil, sediment, surface-water, and groundwater results were compared to potential cleanup levels (PCLs) from Alaska Statutes; and
- The highest results for soil and sediment were compared to one-tenth the Method Two Table B1 soil-cleanup levels for the Arctic Zone, and surface-water and groundwater results to one-tenth the Table C groundwater cleanup levels, in accordance with the ADEC's *Cumulative Risk Guidance*. Fish-sample results were compared to calculated site-specific risk-based fish-screening levels.

Results were also presented in the RI in comparison to TBC criteria, namely the NOAA SQuiRT values or EPA fish-tissue risk-based screening levels. As described in Section 1.3.1, though TBCs have no enforceable requirements, they may be relevant for consideration by stakeholders or other interested parties reviewing the accumulated chemical data.

The COPCs for the Umiat Site were presented in the RI and are reproduced in Table 2-1 of this FS.

2.3 Preliminary Remediation Goals

Alaska Statute 18 AAC 75.325(g) states that a responsible party applying soil-cleanup levels found in 18 AAC 75.341 (Method Two) or groundwater-cleanup levels found in 18 AAC 75.345 "shall ensure that, after completing site cleanup, the risk from hazardous substances does not exceed a cumulative carcinogenic risk standard of 1 in 100,000 across all exposure pathways and does not exceed a cumulative noncarcinogenic risk standard at a hazard index of one across all exposure pathways." Cumulative risk is defined as the sum of risks resulting from multiple sources and pathways to which humans are exposed. The ADEC's *Cumulative Risk Guidance* (June 2008) states, "when more than one hazardous substance is present at a site or multiple exposure pathways exist, the cleanup levels in Table B1 of 18 AAC 75.341 and Table C of 18 AAC 75.345 may need to be adjusted downward."

The CRE calculations were based on RBCs that assume residential exposure scenarios for the Arctic Zone, and likely overestimate the risk for the site. The Umiat camp is a non-residential seasonal (summer) facility typically managed by a small facility-operations staff. Various state and federal agencies maintain storage and operations facilities at the camp for use by itinerant site workers on short-term assignments. Applying cleanup levels and calculating cumulative risk based on residential exposure scenarios overestimates current, and potentially future, risks.

No PRGs for contaminants in fish tissue were developed for this site. Based on its 2003 *Health Consultation*, the ATSDR found that “while PCBs, DDT, and DDT derivatives were detected in fish collected from multiple areas of the Colville River, the levels were very low and exposures to them are not expected to cause harmful health effects.” Thus, the ATSDR determined it is safe to eat the fish. Additionally, PCB Aroclor 1260 and Aroclor 1016/1242 were only detected in fish tissue but none were found in soil, sediment, surface water, or groundwater at the Umiat Site (only Aroclor 1254 was detected in site soil and sediment). This suggests fish may be affected by contaminant sources other than the landfill.

The COPCs developed during the RI were further refined during this FS for the purpose of developing PRGs using the following considerations:

- No PRGs were developed for fish tissue (ATSDR found no harmful human health effects);
- No PRGs were developed for contaminants in groundwater or surface water (assume source-area removal will result in cleanup of groundwater and surface water)
- No PRG was developed for methylene chloride. It was removed as a COPC (assumed as a lab contaminant and determined to not substantially contribute to cumulative risk at the site).

The refined list of COPCs for which PRGs were developed includes PCBs, 4,4’-DDD, and 4,4’-DDT. Following ADEC guidance, PRGs for lead is based solely on chemical-specific applicable or relevant and appropriate requirements (ARARs) (see Section 3.1 for discussion of ARARs). ARARs do not apply to petroleum hydrocarbons but risk-based standards can be used as PRGs.

The ADEC *Method Three & Cumulative Risk Calculator* was used to evaluate potential PRGs for PCBs, 4,4’-DDD, 4,4’-DDT, and naphthalene. The maximum concentration of each of these COPCs in soil and water was input into the calculator under the Arctic Zone, Residential Exposures scenario. Default values were used for the calculator’s volatilization and groundwater pathway parameters. The calculator output provided cumulative risk-based concentrations for the following soil-exposure pathways: direct contact – indoor worker; direct contact – outdoor worker; inhalation (where applicable); and migration-to-groundwater.

For each case, the most stringent of these output parameters was equal to the ADEC Method Two migration-to-groundwater cleanup levels for the Arctic Zone. Using these values as potential PRGs, cumulative risk was evaluated to determine if the PRGs developed for these soil analytes were sufficiently protective of human health (Table 2-2). The results of this CRE indicate that the PRGs set at the ADEC Method Two soil cleanup levels for the migration-to-groundwater exposure pathway are sufficiently protective of human health.

The refined list of COPCs at the site and their respective PRGs is presented in (Table 2-3).

Table 2-1
Summary of Contaminants of Potential Concern

Contaminant of Potential Concern	Affected media	Date and media of highest-concentration sample	Highest Concentration (No. of Samples Exceeding PCL or RBSL out of Total Samples*)	COPC Basis	
				PCL Exceeded	Substantial contribution to cumulative risk
Diesel Range Organics	Soil & sediment	1996; SL	1,300 mg/kg (2/70)	✓	
	Surface water & groundwater	1996; GW	76.1 mg/L (2/46)	✓	
Naphthalene	Surface water & groundwater	1996; GW	0.350 mg/L (1/29)		✓
Methylene Chloride	Soil & sediment	1994; SL	0.019 mg/kg (1/58)	✓	
4,4'-DDD	Soil & sediment	1996; SL	31.4 mg/kg (2/81)	✓	✓
	Surface water & groundwater	1996; GW	0.0173 mg/L (1/51)	✓	✓
	Fish	1998; FT	0.480 mg/kg (8/29)		✓
4,4'-DDE	Fish	1998; FT	0.740 mg/kg (10/29)		✓
4,4'-DDT	Soil & sediment	1996; SL	38.2 mg/kg (2/81)	✓	✓
	Surface water & groundwater	1996; GW	0.0311 mg/L (3/51)	✓	
	Fish	1998; FT	0.079 mg/kg (7/29)		✓
Aroclor 1254	Soil & sediment	1996; SD	17.8 mg/kg (33/112)	✓	✓
	Fish	1997; FT	1.4 mg/kg (35/49)		✓
Aroclor 1260	Fish	1998; FT	0.190 mg/kg (22/49)		✓
Aroclor 1016/1242	Fish	1998; FT	0.0061 mg/kg (3/49)		✓
Lead	Soil & sediment	2001; SL	1,170 mg/kg (2/46)	✓	
	Surface water & groundwater	1996; SW	0.003 mg/L (2/12)	✓	

Notes:

Media considered affected where the COPC was detected above PCLs or RBSLs

mg/kg milligrams per kilogram
mg/L milligrams per liter
SL soil
SD sediment
SW surface water
GW groundwater
FT fish tissue
* Total number of samples analyzed for COPC; includes QA/QC duplicates/triplicates; does not include background samples

Table 2-2
Cumulative Risk Evaluation

COPC	Preliminary Remediation Goal	RBC[2,5]	Units	PRG/RBC	Site Risk at PRG Concentration [3,4]
Carcinogens; Soil/Sediment; Direct contact pathway[1]					
Aroclor 1254	1.0	3.8	mg/kg	2.63E-01	2.6E-06
4,4'-DDT	7.3	29	mg/kg	2.52E-01	2.5E-06
4,4'-DDD	7.2	41	mg/kg	1.76E-01	1.8E-06
				Total	**6.9E-06**
Carcinogens; Soil/Sediment; Inhalation pathway[1]					
Aroclor 1254	1.0	25	mg/kg	4.00E-02	4.0E-07
4,4'-DDT	7.3	2200	mg/kg	3.32E-03	3.3E-08
				Total	**4.3E-07**
				Carcinogenic Cumulative Risk	**7E-06**
COPC	**Preliminary Remediation Goal**	**RBC[2,6]**	**Units**	**PRG/RBC**	**Site Risk at PRG Concentration [3,4]**
Non-carcinogens; Soil/Sediment; Direct contact pathway[1]					
4,4'-DDT	7.3	61	mg/kg	1.20E-01	0.12
4,4'-DDD	7.2	240	mg/kg	3.00E-02	0.03
				Total	**0.15**
				Non-carcinogenic Cumulative Risk	**0.15**

Notes:

[1] Methodology and risk-based concentration (RBC) followed Cumulative Risk Guidance (ADEC 2008)

[2] RBC is for Arctic Zone; data from Cumulative Risk Guidance (ADEC 2008)

[3] Risk at site concentration = (site concentration/RBC) x 10^{-5}

[4] Carcinogenic cumulative risk and cumulative Hazard Index are rounded to one significant figure; individual carcinogenic risks and hazard indices are rounded to two significant figures (ADEC 2008, page 11)

[5] RBC for total PCBs used for Aroclor 1254

Abbreviations:

COPC	Contaminant of Potential Concern
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
HI	Hazard Index for noncarcinogenic risk
HQ	Hazard Quotient for noncarcinogenic risk
RBC	risk-based concentration

Conclusions:

- **Calculated carcinogenic cumulative risk exceeds screening criterion (1 x 10^{-5}) for soil.**
- **Calculated risk exceeds noncarcinogenic Hazard Index screening criterion (1) for soil.**

Note: In accordance with the ADEC Cumulative Risk Guidance (June 9, 2008), lead is not included in the CRE.

Table 2-3
Refined Summary of Contaminants of Potential Concern and PRGs

Contaminant of Potential Concern	Affected media	Date and media of highest-concentration sample	Highest Concentration (No. of Samples Exceeding PCL or RBSL out of Total Samples*)	PRG
Diesel Range Organics	Soil & sediment	1996; SL	1,300 mg/kg (2/70)	230 mg/kg
	Surface water & groundwater	1996; GW	76.1 mg/L (2/46)	1.5 mg/L
Naphthalene	Surface water & groundwater	1996; GW	0.350 mg/L (1/29)	0.73 mg/L
4,4'-DDD	Soil & sediment	1996; SL	31.4 mg/kg (2/81)	7.2 mg/kg
	Surface water & groundwater	1996; GW	0.0173 mg/L (1/51)	0.0035 mg/L
4,4'-DDT	Soil & sediment	1996; SL	38.2 mg/kg (2/81)	7.3 mg/kg
	Surface water & groundwater	1996; GW	0.0311 mg/L (3/51)	0.0025 mg/L
Aroclor 1254	Soil & sediment	1996; SD	17.8 mg/kg (33/112)	1 mg/kg
Lead	Soil & sediment	2001; SL	1,170 mg/kg (2/46)	400 mg/kg
	Surface water & groundwater	1996; SW	0.003 mg/L (2/12)	0.015 mg/L

Notes:

Media considered affected where the COPC was detected above PCLs or RBSLs

mg/kg milligrams per kilogram
mg/L milligrams per liter
SL soil
SD sediment
SW surface water
GW groundwater
FT fish tissue

* Total number of samples analyzed for COPC; includes QA/QC duplicates/triplicates; does not include background samples

3.0 IDENTIFICATION AND SCREENING OF RESPONSE ACTIONS

3.1 Summary of ARARs

CERCLA Section 121(d)(1) requires that remedial actions be protective of human health and the environment. In addition, CERCLA Section 121(d) requires remedial actions meet federal or state standards, requirements, criteria, or limitations that are legally applicable or relevant and appropriate, unless those requirements are waived pursuant to Section 121(d)(4) under appropriate site-specific circumstances. These requirements are commonly referred to as Applicable or Relevant and Appropriate Requirements (ARARs).

According to the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) at 40 Code of Federal Regulations (CFR) 300.5, *applicable requirements* 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 identified by a state in a timely manner and more stringent than federal requirements may be applicable.

Relevant and appropriate requirements 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 a particular site. Only those state standards identified in a timely manner and more stringent than federal requirements may be relevant and appropriate.

Petroleum contamination has been detected at the Umiat site. Petroleum, oil, and lubricant (POL)-contaminated sites fall under the CERCLA petroleum exclusion and ARARs do not apply to petroleum. The petroleum contamination therefore addressed under the Defense Environmental Restoration Program (DERP), as authorized in the United States Code, Title 10, Section 2701, et seq. The DERP provides authority to clean up petroleum releases that pose an imminent and substantial endangerment to public health, welfare, or the environment.

There are three categories of ARARs: chemical-, location-, and action-specific. Descriptions of these categories follow:

3.1.1 Chemical-Specific ARARs

Chemical-specific ARARs define acceptable exposure concentrations or water-quality standards and are used in establishing PRGs. They are medium-specific laws and requirements that regulate the release to the environment of materials possessing 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 requirements establish the acceptable concentration of a contaminant that may be found in or discharged to the environment. They form the basis for the development of RAOs.

Table B-1 (Appendix B) presents a summary of potentially applicable chemical-specific ARARs. PRGs were developed based on applicable chemical-specific ARARs in Section 2.0 that account for cumulative risk for contaminants for which cumulative risk is addressed. The PRG for lead is based solely on chemical-specific ARARs. ARARs do not apply to petroleum hydrocarbons but risk-based standards are used as PRGs. The PRGs for the Umiat Site are presented in Table 2-3.

3.1.2 Location-Specific ARARs

Location-specific ARARs establish restrictions on remedial activities or limitations on contaminant levels on the basis of site characteristics or physical characteristics of the surrounding area. These requirements must be considered when developing RAOs and may limit the types of alternatives that can be selected. Examples of such ARARs include laws for siting hazardous waste facilities, laws pertaining to development or other activities in sensitive areas such as wetlands and floodplains, historic preservation laws, and laws for the protection of endangered species.

Table B-2 (Appendix B) presents a summary of potentially applicable location-specific ARARs. Where identified, location-specific ARARs are described for remedial alternatives developed in Section 5.0.

3.1.3 Action-Specific ARARs

Action-specific ARARs are standards that establish restrictions or controls on particular kinds of remedial activities related to the management of hazardous substances or pollutants. These requirements are triggered by the particular remedial activities rather than the specific chemicals present at the site. Examples of action-specific ARARs include state and federal landfill operation and closure regulations, incineration standards, transportation standards, and surface-discharge standards. The action-specific ARARs that would have the most significant impact on remedial actions at the site pertain to the treatment and/or disposal of contaminated soils. Action-specific ARARs by themselves determine no appropriate remedial alternative, but indicate the performance levels to be achieved by the alternative.

Table B-3 (Appendix B) presents a summary of potentially applicable action-specific ARARs. Where identified, action-specific ARARs are described for remedial alternatives developed in Section 5.0.

3.1.4 To Be Considered

Since conditions vary widely from site to site, ARARs alone may provide no protection for human health and the environment. For these conditions, EPA may implement other federal or state policies, guidelines, or proposed rules capable of reducing the risks posed by a site. Such To Be Considered (TBC) standards, may be used in conjunction with ARARs to achieve an acceptable level of risk. TBCs are evaluated along with ARARs to set protective cleanup levels and goals. Proposed concentration-based action levels under RCRA could be used as TBC guidelines to trigger treatment of soils contaminated with hazardous wastes. TBCs may also include potential ADEC requirements under 18 AAC 75.345(c).

3.1.5 ARAR Waivers

Superfund Amendments & Reauthorization Act (SARA) Section 121(d) requires compliance with federal and state ARARs for on-site response actions. In certain circumstances, a law or regulation that would normally be an ARAR may be waived in favor of another protective remedy (CERCLA Section 121(d)(4) and 40 CFR Section 300.430(f)(1)(ii)(B)). The following six types of "ARAR waivers" may be invoked during a remedial action: interim measures, greater risk to human health and the environment, technical impracticability, equivalent standard of performance, inconsistent application of a state standard, and fund-balancing. All but fund-balancing are available for use in this project. ADEC concurrence with any EPA waivers will be required under CERCLA Section 300.

3.2 Remedial Action Objectives

The remedial action objectives (RAOs) are to protect human health and the environment under both current and future conditions and to comply with ARARs. These objectives include the reduction of COPCs to a level at which the human health risk does not exceed the cancer risk management range of 1 in 10,000 (1×10^{-4}) to 1 in 1,000,000 (1×10^{-6}) and a noncarcinogenic risk standard or HI of 1.0, set forth in 18 AAC 75.325(h). The overall risk may be reduced by lowering the contaminant levels or the exposure routes, or both. PRGs established to achieve these objectives are presented in Table 2-3.

Subsurface contaminants or buried debris, potentially containing hazardous substances, could continue to be exposed by seasonal flooding. Without the implementation of appropriate remedial actions, ongoing erosion of the landfill surface will continue to present an exposure risk.

Ecological risks have not been evaluated as part of this RI/FS process. It is assumed that terrestrial and avian species may be exposed to site contaminants through ingestion of soil, sediment, terrestrial and aquatic plants, fish, and/or soil and benthic invertebrates. While these ecological exposure pathways have not evaluated, it is assumed that cleanup of contaminants to the PRGs presented in Table 2-3 would be adequately protective of ecological and human receptors.

3.3 General Response Actions

General response actions (GRAs) are general approaches to remedial actions and include active and passive measures to reduce site concentrations or exposure. Active measures may include removal, treatment, or isolation of the contaminated media. Passive measures rely on natural processes to reduce the toxicity, mobility, or volume of the source of contamination. Screening the GRAs streamlines the FS process by focusing on a set of viable alternatives for detailed evaluation. The GRAs considered for the Umiat Site are:

- Land Use Controls
- Containment
- Treatment
- Disposal

4.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES

4.1 Identification and Screening of Technologies

There is a wide variety of technologies available to accomplish the GRAs established for this site. Each of these technologies has numerous process options; for example, on-site treatment could be completed by either chemical or physical means. Chemical treatment options include a range of further options such as solvent extraction and oxidation/reduction; however, due to the remote nature of the site, the arctic climate, and the COPCs present, few process options have been demonstrated to be effective and implementable with a reasonable cost. Many on-site treatment options require large volumes to offset mobilization and setup fees.

To streamline the FS process, only those process options appropriate to these site-specific conditions based on corrective actions implemented at similar sites have been considered. This initial technology screening is based on consideration of the potential for each technology to achieve site-specific RAOs given the characteristics of the affected media, the nature of contamination, and other site conditions. The focus of screening was on those technologies that have a reasonable chance of use at the site. Figure 4-1 summarizes the initial screening of technologies and process options.

Land use control-process options considered potentially appropriate include deed restrictions and monitored natural attenuation; treatment-process options include on-site and off-site thermal desorption, solvent extraction, soil washing and incineration; containment-process options considered potentially appropriate include placing a clean fill or multimedia cover over the contaminated areas, constructing vertical barrier using augercast piles, grout curtains or thermosyphon, and control hydraulic flow using slough blocks; and disposal-process options include constructing an on-site containment cell or shipping to an approved disposal facility.

These various process options are combined to develop the remedial alternatives presented in the following section.

4.2 Evaluation of Process Options

Figure 4-2 presents the process options considered in the identification and initial screening process for this FS. These process options form the basis for the development of alternatives, which involve one discrete process for comparative purposes; the final remedial action for the site could include a combination of these processes to meet the RAOs. The screening of process options was accomplished in general accordance with the evaluation criteria described in EPA guidance (EPA, 1988). The process options were screened for effectiveness, implementability, and relative cost, as described below:

- Effectiveness - The focus for this criterion was on the potential effectiveness of the alternative 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 were estimated for comparative purposes.

Process options judged to be ineffective, not technically implementable, or too costly at the site were eliminated from further consideration. These include:

- **On-Site Physical or Chemical Treatment –** rejected due to difficult implementation and high cost as a result of the site's remote location, lack of infrastructure, and COPCs present.
- **Soil Cover Cap –** rejected due to limited effectiveness of soil-only cap materials to protect landfill contents during high velocity flooding events. Multi-media landfill cover options are retained for further consideration.
- **Grout Curtain and Thermosyphon Vertical Barriers –** rejected due to limited effectiveness and difficult implementation. Installation of grout curtain would likely lead to leakage of grout in coarse-grained materials and the method would be least effective at keying into permafrost. Thermosyphons would be successful at keying into the permafrost but long-term effectiveness could be compromised as the permafrost layer changes.
- **Landfill Cell at Current Location –** rejected due to limited effectiveness of cell cap materials to protect landfill contents during high velocity flooding events.

The various technologies and process options retained from the initial screening and evaluation were combined to develop the remedial alternatives presented below and further described in the following section.

- **Alternative 1: No Action** - The consideration of a no-action alternative is consistent with USACE and EPA guidelines.
- **Alternative 2: Land Use Controls** - This response action would involve the establishment of land use controls such as restrictions listed on the BLM's Master Title Plat and ADOT&PF's Land Occupancy Drawing, thereby restricting excavations or other soil disturbance. This alternative would be effective in reducing exposure to contaminated media by planned activities but access to these areas by

unplanned activities may be difficult to restrict due to the remoteness of the site. Additionally, the current site of the landfill is not stable and recontamination of downstream sediments is likely, limiting the reliability of administrative controls over time.

- **Alternative 3: Land Use Controls and Hot Spot Sediment Removal** - This response action would involve the establishment of land use controls as in Alternative 2 but would only apply to the landfill area. Hot spot sediments would be excavated and transported off-site for treatment/disposal at an approved facility. Based on previous sampling results, the sediment material is expected to be below Toxic Substances Control Act (TSCA) criteria (e.g., below 50 milligram per kilogram [mg/kg]) for PCBs and suitable for disposal at a Resource Conservation and Recovery Act (RCRA) Subtitle D facility.
- **Alternative 4: Containment and Capping** - This response action would consist of physical isolation of the landfill by construction of vertical barriers using augercast piles and an erosion-resistant cap, and controlling flow velocities around the landfill during flooding events using slough blocks. Because contamination would be left in place, land use controls would also be needed.
- **Alternative 5: Excavation and On-site Disposal -** For this response action, the landfill contents and hot spot sediments would be excavated, segregated, and characterized for disposal. Soil characterized as clean would be used as backfill for the landfill excavation. Solid waste and material characterized as contaminated would be placed in a containment cell constructed at an alternative location at Umiat.
- **Alternative 6: Excavation and Off-site Treatment/Disposal** - For this response action, the landfill contents and hot spot sediments would be excavated, segregated, and transported off-site for treatment/disposal at an approved facility. Based on previous sampling results, the sediment material is expected to be below TSCA criteria for PCBs and suitable for disposal at a RCRA Subtitle D facility. While not previously identified at the site, for planning purposes, liquid waste and heavily contaminated soils that exceed TSCA criteria are assumed to be present within the landfill contents as a percentage of total volume, while the remainder is assumed to be suitable for disposal at a RCRA Subtitle D facility. The assumption that TSCA wastes are present is based on poorly documented waste records, known events such as the transformer exposed by flooding in 2001, and having a general contingency for encountering such wastes during a cleanup.
- **Alternative 7: Excavation, On-site Disposal of Clean Material, Off-site Disposal of Contaminated Material** - For this response action, the landfill contents and hot spot sediments would be excavated, segregated, and characterized for disposal. Soil characterized as clean would be used as backfill for the landfill excavation. Solid waste and material characterized as contaminated would be disposed off-site. While not previously identified at the site, for planning purposes, liquid waste and heavily contaminated soils that exceed TSCA criteria are assumed to be among the landfill

contents as a percentage of total volume requiring off-site disposal. The remainder of the characterized landfill contents and the sediment material is assumed to be suitable for disposal at a RCRA Subtitle D facility.

- **Alternative 8: Step-Wise Implementation of Interim Actions** - This response action would involve the implementation of interim actions in step-wise, phased approach. Immediate action will be taken to establish land use controls to restrict access to the landfill and hot spot sediment areas. This will be followed by the interim action of hot spot sediment removal and disposal off-site. The ultimate response action will include excavation of the landfill contents according to one of the alternatives presented herein.

These alternatives are further described in following sections.

4.3 Remedial Alternatives

4.3.1 General Notes on Umiat

The Umiat camp and associated runway are seasonally used to support a variety of industry and government agency activities. To run the runway with larger charter flights, a staffed weather station should be operational. Alternatives requiring transport across the airstrip will require coordination with operators. Flagging and radio communication would be provided as necessary.

Overland travel is typically available and approved from late November through the end of April depending on snow coverage and temperatures. Ice road construction is typically approved to begin in early December. Additionally, construction of an ice road requires permits and authorizations from the North Slope Borough. Steigers or Rolligon, however, do not require ice roads on which to travel. Trails can be packed and groomed in order for travel at efficient speeds, but are not “ice roads” by industry standards. Rolligons, however, are the preferred method of overland transport because of the increase payload capacities over Steigers, as well as low ground pressures, which have less impact on tundra vegetation. Their effective use has been recognized by ADNR, BLM, and the NSB. The impact on trundra vegetation from a large number Rolligons would be significant and, therefore, is not appropriate and can’t be used for all alternatives.

The distance between Franklin Bluffs on the Dalton Highway (approximately 40 miles from Deadhorse) and Umiat is 110 miles, and between Drill Site 2P in Kuparak and Umiat is 89 miles. Both routes are considered feasible but the route between Drill Site 2P and Umiat is preferred because it has easier terrain. A total distance of 100 miles was used for cost estimating purposes.

Mid June through early September is a conservative estimate for planning summer field activity. Spring breakup of local area rivers and streams usually do not occur until early to mid-May of each year. This breakup usually will last four weeks before water levels will subside. By the beginning of September, weather conditions usually result in the start of freezing temperatures. This does not necessarily mean that all field activities will need to stop, but they will likely start being impacted by colder temperatures. The mid-June to early-September timeframe is considered the most reliable period of time for summer field activities.

It is assumed that material required for alternatives can be obtained from a short distance from the project site. Based on discussions with the General Manager for UIC lands, up to 500,000 cubic yards of gravel may be obtained through their company at a location roughly 5.0 miles from Umiat. The estimated project would include environmental permitting, road construction, and material extraction and placement. The project has an estimated duration of three years and is assumed to largely occur prior to alternative implementation (i.e., environmental permitting and agency coordination is such that extraction and placement of material can occur during on site remedial activities). The estimated cost provided by UIC for 500,000 cubic yards was scaled for each alternative.

4.3.2 Alternative 1 – No Action

The No Action alternative does not include actions to monitor or improve site conditions, or provide for administrative actions to limit site activities in areas of contamination. This alternative is included in the FS as recommended in the EPA and FUDS guidance.

4.3.3 Alternative 2 – Land Use Controls

Land use controls such as administrative restrictions and the placement of warning signs at exposure areas are considered potentially applicable and may be implemented to protect human health from exposure to site COPCs. Alternative 2 would not involve containment, treatment, or disposal-oriented remedial action of site soils or sediments. Relevant land use controls based on land ownership will need to be obtained for this alternative. As noted in Section 1.2.2, the ownership boundary between BLM and the ADOT&PF crosses the former landfill, with the southern portion on BLM land and the northern portion on ADOT&PF land (Figure 1-3). Land use controls that would be implemented for this alternative include:

- Administrative restrictions on construction, excavation, and/or disturbance of soil in areas where COPC concentrations exceed the PRGs in soil and sediment (i.e., the landfill and hot spot sediment areas). Both BLM and ADOT&PF will require a document, such as a Notice of Environmental Contamination or an ADEC-issued Decision Document, describing all institutional controls placed on the site. This information will be used to update the BLM's Master Title Plat and the ADOT&PF's Land Occupancy Drawing. The detailed information will be placed in a casefile. The Master Title Plat and the Land Occupancy Drawing will list restrictions and refer to the casefile for additional details.
- Placement of warning signs (in English and Iñupiat) as a precautionary measure to alert site residents and visitors to areas where COPC concentrations are present exceeding the PRGs. These signs are intended to convey a warning regarding a general area rather than specific sample locations.
- Public notification and education to provide locals with enough knowledge to understand the nature of the contamination and avoid exposure to contaminated media. This would likely involve mailing information packets to residents of, and/or participating in Restoration Advisory Board meetings in, the Village of Nuiqsut.

Equipment and personnel would be mobilized by small aircraft during the summer field season to install signage.

4.3.4 Alternative 3 – Land Use Controls and Hot Spot Sediment Removal

This alternative includes three primary components: 1) land use controls implemented to protect human health for the landfill area; 2) construction of a temporary processing pad; and 3) removal and disposal of hot spot sediments.

Land use controls would be implemented as in Alternative 2, but only for the landfill area. Hot spot contaminated sediments would be removed using an excavator, with appropriate measures taken to prevent transport of resuspended sediments, and transported to a temporary processing pad and dewatered prior to disposal at a RCRA facility. Preparation of planning documents would be the first step in proceeding with this alternative. The general sequencing of events for Alternative 3 includes:

- Late February/Early March – Mobilize equipment and crews. Mobilization will take place from Prudhoe Bay to Umiat via overland trail utilizing Rolligon ATVs.

- March – Perform site work. Crews will build the processing pad and begin excavation of sediment. Sediment will be excavated while frozen and loaded into Geotubes® using a Supersack hopper. Geotubes will be placed on the processing pad and covered for the summer. It is anticipated that Geotubes will dewater during the summer months.
- Late March/Early April – Install signage. Demobilize most equipment.
- Summer – Check on progress of dewatering (estimated once per week).
- Late December – Mobilize personnel to Umiat to collect the Geotubes and remaining equipment, and demobilize from Umiat via overland trail. The processing pad will be picked up and transported back to Deadhorse for disposal. Geotubes will then be loaded into open-top containers and transported to the Treatment, Storage and Disposal Facility (TSDF).

For planning purposes, the volume of sediment for targeted removal is assumed to be an approximate 200-foot by 300-foot area identified in previous investigations (shown on Figure 4-3) and a depth of 2 feet. The defined area of sediment excavation was based on the location of a limited number of sediment samples with PCB concentrations exceeding regulatory levels. Because the area of sediment contamination may have significantly changed since previous investigations, the excavation processes will be conducted based on field-screening results and confirmation analytical sampling performed on-site using a mobile laboratory. Sediments with concentrations of COPCs exceeding the PRGs will be dewatered using geosynthetic filter tubes, or Geotubes. Approximately 450 Geotubes with 10 cubic yards (CY) capacity each are estimated to be required.

A base pad for the temporary processing pad will be built by placing a geomembrane liner and gravel at one of the two locations shown on Figure 4-3. The northernmost pad is on BLM land and the southernmost pad is on ADOT&PF land. The preferred location would be the ADOT&PF location because of its close proximity to the landfill area. Construction of the temporary processing pad will include leveling the gravel pad and building berms from timbers and locally-sourced soil materials. A layer of geomembrane liner material will be added to the area and then a 1- to 2-foot cap of soil will be placed on top of the liner and leveled. A second petroleum-resistant liner will be added to the surface, secured, and extended outside the perimeter of the bermed area. All seams will be welded to maintain the integrity of the liner. Another geomembrane fabric will be placed to protect the impermeable liner and then another sand layer.   Upon completion, the temporary processing pad materials will be disposed and the base pad would be tested to demonstrate that no contaminants were left behind.

Dewatering of the Geotubes would occur on the processing pad and is planned during the first summer season following the winter excavation work. Dewatering activities would be complete by the following winter when the Geotubes would be loaded on overland transport vehicles and transported off site. Dewatering fluids will be contained by the processing pad and wastewater will be pumped to a temporary wastewater treatment system for recycling and ultimate discharge locally. Water will be treated and discharged as needed during dewatering. The system will include a 2,000-gallon baffled sedimentation tank, an oil/water separator, bag filters, and granulated activated carbon tanks. Effluent water from the treatment system would be tested to demonstrate it met water quality standards before being discharged.

Relevant land use controls based on land ownership will need to be obtained for this alternative. As noted in Section 1.2.2, the ownership boundary between BLM and the ADOT&PF crosses the former landfill, with the southern portion on BLM land and the northern portion on ADOT&PF land (Figure 1-3). Landowner approval for construction of a base pad and temporary processing pad will also need to be obtained. The temporary processing pad is proposed on land owned by ADOT&PF.

4.3.5 Alternative 4 – Containment and Capping

This alternative includes four primary components: 1) hot spot sediment removal; 2) a subsurface vertical barrier around the landfill footprint; 3) a reinforced landfill cap; and 4) construction of permanent slough blocks to limit flooding of the landfill area. Hot spot sediments will be excavated and placed in the location of the landfill. Landfill contents will be isolated using the vertical barrier and cap, and the installation of slough blocks will reduce water velocities to prevent erosion of the containment structure. Preparation of planning and design documents would be the first step in proceeding with this alternative. The general sequencing of events for Alternative 4 includes:

- Mid-December – Mobilize to site from Prudhoe Bay via overland trail utilizing Rolligon ATVs.
- Early January – Construct an ice road to and around the landfill for construction access from an ice pad constructed to stage grout and materials needed for pile installation. Crew will concurrently locate and prepare gravel pit for fill material for the slough blocks. It is assumed that the gravel source will be within 5.0 miles of the landfill and that overburden removal and/or dewatering activities will not be needed.

- Early March (with a hiatus during break up period) – Begin the pile installation using the drill, set, and slurry (grout) method. Crew will concurrently construct slough blocks.
- Before break up period – Begin the hauling capping material for the landfill.
- After breakout period – Begin placement of geotextiles and capping material over the landfill.
- Late September – Demobilize all crew and equipment.

Ice roads described herein for Alternative 4 are limited to the immediate Umiat work area and, in combination with proposed work pads, would not exceed 12 acres in size. The ice work pad would be located in close proximity to the landfill. All equipment and personnel for ice road, pad construction, and remediation would be mobilized to location by Rolligon ATVs.

Permanent slough blocks will be constructed to reduce the water velocity that inundates the landfill area and prevent erosion of the landfill cap. The structures would block the low elevation channel in the slough and tie it into high ground. Flooding would only occur over the landfill when the surrounding area is flooded, thereby minimizing impacts to site work. Tentative locations for the slough blocks are shown in Figure 4-4. Two slough blocks would be constructed on either side of the landfill area to block entry of water into the slough channel and reduce the water velocity onto the landfill cap. A third slough block could be placed at the mouth of a channel that feeds into the slough and a fourth slough block would be placed at the downstream end of the slough to prevent the development of a head cut traveling back into the landfill area.

- Block 1 is approximately 800 feet long, 120 feet wide, and averages 15 feet deep.
- Block 2 is approximately 200 feet long, 100 feet wide, and averages 15 feet deep.
- Block 3 is approximately 200 feet long, 100 feet wide, and averages 15 feet deep.
- Block 4 is approximately 400 feet long, 100 feet wide, and averages 15 feet deep.

The slough blocks would be set at an elevation of 270 feet, which is 3 feet above the current Umiat Airport Runway, and would provide excess material for fill at any areas that might erode during high water events. Approximately 120,000 cubic yards of locally-sourced aggregate material, if suitable, will be required for construction of the slough blocks.

For planning purposes, the landfill area to be capped is estimated at 8 acres (348,480 square feet), which includes the areas of the six debris cells identified from geophysical studies and the areas between the debris cells (Figures 1-4 and 4-4).

The vertical barrier comprised of augercast piles would be installed around the perimeter of the landfill footprint and keyed into the permafrost at least 2 feet. The permafrost is assumed present below the landfill area at an elevation of 257 feet, with the ground surface at an elevation of approximately 268 feet and the south end and 262 feet at the north end of the landfill footprint. The perimeter of the capped area is approximately 2,600 lineal feet, and an average pile depth of 10 feet is assumed. Two-foot-diameter augercast piles will be installed using a cement grout. Piles will be placed every 36 inches on center around the perimeter of the landfill footprint, and then piles will be advanced with a 6-inch overlap in between previously installed piles to complete the vertical barrier. Approximately 1,735 piles will be required for this alternative, for an approximate total footage of 17,350.

The engineered landfill cap for this alternative would include a geotextile layer on the existing ground surface and a 1-foot layer of soil covered by large diameter aggregate to prevent erosion of the cap. It is assumed the soil and aggregate for the cap could be obtained from a source within 5.0 miles of the site. Site preparation would require preparing a smooth surface, including clearing or covering debris that could damage the geotextile and grading to provide adequate drainage. Land use controls and periodic site visits would be needed to ensure long-term viability of the soil cap, as well as to observe and document potential leachate concentrations within the confines of the containment, and to monitor potential changes to the depth of the permafrost.

Because contamination will remain in place, relevant land use controls based on land ownership will need to be obtained for this alternative. As noted in Section 1.2.2, the ownership boundary between BLM and the ADOT&PF crosses the former landfill, with the southern portion on BLM land and the northern portion on ADOT&PF land (Figure 1-3). The USACE has the authority and responsibility under DERP, established by Section 211 of SARA in 1986, to conduct remediation pursuant to the CERCLA to address contamination as a result of DoD activities. In conducting FUDS cleanups, the Corps is required to comply with the National Contingency Plan (NCP), established under CERCLA, and also to ensure that cleanup complies with all ARARs. As owner, BLM is expected to coordinate ongoing land management activities at this site with the USACE in a manner that promotes implementation of this alternative, as they have demonstrated recently in Alaska (DoI, 2012). Permission will need to be obtained for placement of the slough blocks on BLM property. The National Petroleum Reserve Production Act of 1976 withdrew all lands within NPRA from all forms of entry or disposition under the public land laws. In addition, the 2013 Record of Decision (ROD) from the 2012 NPRA Integrated Activity Plan specifies Best Management Practices (BMPs) that BLM must follow for the NPRA. The 2013 ROD prohibits all non-subsistence permanent infrastructure within the NPRA. The ADOT&PF, as owner, would issue various right-of-entry agreements for the USACE to conduct environmental assessment and remediation activities. Each right-of-entry agreement would be subject to the application review process before being approved.

4.3.6 Alternative 5 – Excavation and On-Site Disposal

This alternative involves excavating the contents of the landfill, segregating contaminated and non-contaminated material, and disposal of contaminated material in a containment cell constructed in close proximity to the site. Hot spot removal of contaminated sediments will also be included in this alternative. Non-contaminated material will be reused on site, if appropriate. Preparation of planning and design documents would be the first step in proceeding with this alternative. The general sequencing of events for Alternative 5 includes:

- Early March – Mobilize to site from Prudhoe Bay via overland trail utilizing Rolligon ATVs. Processing pad and sediment removal equipment will be prioritized.
- March – Construct processing pad and conduct sediment removal as detailed in Alternative 3.
- May/June – Mobilize personnel and begin construction of the containment cell and excavation of the landfill.
- September –Site work is complete.
- Late December – Demobilize to Prudhoe Bay via overland trail.

For this alternative, excavated material will be segregated and the waste streams disposed or reused as appropriate. Soil fractions and sediment with concentrations of COPCs exceeding the PRGs will be disposed of in an on-site containment cell, with discrete cells established for general medium/COPC groups (e.g., pesticide-contaminated sediment will be segregated from POL-contaminated soil). Soil and sediment fractions considered suitable for re-use will be used on-site. Solid waste encountered will be segregated and disposed in the on-site containment cell. Any liquid waste (i.e., drum or transformer contents) will be contained for transport and disposal at a permitted waste facility.

For planning purposes, the landfill area to be excavated is estimated at 8 acres (348,480 square feet), which includes the areas of the six debris cells (approximately 4.2 acres) identified from geophysical studies and the areas between the debris cells (Figures 1-4 and 4-5). The basal depth of the waste is believed to range between 8 and 17 feet. A uniform depth of 17 feet will be used for conservative estimates of material volumes. Solid waste is assumed to occupy the volume identified by the six debris cells. Because persistent COPCs such as PCBs, pesticides, and metals are more commonly associated with fines and sands, we assume these fractions of the excavated material will require on-site disposal. From boring logs, the fraction of fines and sands is estimated to be 38 percent. The volume and location of hot spot sediment removal is described in Alternative 3. The estimated in-place waste stream volumes are assumed to be:

- Landfill total: 224,500 CY (includes 4,500 CY sediment)
- Landfill solid waste: 115,000 CY
- Landfill contaminated material (fines and sands): 44,500 CY (includes sediment)
- Landfill non-contaminated material (gravels and cobbles): 65,000 CY

A temporary material processing pad with a wastewater treatment system will be designed and constructed as described in Alternative 3 to accommodate segregation activities and to capture liquids, dewatering fluids, and runoff. The preferred location of the temporary processing pad for this alternative is the BLM location because of its proximity to the proposed containment cell location. Likewise, if an alternative BLM location is ultimately negotiated, then a temporary processing pad near that location would be preferred.

A backhoe or other suitable excavation equipment will be used to excavate the landfill contents and the material will be transported to the pad. Material processing will include removing discrete pieces of solid waste (e.g., drums, transformers, etc.) and screening out fractions of fines and sand using a sorting machine and/or sluice.

Contaminated sediment will be excavated, with appropriate measures taken to prevent transport of resuspended sediments. The sediments will be transported to the processing pad and dewatered prior to disposal in the on-site containment cell using Geotubes as described in Alternative 3.

The excavation processes will be conducted based on field-screening results and confirmation analytical sampling performed on-site using a mobile laboratory.

Accounting for soil bulk during excavation of sediment, sands and fines and assuming the temporary processing pad will be deconstructed and liner material placed into the containment cell, approximately 170,000 CY of contaminated material is estimated for placement into the containment cell. Based on this volume, the containment cell is estimated to measure approximately 1,000 feet long, 500 feet wide, and a peak height of approximately 15 feet tall. The remaining material is considered clean and may be reused on site as appropriate (i.e., leveling, capping or backfill material).

A preliminary location for on-site disposal is owned by BLM and is shown on Figure 4-5. The site was chosen to minimize impacts to wetland areas, for easy access from an existing roadway, and its proximity to the proposed location of the temporary processing pad. The containment cell will be designed in general accordance with 18 AAC 60, Solid Waste Management and meets the following permit criteria for landfills located within a floodplain:

1. **The landfill will cause no 100-year flood flow restriction.**
   No Federal Emergency Management Agency (FEMA) floodplain studies have been performed in the area and No FEMA Flood Insurance Rate Map (FIRM) map exists for Umiat. The USACE 2011 Hydrologic Analysis of Umiat Landfill (USACE, 2011a) uses as a design event, the peak measured flow over its dataset (2003-2009). This peak flow occurred in 2004, at 261,000 cfs. The Army Corps 2D hydraulic model of the 2004 flood event is the best source of floodplain extents available. The Proposed Landfill is 2 miles north and west of the 2004 floodplain boundaries. The relocated landfill will cause no flow restriction during such an event.

2. **The landfill will reduce no temporary storage capacity of the floodplain.**
   The proposed landfill is a cut-fill net of zero and therefore displace no flood storage volume for the 100-year event.

3. **The landfill will result in no washout of solid waste that would pose a hazard to public health or the environment.**
   The existing conditions of the landfill contain solid waste within both the mapped 2004 year flood extents and an area of moderately high flood velocity. The removal of the existing waste, and relocation to the proposed site will remove solid waste washout potential that is present in existing conditions. The proposed relocation of the landfill will be located approximately 2 miles from the edge of the Colville River. The relocated landfill cell will have clean fill base elevation of 270 feet, which is 3 feet above the current Umiat Airport Runway, estimated at 267 feet. The clean fill elevations will be confirmed in the field with the Umiat Airport runway elevations.

Additionally, the ADEC will prohibit construction of a landfill on a site underlain by permafrost unless the owner or operator can demonstrate that no practical alternative is available

(18 AAC 60.227). If built on permafrost, the landfill must be designed to maintain frozen ground to the maximum extent practical.

Site preparation for containment-cell construction would include placing a geotextile and 2-foot lift of clean soil before stockpiling the contaminated materials. Solid waste will be placed in the central portion of the containment area and contaminated soil and sediment (i.e. removed from Geotubes or other areas) will be used to cover the waste and create a smooth surface. Additional clean soil may be required to provide an adequate cap surface. Once the surface is prepared, another layer of geotextile and a 1-foot lift of soil would be placed over the geotextile. The surface of the containment cell would be covered with large diameter rock to minimize erosion. Provisions will be included to sample/drain any accumulated leachate in the cell (e.g., drainage line, sump, etc.).

The landfill excavation will be backfilled using material consisting of locally available material suitable for this purpose. Depending on the final location selected, the containment cell as well as the temporary material processing pad can be designed and reused for other site activities (i.e., vehicle and equipment parking). Land use controls and periodic site visits would be needed to ensure long-term viability of the containment cell. Additionally, long-term requirements must be met for landfill operations, closure, and post-closure monitoring.

Permission will need to be obtained for placement of the landfill on BLM property in Umiat. The USACE has the authority and responsibility under DERP, established by Section 211 of SARA in 1986, to conduct remediation pursuant to the CERCLA to address contamination as a result of DoD activities. In conducting FUDS cleanups, the Corps is required to comply with the National Contingency Plan (NCP), established under CERCLA, and also to ensure that cleanup complies with all ARARs. As owner, BLM is expected to coordinate ongoing land management activities at this site with the USACE in a manner that promotes implementation of this alternative, as they have demonstrated recently in Alaska (DoI, 2012). The National Petroleum Reserve Production Act of 1976 withdrew all lands within NPRA from all forms of entry or disposition under the public land laws. In addition, the 2013 ROD from the 2012 NPRA Integrated Activity Plan specifies BMPs that BLM must follow for the NPRA. Besides prohibiting the burial of waste, the 2013 ROD prohibits all non-subsistence permanent infrastructure within the NPRA.

Relevant land use controls based on land ownership and approval for construction of a base pad and temporary processing pad will need to be obtained. As noted in Section 1.2.2, the ownership boundary between BLM and the ADOT&PF crosses the former landfill, with the southern portion on BLM land and the northern portion on ADOT&PF land (Figure 1-3). The temporary processing pad is proposed on land owned by BLM.

4.3.7 Alternative 6 – Excavation and Off-Site Disposal/Treatment

This alternative involves the excavation of landfill contents and contaminated sediment and their disposal at an off-site permitted facility. Preparation of planning and design documents would be the first step in proceeding with this alternative. The general sequencing of events for Alternative 6 includes:

- Early March – Mobilize to site from Prudhoe Bay via overland trail utilizing Rolligon ATVs. Processing pad and sediment removal equipment will be prioritized.
- March – Construct processing pad and conduct sediment removal as detailed in Alternative 3. Crew will concurrently locate and prepare gravel pit for fill material. It is assumed that the gravel source will be within 5.0 miles of the landfill and that overburden removal and/or dewatering activities will not be needed.
- Mid-June – Mobilize personnel and begin excavation of the landfill, debris processing, and Supersacking of waste.
- September –Excavation work complete. It is anticipated that Supersacking will continue for approximately two weeks following completion of excavation activities.
- Late December – Begin construction of ice road from Drill Site 2P in Kaparuk to Umiat to haul landfill contents and excavated sediments to off-site disposal facility. It is anticipated that this will take 2 months to complete the 100 mile ice road.
- Early February – Begin waste load out using standard truck and trailers from Umiat to Deadhorse. Waste will then be transferred to the disposal company for transport to the TSDF. Metal debris (verified washed and cleaned) can be recycled by the disposal company for reduced waste bill or disposed of in the North Slope Borough (NSB) landfill in Deadhorse.
- Late April – Complete demobilization of equipment and personnel from Umiat using the ice road and standard equipment.

The volume of material in the landfill is estimated at 220,000 CY and the volume of sediment is estimated at 4,500 CY (see previous sections for rationale). Figure 4-3 shows the areas to be removed. The contents of the landfill will be excavated using a backhoe or other suitable equipment. The sediment will be excavated and dewatered using Geotubes. A dewatering pad will be constructed to contain and capture dewatering fluids as described in previous sections. The preferred location of the temporary processing pad for this alternative is the ADOT&PF location because of its proximity to the landfill area. Liquid waste (i.e., drum or transformer contents) will be contained for transport and disposal at a permitted waste facility.

The excavation processes will be conducted based on field-screening results and confirmation analytical sampling performed on-site using a mobile laboratory. Excavated materials will be placed into suitable containers for transportation to the treatment or disposal facility. For estimating purposes, it is assumed the material removed will be placed into sealed containers.

Backfill material would consist of locally available material suitable for this purpose, with the surface graded to provide adequate drainage and restored as appropriate.

Landowner approval for construction of a base pad and temporary processing pad will need to be obtained. As noted in Section 1.2.2, the ownership boundary between BLM and the ADOT&PF crosses the former landfill, with the southern portion on BLM land and the northern portion on ADOT&PF land (Figure 1-3). The temporary processing pad is proposed on land owned by ADOT&PF.

4.3.8 Alternative 7 – Excavation, On-Site Disposal of Clean Material, and Off-Site Disposal/Treatment of Contaminated Material

This alternative involves the on-site disposal of clean landfill material (e.g., uncontaminated solid wastes, debris, and soil/sediment that does not contain contaminants above regulatory levels) and off-site disposal of contaminated landfill and sediment material. Preparation of planning and design documents would be the first step in proceeding with this alternative. The general sequencing of events for Alternative 7 includes:

- Early March – Mobilize to site from Prudhoe Bay via overland trail utilizing Rolligons ATVs. Processing pad and sediment removal equipment will be prioritized.

- March – Construct processing pad and conduct sediment removal as detailed in Alternative 3. Crew will concurrently locate and prepare gravel pit for fill material. It is assumed that the gravel source will be within 5.0 miles of the landfill and that no overburden removal and/or dewatering activities will be needed.

- May/June – Mobilize personnel and begin excavation of the landfill, debris processing, and Supersacking of waste.

- September – All excavation work complete. It is anticipated that Supersacking will continue approximately two weeks following completion of excavation activities.Late December – Begin construction of ice road from Drill Site 2P in Kaparuk to Umiat to haul landfill contents and excavated sediments to off-site disposal facility.. It is anticipated that this will take 2 months to complete the 100 mile ice road.

- Early February – Begin contaminated waste load-out using standard truck and trailers from Umiat to Deadhorse. Waste will then be transferred to the disposal company for transport to the TSDF. Metal debris (assumed washed and cleaned) can be recycled by the disposal company for reduced waste bill or disposed of at the NSB landfill in Deadhorse.

- Late April – Complete demobilization of equipment and personnel from Umiat using the ice road and standard equipment.

The volume of contaminated material in the landfill is estimated at 40,000 CY, the volume of sediment is estimated at 4,500 CY, and the volume of solid waste is estimated at 115,000 CY (see previous sections for rationale). Figure 4-3 shows the areas to be removed. The contents of the landfill will be excavated using a backhoe or other suitable equipment. The sediment will be excavated and dewatered using Geotubes. A dewatering pad will be constructed to contain and capture dewatering fluids as described in previous sections. The preferred location of the temporary processing pad for this alternative is the ADOT&PF location because of its proximity to the landfill area. Any liquid waste (i.e., drum or transformer contents) will be contained for transport and disposal at a permitted waste facility.

The excavation processes will be conducted based on field-screening results and confirmation analytical sampling performed on-site using a mobile laboratory. Excavated materials will be placed into suitable containers for transportation to the treatment or disposal facility. For estimating purposes, it is assumed the material removed will be placed into sealed containers.

Backfill material would consist of locally available material suitable for this purpose, with the surface graded to provide adequate drainage and restored as appropriate. Clean excavated material may be reused as backfill, if appropriate.

Landowner approval for construction of a base pad and temporary processing pad will need to be obtained. As noted in Section 1.2.2, the ownership boundary between BLM and the

ADOT&PF crosses the former landfill, with the southern portion on BLM land and the northern portion on ADOT&PF land (Figure 1-3). The temporary processing pad is proposed on land owned by ADOT&PF.

4.3.9 Alternative 8 – Step-Wise Implementation of Interim Actions

Alternative 8 involves the implementation of interim actions with progressively increasing levels of environmental protection in steps to be phased over several years. The interim actions would begin with land use controls, followed by hot spot sediment removal and disposal and landfill removal and disposal in subsequent years. Immediate action will be taken to establish land use controls as described in Alternative 2 to restrict access to the landfill and hot spot sediment areas. The next phase would be hot spot sediment removal, dewatering, and disposal off-site as described in Alternative 3. Lastly, the final response action will include excavation of the landfill contents, which could be accomplished by options described in Alternative 5, Alternative 6, or Alternative 7.

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	SCREENING COMMENTS
No Action	None	Not Applicable	No action taken.	Required for consideration.
Institutional Controls	Access Restriction	Deed Restriction	Deed would include restrictions on excavation in contaminated areas.	Potentially feasible.
		Fencing	Physical barrier to prevent exposure to areas of contamination.	Not feasible due to long-term maintenance challenges
	Monitoring	Monitored Natural Attenuation	Ongoing monitoring of site with natural cleanup processes.	Potentially feasible.
Treatment	In Situ Chemical Treatment	Alkaline Hydrolysis	Degradation of contaminants initiated by high pH conditions.	Not feasible due to presence of solid waste or for degradation of inorganic contamination.
		Heat-Activated Persulfate Treatment	Persulfate reduction of contaminants in presence of heat.	Not feasible due to presence of solid waste, inability to degrade inorganics, and high energy needs.
		Chemical Dehalogenation	Destruction or chemical alteration of contaminants using chemical reagents and reduction processes.	Not feasible due to presence of solid waste and inability to degrade inorganics.
		Solidification/Stabilization	Encapsulate into a solid matrix using a binding agent such as Portland cement or asphalt.	Not feasible due to presence of solid waste.
		Bioremediation	Enhancement of soil matrix to encourage degradation of contamination by microorganisms.	Not feasible due to presence of solid waste and inability to degrade inorganics.
		Vitrification	Solidification of the soil matrix using heat to melt soil and destroy contamination.	Not feasible due to presence of solid waste and high energy needs.
		Advanced Oxidative Processes	Use of free radicals produced by oxidizing compounds to destroy contamination.	Not feasible due to presence of solid waste and inability to degrade inorganics.
		Fenton's Reagent	Use of free radicals produced through input of electrical current to destroy contamination.	Not feasible due to presence of solid waste, inability to degrade inorganics, and high energy needs.

(See Sheet 2 of 3)

KEY

Technologies that are screened out (shaded grey: Fencing, Alkaline Hydrolysis, Heat-Activated Persulfate Treatment, Chemical Dehalogenation, Solidification/Stabilization, Bioremediation, Vitrification, Advanced Oxidative Processes, Fenton's Reagent)

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INITIAL SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

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FIG. 4-1

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	SCREENING COMMENTS
(See Sheet 1 of 3)				
Treatment (continued)	On-site Treatment	Thermal Desorption	Physical separation achieved using application of heat to volatize contaminants.	Potentially feasible.
		Solvent Extraction	Physical separation achieved using non-aqueous extracting chemicals to remove contaminants.	Potentially feasible.
		Soil Washing	Physical separation achieved using a water-based chemical wash to remove contaminants.	Potentially feasible.
		Incineration	Destroys contamination by subjecting material to high temperatures in the presence of oxygen.	Potentially feasible.
	Off-site Treatment	Thermal Desorption	Physical separation achieved using application of heat to volatize contaminants.	Potentially feasible.
		Solvent Extraction	Physical separation achieved using non-aqueous extracting chemicals to remove contaminants.	Potentially feasible.
		Soil Washing	Physical separation achieved using a water-based chemical wash to remove contaminants.	Potentially feasible.
		Incineration	Destroys contamination by subjecting material to high temperatures in the presence of oxygen.	Potentially feasible.
Containment	Cap	Soil Cover	Cover areas of contamination with layer of clean soil.	Potentially feasible.
		Multimedia Landfill Cover	Cover areas of contamination with combination of clean soil, geosynthetics, and erosion armoring.	Potentially feasible.
(See Sheet 3 of 3)				

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INITIAL SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

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FIG. 4-1
Sheet 2 of 3

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GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	SCREENING COMMENTS
Containment (continued)	Vertical Barriers	Sheet Piles	Create barrier around landfill using interlocking steel sheet piles.	Not feasible as a barrier to prevent groundwater flow.
		Augercast Piles	Create barrier around landfill using overlapping auger-drilled piles backfilled with cement or grout.	Potentially feasible.
		Grout Curtain	Create barrier around landfill using trench backfilled with grout.	Potentially feasible.
		Thermosyphon	Create barrier around landfilll using passive heat pump technology to maintain freezing temperatures.	Potentially feasible.
	Flow Control	Slough Blocks	Block slough channels to reduce flow velocities during flooding events to prevent erosion of landfill.	Potentially feasible.
		Permanent Dam	Dam slough channel to reduce flow velocities during flooding events to prevent erosion of landfill.	Not feasible due to high demand for infrastructure and energy.
		Groundwater Seepage Control	Install dewatering wells to prevent groundwater from contacting landfill contents.	Not feasible for coarse-grained material and due to high energy needs.
Disposal	On-site Disposal	Landfill Cell	Excavate and dispose of contaminated material in a landfill containment cell.	Potentially feasible.
	Off-site Disposal	Barge/Truck to RCRA Landfill	Transport contaminated material off site via barge and haul contaminated material to permitted facility.	Not feasible due to limited navigation of river in area of project.
		Ice Road/Truck to RCRA Landfill	Transport contaminated material off site via ice road and haul contaminated material to permitted facility.	Potentially feasible.
		Fly/Truck to RCRA Landfill	Transport contaminated material off site via airplane and haul contaminated material to permitted facility.	Potentially feasible.

(See Sheet 2 of 3)

KEY

[shaded box] Technologies that are screened out

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FIG. 4-1

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	EFFECTI□ENESS	IMPLEMENTA□ILITY	COST
No Action	None	Not Applicable	Does not meet remedial action objectives.	Not acceptable to local government.	None.
Institutional Controls	Access Restriction	Deed Restriction	Does not reduce contamination. Effectiveness depends on continued implementation.	Legal requirements and authority.	Negligible cost.
	Monitoring	Monitored Natural Attenuation	Documents conditions and natural processes. Ineffective at reducing contamination.	Easily implemented, permits required for additional wells.	Low capital, low maintenance.
Treatment	On-site Treatment	Thermal Desorption	Effective for reducing organic contamination, but ineffective for inorganics.	Difficult to implement due to energy and infrastructure requirements.	High capital, moderate O&M.
		Solvent Extraction	Effective for reducing organic and inorganic contamination.	Difficult to implement due to energy and infrastructure requirements.	High capital, moderate O&M.
		Soil Washing	Moderately effective for reducing organic and inorganic contamination.	Difficult to implement due to energy and infrastructure requirements.	High capital, moderate O&M.
		Incineration	Effective for reducing organic contamination, but ineffective for inorganics.	Difficult to implement due to energy and infrastructure requirements.	High capital, moderate O&M.
	Off-site Treatment	Thermal Desorption	Effective for reducing organic contamination, but ineffective for inorganics.	Readily implementable. Requires transport to treatment facility.	High capital, low O&M.
		Solvent Extraction	Effective for reducing organic and inorganic contamination.	Readily implementable. Requires transport to treatment facility.	High capital, low O&M.
		Soil Washing	Moderately effective for reducing organic and inorganic contamination.	Readily implementable. Requires transport to treatment facility.	High capital, low O&M.
		Incineration	Effective for reducing organic contamination, but ineffective for inorganics.	Readily implementable. Requires transport to treatment facility.	High capital, low O&M.

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EVALUATION OF PROCESS OPTIONS

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FIG. 4-2
Sheet 1 of 2

GENERAL RESPONSE ACTIONS	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST
Containment	Cap	Soil Cover	Effective but susceptible to erosion. Does not reduce contamination.	Readily implemented with locally sourced materials. Restrictions on land use.	Moderate capital, moderate maintenance.
		Multimedia Landfill Cover	Effective and limits erosion. Does not reduce contamination.	Readily implemented. Restrictions on land use.	High capital, moderate maintenance.
	Vertical Barriers	Augercast Piles	Effective at creating hydraulic barrier. Does not reduce contamination.	Readily implemented. Conventional construction.	High capital, low maintenance.
		Grout Curtain	Effective barrier but may be ineffective at keying into permafrost. Does not reduce contamination.	Conventional construction but implementation difficult due to likely leakage in coarse-grained material.	High capital, low maintenance.
		Thermosyphon	Effective barrier but may be ineffective at keying into permafrost. Does not reduce contamination.	Unconventional construction may lead to difficult implementation.	High capital, low maintenance.
	Flow Control	Slough Blocks	Effective at reducing flow velocities during flooding. Does not reduce contamination.	Readily implemented with locally sourced material.	High capital, high maintenance.
Disposal	On-site Disposal	Landfill Cell	Effective but susceptible to erosion. Does not reduce contamination.	Readily implemented. Conventional construction.	Moderate capital, moderate maintenance.
	Off-site Disposal	Ice Road/Truck to RCRA Landfill	Effective and reliable treatment and transportation.	Readily implemented. Nearest RCRA facility is 1970 miles away (Arlington, OR).	High capital.
		Fly/Truck to RCRA Landfill	Effective and reliable treatment and transportation.	Readily implemented. Nearest RCRA facility is 1970 miles away (Arlington, OR).	Very high capital.

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EVALUATION OF PROCESS OPTIONS

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FIG. 4-2
Sheet 2 of 2

LEGEND

Debris Cells Identified during Geophysical Studies

Approximate Limits of Identified Landfill Debris

0 1,500 3,000

Approximate Scale in Feet

N

NOTE

Map adapted from aerial imagery provided by Google Earth Pro, reproduced by permission granted by Google Earth ™ Mapping Service.

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LANDFILL AND HOT SPOT SEDIMENTATION AREAS

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FIG. 4-3

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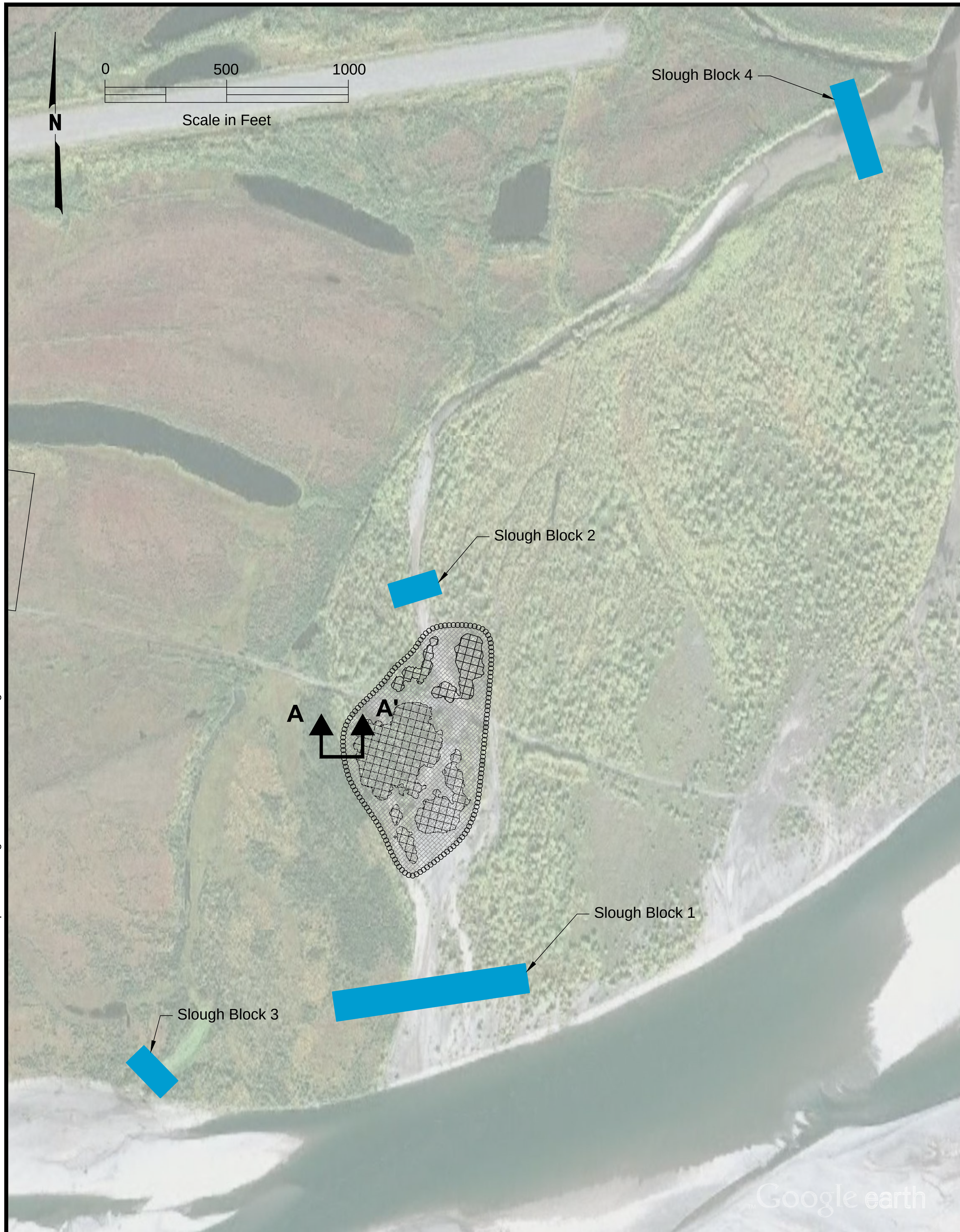
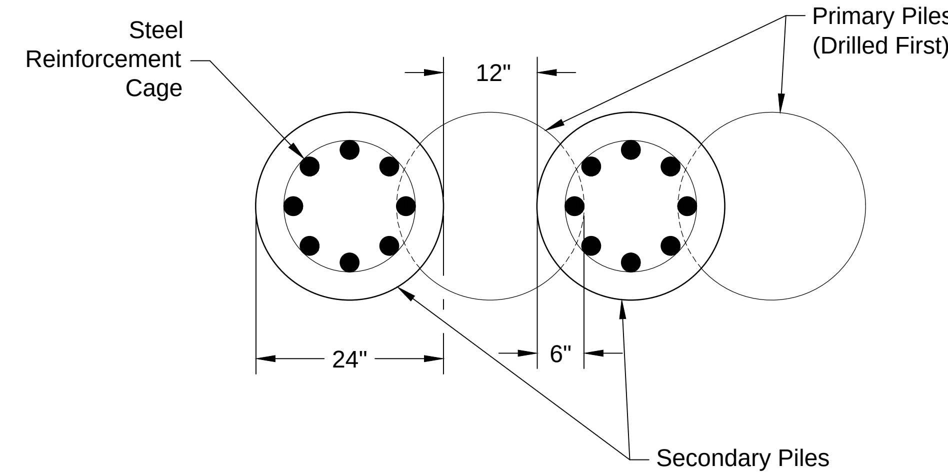
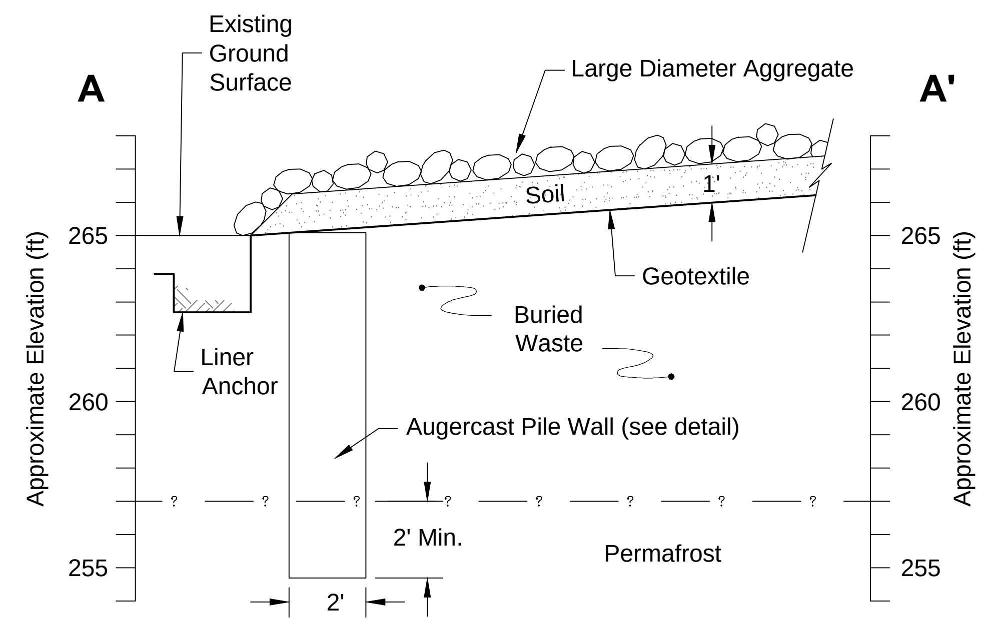




AUGERCAST PILE WALL DETAIL

NTS



SECTION A-A'

NTS

LEGEND

Debris Cells Identified during Geophysical Studies

Augercast Piles with Landfill Cap

A A' Profile Location

NOTE

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REMEDIAL ALTERNATIVE 4
CONTAINMENT AND CAPPING

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FIG. 4-4

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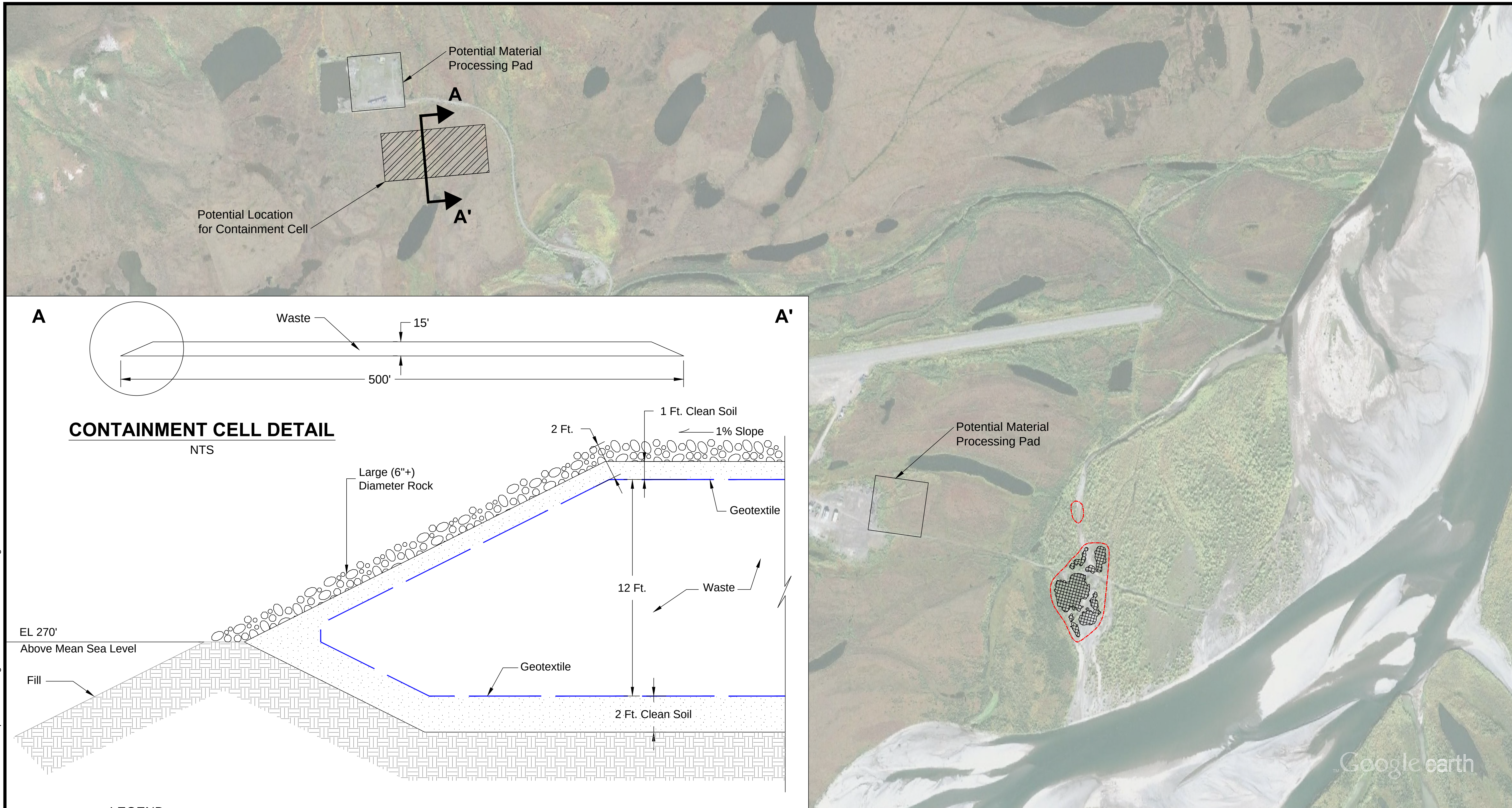

LEGEND

Debris Cells Identified during Geophysical Studies

Approximate Limits of Excavation

A A'

Profile Location

Note:
Will be designed to meet 18 AAC 60 standards and requirements.

0 1000 2000

Scale in Feet

N

NOTE

Map adapted from aerial imagery provided by Google Earth Pro, reproduced by permission granted by Google Earth ™ Mapping Service.

Final Feasibility Study Report Umiat Landfill North Slope Borough, Alaska	
REMEDIAL ALTERNATIVE 5 EXCAVATION AND ON-SITE DISPOSAL	
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SHANNON & WILSON, INC. Geotechnical and Environmental Consultants	**FIG. 4-5**

5.0 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

5.1 Description of Evaluation Criteria

In accordance with CERCLA guidance, the criteria used to assess each remedial action alternative are described in the following sections.

5.1.1 Criterion 1 – Overall Protection of Human Health and the Environment

Evaluation of this criterion focuses on how site risks are eliminated, reduced, or controlled through land use controls. This overall assessment of protectiveness reflects the assessment of long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

5.1.2 Criterion 2 – Compliance with ARARs

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

5.1.3 Criterion 3 – 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 used to manage hazardous wastes remaining on-site after the remediation.

5.1.4 Criterion 4 – Reduction of 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 destroyed or treated; the projected reduction of toxicity, mobility, or volume; the degree to which the treatment is irreversible; and the types and quantities of residuals remaining after treatment. Also considered in this assessment is whether the alternative would satisfy the express preference of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP; 40 CFR 300), for remedial actions that reduce the toxicity, mobility, or volume of hazardous waste through treatment.

5.1.5 Criterion 5 – Short-Term Effectiveness

The potential health effects and environmental impacts of each alternative action during construction and implementation, as well as the reduction of risk in the short term, 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.

5.1.6 Criterion 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 construction; the ease of additional remediation, if necessary; the ease of monitoring the effectiveness of the remediation; and site restoration from intrusive work such as excavation. Administrative feasibility addresses the degree of procedural difficulty anticipated for each alternative in permitting and institutional requirements.

5.1.7 Criterion 7 – Cost

The major cost elements for each alternative are summarized in Appendix C. The estimates are based on quotes obtained from an Alaskan-based North Slope oilfield services company with remote-site access and construction experience, and Shannon & Wilson's own experience in the area. They are intended as a guide in evaluating the alternatives based on information available at the time of the estimate. Actual costs would depend on true labor and material costs, final scope, schedule, actual site conditions, and the timeframe in which they are implemented. Included in the analysis is a discussion of the potential for cost escalation in the event actual contaminant volumes differ significantly from present estimates or other factors that may change (e.g., fuel costs).

5.1.8 Criterion 8 – State/Agency Acceptance

The criterion for state acceptance addresses the technical and administrative issues the State of Alaska may have regarding each of the remediation alternatives. This criterion will be addressed in the Decision Document after public comment on the Proposed Plan (PP) has been received.

5.1.9 Criterion 9 – Community Acceptance

The criterion for community acceptance addresses issues and concerns the public may have regarding the various alternatives. This criterion will be addressed in the Decision Document after public comment on the PP has been received.

5.2 Individual Analysis of Alternatives

5.2.1 Alternative 1 – No Action

Alternative 1 does not include actions to monitor or improve site conditions, or provide for administrative actions to limit site activities in areas of contamination.

***Overall Protectiveness* –** The No Action alternative would mitigate no risks to human health or the environment associated with contamination present at the site. There would be no reduction in risk to human health and the environment, and no provisions to prevent migration of the contaminants from their source.

***Compliance with ARARs* –** The No Action alternative would achieve no compliance with ARARs.

***Long-Term Effectiveness* –** No remediation occurs under the No Action alternative, and potential long-term risks remain essentially unchanged; therefore, the long-term effectiveness of this alternative would depend on the natural attenuation of site COPCs that could be expected to occur over time. Because PCBs and pesticides are persistent and slow to attenuate over time, and no metals naturally attenuate, the No Action alternative would have little long-term effectiveness.

***Reduction in Toxicity, Mobility, or Volume Through Treatment* –** The No Action alternative involves no treatment, so there would be no reduction in toxicity, mobility, or volume of contaminated material other than by natural attenuation. There is a likelihood that ongoing erosion and flooding could result in an increase in the toxicity, mobility, and/or volume of COPCs if the No Action alternative is implemented at the site. This alternative fails to meet the NCP preference for treatment because all contaminants remain on-site.

Short-Term Effectiveness – No short-term risks exist as a result of this alternative because it involves no construction or implementation. In the absence of remedial action, short-term exposure risks are expected to be consistent with those described in the CRE in Section 1.3.5.

Implementability – The No Action alternative has no technical requirement. No interference with future remedial actions would occur, although a repeat of the FS process might be required to accomplish remedial actions.

Cost – Since no action is proposed, there are no present-worth or capital costs associated with this alternative.

5.2.2 Alternative 2 – Land Use Controls

Under this alternative, land use controls such as administrative restrictions and the placement of warning signs would be implemented to protect human health from exposure to COPCs for the landfill and hot spot sediment areas. Alternative 2 would involve no containment, treatment, or disposal-oriented remedial action of site soils or sediments.

Overall Protectiveness – This alternative is potentially effective at reducing human exposure to site contaminants but has no effect on the RAOs for the site and will not reduce soil and sediment contamination levels to below the PRGs. It provides no protection for ecological receptors. Restrictions on future site use may be an undesirable condition for the property owner to comply with. Administrative restrictions at such a remote site are difficult to enforce but an update to the BLM's Master Title Plat and the ADOT&PF's Land Occupancy Drawing, resulting from a Notice of Environmental Contamination or an ADEC-issued Decision Document, would describe all institutional controls place on the site and act as a trigger to limit or prevent any proposed re-development or excavation in the landfill and hot spot sediment areas.

Compliance with ARARs – This alternative fails to comply with chemical-specific ARARs as contamination above PRGs would remain on site. There are no significant action-specific or location-specific ARARs for this alternative.

Long-Term Effectiveness – This alternative is potentially effective at reducing human exposure to site contaminants but has no effect on the RAOs for the site. Restrictions on future site use may be an undesirable condition for the property owner. Concentrations of petroleum in soil and sediment may be reduced by natural processes, but natural attenuation is unlikely to result in a significant reduction of PCB, pesticides, or metals concentrations over time. Erosion of the landfill area can be expected to continue during peak flows of the Colville River. Long-term effectiveness is considered to be low.

Reduction in Toxicity, Mobility, or Volume Through Treatment – The alternative involves no treatment, so there would be no reduction in toxicity, mobility, or volume of contaminated material other than by natural attenuation. This alternative does not meet the NCP preference for treatment because all contaminants remain on-site.

Short-Term Effectiveness – No short-term risks exist as a result of this alternative because it does not involve any construction or site work other than placement of signs. However, in the absence of remedial action, short-term exposure risks are expected to be consistent with those described in the CRE in Section 1.3.5.

Implementability – There would be no treatment-related implementation considerations. Land use controls to limit future use of the site (e.g., adminstrative restrictions) would need to be drafted for the current landowner(s), who would be obligated to implement. Installation of signs alerting visitors to potential health risks associated with the site where contaminant concentrations exceed PRGs (e.g., the landfill and hot spot sediment areas) and preparation and implementation of an education plan for visitors could easily be accomplished.

Cost – The cost of this alternative is estimated at approximately $383,000 of which initial costs are estimated at $145,000 to formalize the land use controls with the ADEC, ADOT&PF, USACE, and BLM and install signage. There is a low potential for cost escalation as site work is limited. The cost of a site visit to install warning signs would be affected by the cost of fuel. The remaining costs are periodic costs for five-year site reviews and reports, which, for the purpose of this FS, are extended for a period of 30 years after the initial implementation of the land use controls.

5.2.3 Alternative 3 – Land Use Controls and Hot Spot Sediment Removal

Under this alternative, land use controls such as administrative restrictions and the placement of warning signs would be implemented to protect human health from exposure to COPCs for the landfill area. Hot spot sediments would also be removed, dewatered, and disposed at an off-site facility. Alternative 3 would involve no containment, treatment, or disposal-oriented remedial action of site soils.

Overall Protectiveness – For the landfill area, this alternative is potentially effective at reducing human exposure to site contaminants but has no effect on the RAOs for the site and will provide no reduction for soil contamination levels below the PRGs. For the hot spot sediment areas, this alternative is effective at reducing human exposure by removing the contamination levels to below the PRGs. The landfill area would remain and provide no protection for ecological receptors and would potentially recontaminate sediments. Restrictions on future site use may be an undesirable condition for the property owner. Administrative restrictions at this remote site will be difficult to enforce. Filing adminstrative restictions with the BLM and ADOT&PF would act as a trigger to limit or prevent any proposed re-development or excavation in the landfill and hot spot sediment areas.

Compliance with ARARs – This alternative fails to comply with chemical-specific ARARs for soil in the landfill area as contamination above PRGs would remain. The removal of hot spot sediments to levels below PRGs would comply with chemical-specific ARARs. Action-specific ARARs identified include regulations governing spill prevention and discharge permitting for wastewater. Action-specific ARARs can be appropriately managed with proper planning. No significant location-specific ARARs were identified for this alternative.

Long-Term Effectiveness – This alternative is effective at reducing human exposure to contaminated sediments through removal and disposal and is potentially effective at reducing human exposure to contaminated soil in the landfill area by limiting access and land use. Therefore, this alternative has no effect on the RAOs for the site (i.e., the reduction of site sediments *and* soils to levels below PRGs). Site confirmation sampling would be conducted to establish that no contaminated sediments exceed the PRGs. Restrictions on future site use may be an undesirable condition for the property owner. Concentrations of petroleum in soil may be reduced by natural processes, but natural attenuation is unlikely to reduce significant concentrations of PCBs or pesticides over time, and no metals attenuate. Because erosion of the landfill area can be expected to continue during peak flows of the Colville River, mobilization of landfill contents that may be contaminated with COPCs can result in recontamination of downstream sediments. Long-term effectiveness is considered to be low.

Reduction in Toxicity, Mobility, or Volume Through Treatment –Though hot spot sediments would be removed, this alternative involves no treatment of the landfill area. Consequently there would be no reduction in toxicity, mobility, or volume of contaminated source material other than by natural attenuation. This alternative fails to meet the NCP preference for treatment because all contaminants remain on-site.

Short-Term Effectiveness – This alternative would be effective reducing potential exposure to soils exceeding PRGs to humans implementing land use controls. It will also reduce potential exposure to sediments exceeding PRGs by removing those sediments from the site environment. Short-term risks include exposure during excavation and handling of the contaminated sediment and dewatering fluids. It is anticipated this risk would persist over the course of approximately nine months of site activity. Site workers would be required to wear personal protective equipment. Site workers would also be exposed to the hazards of heavy equipment operation, mitigated by adherence to a site safety and health plan. Negligible risks would be associated with the obtaining material for excavation backfill. Lastly, there is the possibility of accidents/spills during transport over long distances and difficult terrain. A spill-response plan should be developed by the transport contractor to mitigate the risk from spills.

Implementability – This alternative can be readily implemented using construction technologies commonly used in the construction industry. The equipment and labor required for the construction of the temporary processing pad and dewatering are readily available and would be transported to and from the site via overland trail utilizing Rolligon ATVs. No ice-road construction would be necessary. Land use controls to limit future use of the site (e.g., warning signs and administrative restrictions), would be necessarily drafted for the current landowner, who would be obligated to implement. Installation of signs alerting visitors to potential health risks associated with soil where contaminant concentrations exceed PRGs (e.g., the landfill area) and preparation and implementation of an education plan for visitors could easily be accomplished.

Cost – The cost of this alternative is estimated at approximately $66,160,000, of which remedial activity capital costs are estimated at approximately $65,871,000 for mobilization, processing pad construction work,and dewatering. The remaining costs are for five-year site reviews and minor site maintenance. Included are administrative costs to formalize the land use controls with the ADEC, ADOT&PF, USACE, and BLM. Potential for cost escalation is considered moderate, as the cost of mobilization/demobilization and site visits could be affected by the cost of fuel. Additional sediment material at levels above PRGs could also require removal and disposal. Extra time on-site would be required for additional sediment removal and costs for

Geotubes and disposal would increase; no additional mobilization or demobilization cost would be incurred.

5.2.4 Alternative 4 – Containment and Capping

Alternative 4 includes isolation of the landfill contents by constructing a vertical barrier and a reinforced landfill cap. Hot spot sediments would be removed and placed in the landfill area prior to containment and capping. Slough blocks will be constructed to reduce water velocities during periods of inundation to prevent erosion during site work.

Overall Protectiveness – Alternative 4 would be protective of human health and ecological receptors by eliminating exposure to contaminated sediments and landfill soils at levels above PRGs. However, the alternative has no effect on the RAOs for the site as no soil or sediment contamination levels will be reduced below the PRGs.

Compliance with ARARs – The objective of this alternative is to provide protection to human health and ecological receptors by limiting exposure through direct contact. This alternative would comply with chemical-specific ARARs for COPCs for the landfill and hot spot sediment areas by eliminating the direct-contact exposure pathway. Isolation of the landfill would eliminate the potential for additional migration of source contamination. Water quality is expected to slowly improve through natural attenuation processes following source area isolation. Compliance with action-specific and location-specific ARARs could largely be achieved through proper design and construction planning and implementation, but the landfill lies within floodplain of the Colville River and does not conform to 18 AAC 600, Solid Waste Management. However, the action-specific ARAR governed by 40 CFR 761.61(a)(7) and (8) describes construction/maintenance requirements and deed restrictions, respectively, for caps covering PCB remediation wastes. A cap would necessarily be maintained in perpetuity, with repairs taking place within 72 hours of discovery for any breaches that would impair the cap integrity. Given the remote site location, it is unlikely this action-specific ARAR can be met.

Long-Term Effectiveness – The technologies used in removing sediment and containing the contaminated material are reliable and have been adequately demonstrated at other solid waste sites. Removal of contaminated sediments and containment of contaminated materials would mitigate the direct contact and surface run-off migration exposure routes outside the landfill and sediment areas. Site confirmation sampling would be conducted to establish that no contaminated sediments exceed the PRGs. The primary concern with this approach is the long-term integrity of the vertical barrier and cap system, particularly with respect to climatic stresses and natural river processes. The presence of permanent slough blocks will help mitigate potential damage from high-velocity flows, but significant events have the potential to alter hydraulic dynamics and render flow controls ineffective. Long-term effectiveness of this alternative would depend on routine inspection and maintenance. However, its timeframe is unpredictable. Because contaminated material would remain on-site, a site review would be required on a periodic basis. Damage to any part of the engineered controls would necessarily be repaired to avoid the potential for direct contact with the contaminated material. Long-term effectiveness is considered to be low.

Reduction in Toxicity, Mobility, or Volume Through Treatment – Alternative 4 leaves solid waste, contaminated soil, contaminated sediment, and possible residual chemicals in vessels (i.e., within drums, transformers, batteries, etc.) on-site. Consolidation and isolation of contaminated materials would reduce mobility and thus reduce the potential for human or animal exposure. Because all contaminants would remain on-site, this alternative fails to meet the NCP preference for contaminant reduction by treatment.

Short-Term Effectiveness – Implementation of the containment alternative would result in a small, temporary increase of risk to future site workers because of the potential exposure to contaminated materials during sediment removal and construction of engineered controls. It is anticipated that this risk would persist over the course of approximately 9 months of site activity. Site workers would be required to wear personal protective equipment to reduce these risks. Site workers would also be exposed to the hazards to heavy equipment operation, which would be mitigated by adherence to a site safety and health plan.

Implementability – This alternative is readily implementable. The technologies used for materials handling, sediment excavation, barrier and cap installation, and slough block construction are commonly used in the construction industry. The equipment, geosynthetics, and labor required for the primary work elements would be transported to and from the site via overland trail utilizing Rolligon ATVs. It is assumed that material can be obtained from a short distance used to construct the slough blocks and landfill cap. If at some future date excavation or removal of the waste materials are considered, the cap would present no impediment to future actions. Land use controls, including future deed restrictions, would be necessary to prevent any compromise of the integrity of the landfill cap and would need to be drafted and adopted by the current landowner(s). Installation of signs alerting visitors that the landfill cap should not be disturbed and preparation and implementation of an education plan for visitors could easily be accomplished.

Cost – The cost of this alternative is estimated at approximately $123,919,000, of which remedial activity capital costs are estimated at $123,181,000 for mobilization, material extraction and containment construction work. The remaining costs are for five-year site reviews and minor site maintenance and repairs. Included are administrative costs to formalize the land use controls with the ADEC, ADOT&PF, USACE, and BLM. The purpose of the 5-year reviews is to inspect the cap and identify possible changes in site use. The potential for cost escalation is considered high due to potential interruptions to work by weather and by other factors such as break up and high water in the Colville river and the due to need to go through extraordinary means to get local material. Additional sediment material at levels above PRGs could also require removal. Extra time on-site would be required for additional sediment removal, but no additional mobilization or demobilization cost would be incurred.

5.2.5 Alternative 5 – Excavation and On-Site Disposal

This alternative involves excavating the contents of the landfill and hot spot sediments above PRGs, segregating contaminated and non-contaminated material, and disposal of contaminated materials in a containment cell. The cell will be within the immediate vicinity of the Umiat facility but away from the landfill's present location. Non-contaminated material (clean soil and sediment) would be reused, if appropriate.

Overall Protectiveness – This alternative would be protective of human health and ecological receptors by eliminating the exposure to solid waste and contaminated media above their PRGs. Further evaluation of erosion potential would be required to finalize design for the containment cell to mitigate impacts to wetlands and floodplain flow. Land use controls would be required to ensure future land use activities and maintain the containment cell's integrity.

Compliance with ARARs – The objective of this alternative is to provide protection to human health and ecological receptors by limiting exposure through direct contact. This alternative would comply with chemical-specific ARARs for COPCs by preventing exposure by direct contact to soils and sediments at levels above PRGs. It would eliminate the potential for migration of contaminants from the source areas. Water quality is expected to continue to improve through natural attenuation processes following source area remediation. Action-specific ARARs identified include regulations governing solid waste disposal siting and construction, transport and disposal of any encountered contaminated liquids to a TSDF facility, spill prevention, and discharge permitting for wastewater. Action-specific ARARs can be appropriately managed with proper planning. No significant location-specific ARARs were identified for this alternative.

Long-Term Effectiveness – The technologies used for excavation and processing pad and containment cell construction are reliable and have been adequately demonstrated at other sites on the North Slope. Removal of contaminated sediments and containment of contaminated materials would mitigate the direct-contact and surface run-off migration exposure routes as well as leaching to groundwater. Site confirmation sampling would be conducted to establish that no contaminated sediments exceed the PRGs. This alternative is considered effective in the long term because the identified risks will be eliminated through the removal action. Because contaminated material would remain in the containment cells, 5-year site reviews would be required.

Reduction in Toxicity, Mobility, or Volume Through Treatment – This alternative will remove solid waste and contaminated materials (soil and sediment) from the site environment by isolating contaminants in a containment cell. Liquid wastes that could be present in the waste stream will be properly disposed. This eliminates the potential for exposure to humans and ecological receptors and reducing the COPCs mobility. This alternative provides no reduction for the toxicity or volume of the contaminated materials, though the volume of material in the containment cell would be lower than that currently in the landfill.

Short-Term Effectiveness – This alternative would be effective in reducing potential exposure of humans and ecological receptors to soils and sediments exceeding PRGs by removing those materials from the site environment. Short-term risks posed by this alternative include exposure during excavation and material processing of the contaminated media. It is anticipated this risk would persist over the course of approximately 10 months of site activity. Site workers would be required to wear personal protective equipment. Site workers would also be exposed to the hazards of heavy equipment operation, which would be mitigated by adherence to a site safety and health plan. Negligible risks would be associated with the obtaining material for excavation backfill. Lastly, there is the possibility of accidents/spills during transport. A spill-response plan should be developed by the transport contractor to mitigate the risk from spills.

Implementability – This alternative is readily implementable. The technologies used for materials handling, sediment dredging, and containment-cell cap installation are commonly used in the construction industry. The equipment, geosynthetics, and labor required for the primary work elements would be transported to and from the site via overland trail utilizing Rolligon ATVs. No ice-road construction would be necessary. It is assumed that local material can be used for processing pad and cell construction and excavation backfill. Land use controls, including future restrictive covenants, would be necessary to prevent any compromise of the integrity of the landfill cap. Implementability will ultimately require BLM acceptance of the proposed containment cell location.

Cost – The cost of this alternative is estimated at approximately $155,361,000, of which remedial activity capital costs are estimated at $154,663,000 for mobilization, excavation and processing pad and containment cell construction work. The remaining costs are for five-year site reviews and minor site maintenance and repairs. Included are administrative costs to formalize the land use controls with the ADEC, ADOT&PF, USACE, and BLM. The purpose of the 5-year reviews is to inspect the containment cell condition and identify possible changes in site use. Potential for cost escalation is considered high due to potential interruptions to work by weather and by other factors such as break up and high water in the Colville river and the due to need to go through extraordinary means to get local material. Additional sediment material at levels above PRGs could also require removal and placement within the containment cell. Extra time on-site would be required for additional sediment removal and the cell size could potentially be increased, but no additional mobilization or demobilization cost would be incurred.

5.2.6 Alternative 6 – Excavation and Off-Site Disposal/Treatment

Alternative 6 involves the excavation and disposal of landfill contents (soil and solid waste) and contaminated sediment at an off-site permitted facility.

Overall Protectiveness – This alternative would be protective of human health and ecological receptors by eliminating the exposure to contaminated soil and sediment above the PRGs.

Compliance with ARARs – The objective of this alternative is to provide protection to human health and ecological receptors. This alternative would comply with chemical-specific ARARs for the COPCs by removing contaminated materials at levels above the PRGs from the site. Action-specific ARARs for this alternative would pertain to regulations for action involving the transportation and handling of contaminated material. Disposal and/or recycling of metal debris would be at a permitted facility. Location-specific ARARs may include limitations on the use of vehicles or equipment to access areas of concern.

Long-Term Effectiveness – This alternative is effective over the long-term because the identified risks would be eliminated through the removal action. Site confirmation sampling would be conducted to establish that contaminants at the excavation limits exceed no PRGs. The technology used in excavation, transportation, and disposal is reliable and has been adequately demonstrated at other solid waste sites.

Reduction in Toxicity, Mobility, or Volume Through Treatment – This alternative removes solid waste and contaminated soil and sediment from the site, permanently eliminating the potential for exposure to humans and ecological receptors. The removal action directly addresses a reduction in mobility and volume, but involves no treatment so no toxicity is reduced.

Short-Term Effectiveness –This alternative would be effective at reducing the potential exposure of humans and ecological receptors by removing contaminated materials from the site. Short-term risks posed by this alternative include exposure during excavation and transportation of the contaminated materials. This risk is anticipated to persist over the course of approximately 14 months of site activity. Site workers would be required to wear personal protective equipment. Site workers would also be exposed to the hazards of heavy equipment operation, which would be mitigated by adherence to a site-safety and health plan. Negligible risks would be associated with obtaining material for excavation backfill. It is assumed that material can be obtained from a short distance. Lastly, there is the possibility of accidents/spills during transport over long distances and difficult terrain. A spill-response plan should be developed by the transport contractor to mitigate the risk from spills.

Implementability – This alternative can be readily implemented using typical excavating equipment and Supersacks or other containers for transporting the waste. The technologies used for excavation, containment, and shipping are commonly used in the construction industry and would be transported to and from the site via overland trail utilizing Rolligon ATVs, and standard tractor/trailer vehicles. The use of tractor/trailer transport trucks requires ice-road construction to facilitate site access. With the successful implementation of this alternative, no land use controls would be necessary, resulting in unrestricted use of the site.

***Cost* –** The cost of this alternative is estimated at approximately $368,252,000, all of which would be remedial action capital costs for mobilization, excavation, transportation, and disposal/treatment. Potential for cost escalation is considered high due to potential interruptions to work by weather and by other factors such as break up and high water in the Colville river and the due to need to go through extraordinary means to get local material. Additional sediment material at levels above PRGs could also require removal. Extra time on-site would be unlikely for additional sediment removal, and no additional mobilization or demobilization cost would be incurred.

5.2.7 Alternative 7 – Excavation, On-Site Disposal of Clean Material, and Off-Site Disposal/Treatment of Contaminated Material

Alternative 7 involves the excavation and disposal of landfill contents (solid waste and soil) and contaminated sediment, segregation of contaminated and non-contaminated material, disposal of clean material on-site, and disposal of contaminated material at an off-site permitted facility.

***Overall Protectiveness* –** This alternative would be protective of human health and ecological receptors by eliminating the exposure to contaminated soil and sediment above the PRGs.

***Compliance with ARARs* –** The objective of this alternative is to provide protection to human health and ecological receptors. This alternative would comply with chemical-specific ARARs for the COPCs by removing contaminated materials at levels above the PRGs from the site. Action-specific ARARs for this alternative would pertain to regulations for action involving the transportation and handling of contaminated material. Disposal and/or recycling of metal debris would be at a permitted facility. Location-specific ARARs may include limitations on the use of vehicles or equipment to access areas of concern.

***Long-Term Effectiveness* –** This alternative is effective over the long-term because the identified risks would be eliminated through the removal action. Analytical sampling during material processing would properly segregate contaminated soils. Site confirmation sampling would be conducted to establish that no contaminants at the excavation limits exceed the PRGs. The technology used in excavation, transportation, and disposal is reliable and has been adequately demonstrated at other solid waste sites.

Reduction in Toxicity, Mobility, or Volume Through Treatment – This alternative removes solid waste and contaminated soil and sediment from the site, thus permanently eliminating the potential for exposure to humans and ecological receptors. The removal action directly addresses a reduction in mobility and volume, but involves no treatment so no toxicity is reduced.

Short-Term Effectiveness – This alternative would be effective in reducing the potential exposure of humans and ecological receptors to contaminated materials by removing those materials from the site. Short-term risks posed by this alternative include exposure during excavation of the contaminated materials, material processing, and the transportation process. This risk is anticipated to persist over the course of approximately 14 months of site activity. Site workers would be required to wear personal protective equipment. Site workers would also be exposed to the hazards of heavy equipment operation, which would be mitigated by adherence to a site-safety and health plan. Negligible risks would be associated with obtaining material for excavation backfill. It is assumed backfill material would be obtained from an on-site source area. Lastly, there is the possibility of accidents/spills during transport over a long distance under difficult terrain. A spill response plan should be developed by the transport contractor to mitigate the risk from spills.

Implementability – This alternative can be readily implemented using typical excavating and sorting equipment and Supersacks or other containers for transporting the waste. The technologies used for excavation, material processing, containment, and shipping are commonly used in the construction industry and would be transported to and from the site via overland trail utilizing Rolligon ATVs and standard tractor/trailer vehicles. The use of tractor/trailer transport trucks requires ice-road construction to facilitate site access. Administrative requirements would include preparing transportation documents and waste profiles in support of disposal. No land use controls would be necessary, although the Army would retain long-term CERCLA liability for wastes disposed off-site.

Cost – The cost of this alternative is estimated at approximately $223,681,000, all of which would be remedial activity capital costs for mobilization, excavation, processing pad construction, transportation, and disposal/treatment. Potential for cost escalation is considered high due to potential interruptions to work by weather and by other factors such as break up and high water in the Colville river and the due to need to go through extraordinary means to get local material. . Additional sediment material at levels above PRGs could also require removal. Extra time on-site would be unlikely for additional sediment removal, and no additional mobilization or demobilization cost would be incurred.

5.2.8 Alternative 8 – Step-Wise Implementation of Interim Actions

Alternative 8 involves the implementation of interim actions in a step-wise, phased approach over several years as incremental funding is/can be obtained. Land use controls to restrict access to the landfill and hot spot sediment areas will first be implemented, followed by hot spot sediment removal, dewatering, and disposal. The ultimate response action will include excavation and removal of the landfill contents. For this alternative we assume that segregation of contaminated and non-contaminated material will occur and that contaminated material will be disposed at an off-site facility. Non-contaminated material (i.e., clean soil and sediment) will be disposed or reused on site.

Overall Protectiveness – This alternative would be protective of human health by limiting access and eliminating the exposure to contaminated soil and sediment above the PRGs. However, the alternative would provide no protection for ecological receptors until all contaminated soil and sediment are removed. Administrative restrictions at this remote site are difficult to enforce. Filing restrictions with BLM and ADOT&PF would act as a trigger for any proposed re-development or excavation in the landfill and hot spot sediment areas.

Compliance with ARARs – The objective of this alternative is to provide protection to human health and ecological receptors. This alternative would initially provide no compliance with chemical-specific ARARs as only land use controls would be implemented and contamination would remain in place. Next-phase actions would comply only with chemical-specific ARARs for the COPCs in sediments upon hot spot removal. Final remedial action would fully insure compliance with chemical-specific ARARs for the COPCs in soil by removing remaining contamination at levels above PRGs from the site. Action-specific ARARs identified include regulations governing transport and disposal of sediments at a RCRA and/or TSDF facility, spill prevention, and discharge permitting for wastewater. Action-specific ARARs can be appropriately managed with proper planning. No significant location-specific ARARs were identified for this alternative.

Long-Term Effectiveness – This alternative is effective over the long-term because the identified risks would be eliminated through the removal action. Site confirmation sampling would be conducted to establish that no contaminants at the excavation limits exceed the PRGs. The technology used in excavation, transportation, and disposal is reliable and has been adequately demonstrated at other solid waste sites.

Reduction in Toxicity, Mobility, or Volume Through Treatment – This alternative would result in the removal of solid waste and contaminated soil and sediment from the site, permanently eliminating the potential for exposure to humans and ecological receptors. The removal action directly addresses a reduction in mobility and volume, but involves no treatment so no toxicity is reduced.

Short-Term Effectiveness – The short-term effectiveness of this alternative reducing the potential exposure of humans would be controlled by the timing of each phase. As described in Alternative 2, the short-term effectiveness of the initial land-use controls is low, as those controls only limit exposures through the use of signage and other administrative controls. The hot-spot removal phase will result in slightly greater short-term effectiveness than land use controls only. However, it does nothing to address potential exposure to landfill soils. The final landfill removal phase will have the greatest short-term effectiveness by removing those materials from the site. Short-term risks posed by implementing this alternative include exposure during excavation of the contaminated materials, material processing, and the transportation process. This risk is anticipated to persist over the course of multiple phases of site work, particularly during hot spot sediment removal and excavation of landfill contents. Site workers would be required to wear personal protective equipment. Site workers would also be exposed to the hazards of heavy equipment operation, mitigated by adherence to a site-safety and health plan. Negligible risks would be associated with obtaining material for excavation backfill. It is assumed backfill material would be obtained from an on-site source area. Lastly, there is the possibility of accidents/spills during transport over long distances and difficult terrain. A spill-response plan should be developed by the transport contractor to mitigate the risk from spills.

Implementability – This alternative can be readily implemented using typical excavating,and sorting equipment and Supersacks or other containers for transporting the waste. The equipment and labor required for the construction of the temporary processing pad, excavation, and dewatering are readily available and would be transported to and from the site via overland trail utilizing Rolligon ATVs. Land use controls to limit future use of the site (e.g., covenants), would be necessarily drafted and the current landowner would be obliged to implement. Installation of signs alerting visitors that the landfill cap should not be disturbed and preparation and implementation of an education plan for visitors could easily be accomplished. Land use controls may be modified as interim remedial measures are completed.

Cost – Because of high mobilization costs and a general lack of overlapping elements between the land use control, hot spot sediment removal, and landfill removal phases, the cost of Alternative 8 is assumed to roughly equal the cumulative estimated costs of the various alternatives implemented therein; however, some efficiencies such as material source permitting and pad construction can be obtained. These costs would be subject to the same escalation potentials as described in the component alternatives.

5.3 Comparative Analysis of Alternatives

This section presents at comparative analysis of the eight remedial action alternatives to evaluate their relative performance in relation to the evaluation criteria identified in Section 5.1 except for Criterion 8 and 9, which will be addressed in the Decision Document after public comment on the PP has been received. The purpose of this analysis is to identify the relative advantages and disadvantages of each alternative. This comparison can then be used in considering tradeoffs that may be necessary in the selection of a site remedy.

5.3.1 Overall Protection of Human Health and the Environment

Results of the RI for the Umiat Landfill show that COPCs in soil and sediment exceed PRG levels. Of the alternatives subjected to the detailed analysis, Alternatives 4, 5, 6, 7, and 8 would reduce or eliminate the risk posed to human health and ecological receptors from direct contact, ingestion, or inhalation of site soils and sediments. Alternatives 1 and 2 would rely on natural attenuation, which is an ineffective process for COPCs such as PCBs, pesticides, and metals, and would require an unacceptably long period of time before risk reduction was realized.

Alternatives 1 and 2 would provide no mitigation for site contamination or exposure pathways unless natural attenuation reduces the contaminant levels. Because contaminated soil and sediment remain on the site and no reduction in contaminant levels below PRGs would occur, these alternatives provide no protection of human health and the environment. Alternatives 1 and 2 are ineligible for selection as a final remedy.

Alternative 3 would mitigate the sediment contamination or exposure pathways to levels below PRGs but the landfill contamination will remain unless natural attenuation reduces the contaminant levels. Accordingly, no reduction in contaminant levels below PRGs would occur for the landfill contaminants, providing no protection for human health and the environment. Alternative 3 is ineligible for selection as a final remedy.

Alternative 4 would control exposure by isolating the landfill contents, including sediments removed from downgradient of the landfill. This alternative would be more effective than Alternatives 1 through 3 by preventing exposure to contaminated materials. However this alternative would require land use controls to restrict future site uses and maintain the cap and slough blocks.

Alternative 5 would result in removal of the solid waste and contaminated soils and sediments exceeding the PRGs for on-site containment. The containment cell would reduce the potential for exposure and contaminant redistribution. This alternative relies on the availability of an acceptable site for containment cell construction and long-term stablility. This alternative would require land use controls to restrict future site uses and maintain the containment cell.

Alternative 6 would remove the solid waste and contaminated soils and sediments exceeding the PRGs for off-site disposal. No clean material would be segregated. This alternative would be protective preventing exposure to contaminated soil and sediment and eliminating the need for future land use restrictions or monitoring.

Alternative 7 would remove the solid waste and contaminated soils and sediments exceeding the PRGs for off-site disposal. Non-contaminated material (i.e., clean soil and sediment) would be disposed on site. This alternative would be protective preventing exposure to contaminated soil and sediment eliminating the need for future land use restrictions or monitoring.

Alternative 8 step-wise interim actions would initially provide no protection and would require land use controls to restrict future site uses in the near term. The alternative would then remove to the extent feasible the contaminated sediments exceeding the PRGs for off-site disposal. Solid waste and contaminated soil exceeding the PRGs would then be transported for off-site disposal. This alternative would be protective in preventing exposure to contaminated soil and sediment eliminating the need for future land-use restrictions or monitoring.

5.3.2 Compliance with ARARs

Alternatives 1 and 2 would leave solid waste and contaminated soils and sediments on-site, and Alternative 3 would leave solid waste and contaminated soils on-site. These materials would be accessible to site users and available for potential contaminant transport, and provide no compliance with chemical-specific ARARs as soil and sediment would remain on-site at levels above PRGs. Because Alternatives 1, 2, and 3 meet no threshold criterion, they are ineligible for selection as a final remedy. Alternative 4 would meet chemical-specific ARARs by preventing direct contact and limiting contaminant migration pathways for the contents of the landfill (including removed hot spot sediments). However, the isolated contamination would remain on the site. Alternative 5 would meet chemical-specific ARARs by preventing direct contact and eliminating contaminant migration pathways, but contaminated material would remain at the site in the containment cell. Alternatives 6, 7 and, 8 (the latter upon completion) would meet chemical-specific ARARs by removing contaminants that exceed PRGs from the site.

Action-specific ARARs can be met for each alternative through the project planning and design process. Alternative 2 would have limited site work, consisting of placing warning signs around the site and periodically maintaining these signs. Alternative 3 would also have limited site work, consisting of placing and maintaining warning signs and removal, dewatering, and disposal of hot spot sediments. Soil caps or containment cells (Alternatives 4 and 5) can be designed to optimally protect site visitors and ecological receptors from direct contact with contaminated soil. Alternatives 4 and 5 would be considered landfills and subject to permitting and long-term monitoring requirements. Excavation activities can be implemented in a manner protective of site workers (Alternatives 4 through 8). Alternatives 3, 6, 7, and 8 include transportation and off-site disposal processes that can be addressed with proper planning.

Location-specific ARARs can also be met for each alternative through the project planning and design process. Site work should be done in a manner protective of area wildlife and permissible within the boundaries of BLM and ADOT&PF. Soil cap or containment areas (Alternatives 4 and 5) would be considered landfills and subject to an evaluation of the area for seismic and flood potential and must meet construction standards. Excavation activities (Alternatives 3, 4, and 5) may be subject to limits on access (e.g., travel on tundra).

5.3.3 Long-Term Effectiveness and Permanence

Alternatives 1, 2, and 3 would be ineffective reducing long-term risk except by the gradual natural attenuation of the organic contaminants. The long-term effectiveness of Alternatives 4 and 5 would depend largely on the integrity and effectiveness of the containment structures. Alternatives 6, 7, and 8 would meet goals for long-term effectiveness by removing contaminated material exceeding PRGs from the site. While removed from the site, contaminated material would remain at the selected permitted disposal facility, although under controlled conditions.

5.3.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

No on-site treatment is proposed for any of the alternatives.

5.3.5 Short-Term Effectiveness

Alternatives 1 and 2 would provide no short-term effectiveness because no remedial action would be taken. Alternative 3 would have minimal short-term impacts because site work is limited to excavation and dewatering of hot spot sediments. Alternative 4 would have minimal short-term impacts because little sediment, and little or no contaminated soil, would be handled during construction of the vertical barrier and cap. Alternatives 5, 6, 7, and 8 would have short-term impacts resulting from the excavation and handling of contaminated materials. Impacts from any site activities would be reduced by the use of appropriate worker personal protection equipment.

The time required to implement alternatives can also affect short-term effectiveness. Alternatives 4 through 8 require significant funding and would be ineffective in the short term if no funding can be obtained in the foreseeable future.

5.3.6 Implementability

Alternative 1 would require no implementation because it involves no remedial action. Alternative 2 would require minimal site work but would focus on administrative procedures to reduce potential exposures. Alternatives 3 through 8 could be implemented using available construction equipment and materials readily transported to the site.

The portions of the site affected by these alternatives are accessible to construction equipment, although seasonal conditions should be considered when performing site work. The presence of the river, shallow groundwater, and permafrost could cause significant implementability issues during construction. River and shallow groundwater impacts have been mitigated with excavation occurring in colder, low-flow months. Significant groundwater impacts may require augercast piles using readily available equipment and materials transported to the site.   The ADEC will prohibit construction of a landfill on a site underlain by permafrost unless the owner or operator can demonstrate that no practical alternative is available (18 AAC 60.227). If built on permafrost, the landfill must be designed to maintain frozen ground to the maximum extent practical.

Alternatives requiring land use controls (Alternatives 2, 3, 4, 5 and 8) would require landowner acceptance. Implementation of Alternative 5 is expected to require Permission will need to be obtained for placement of the landfill on BLM property in Umiat. As owner, BLM is expected to coordinate ongoing land management activities at these sites with the Corps in a manner that promotes clean-up under CERCLA.

5.3.7 Cost

Alternatives 1, 2, and 3 are the lowest cost alternatives. Because Alternatives 1, 2 and 3 fail to meet the threshold criteria of overall protectiveness and compliance with ARARs, they are ineligible for selection as a final remedy. Alternatives 4 and 5 provide protection of human health and ecological receptors at moderate costs. However contaminated material remains on site and the future effectiveness of the processes relies on maintenance of the containment structures. Alternatives 6, 7, and 8 have the highest costs but achieve the greatest reduction in concentrations of COPCs at the site. The costs for these alternatives are summarized in Table 5-1.

5.4 Summary

Risks to human health and the environment posed by contaminated materials present at the Umiat Site were evaluated based on their ability to meet or exceed PRGs. The initial development and screening of alternatives provided a range of remedies to address those risks.

These remedies were developed under the assumption the site will be visited and may be occupied by workers, and supports a variety of ecological receptors. The remedies are weighted towards those that include no restrictions on future site uses, including the future residential (unrestricted use) scenario. The alternatives are directed at addressing contaminants within the landfill footprint as well as contamination that has migrated to sediments downgradient of the landfill. A qualitative assessment of each alternative is presented in Table 5-2.

The No Action alternative (Alternative 1) provides no protection for human health or ecological receptors. Its inclusion in the FS process follows EPA guidance and serves as a point of comparison against which other alternatives may be evaluated. Alternative 2 would include minimal site work, relies on land-use controls to limit potential exposure, and wouldnot have an effect on contaminant concentrations at the site. Alternative 3 would include hot spot sediment removal, but relies on land use controls to limit potential exposure to the landfill area. It would leave contaminant concentrations at current levels and would not have an effect on contaminant concentrations at the site. Because Alternatives 1, 2, and 3 fail to meet the threshold criteria of overall protectiveness and compliance with ARARs, they are ineligible for selection as a final remedy. Alternatives 4 through 8 meet the threshold criteria of overall protectiveness and compliance with ARARs and are eligible for selection as a final remedy.

TABLE 5-1
REMOVAL ACTION ALTERNATIVE COST SUMMARY

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8		
	No Action	Land Use Controls	Land Use Controls/Hot Spot Sediment Removal	Containment & Capping	Excavation and On-Site Disposal	Excavation and Off-Site Disposal/ Treatment	Excavation/On-Site and Off-Site Disposal	Step-wise with Alternative 5 Disposal	Step-wise with Alternative 6 Disposal	Step-wise with Alternative 7 Disposal
Capital Cost Subtotal	$ -	$ 144,930	$ 37,215,368	$ 69,593,852	$ 87,357,524	$ 208,051,742	$ 126,373,343	$ 105,645,882	$ 226,275,540	$ 144,417,357
Project Management (10%)	$ -	$ -	$ 3,721,537	$ 6,959,385	$ 8,735,752	$ 20,805,174	$ 12,637,334	$ 10,564,588	$ 22,627,554	$ 14,441,736
Remedial Design (12%)	$ -	$ -	$ 4,465,844	$ 8,351,262	$ 10,482,903	$ 24,966,209	$ 15,164,801	$ 12,677,506	$ 27,153,065	$ 17,330,083
Construction Management (15%)	$ -	$ -	$ 5,582,305	$ 10,439,078	$ 13,103,629	$ 31,207,761	$ 18,956,001	$ 15,846,882	$ 33,941,331	$ 21,662,604
Design Contingency (15%)	$ -	$ -	$ 5,582,305	$ 10,439,078	$ 13,103,629	$ 31,207,761	$ 18,956,001	$ 15,846,882	$ 33,941,331	$ 21,662,604
Bid Contingency (25%)	$ -	$ -	$ 9,303,842	$ 17,398,463	$ 21,839,381	$ 52,012,936	$ 31,593,336	$ 26,411,471	$ 56,568,885	$ 36,104,339
5-Year Reviews/Minor Site Maint.	$ -	$ 238,327	$ 288,327	$ 738,327	$ 738,327	$ -	$ -	$ 738,327	$ -	$ -
Total Estimated Present-Worth Cost of Alternative	**$ -**	**$ 383,257**	**$ 66,159,528**	**$ 123,919,444**	**$ 155,361,144**	**$ 368,251,583**	**$ 223,680,817**	**$ 187,731,538**	**$ 400,507,706**	**$ 255,618,722**
		$ 144,930	$ 65,871,201	$ 123,181,117	$ 154,622,817			$ 186,993,211		

TABLE 5-2
COMPARATIVE ANALYSIS OF ALTERNATIVES

Evaluation Criteria	***Alternative 1** No Action	***Alternative 2** Land Use Controls	***Alternative 3** Land Use Controls/Hot Spot Sediment Removal	**Alternative 4** Containment & Capping	**Alternative 5** Excavation and On-Site Disposal	**Alternative 6** Excavation and Off-Site Disposal /Treatment	**Alternative 7** Excavation/On-Site and Off-Site Disposal	**Alternative 8** Step-Wise Interim Actions with Disposal Alternatives
Overall Protection of Human Health and the Environment	○	○	○	●	●	●	●	●
Compliance with applicable or relevant and appropriate requirements	○	○	◗	◗	◗	●	●	●
Long-Term Effectiveness and Permanence	○	◗	◗	◗	◗	●	●	●
Reduction in Toxicity, Mobility, and Volume Through Treatment	○	○	○	○	○	○	○	○
Short-Term Effectiveness	○	◗	◗	●	●	●	●	◗
Implementability	○	●	●	◗	◗	◗	◗	◗
2015 capital cost (in 1000's)	$0	$145	$65,871	$123,181	$154,663	$368,252	$223,681	$186,993 – $400,508
Lifetime operation and maintenance (O&M) cost (in 1000's)	$0	$238	$288	$738	$738	$0	$0	$0 – $738
Lifetime present-worth capital and O&M cost (in 1000's)	$0	$383	$66,160	$123,919	$155,361	$368,252	$223,681	$187,732 - $400,508

Key: ○ = does not meet criteria ◗ = partially meets criteria ● = meets or exceeds criteria
*Does not meet the threshold criterion of compliance with ARARs, therefore it is not eligible for selection as a remedy.

The information presented in this FS should be used by stakeholders to select a preferred alternative for remedial action at the Umiat Site. A Proposed Plan (PP) should be prepared to present to the stakeholders and general public for further comment. The PP should include a summary of the information presented in the RI and FS reports, and identify the preferred alternative. A public meeting should be conducted in the Village of Nuiqsut to solicit input from local residents and other interested stakeholders. Responses to the PP should be used to assess the final two evaluation criteria to the alternatives described herein (State/Support Agency Acceptance and Community Acceptance). Finally, a Decision Document should be prepared describing the selected alternative.

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APPENDIX A

COPC AND CUMULATIVE RISK TABLES

Table A-1
Chemical-Specific PCLs and TBCs Used to Evaluate Analytical Results
and Identify Contaminants of Potential Concern

Medium	Chemical-Specific PCL	Chemical-Specific TBC
Soil	Petroleum Hydrocarbons • 18 AAC 75.341, Table B2, Over-40-inch Migration to Groundwater petroleum hydrocarbon soil-cleanup levels Other Most stringent of: • 18 AAC 75.341, Table B1, Arctic Zone Direct Contact soil-cleanup levels • 18 AAC 75.341, Table B1, Arctic Zone Outdoor Inhalation soil-cleanup levels • 18 AAC 75.341, Table B1, Migration to Groundwater soil-cleanup levels	• Most stringent NOAA SQuiRT value for soil.[1]
Sediment	Petroleum Hydrocarbons • 18 AAC 75.341, Table B2, Over-40-inch Migration to Groundwater petroleum hydrocarbon soil-cleanup levels Other Most stringent of: • 18 AAC 75.341, Table B1, Arctic Zone Direct Contact soil-cleanup levels • 18 AAC 75.341, Table B1, Arctic Zone Outdoor Inhalation soil-cleanup levels • 18 AAC 75.341, Table B1, Migration to Groundwater soil-cleanup levels	• Most stringent NOAA SQuiRT value for freshwater sediment.
Groundwater	More stringent of: • 18 AAC 75.345, Table C groundwater-cleanup levels • 18 AAC 70 Water Quality Standards including: Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances; most stringent criteria for fresh water	• Most stringent NOAA SQuiRT value for groundwater.
Surface Water	More stringent of: • 18 AAC 75.345, Table C groundwater-cleanup levels • 18 AAC 70 Water Quality Standards including: Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances; most stringent criteria for fresh water	• Most stringent NOAA SQuiRT value for fresh surface water.[2]
Fish Tissue	—	• EPA Fish Tissue Risk-Based Screening Levels, modified for site-specific consumption rates.[3] See Table F-1C for a full list of assumptions.

Notes:

[1] Soil SQuiRTs include values for: Invertebrates, Mammals, Plants, and Other

[2] Surface water SQuiRTs include: Acute and Chronic levels

[3] Fish consumption rate is 390 g/day, carcinogenic target risk is 10^{-6}, hazard index is 1

Abbreviations:

AAC Alaska Administrative Code
ADEC Alaska Department of Environmental Conservation
NOAA National Oceanic and Atmospheric Administration
PCL Potential cleanup level
SQuiRT Screening Quick Reference Table (NOAA 2008)
TBC To Be Considered criteria

Table A-2
Highest Detected Analyte and PQL Concentrations in Soil Samples

Analytical Method	Analyte	PCL	PCL Source	TBC	RBSL	Units	1994 E&E		1996 AGRA		1996 E&E		1997 E&E		2001 Jacobs	
							Result	[PQL]	Result	[PQL]	Result	[PQL]	Result	[PQL]	Result	[PQL]
AK 101	Gasoline range organics	260	OFMTG	—	—	mg/kg	—	—	—	—	19	[6.2]	—	—	—	—
	Toluene	6.5	MTG	0.01	22	mg/kg	—	—	—	—	0.5	[0.15]	—	—	—	—
	Xylenes (total)	63	MTG	0.1	6.3	mg/kg	—	—	—	—	0.22	[0.31]	—	—	—	—
AK 102	Diesel range organics	230	OFMTG	—	—	mg/kg	—	—	—	—	**1300**	[4.6]	14	[4.6]	—	—
AK M 8100	Diesel range organics	230	OFMTG	—	—	mg/kg	44	[13]	—	—	—	—	—	—	—	—
AK 103	Residual range organics	8,300	OFIG	—	—	mg/kg	—	—	—	—	4100	[120]	—	—	—	—
SW8260	Acetone	88	MTG	2.5	10,200	mg/kg	—	[0.05]	—	[2]	0.0199	[0.0519]	—	—	—	—
	Methylene chloride	0.016	MTG	0.4	24	mg/kg	**0.019**	[0.01]	—	[0.1]	0.0135	[0.00555]	—	—	—	—
	Toluene	6.5	MTG	0.01	22	mg/kg	0.008	[0.0062]	—	[0.1]	0.0045	[0.026]	—	—	—	—
	Xylenes (total)	63	MTG	0.1	6.3	mg/kg	0.005	[0.0062]	—	—	0.00859	[0.00619]	—	—	—	—
	m,p-Xylene	63	MTG	0.1	6.3	mg/kg	—	—	—	[0.1]	0.00572	[0.00619]	—	—	—	—
	o-Xylene	63	MTG	0.1		mg/kg	—	—	—	[0.1]	0.00288	[0.00619]	—	—	—	—
PAH SIM	2-Methylnaphthalene	6.1	MTG	3.24	38	mg/kg	—	—	0.024	[0.005]	—	—	—	—	—	—
	Benzo(b)fluoranthene	6.6	AZDC	59.8	0.66	mg/kg	—	—	0.01	[0.005]	—	—	—	—	—	—
	Benzo(g,h,i)perylene	1,900	AZDC	119	190	mg/kg	—	—	0.007	[0.005]	—	—	—	—	—	—
	Chrysene	360	MTG	4.73	66	mg/kg	—	—	0.017	[0.005]	—	—	—	—	—	—
	Dibenzofuran	11	MTG	—	27	mg/kg	—	—	0.007	[0.005]	—	—	—	—	—	—
	Naphthalene	20	MTG	0.0994	4.2	mg/kg	—	—	0.014	[0.005]	—	—	—	—	—	—
	Phenanthrene	3,000	MTG	45.7	2,780	mg/kg	—	—	0.039	[0.005]	—	—	—	—	—	—
	Pyrene	1,000	MTG	78.5	190	mg/kg	—	—	0.005	[0.005]	—	—	—	—	—	—
SW8270	2-Methylnaphthalene	6.1	MTG	3.24	38	mg/kg	—	—	—	—	0.0753	[3.43]	—	—	—	—
	Benzoic acid	410	MTG	—	42,800	mg/kg	—	—	—	—	0.0585	[17.1]	—	—	—	—
	bis(2-Ethylhexyl)phthalate	13	MTG	0.1	30	mg/kg	—	—	—	—	0.118	[3.43]	—	—	—	—
	Di-n-octyl phthalate	3,800	MTG	0.1	420	mg/kg	—	—	—	—	0.159	[3.43]	—	—	—	—
	Phenanthrene	3,000	MTG	45.7	2,780	mg/kg	—	—	—	—	0.0691	[3.43]	—	—	—	—
	Pyrene	1,000	MTG	78.5	190	mg/kg	—	—	—	—	0.616	[0.409]	—	—	—	—
SW8080 Series	4,4'-DDD	7.2	MTG	0.01	4.1	mg/kg	0.026	[0.1]	—	—	**31.4**	[0.00231]	0.0059	[0.0037]	—	—
	4,4'-DDE	5.1	MTG	0.01	2.9	mg/kg	—	[0.1]	—	—	0.00062	**[4.15]**	—	—	—	—
	4,4'-DDT	7.3	MTG	0.01	2.9	mg/kg	0.05	[0.01]	—	—	**38.2**	[0.00579]	0.0065	[0.0037]	—	—
	Aroclor 1254	1	AZDC	0.00033	0.1	mg/kg	—	[0.105]	—	—	0.224	**[41.5]**	—	—	**2.3**	[0.11]

Table A-2
Highest Detected Analyte and PQL Concentrations in Soil Samples

Analytical Method	Analyte	PCL	PCL Source	TBC	RBSL	Units	1994 E&E		1996 AGRA		1996 E&E		1997 E&E		2001 Jacobs	
							Result	[PQL]	Result	[PQL]	Result	[PQL]	Result	[PQL]	Result	[PQL]
SW6000/ 7000 Series	Aluminum	—	—	50	—	mg/kg	—	—	—	—	9,280	—	—	—	—	—
	Antimony	3.6	MTG	0.142	5.5	mg/kg	—	—	—	—	0.95	**[7.1]**	—	—	—	—
	Arsenic	3.9	MTG	5.7	0.61	mg/kg	**7**	—	**8**	**[1]**	**8.4**	—	—	—	—	—
	Barium	1100	MTG	1.04	2,740	mg/kg	430	—	—	—	552	—	—	—	—	—
	Beryllium	42	MTG	1.06	27	mg/kg	—	—	—	—	0.37	—	—	—	—	—
	Calcium	—	—	—	—	mg/kg	—	—	—	—	4,290	—	—	—	—	—
	Chromium	25	MTG	—	41	mg/kg	23	—	—	—	19.2	—	—	—	—	—
	Cobalt	—	—	0.14	—	mg/kg	—	—	—	—	13.8	—	—	—	—	—
	Copper	460	MTG	5.4	550	mg/kg	—	—	—	—	31.4	—	—	—	—	—
	Iron	—	—	200	—	mg/kg	—	—	—	—	27,800	—	—	—	—	—
	Lead	400	AZDC	0.0537	—	mg/kg	10	—	—	[20]	**598**	—	—	—	**1170**	[18.7]
	Magnesium	—	—	—	—	mg/kg	—	—	—	—	5170	—	—	—	—	—
	Manganese	—	—	100	—	mg/kg	—	—	—	—	805	—	—	—	—	—
	Mercury	1.4	MTG	0.1	2.6	mg/kg	—	[0.2]	—	—	0.06	[0.02]	—	—	—	—
	Nickel	86	MTG	13.6	270	mg/kg	—	—	—	—	38.5	—	—	—	—	—
	Potassium	—	—	—	—	mg/kg	—	—	—	—	912	—	—	—	—	—
	Selenium	3.4	MTG	0.52	68	mg/kg	3	[1]	—	—	0.45	[0.5]	—	—	—	—
	Sodium	—	—	—	—	mg/kg	—	—	—	—	61.4	[85.5]	—	—	—	—
	Vanadium	960	AZDC	1.59	96	mg/kg	—	—	—	—	30.7	—	—	—	—	—
	Zinc	4100	MTG	6.62	4,110	mg/kg	—	—	—	—	121	—	—	—	—	—

Notes:

mg/kg	milligrams per kilogram
PCL	Potential cleanup level
TBC	To Be Considered, non-promulgated advisories, guidance, or proposed standards
RBSL	Risk-based screening level (Hazard Quotient = 0.1 or Cancer Risk = 10^{-6}) - more stringent of Direct Contact or Inhalation Pathways for the Arctic Zone
PQL	practical quantitation limit (also known as reporting limit)
bold	result or PQL exceeds the ARAR
shaded	result exceeds the RBSL, and analyte is included in the CRE (Table 6-2)
—	not applicable, analysis not performed, or ARAR/TBC/RBSL does not exist
AZDC	18 AAC 75.341 (April 2012) - Method Two Tables B1 and B2 Soil Cleanup Levels: Arctic Zone Direct Contact
MTG	18 AAC 75.341 (April 2012) - Method Two Tables B1 and B2 Soil Cleanup Levels: Migration to Groundwater
OFIG	18 AAC 75.341 (April 2012) - Method Two Tables B1 and B2 Soil Cleanup Levels: Over 40 Inch Zone, Ingestion
OFMTG	18 AAC 75.341 (April 2012) - Method Two Tables B1 and B2 Soil Cleanup Levels: Over 40 Inch Zone, Migration to Groundwater

Results and PQLs listed where available from tabulated results in historic remedial investigations; data flags not listed, see Appendix F tables for data flags.

Table A-3
Highest Detected Analyte and PQL Concentrations in Sediment Samples

Analytical Method	Analyte	PCL	PCL Source	TBC	RBSL	Units	1986 USACE		1996 AGRA		1996 E&E		1997 E&E		1998 E&E	
							Result	[PQL]	Result	[PQL]	Result	[PQL]	Result	[PQL]	Result	[PQL]
AK 102	Diesel range organics	230	OFMTG	—	—	mg/kg	10	—	—	—	—	—	—	—	54	[3.1]
AK 103	Residual range organics	8300	OFIG	—	—	mg/kg	—	—	—	—	48	[50]	—	—	—	—
SW8260	2-Butanone	59	MTG	89.6	2,330	mg/kg	—	—	—	—	0.0118	[0.0125]	—	—	0.012	[0.0055]
	Acetone	88	MTG	2.5	10,200	mg/kg	—	—	—	—	0.0443	—	—	—	0.13	[0.0052]
	Methylene chloride	0.016	MTG	0.4	24	mg/kg	—	—	—	—	0.00267	0.00629	—	—	—	[0.00093]
	2-Methylnaphthalene	6.1	MTG	3.24	38	mg/kg	—	[0.04]	—	—	0.0523	[0.41]	—	—	—	[0.33]
	bis(2-Ethylhexyl)phthalate	13	MTG	0.1	30	mg/kg	—	[0.04]	—	—	0.135	[0.385]	—	—	—	[0.43]
PAH SIM	2-Methylnaphthalene	6.1	MTG	3.24	38	mg/kg	—	—	0.075	[0.005]	—	—	—	—	—	—
	Benzo(b)fluoranthene	6.6	AZDC	59.8	0.66	mg/kg	—	—	0.011	[0.005]	—	—	—	—	—	—
	Benzo(g,h,i)perylene	1900	AZDC	119	190	mg/kg	—	—	0.008	[0.005]	—	—	—	—	—	—
	Chrysene	360	MTG	4.73	66	mg/kg	—	—	0.019	[0.005]	—	—	—	—	—	—
	Dibenzofuran	11	MTG	—	27	mg/kg	—	—	0.021	[0.005]	—	—	—	—	—	—
	Fluoranthene	1400	MTG	122	250	mg/kg	—	—	0.009	[0.005]	—	—	—	—	—	—
	Naphthalene	20	MTG	0.0994	4.2	mg/kg	—	—	0.042	[0.005]	—	—	—	—	—	—
	Phenanthrene	3000	MTG	45.7	2,780	mg/kg	—	—	0.075	[0.005]	—	—	—	—	—	—
	Pyrene	1000	MTG	78.5	190	mg/kg	—	—	0.008	[0.005]	—	—	—	—	—	—
SW8080 Series	4,4'-DDD	7.2	MTG	0.01	4.1	mg/kg	0.65	—	—	[0.01]	0.00838	[0.124]	—	—	0.054	[0.0021]
	4,4'-DDT	7.3	MTG	0.01	2.9	mg/kg	—	[0.043]	—	[0.01]	0.0325	[0.311]	—	—	0.059	[0.0025]
	Aroclor 1254	1	AZDC	0.000332	0.1	mg/kg	0.68	—	0.3	[0.1]	**17.8**	—	**1.3**	[0.059]	—	[0.0098]

Table A-3
Highest Detected Analyte and PQL Concentrations in Sediment Samples

Analytical Method	Analyte	PCL	PCL Source	TBC	RBSL	Units	1986 USACE		1996 AGRA		1996 E&E		1997 E&E		1998 E&E	
							Result	[PQL]	Result	[PQL]	Result	[PQL]	Result	[PQL]	Result	[PQL]
SW6000/ 7000 Series	Aluminum	—	—	50	—	mg/kg	—	—	—	—	6250	—	—	—	—	—
	Arsenic	3.9	MTG	5.7	0.61	mg/kg	—	—	**7**	[1]	**5**	—	—	—	—	—
	Barium	1100	MTG	1.04	2,740	mg/kg	—	—	—	—	309	—	—	—	—	—
	Beryllium	42	MTG	1.06	27	mg/kg	—	—	—	—	0.22	—	—	—	—	—
	Calcium	—	—	—	—	mg/kg	—	—	—	—	2030	—	—	—	—	—
	Chromium	25	MTG	—	41	mg/kg	—	—	—	—	12.1	—	—	—	—	—
	Cobalt	—	—	0.14	—	mg/kg	—	—	—	—	8.7	—	—	—	—	—
	Copper	460	MTG	5.4	550	mg/kg	—	—	—	—	19.4	—	—	—	—	—
	Iron	—	—	200	—	mg/kg	—	—	—	—	18,800	—	—	—	—	—
	Lead	400	AZDC	0.0537	—	mg/kg	—	—	22	[20]	9.7	—	—	—	—	—
	Magnesium	—	—	—	—	mg/kg	—	—	—	—	3270	—	—	—	—	—
	Manganese	—	—	100	—	mg/kg	—	—	—	—	608	—	—	—	—	—
	Mercury	1.4	MTG	0.1	2.6	mg/kg	—	—	—	—	0.05	[0.02]	—	—	—	—
	Nickel	86	MTG	13.6	270	mg/kg	—	—	—	—	25	—	—	—	—	—
	Potassium	—	—	—	—	mg/kg	—	—	—	—	695	—	—	—	—	—
	Sodium	—	—	—	—	mg/kg	—	—	—	—	64.3	[95.4]	—	—	—	—
	Vanadium	960	AZDC	1.59	96	mg/kg	—	—	—	—	19.5	—	—	—	—	—
	Zinc	4100	MTG	6.62	4,110	mg/kg	—	—	—	—	164	—	—	—	—	—

Notes:

mg/kg milligrams per kilogram
PCL Potential cleanup level
TBC To Be Considered, non-promulgated advisories, guidance, or proposed standards
RBSL Risk-based screening level (Hazard Quotient = 0.1 or Cancer Risk = 10^{-6}) - more stringent of Direct Contact or Inhalation Pathways for the Arctic Zone
PQL practical quantitation limit (also known as reporting limit)
bold result or PQL exceeds the ARAR
shaded result exceeds the RBSL, and analyte is included in the CRE (Table 6-2)
— not applicable, analysis not performed, or ARAR/TBC/RBSL does not exist
AZDC 18 AAC 75.341 (April 2012) - Method Two Tables B1 and B2 Soil Cleanup Levels: Arctic Zone Direct Contact
MTG 18 AAC 75.341 (April 2012) - Method Two Tables B1 and B2 Soil Cleanup Levels: Migration to Groundwater
OFIG 18 AAC 75.341 (April 2012) - Method Two Tables B1 and B2 Soil Cleanup Levels: Over 40 Inch Zone, Ingestion
OFMTG 18 AAC 75.341 (April 2012) - Method Two Tables B1 and B2 Soil Cleanup Levels: Over 40 Inch Zone, Migration to Groundwater
Results and PQLs listed where available from tabulated results in historic remedial investigations; data flags not listed, see Appendix F tables for data flags.

Table A-4

Highest Detected Analyte and PQL Concentrations in Surface-Water Samples

Analytical Method	Analyte	PCL	PCL Source	TBC	RBSL	Units	1986 USACE		1996 AGRA		1996 E&E		1998 E&E		1999 E&E	
							Result	[PQL]	Result	[PQL]	Result	[PQL]	Result	[PQL]	Result	[PQL]
AK 102	Diesel range organics	1.5	C	—	—	mg/L			—	—	—	—	—	[0.12]	0.123	—
SW8080 Series	4,4'-DDT	1E-06	A	5E-07	0.00025	mg/L	**0.0003**	—	—	—	—	—	—	—	—	—
SW6000/ 7000 Series	Aluminum	0.087	A	0.087	—	mg/L			—	—	**0.136**	[0.0239]	—	—	—	—
	Barium	2	C	0.0039	0.2	mg/L			—	—	0.192	—	—	—	—	—
	Calcium	—	—	—	—	mg/L			—	—	20.6	—	—	—	—	—
	Iron	1	A	1	—	mg/L			—	—	0.39	[0.0053]	—	—	—	—
	Lead	0.001	A[4]	0.0025	—	mg/L			—	**[0.002]**	**0.003**	**[0.0028]**	—	—	—	—
	Magnesium	—	—	—	—	mg/L			—	—	8.2	—	—	—	—	—
	Manganese	0.05	A	0.08	—	mg/L			—	—	0.0355	—	—	—	—	—
	Potassium	—	—	373	—	mg/L			—	—	1.1	—	—	—	—	—
	Sodium	—	—	—	—	mg/L			—	—	1.93	—	—	—	—	—
	Zinc	0.07	A[4]	0.12	0.5	mg/L			—	—	0.0206	[0.0038]	—	—	—	—
SW8260	Acetone	33	C	1.5	3.3	mg/L			—	[0.02]	0.00135	[0.010]	—	[0.0050]	—	—
	Toluene	1	C	0.0098	0.1	mg/L			—	[0.001]	—	—	0.0010	[0.00013]	—	—

Notes:

mg/L	milligrams per liter
PCL	Potential cleanup level
TBC	To Be Considered, non-promulgated advisories, guidance, or proposed standards
A	ARAR - 18 AAC 70.020 - Alaska Water Quality Criteria Manual (December 2008) - Fresh Water, most stringent criteria
A4	18 AAC 70.020 - Alaska Water Quality Criteria Manual (December 2008) - Hardness Dependant Water Quality - Reference Appendix A
C	18 AAC 75.345 (April 2012) - Table C Groundwater Cleanup Levels
[4]	ARAR is hardness dependent; a hardness value of 50 mg/L was assumed for calculations.
PQL	practical quantitation limit (also known as reporting limit)
bold	result or PQL exceeds the ARAR
shaded	result exceeds the RBSL, and analyte is included in the CRE (Table 6-2)
—	not applicable, analysis not performed, or ARAR/TBC/RBSL does not exist
RBSL	Risk-based screening level (Hazard Quotient = 0.1 or Cancer Risk = 10^{-6}) - more stringent of Direct Contact or Inhalation Pathways for the Arctic Zone

Results and PQLs listed where available from tabulated results in historic remedial investigations; data flags not listed, see Appendix F tables for data flags.

Table A-5
Highest Detected Analyte and PQL Concentrations in Groundwater Samples

Analytical Method	Analyte	PCL	PCL Source	TBC	RBSL	Units	1996 E&E		1997 E&E		1998 E&E		1999 E&E	
							Result	[PQL]	Result	[PQL]	Result	[PQL]	Result	[PQL]
AK 101	Gasoline range organics	2.2	C	—	—	mg/L	0.761	[0.100]	—	—	—	—	—	—
AK 102	Diesel range organics	1.5	C	—	—	mg/L	**76.1**	—	0.73	[0.27]	0.15	[0.11]	0.107	[0.105]
SW8260	Acetone	33	C	—	3.3	mg/L	0.00183	—	—	—	—	—	—	—
	2-Butanone	22	C	6	2.2	mg/L	0.00612	—	—	—	—	—	—	—
SW8310	Anthracene	9.6	A	7E-07	1.1	mg/L	0.00110	—	—	—	—	—	—	—
	Fluorene	1.3	A	—	0.15	mg/L	0.00532	—	—	—	—	—	—	—
	Naphthalene	0.73	C	0.00001	0.073	mg/L	0.350	—	—	—	—	—	—	—
	Phenanthrene	11	C	0.000003	1.1	mg/L	0.00417	—	—	—	—	—	—	—
SW8080 Series	4,4'-DDD	0.0035	C	0.000004	0.00035	mg/L	**0.0173**	—	—	[0.0010]	—	**[0.0071]**	—	**[0.0530]**
	4,4'-DDT	0.000001	A	0.000004	0.00025	mg/L	**0.0311**	—	—	**[0.0010]**	—	**[0.0087]**	—	**[0.0530]**

Notes:

mg/L milligrams per liter
PCL Potential cleanup level
TBC To Be Considered, non-promulgated advisories, guidance, or proposed standards
A 18 AAC 70.020 - Alaska Water Quality Criteria Manual (December 2008) - Fresh Water, most stringent criteria
C 18 AAC 75.345 (April 2012) - Table C Groundwater Cleanup Levels
PQL practical quantitation limit (also known as reporting limit)
bold result or PQL exceeds the ARAR
shaded result exceeds the RBSL, and analyte is included in the CRE (Table 6-2)
— not applicable, analysis not performed, or ARAR/TBC/RBSL does not exist
RBSL Risk-based screening level (Hazard Quotient = 0.1 or Cancer Risk = 10^{-6}) - more stringent of Direct Contact or Inhalation Pathways for the Arctic Zone

Results and PQLs listed where available from tabulated results in historic remedial investigations; data flags not listed, see Appendix F tables for data flags.

Table A-6
Highest Detected Analyte and PQL Concentrations in Fish-Tissue Samples

Analytical Method	Analyte	RBSL	Source	Units	1997 E&E		1998 E&E	
					Result	[PQL]	Result	[PQL]
SW8080 Series	Aroclor 1254	0.218	F	µg/kg	**1400**	**[10]**	**870**	**[26]**
	Aroclor 1260	0.218	F	µg/kg	—	**[10]**	**190**	**[12]**
	4,4'-DDD	1.82	F	µg/kg	—	—	**480**	[0.57]
	4,4'-DDE	1.28	F	µg/kg	—	—	**740**	[0.75]
	4,4'-DDT	1.28	F	µg/kg	—	—	**79**	[0.06]
	2,4'-DDD	—	—	µg/kg	—	—	62	[0.11]
	2,4'-DDE	—	—	µg/kg	—	—	15	[0.05]
	Aroclor 1016/1242	0.218†	F	µg/kg	—	—	**6.1**	**[3.5]**

Notes:

µg/kg micrograms per kilogram
F EPA Region 3 Fish Tissue Risk-Based Screening Levels with a target hazard quotient of 0.1 and cancer risk of 1.0E-06, modified for site-specific consumption rates. See Table F-1c for a full list of assumptions.
PQL Practical Quantitation Limit
bold result or PQL exceeds the RBSL
shaded result exceeds the RBSL, and analyte is included in the CRE (Table 6-2)
— not applicable, analysis not performed, or RBSL does not exist
† more stringent RBSL of individual Aroclors listed

Results and PQLs listed where available from tabulated results in historic remedial investigations; data flags not listed, see Appendix F tables for data flags.

Table A-7
Cumulative Risk Evaluation

COPC	Highest Detected Site Concentration	RBC[2,6]	Units	Site Concentration/RBC	Risk at Site Concentration [3,4]
Carcinogens; Soil/Sediment; Direct contact pathway[1]					
Aroclor 1254	17.8	3.8	mg/kg	4.68E+00	4.7E-05
4,4'-DDT	38.2	29	mg/kg	1.32E+00	1.3E-05
4,4'-DDE	0.00062	29	mg/kg	2.14E-05	2.1E-10
4,4'-DDD	31.4	41	mg/kg	7.66E-01	7.7E-06
				Total	**6.8E-05**
Carcinogens; Soil/Sediment; Inhalation pathway[1]					
Aroclor 1254	17.8	25	mg/kg	7.12E-01	7.1E-06
4,4'-DDT	38.2	2200	mg/kg	1.74E-02	1.7E-07
Naphthalene	0.042	42	mg/kg	1.00E-03	1.0E-08
				Total	**7.3E-06**
Carcinogens; Groundwater/Surface Water[1]					
4,4'-DDT	0.0311	0.0025	mg/L	1.24E+01	1.2E-04
4,4'-DDD	0.0173	0.0035	mg/L	4.94E+00	4.9E-05
				Total	**1.7E-04**
Carcinogens; Fish Tissue[1]					
Aroclor 1254	1.4	0.00218	mg/kg	6.42E+02	6.4E-03
Aroclor 1260	0.19	0.00218	mg/kg	8.72E+01	8.7E-04
Aroclor 1016/1242[7]	0.0061	0.00218	mg/kg	2.80E+00	2.8E-05
4,4'-DDT	0.079	0.0128	mg/kg	6.17E+00	6.2E-05
4,4'-DDE	0.74	0.0128	mg/kg	5.78E+01	5.8E-04
4,4'-DDD	0.48	0.0182	mg/kg	2.64E+01	2.6E-04
				Total	**8.2E-03**
				Carcinogenic Cumulative Risk	**8E-03**

Table A-7
Cumulative Risk Evaluation

COPC	Highest Detected Site Concentration	RBC[2,6]	Units	Site Concentration/RBC	Risk at Site Concentration [3,4]
Non-carcinogens; Soil/Sediment; Direct contact pathway[1]					
4,4'-DDT	38.2	61	mg/kg	6.26E-01	6.3E-01
4,4'-DDD	31.4	240	mg/kg	1.31E-01	1.3E-01
Naphthalene	0.042	1900	mg/kg	2.21E-05	2.2E-05
				Total	**7.6E-01**
Non-carcinogens; Soil/Sediment; Inhalation pathway[1]					
Naphthalene	0.042	180	mg/kg	2.33E-04	2.3E-04
				Total	**2.3E-04**
Non-carcinogens; Groundwater/Surface Water[1]					
4,4'-DDT	0.0311	0.018	mg/L	1.73E+00	1.7E+00
4,4'-DDD	0.0173	0.073	mg/L	2.37E-01	2.4E-01
Naphthalene	0.350	0.73	mg/L	4.79E-01	4.8E-01
				Total	**2.4E+00**
Non-carcinogens; Fish Tissue[1]					
Aroclor 1254	1.4	3.74	mg/kg	3.74E-01	3.7E-01
Aroclor 1016/1242[7]	0.0061	13.1	mg/kg	4.66E-04	4.7E-04
4,4'-DDD	0.48	93.6	mg/kg	5.13E-03	5.1E-03
				Total	**3.8E-01**
				Non-carcinogenic Cumulative Risk	**3.6**

Notes:

[1] Methodology and risk-based concentration (RBC) followed Cumulative Risk Guidance (ADEC 2008)

[2] RBC is for Arctic Zone; data from Cumulative Risk Guidance (ADEC 2008)

[3] Risk at site concentration = (site concentration/RBC) x 10^{-5}

[4] Carcinogenic cumulative risk and cumulative Hazard Index are rounded to one significant figure; individual carcinogenic risks and hazard indices are rounded to two significant figures (ADEC 2008, page 11)

[5] HQ at site concentration = (site concentration/RBC) x 1

[6] RBC for more stringent Aroclor used for Aroclor 1016/1242

Abbreviations:

COPC	Contaminant of Potential Concern
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
HI	Hazard Index for noncarcinogenic risk
HQ	Hazard Quotient for noncarcinogenic risk
RBC	risk-based concentration

Conclusions:

- **Calculated carcinogenic cumulative risk exceeds screening criterion (1 x 10^{-5}) for soil.**
- **Calculated risk exceeds noncarcinogenic Hazard Index screening criterion (1) for soil.**

Note: In accordance with the ADEC Cumulative Risk Guidance (June 9, 2008), DRO and lead are not included in the CRE.

Table A-8
Summary of Contaminants of Potential Concern

Contaminant of Potential Concern	Affected media	Date and media of highest-concentration sample	Highest Concentration (No. of Samples Exceeding PCL or RBSL out of Total Samples*)	COPC Basis: PCL Exceeded	COPC Basis: Substantial contribution to cumulative risk
Diesel Range Organics	Soil & sediment	1996; SL	1,300 mg/kg (2/70)	✓	
	Surface water & groundwater	1996; GW	76.1 mg/L (2/46)	✓	
Naphthalene	Surface water & groundwater	1996; GW	0.350 mg/L (1/29)		✓
Methylene Chloride	Soil & sediment	1994; SL	0.019 mg/kg (1/58)	✓	
4,4'-DDD	Soil & sediment	1996; SL	31.4 mg/kg (2/81)	✓	✓
	Surface water & groundwater	1996; GW	0.0173 mg/L (1/51)	✓	✓
	Fish	1998; FT	0.480 mg/kg (8/29)		✓
4,4'-DDE	Fish	1998; FT	0.740 mg/kg (10/29)		✓
4,4'-DDT	Soil & sediment	1996; SL	38.2 mg/kg (2/81)	✓	✓
	Surface water & groundwater	1996; GW	0.0311 mg/L (3/51)	✓	
	Fish	1998; FT	0.079 mg/kg (7/29)		✓
Aroclor 1254	Soil & sediment	1996; SD	17.8 mg/kg (33/112)	✓	✓
	Fish	1997; FT	1.4 mg/kg (35/49)		✓
Aroclor 1260	Fish	1998; FT	0.190 mg/kg (22/49)		✓
Aroclor 1016/1242	Fish	1998; FT	0.0061 mg/kg (3/49)		✓
Lead	Soil & sediment	2001; SL	1,170 mg/kg (2/46)	✓	
	Surface water & groundwater	1996; SW	0.003 mg/L (2/12)	✓	

Notes:

Media considered affected where the COPC was detected above PCLs or RBSLs

mg/kg milligrams per kilogram
mg/L milligrams per liter
SL soil
SD sediment
SW surface water
GW groundwater
FT fish tissue
* Total number of samples analyzed for COPC; includes QA/QC duplicates/triplicates; does not include background samples

APPENDIX B

POTENTIAL ARARs

Table B-1
Potential Chemical-Specific Applicable or Relevant and Appropriate Requirements
Umiat Landfill, Alaska

Potential ARARs	Citation or Reference	Requirements	Applicability	Comments and Analysis/Rationale for Decision
Clean Air Act of 1963, as amended (42 USC 7401-7462)				
National Ambient Air Quality Standards (NAAQS)	40 Code of Federal Regulations (CFR) Part 50	Establishes primary and secondary NAAQS for ambient air quality to protect public health and welfare; focuses on sulfur dioxide, nitrogen oxide, carbon monoxide, ozone, lead, and particulate matter.	Potentially Applicable	Applicable to remedial actions because of the potential to impact ambient air quality.
Clean Water Act, as amended (33 USC Sect. 1251-1376)				
Effluent Limitations	40 CFR 301	Technology-based limitations for point source discharges to surface waters of conventional, nonconventional, and toxic pollutants.	Potentially Applicable	Pertains to any discharge permits in effect at waste disposal facilities. All wastes generated from removal actions will be disposed at appropriately licensed and permitted facilities. Applicable if water is treated on-site.
Water Quality Standards and Effluent Limitations	40 CFR 302	Protection of intended uses of receiving waters (e.g., public water supply, recreational uses).	Potentially Applicable	Pertains to any discharge permits in effect at waste disposal facilities. All wastes generated from removal actions will be disposed at appropriately licensed and permitted facilities. Applicable if water is treated on-site.
Toxic and Pretreatemtn Effluent Standards	40 CFR 307	Establishes list of toxic pollutants and promulgate pretreatment standards for publicly-owned treatment works (POTW) facility discharges.	Potentially Applicable	Pertains to any discharge permits in effect at waste disposal facilities. All wastes generated from removal actions will be disposed at appropriately licensed and permitted facilities.
National Pollutant Discharge Elimination System (NPDES) Permit Regulations	40 CFR 122, 125	Establishes permitting requirements, criterial, and standards for technology-based treatment requirements for effluent dischage and stormwater runoff.	Potentially Applicable	Pertains to any discharge permits in effect at waste disposal facilities. All wastes generated from removal actions will be disposed at appropriately licensed and permitted facilities. Remediation (construction) activities that disturb more than 1 acre are subject to storm water permits.
Water Quality Criteria	40 CFR Part 131 Quality Criteria for Water, 1976, 1980, 1986	Sets criteria for water quality based on toxicity to aquatic organisms and human health.	Potentially Applicable	Pertains to any discharge permits in effect at waste disposal facilities.
Deposit of Refuse in Navigable Waters	40 CFR, Section 407, 33 USC 1342	Solid debris cannon be placed intentionally or unintentionally into navagable water or into any tributary of any navigable water of the United States where navication shall or may be impeded or obstructed. Suck action is a violation os Section 407 of the Clean Water Act and may be cited under 33 USC 1342 by the U.S. Environmental Protection Agency.	Potentially Applicable	Debris at the Umiat Landfill is present in the floodplain of the Colville River.
Safe Drinking Water Act of 1974 (40 USC Sect. 300)				
National Primary Drinking Water Standards	40 CFR Part 141	Establishes health-based standards (maximum-contaminant levels [MCLs]), monitoring requirements, and treatment techniques for public water systems.	Potentially Applicable	MCLs were used to assess water quality from contaminatns of concern (COC) levels.
National Secondary Drinking Water Standards	40 CFR Part 143	Establishes aesthetic-based standards for public water systems.	Potentially Applicable	Surface water at some locations could potentially serve as drinking water sources.
Maximum Contaminant Level Goals (MCLGs)	40 CFR 141.50, 141.51, 141.52, 52	Establishes drinking water quality quals set at levels of no known or anticipated adverse health effects, with an adequate margin of safety.	Potentially Applicable	Surface water at some locations could potentially serve as drinking water sources.

Table B-1
Potential Chemical-Specific Applicable or Relevant and Appropriate Requirements
Umiat Landfill, Alaska

Potential ARARs	Citation or Reference	Requirements	Applicability	Comments and Analysis/Rationale for Decision
Toxic Substances Control Act				
Polychlorinated Biphenyl (PCB) Waste Removal	15 USC 2605	Applicable to the storage and disposal of PCB-contaminated material.	Potentially Applicable	No solid wastes/materials containing PCBs > 50 milligrams per kilogram have been identified at the Umiat Landfill; however, the contents of the landfill have not been completely characterized.
USEPA PCB Spill Cleanup Policy	40 CFR 761, Subpart G	Cleanup policy applies to intentional and accidental spills of materail containing at least 50 milligram per kilogram PCBs occuring after May 4, 1987. For spills prior to that date, cleanup levels are established on a case-by-case basis, using the PCB cleanup policy as guidelines.	Applicable	PCB spills being addressed occurred prior to May 4, 1987, but applicable as guidance.
PCB Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions	40 CFR 761	Contains parts addressing the storage and disposal of PCB remediation waste (subpart D) and cleanup site verification (subparts N and O).	Applicable	Applicable to sites that may generate PCB remediation waste.
Resource Conservation and Recovery Act of 1976, as amended by HSWA of 1984 (40 USC 6901)				
Identification and Listing of Hazardous Waste	40 CFR Part 261	Defines those solid wastes that are subject to regulation as hazardous waste under 40 CFR Parts 262-265 and Parts 124, 270, and 271.	Applicable	Applicable because removal activities may involve remote transport and disposal of wastes classifies as hazardous.
Resource Conservation and Recovery Act (RCRA) Standards	55 FR 30798	Standards for Solid Waste Management Units (SWMUs).	Relevant and Appropriate	Applicable if a removal alternative involves the use of SWMUs.
RCRA	40 CFR 268.35, 263	Standards for generators of Hazardous Waste and Land disposal restrictions for wastes with specific prohibitions.	Relevant and Appropriate	Applicable since removal activities may involve generation and disposal of wastes classified as hazardous.
Protection and Enhancement of Environmental Quality	Executive Order 11514	Requires federal agencies to demonstrate leadership in achieving the environmental quality goals of the National Environmental Policy Act; provides for consultation with federal, state, and local agencies.	Relevant and Appropriate	
Alaska State Regulations				
Alaska Hazardous Waste Management Regulations	18 AAC 62	Regulations of the federal government applicable to a transporter of hazardous waste, including standards for universal waste management, promulgated and published as 40 C.F.R. Part 263 and 40 C.F.R. 273.50 - 273.56, as revised as of July 1, 2002, are adopted by reference.	Applicable	Detail requirements and standards adopted by the State of Alaska for hazardous waste management, should this be required based on what is excavated.
Alaska Water Quality Standards	18 AAC 70.015	Specify the degree of degradation that may not be exceeded in a water body as a result of human action.		Regulates site discharges that have the potential to affect surface water. Discharges from a site cannot exceed AWQS. Regulations primarily address surface water. Provisions of 18 AAC 70 applicable to groundwater do not apply to cleanups approved by the Alaska Department of Environmental Conservation (ADEC) under 18 AAC 75. Also restricts discharge of dredged or fill materials onto wetlands.
Oil and Hazardous Substances Pollution Control Regulations	18 AAC 75	These regulations govern discharge of oil and hazardous substances and state necessary cleanup requirements.		The site is known to be affected by a release of petroleum hydrocarbon fuels or PCBs greater than 1 ppm.

Table B-1
Potential Chemical-Specific Applicable or Relevant and Appropriate Requirements
Umiat Landfill, Alaska

Potential ARARs	Citation or Reference	Requirements	Applicability	Comments and Analysis/Rationale for Decision
Oil and Hazardous Substances Pollution Control Regulations	18 AAC 75.300 - 18 AAC 75.396	Regulations establishing dischage reporting, cleanup, and disposal requirements for oil and other hazardous substances. Does not apply to discharges from underground storage tanks. Provides cleanup standards for soil and groundwater.	Applicable	These regulations provide cleanup standards for petroleum and other hazardous substances. These regulations are directly applicable for comparison of constituent concentrations with cleanup standards.
Oil and Hazardous Substances Pollution Control Regulations	18 AAC 75.340 - 345	Provides requirements for cleanup levels for hazardous substances in soil and groundwater.		Addressing site-specific cleanup levels.
Drinking Water Standards	18 AAC 80	Establishes maximum contaminant levels for public drinking water systems.	Potentially Applicable	Applicable if public drinking water system would be impaired or threatened by release or remedial action.

Table B-2
Potential Location-Specific Applicable or Relevant and Appropriate Requirements
Umiat Landfill, Alaska

Potential ARARs	Citation or Reference	Requirements	Applicability	Comments and Analysis/Rationale for Decision
Endangered Species Act of 1973	16 USC 1531 et seq. 50 CFR 402, 50 CFR Part 200, 50 CFR Part 402	Establishes requirements to protect species threatened by extinction and habitats critical to their survival.	Potentially Applicable	Applicable if endangered, threatened, and/or species of special concern are present on-site.
Resource Conservation and Recovery Act Standards for Owneers and Operators of Hazardous Waste Treatment, Storage, or Disposal (TSD) Facilities	40 CFR 264.18	Establishes location standards including seismic considerations and floodplain requirements. TSD cannot be within 200 ft of a fault displaced in Holocene time. Design/construction requirements apply if located in 100-year floodplain.	Potentially Applicable	Pertains to locations of any remote waste disposal facilities. All wastes generated from this removal action will be disposed at appropriately licensed and permitted facilities.
The Migratory Bird Treaty Act	16 USC 703	Law make is unlawful to take, kill, or possess any migratory bird or any part, nest, or eggs of any such bird.	Potentially Applicable	There are known areas on the North Slope suitable for visitation by migatory birds. It is possible migratory birds visit the Umiat Landfill site.
Protection of Wetlands	Executive Order 11990. 40 CFR 6, Appendix A. CWA Section 404, 40 CFR Parts 230 and 231.	requires minimization of destruction, loss, or degredation of wetlands. Prohibits discharge of dredged or fill material into wetlands without a permit.	Potentially Applicable	Wetlands may be adjacent to portions of the site.
Protection of Floodplains	Executive Order 11988; 40 CFR 6, Appendix A	Establishes federal policy and guidance for activities completed in floodplains. Requires measures to avoid adverse effects and preserve natural and beneficial values.	Relevant and Appropriate	Applicable if removal activities result in a disturbance to a 100-year floodplain.
Coastal Zone Management Act	16 USC 3501 et seq.	Conduct activities in a manner consistent with approved state management programs for coastal zones.	Potentially Applicable	Applicable to activities affecting the coastal zone including lands therein and thereunder and adjacent shorelines.
Marine Mammal Protection Act	16 USC 1361-1421h. Implementing regulations 50 CFR, Parts 13, 18, 216, and 229	Provides for the protection and management of marine mammals and their products. Includes walruses, polar bears, sea otters, whales, porpoises, seals, and sea lions. Primary authorities are the U.S. Fish and Wildlife Service and the National Marine Fisheries Service.	Applicable	Removal actions cannot impair protected species.
Wildlife Refuge Protection	16 USC 668dd et seq.	Only actions allowed under the provisions of 16 USC 668dd[c] may be undertaken in areas that are part of the National Wildlife Refuge System.	Potentially Applicable	The Umiat Landfill is within the Artic National Wildlife Refuge.
Fish and Wildlife Coordination Act	16 USC 661-666, 40 CFR 6 302	Requires consultation when a federal department or agency proposes or authroizes any modifcation of any stream or other water body; requires adequate provisions for protection of fish and wildlife resources.	Potentially Applicable	May be applicable during removal actions.

Table B-2
Potential Location-Specific Applicable or Relevant and Appropriate Requirements
Umiat Landfill, Alaska

Potential ARARs	Citation or Reference	Requirements	Applicability	Comments and Analysis/Rationale for Decision
Alaska State Regulations				
Historic, Prehistoric, and Archeological Resources	11 AAC 16	State regulations providing for the protection of archaeological resources on federal and Indian lands. Requires actions to recover and preserve artifacts if threatened by remedial action.		Applicable during any ground-disturbing activities at the site. Presence of burial sites near the project area indicates the potential for discovery of archaeological resources. If artifacts are encountered, work will cease and local tribes and the State Historic Preservation Officer (SHPO) will be contacted.
ADEC Solid Waste Regulations	18 AAC 60	Standards and requirements for solid waste management and landfill construction; each type of waste must be placed in a landfill that meets the standards for that type of waste.	Applicable	Applicable if solid waste from the site is disposed on-site, at the installation, or at an off-site landfill in Alaska.
Solid Waste Management Regulations	18 AAC 60.200 - 270	Provides regulations governing the permitting and location of landfills.	Potentially Applicable	A landfill is proposed for disposal of solid waste, and potentially contaminated material.
Alaska Siting of Hazardous Waste Management Facilities Regulations	18 AAC 63	Permitting requirement for any hazardous waste land facility, including injection well, PCB incinerator, and chemical waste landfill.	Potentially Applicable	Detail requirements and standards adopted by the State of Alaska for hazardous waste management.
Alaska Water Quality Standards	18 AAC 70	Regulates activities in waters of the United States.	Applicable	Considered for impacts to wetlands in sites which are adjacent to or inclusive of wetlands.
Oil and Hazardous Substances Pollution Control Regulations	18 AAC 75.370	Established specific soil management, separation distances, and storage requirements and timelines for contaminated soil.	Applicable	Required if treatment is proposed.

APPENDIX C

REMEDIAL ALTERNATIVE COST ANALYSIS

Table C-1
Umiat Site
Alternative 2 - Land Use Controls

Institutional Controls Plan	$25,000
Agency Coordination	$7,500
Administrative Restrictions	$7,500
Sign Installation:	
Camp Rental	$54,950
Pickup	$980
Labor	$10,000
Equipment	$7,500
Materials	$2,500
Charter Flight	$19,000
Public Notification and Education	$10,000
TOTAL	**$144,930**

Periodic Costs			
Five-Year Site Reviews (30-year term)	$50,000	per event	
Number of five-year site reviews	6		
Assumed annual interest rate	7%		
PERIODIC COST SUBTOTAL, PRESENT WORTH			**$238,327**

TOTAL ESTIMATED PROBABLE COST OF ALTERNATIVE 2 **$383,257**

Table C-2
Umiat Site
Alternative 3 - Land Use Controls and Hot Spot Sediment Removal

Mobilization		**Cost**	**Quantity**	**Unit**	**Extended Price**		
Trail Establishment (2P to Umiat)	$	68,600	1	EA	$ 68,600		
Site Equipment/Materials	$	12,000	20	EA	$ 240,000		
Personnel (charter flights w/ RAVN)	$	18,500	1	EA	$ 18,500		
					Subtotal	$	327,100
Processing Pad Construction		**Cost**	**Quantity**	**Unit**	**Extended Price**		
Gravel (75,000 CY)*	$	28,603,500	1	EA	$ 28,603,500		
Labor	$	85,944	1	EA	$ 85,944		
Equipment	$	32,240	1	EA	$ 32,240		
Liner (3 layers)	$	1.95	750000	SF	$ 1,462,500		
Timbers	$	125	100	EA	$ 12,500		
					Subtotal	$	30,196,684
Excavation							
Labor		**Cost**	**Quantity**	**Days**	**Extended Price**		
Driver	$	95	6	8	$ 54,720		
Laborer	$	86	4	12	$ 49,536		
Operator (loader)	$	103	4	12	$ 59,328		
Operator (excavation)	$	103	2	8	$ 19,776		
					Subtotal	$	183,360
Equipment							
Rock Truck	$	1,752	3	8	$ 42,048		
Excavator	$	4,440	1	8	$ 35,520		
Loader	$	1,140	2	12	$ 27,360		
					Subtotal	$	104,928
Materials and Supplies		**Cost**	**Quantity**	**Unit**	**Extended Price**		
Diesel	$	4.50	25,000	Gallons	$ 112,500		
PPE	$	1,000	12	days	$ 12,000		
Supersacking/Geotube Hoppers	$	3,000	4	EA	$ 12,000		
Sandbags	$	0.35	20,000	EA	$ 7,000		
Geotube	$	600	500	EA	$ 300,000		
					Subtotal	$	443,500
Signage Installation							
Labor	$	10,000	1	EA	$ 10,000		
Equipment	$	7,500	1	EA	$ 7,500		
Materials	$	2,500	1	EA	$ 2,500		
					Subtotal	$	20,000

Table C-2
Umiat Site
Alternative 3 - Land Use Controls and Hot Spot Sediment Removal

General Site Wide Equipment		**Cost**	**Quantity**	**Days**	**Extended Price**			
Camp Rental	$	7,850	1	32	$	251,200		
Contractor Supervisor	$	110	2	32	$	84,480		
Heater	$	450	3	22	$	29,700		
Light Plant	$	175	4	22	$	15,400		
Charter Flight	$	13,500	5	1	$	67,500		
Pickup	$	140	3	32	$	13,440		
Job Trailer	$	200	1	22	$	4,400		
						Subtotal	$	466,120
Oversummer Work								
		Cost	**Quantity**	**Days**	**Extended Price**			
Laborer	$	86	2	14	$	28,896		
Operator	$	103	1	14	$	17,304		
Charter Flight	$	9,500	1	7	$	66,500		
				Months				
Loader (monthly rental)	$	20,520	1	7	$	143,640		
Pickup (monthly rental)	$	2,520	1	7	$	17,640		
						Subtotal	$	273,980
Waste Load-out and Disposal								
Labor		**Cost**	**Quantity**	**Days**	**Extended Price**			
Driver	$	95	2	21	$	47,880		
Operator (Loader)	$	103	4	21	$	103,824		
Crane Operator	$	106	4	21	$	106,848		
Laborer	$	86	12	21	$	260,064		
Equipment								
Loader	$	1,140	2	21	$	47,880		
Umiat to 2P (per trip)	$	12,000	100		$	1,200,000		
Tractor/Trailer	$	1,620	1	21	$	34,020		
Crane	$	2,100	2	21	$	88,200		
						Subtotal	$	1,888,716
Disposal		**Cost**	**Quantity**	**Unit**	**Extended Price**			
Open Top Container Rental	$	12	170	61	$	119,255		
Nonhazardous Waste - From Deadhorse to TSDF - In Open Tops	$	13,775	170	EA Container	$	2,341,750		
Contaminated Soils	$	73	8000	Tons	$	580,000		
Prepare and Submit Complete Manifest Packages	$	55	170	EA Container	$	9,350		
Prepare and Submit Profiles	$	125	17	EA Group	$	2,125		
						Subtotal	$	3,052,480
Demobilization		**Cost**	**Quantity**	**Unit**	**Extended Price**			
Site Equipment/Materials	$	12,000	20	EA	$	240,000		
Personnel (charter flights w/ RAVN)	$	18,500	1	EA	$	18,500		
						Subtotal	$	258,500

Table C-2

Umiat Site

Alternative 3 - Land Use Controls and Hot Spot Sediment Removal

Subtotal	**$**	**37,215,368**

Project Management (10 percent)	$3,721,537
Remedial Design (12 percent)	$4,465,844
Construction Management (15 percent)	$5,582,305
Design Contingency (15 percent)	$5,582,305
Bid Contingency (25 percent)	$9,303,842
5-year Reviews	$238,327
Minor Site Maintenance	$50,000
TOTAL ESTIMATED PROBABLE COST OF ALTERNATIVE 3	**$66,159,528**

* See text for detail on gravel extraction and placement

Table C-3
Umiat Site
Alternative 4 - Containment and Capping

Mobilization		**Cost**	**Quantity**	**Unit**		**Extended Price**		
Trail Establishment (2P to Umiat)	$	68,600	1	EA	$	68,600		
Site Equipment/Materials	$	12,000	100	Trip	$	1,200,000		
Personnel (charter flights w/ RAVN)	$	18,500	8	EA	$	148,000		
						Subtotal	$	1,416,600
Slough Blocks								
Labor		**Hourly**	**Qty.**	**Hours**		**Extended Price**		
Supervisor	$	110	1	495	$	54,450		
Dozer Op.	$	103	4	1716	$	176,748		
Excavator Operator	$	103	2	858	$	88,374		
Loader Operator	$	103	4	1716	$	176,748		
Driver Truck	$	95	10	4290	$	407,550		
Trimmer Op.	$	103	2	858	$	88,374		
Laborer	$	86	1	429	$	36,894		
						Subtotal	$	1,029,138
Equipment		**Day Rate**	**Qty.**	**Days**		**Extended Price**		
Pickup	$	140	3	33	$	13,860		
Dozer	$	2,976	2	33	$	196,416		
Excavator	$	4,440	1	33	$	146,520		
Loader	$	1,140	2	33	$	75,240		
Rock Truck	$	1,752	5	33	$	289,080		
Trimmer	$	3,240	1	33	$	106,920		
Heater	$	450	3	33	$	44,550		
Light Plant	$	175	4	33	$	23,100		
Changeout Van	$	280	2	33	$	18,480		
						Subtotal	$	914,166
Materials & Supplies		**Cost**	**Qty.**	**Unit**		**Extended**		
Gravel (195,000 CY)*	$	56,062,860	1	EA	$	56,062,860		
Diesel Fuel	$	4.50	50000.00	gallons	$	225,000		
						Subtotal	$	56,287,860
Vertical Barrier Installation								
Labor		**Hrly Rate**	**Qty.**	**Hours**		**Extended Price**		
Drill Operator	$	103	2	2304	$	237,312		
Laborer (Driller Helper)	$	86	4	4608	$	396,288		
Loader Operator	$	103	2	1824	$	187,872		
Laborer (Rebar Cage Setting)	$	86	5	4560	$	392,160		
Laborer (Grout/ Slurry)	$	86	6	3888	$	334,368		
						Subtotal	$	1,548,000

Table C-3
Umiat Site
Alternative 4 - Containment and Capping

Equipment		**Rate**	**Qty.**	**Unit of Measure**		**Extended Price**		
Ice Road & Working Surface								
Ice Road	$	70,000	1	Mile	$	70,000		
Ice Pad	$	20,000	8	Acre	$	160,000		
Maintenance	$	10,000	60	Day	$	600,000		
						Subtotal	$	830,000
VSM Installation		**Day Rate**	**Qty.**	**Days**		**Extended Price**		
Rotary Drill	$	4,620	1	124	$	572,880		
Pickup	$	140	4	124	$	69,440		
Loader	$	1,140	2	124	$	282,720		
Heaters	$	450	2	124	$	111,600		
Light Plants	$	175	2	124	$	43,400		
Skid Steer	$	780	1	124	$	96,720		
Job Trailer	$	200	1	124	$	24,800		
Grout Pump	$	1,050	1	124	$	130,200		
Water Truck	$	1,296	1	124	$	160,704		
Boiler Unit	$	475	1	124	$	58,900		
						Subtotal	$	1,551,364

Materials & Supplies		**Quantity**		**Cost Each**		**Extended Price**		
Diesel Fuel	$	40,000	$	4.50	$	180,000		
Grout	$	2,795	$	165.00	$	461,175		
Rebar Cages	$	1,560	$	257.00	$	400,920		
Orange Safety Fencing	$	2,500	$	12.00	$	30,000		
Trucking & Transport of Rebar	$	8	$	5,000.00	$	40,000		
						Subtotal	$	1,112,095

Cap Placement (Geotextile, cap, errosion blanket)

Labor		**Hrly Rate**	**Qty.**	**Hours**		**Extended Price**
Supervisor	$	110	1	180	$	19,800
Blade Operator	$	103	2	282	$	29,046
Excavator Operator	$	103	2	282	$	29,046
Loader Operator	$	103	4	624	$	64,272
Rock Truck Driver	$	95	10	910	$	86,450
Laborer	$	86	6	676	$	58,136

Table C-3
Umiat Site
Alternative 4 - Containment and Capping

Equipment		Day Rate	Qty.	Days		Extended Price		
Pickup	$	140	6	12	$	10,080		
Dozer	$	1,560	1	7	$	10,920		
Excavator	$	4,440	1	7	$	31,080		
Loader	$	1,140	2	12	$	27,360		
Rock Truck	$	1,752	5	7	$	61,320		
Heater	$	450	3	12	$	16,200		
Light Plant	$	175	4	12	$	8,400		
Changeout Van	$	280	2	12	$	6,720		
						Subtotal	$	458,830
Materials & Supplies		**Cost**	**Quantity**	**Unit**		**Extended Price**		
Diesel Fuel	$	4.50	25000	gallons	$	112,500		
Geotextile (sf)	$	1.95	348480	sf	$	679,536		
Geotextile (roll)	$	616.59	78	roll	$	48,094		
Erosion geoweb (roll)	$	147.27	388	roll	$	57,141		
Geo Fabric Staples	$	85.27	66	ea	$	5,628		
Geofabric Trucking	$	5,250	25	ea	$	131,250		
Fencning Trucking	$	5,250	3	ea	$	15,750		
Coconut Errosion Matting Trucking	$	5,250	5	ea	$	26,250		
						Subtotal	$	1,076,149
Signage Installation								
Labor	$	10,000	1	EA	$	10,000		
Equipment	$	7,500	1	EA	$	7,500		
Materials	$	2,500	1	EA	$	2,500		
						Subtotal	$	20,000
General Site Wide Equipment		**Cost**	**Quantity**	**Days**		**Extended Price**		
Camp Rental	$	7,850	1	175	$	1,373,750		
Charter Flight	$	13,500	12	1	$	162,000		
Miscellaneous Supplies (Mechanical, trimmer teeth, comms)	$	250,000	1	1	$	250,000		
10K gallon Fuel Tank	$	5,400	4	4	$	86,400		
Job Trailer	$	3,600	1	4	$	14,400		
Envirovac	$	6,750	2	4	$	54,000		
Mechanic Truck	$	10,000	1	4	$	40,000		
Fuel Truck	$	15,000	1	4	$	60,000		
Welding Truck	$	15,000	1	4	$	60,000		
						Subtotal	$	2,100,550

Table C-3
Umiat Site
Alternative 4 - Containment and Capping

Demobilization		Cost	Quantity	Unit		Extended Price		
Trail Establishment (2P to Umiat)	$	68,600	1	EA	$	68,600		
Site Equipment/Materials	$	15,000	75	Trips	$	1,125,000		
Personnel (charter flights w/ RAVN)	$	18,500	3	EA	$	55,500		
						Subtotal	$	1,249,100
						Subtotal	**$**	**69,593,852**

Project Management (10 percent)	$6,959,385
Remedial Design (12 percent)	$8,351,262
Construction Management (15 percent)	$10,439,078
Design Contingency (15 percent)	$10,439,078
Bid Contingency (25 percent)	$17,398,463
5-year Reviews	$238,327
Minor Site Maintenance/Repairs	$500,000
TOTAL ESTIMATED PROBABLE COST OF ALTERNATIVE 4	**$123,919,444**

* See text for detail on gravel extraction and placement

Table C-4
Umiat Landfill
Alternative 5 - Excavation and On-Site Disposal

Mobilization		**Cost**	**Quantity**	**Unit**	**Extended Price**			
Trail Establishment (2P to Umiat)	$	68,600	1	EA	$	68,600		
Site Equipment/Materials	$	12,000	60	Load	$	720,000		
Personnel (charter flights w/ RAVN)	$	18,500	2		$	37,000		
						Subtotal	$	825,600
Excavation of Landfill		**Rate**	**Quantity**	**Days**	**Extended Price**			
Labor								
Operator (Excavator)	$	103	6	36	$	266,976		
Operator (Loader)	$	103	4	36	$	177,984		
Driver	$	95	6	36	$	246,240		
Laborer	$	86	8	36	$	297,216		
Equipment								
Excavator	$	4,440	3	36	$	479,520		
Rock Truck	$	1,752	3	36	$	189,216		
Loader	$	1,140	2	36	$	82,080		
						Subtotal	$	1,739,232
Backfill of Landfill		**Rate**	**Quantity**	**Days**	**Extended Price**			
Labor								
Operator (Loader)	$	103	2	19	$	46,968		
Operator (Dozer)	$	103	6	8	$	59,328		
Driver	$	95	8	19	$	173,280		
Equipment					$	-		
Rock Truck	$	1,752	4	19	$	133,152		
Loader	$	1,140	1	19	$	21,660		
D8 Dozer	$	2,976	3	8	$	71,424		
						Subtotal	$	505,812
Processing Pad Construction		**Rate**	**Quantity**	**Unit**	**Extended Price**			
Labor	$	85,944	1	EA	$	85,944		
Liner (3 layers)	$	1.95	750000	SF	$	1,462,500		
Timbers	$	125	100	EA	$	12,500		
Duration to Construct- 7 days						**Subtotal**	$	1,560,944
Debris Processing		**Rate**	**Quantity**	**Days**	**Extended Price**			
Labor								
Laborer	$	86	8	75	$	619,200		
Driver	$	95	4	75	$	342,000		
Operator	$	103	8	75	$	741,600		

Table C-4
Umiat Landfill
Alternative 5 - Excavation and On-Site Disposal

Equipment		Rate	Quantity	Days		Extended Price		
Water Truck	$	1,296	2	75	$	194,400		
Loader	$	1,140	4	75	$	342,000		
Rock Truck	$	1,752	2	75	$	262,800		
						Subtotal	$	2,502,000
Sediment Excavation		**Rate**	**Quantity**	**Days**		**Extended Price**		
Labor								
Driver	$	95	6	8	$	54,720		
Laborer	$	86	8	12	$	99,072		
Operator (loader)	$	103	4	12	$	59,328		
Operator (excavation)	$	103	2	8	$	19,776		
Equipment								
Rock Truck	$	1,752	3	8	$	42,048		
Excavator	$	4,441	1	8	$	35,528		
Loader	$	1,140	2	12	$	27,360		
						Subtotal	$	232,896
Containment Cell Construction		**Rate**	**Quantity**	**Unit**		**Extended Price**		
Labor	$	242,000	1	EA	$	242,000		
Materials	$	5,100,000	1	EA	$	5,100,000		
**Duration - 7 days to construct, 21 days to cap*						**Subtotal**	$	5,342,000
Materials and Supplies		**Cost**	**Quantity**	**Unit**		**Extended Price**		
Gravel (230,000 CY)*	$	64,071,840	1	EA	$	64,071,840		
Diesel	$	4.50	40000	gallons	$	180,000		
PPE	$	1,000	180	days	$	180,000		
Supersacking/Geotube Hoppers	$	3,000	4	EA	$	12,000		
Sandbags	$	0.35	20000	EA	$	7,000		
Geotube	$	600	500	EA	$	300,000		
						Subtotal	$	64,750,840

Table C-4
Umiat Landfill
Alternative 5 - Excavation and On-Site Disposal

Equipment	**Cost**	**Quantity**	**Months**	**Extended Price**		
Excavator	$ 70,000	3	9	$ 1,890,000		
Loader	$ 15,000	6	9	$ 810,000		
Dozer	$ 50,000	3	9	$ 1,350,000		
Rock Truck	$ 25,000	5	9	$ 1,125,000		
Water Truck	$ 20,000	2	9	$ 360,000		
Trimmer	$ 50,000	1	9	$ 450,000		
Pickup	$ 2,000	4	9	$ 72,000		
Heater	$ 5,000	4	9	$ 180,000		
Light Plant	$ 3,150	6	9	$ 170,100		
Fuel Truck	$ 15,000	1	9	$ 135,000		
Fuel Tank	$ 5,400	4	9	$ 194,400		
Job Trailer	$ 3,600	1	9	$ 32,400		
Van	$ 5,000	2	9	$ 90,000		
Porto-Potty	$ 6,750	2	9	$ 121,500		
				Subtotal	$	6,980,400
Housing/Personnel	**Cost**	**Quantity**	**Days**	**Extended Price**		
Contractor Supervisor	$ 110	2	180	$ 475,200		
Camp Rental	$ 7,850	1	180	$ 1,413,000		
Charter Flight	$ 13,500	24	1	$ 324,000		
				Subtotal	$	2,212,200
Demobilization	**Cost**	**Quantity**	**Unit**	**Extended Price**		
Trail Establishment (2P to Umiat)	$ 68,600	1	EA	$ 68,600		
Site Equipment/Materials	$ 12,000	50	Load	$ 600,000		
Personnel (charter flights w/ RAVN)	$ 18,500	2	EA	$ 37,000		
				Subtotal	$	705,600
				Subtotal	**$**	**87,357,524**

Project Management (10 percent)	$8,735,752
Remedial Design (12 percent)	$10,482,903
Construction Management (15 percent)	$13,103,629
Design Contingency (15 percent)	$13,103,629
Bid Contingency (25 percent)	$21,839,381
5-year Reviews	$238,327
Minor Site Maintenance/Repairs	$500,000
TOTAL ESTIMATED PROBABLE COST OF ALTERNATIVE 5	**$155,361,144**

* See text for detail on gravel extraction and placement

Table C-5
Umiat Landfill
Alternative 6 - Excavation and Off-Site Disposal

Mobilization	**Cost**	**Quantity**	**Unit**	**Extended Price**	
Trail Establishment (2P to Umiat)	$ 68,600	1	EA	$ 68,600	
Site Equipment/Materials	$ 12,000	85	Load	$ 1,020,000	
Personnel (charter flights w/ RAVN)	$ 18,500	2	EA	$ 37,000	
18 days total duration				**Subtotal**	$ 1,125,600
Ice Road Construction	**Cost**	**Quantity**	**Unit**	**Subtotal**	
Mobilization/Demobilization	$ 1,100,000	1	EA	$ 1,100,000	
Ice Road Construction	$ 70,000	89	Mile	$ 6,230,000	
River Crossing Consturction	$ 100,000	4	EA	$ 400,000	
Ice Pad Construction	$ 20,000	6	Acre	$ 120,000	
Maintenance	$ 30,000	90	Days	$ 2,700,000	
				Subtotal	$ 10,550,000
Excavation of Landfill	**Rate**	**Quantity**	**Days**	**Extended Price**	
Labor					
Operator (Excavator)	$ 103	6	50	$ 370,800	
Operator (Loader)	$ 103	4	50	$ 247,200	
Driver	$ 95	6	50	$ 342,000	
Laborer	$ 86	12	50	$ 619,200	
Equipment					
Excavator	$ 4,440	3	50	$ 666,000	
Rock Truck	$ 1,752	3	50	$ 262,800	
Loader	$ 1,140	2	50	$ 114,000	
				Subtotal	$ 2,622,000
Backfill of Landfill	**Rate**	**Quantity**	**Days**	**Extended Price**	
Labor					
Operator (Loader)	$ 103	8	26	$ 21,424	
Operator (Dozer)	$ 103	6	11	$ 6,798	
Driver	$ 95	8	26	$ 19,760	
Equipment					
Rock Truck	$ 1,752	4	26	$ 182,208	
Loader	$ 1,140	4	26	$ 118,560	
D8 Dozer	$ 2,976	3	11	$ 98,208	
				Subtotal	$ 446,958
Processing Pad Construction	**Cost**	**Quantity**	**Days**	**Extended Price**	
Labor	$ 85,944	1	EA	$ 85,944	
Materials	$ 1,475,000	1	EA	$ 1,475,000	
Duration to Construct- 7 days				**Subtotal**	$ 1,560,944

Table C-5
Umiat Landfill
Alternative 6 - Excavation and Off-Site Disposal

Debris Processing		**Rate**	**Quantity**	**Days**		**Extended Price**		
Labor								
Laborer	$	86	4	75	$	25,800		
Driver	$	95	2	75	$	14,250		
Operator	$	103	8	75	$	61,800		
Driver	$	95	4	75	$	28,500		
Equipment								
Pickup	$	140	1	75	$	10,500		
Water Truck	$	1,296	1	75	$	97,200		
Loader	$	1,140	4	75	$	342,000		
Rock Truck	$	1,752	2	75	$	262,800		
						Subtotal	$	842,850

Sediment Excavation		**Rate**	**Quantity**	**Days**		**Extended Price**		
Labor								
Driver	$	95	6	8	$	54,720		
Laborer	$	86	8	12	$	99,072		
Operator (loader)	$	103	4	12	$	59,328		
Operator (excavation)	$	103	2	8	$	19,776		
Equipment								
Rock Truck	$	1,752	3	8				
Excavator	$	4,440	1	8	$	35,520		
Loader	$	1,140	2	12	$	27,360		
Pickup	$	140	1	12	$	1,680		
						Subtotal	$	297,456

Supersacking		**Rate**	**Quantity**	**Days**		**Extended Price**		
Labor								
Operator	$	103	6	107	$	793,512		
Operator (loader)	$	103	6	107	$	793,512		
Laborer	$	86	18	107	$	1,987,632		
Equipment								
Excavator	$	4,440	3	107	$	1,425,240		
Loader	$	1,142	3	107	$	366,582		
						Subtotal	$	5,366,478

Materials and Supplies		**Rate**	**Quantity**	**Units**		**Extended Price**
Gravel (295,000 CY)*	$	78,945,660	1	EA	$	78,945,660
Diesel	$	4.50	350000	gallons	$	1,575,000
PPE	$	1,000	250	days	$	250,000
Geotextile	$	1.95	300000	sf	$	585,000
Supersacks (8cy, zip top, double walled)	$	500	14000	ea	$	7,000,000
Supersacking Hoppers	$	3,000	4	ea	$	12,000
Lifting Frames	$	5,000	4	ea	$	20,000

Table C-5
Umiat Landfill
Alternative 6 - Excavation and Off-Site Disposal

Sandbags	$	0.35	20000	ea	$	7,000		
Geotube	$	600	500	ea	$	300,000		
						Subtotal	$	88,694,660
Housing/Personnel		**Cost**	**Quantity**	**Days**		**Extended Price**		
Contractor Supervisor	$	110	2	250	$	660,000		
Camp Rental	$	7,850	1	250	$	1,962,500		
Charter Flight	$	13,500	36	1	$	486,000		
						Subtotal	$	3,108,500
Equipment	**Cost**		**Quantity**	**Months**		**Extended Price**		
Excavator	$	70,000	3	9	$	1,890,000		
Loader	$	15,000	10	9	$	1,350,000		
Dozer	$	50,000	3	9	$	1,350,000		
Rock Truck	$	25,000	5	9	$	1,125,000		
Water Truck	$	20,000	2	9	$	360,000		
Pickup	$	2,000	4	9	$	72,000		
Heater	$	5,000	4	9	$	180,000		
Light Plant	$	3,150	6	9	$	170,100		
Fuel Truck	$	15,000	1	9	$	135,000		
Fuel Tank	$	5,400	4	9	$	194,400		
Job Trailer	$	3,600	1	9	$	32,400		
Van	$	5,000	2	9	$	90,000		
Porto-Potty	$	6,750	2	9	$	121,500		
						Subtotal	$	7,070,400
Waste Loadout		**Cost**	**Quantity**	**Days**		**Extended Price**		
Labor								
Driver (Geotubes)	$	95	10	9	$	102,600		
Driver (Supersacks)	$	95	40	88	$	4,012,800		
Driver (Maxis)	$	95	20	60	$	1,368,000		
Operator (Loader)	$	103	4	88	$	435,072		
Crane Operator	$	106	4	9	$	45,792		
Laborer	$	86	12	88	$	1,089,792		
Equipment								
Loader	$	1,140	2	88	$	200,640		
Tractor/Trailer (Geotube)	$	1,620	5	9	$	72,900		
Crane	$	2,100	2	9	$	37,800		
Tractor/Trailer (Supersacks)	$	1,620	20	88	$	2,851,200		
Maxi Haul - Double (Metal Debris)	$	2,676	10	60	$	1,605,600		
						Subtotal	$	11,822,196

Table C-5
Umiat Landfill
Alternative 6 - Excavation and Off-Site Disposal

Disposal		**Cost**	**Quantity**	**Units**	**Extended Price**			
NSB Landfill (Debris)	$	21	120000	CY	$	2,520,000		
Open Top Container Rental	$	11.50	170	60	$	117,300		
Nonhazardous Waste - From Deadhorse to TSDF - In Open Tops	$	13,775	167	EA Container	$	2,300,425		
Nonhazardous Waste - From Deadhose to TSDF - In Bags	$	11,942	3500	Load	$	41,797,000		
Contaminated Soils	$	72.50	368000	Tons	$	26,680,000		
Prepare and Submit Complete Manifest Packages	$	55	3670	EA Container	$	201,850		
Prepare and Submit Profiles	$	125	1417	EA Group	$	177,125		
						Subtotal	$	73,793,700
Demobilization		**Cost**	**Quantity**	**Unit**	**Extended Price**			
Site Equipment/Materials	$	10,000	75	Load	$	750,000		
						Subtotal	$	750,000
						Subtotal	**$**	**208,051,742**

Project Management (10 percent)	$20,805,174
Remedial Design (12 percent)	$24,966,209
Construction Management (15 percent)	$31,207,761
Design Contingency (15 percent)	$31,207,761
Bid Contingency (25 percent)	$52,012,936
TOTAL ESTIMATED PROBABLE COST OF ALTERNATIVE 6	**$368,251,583**

* See text for detail on gravel extraction and placement

Table C-6
Umiat Landfill
Alternative 7 - Excavation, On-Site Disposal of Clean Material,
Off-Site Disposal of Contaminated Material

Mobilization		**Cost**	**Quantity**	**Unit**		**Extended Price**		
Trail Establishment (2P to Umiat)	$	68,600	1	EA	$	68,600		
Site Equipment/Materials	$	12,000	85	Load	$	1,020,000		
Personnel (charter flights w/ RAVN)	$	18,500	2	Load	$	37,000		
						Subtotal	$	1,125,600
Ice Road Construction		**Cost**	**Quantity**	**Unit**		**Extended Price**		
Mobilization/Demobilization	$	1,100,000	1	EA	$	1,100,000		
Ice Road Construction	$	70,000	89	Mile	$	6,230,000		
River Crossing Consturction	$	100,000	4	EA	$	400,000		
Ice Pad Construction	$	20,000	6	Acre	$	120,000		
Maintenance	$	30,000	90	Days	$	2,700,000		
						Subtotal	$	10,550,000
Excavation of Landfill		**Cost**	**Quantity**	**Days**		**Extended Price**		
Labor								
Operator (Excavator)	$	103	6	50	$	370,800		
Operator (Loader)	$	103	4	50	$	247,200		
Driver	$	95	6	50	$	342,000		
Laborer	$	86	12	50	$	619,200		
Equipment								
Excavator	$	4,440	3	50	$	666,000		
Rock Truck	$	1,752	3	50	$	262,800		
Loader	$	1,140	2	50	$	114,000		
						Subtotal	$	2,622,000
Backfill of Landfill		**Cost**	**Quantity**	**Days**		**Extended Price**		
Labor								
Operator (Loader)	$	103	8	26	$	257,088		
Operator (Dozer)	$	103	6	11	$	81,576		
Driver	$	95	8	26	$	237,120		
Equipment								
Rock Truck	$	1,752	4	26	$	182,208		
Loader	$	1,140	4	26	$	118,560		
D8 Dozer	$	2,976	3	11	$	98,208		
						Subtotal	$	974,760
Processing Pad Construction		**Cost**	**Quantity**	**Days**		**Extended Price**		
Labor	$	85,944	1	EA	$	85,944		
Materials	$	1,475,000	1	EA	$	1,475,000		
						Subtotal	$	1,560,944

Table C-6
Umiat Landfill
Alternative 7 - Excavation, On-Site Disposal of Clean Material,
Off-Site Disposal of Contaminated Material

Debris Processing		**Cost**	**Quantity**	**Days**		**Extended Price**		
Labor								
Laborer	$	86	4	75	$	309,600		
Driver	$	95	4	75	$	342,000		
Operator	$	103	8	75	$	741,600		
Driver	$	95	4	75	$	342,000		
Equipment								
Pickup	$	140	1	75	$	10,500		
Water Truck	$	1,296	2	75	$	194,400		
Loader	$	1,140	4	75	$	342,000		
Rock Truck	$	1,752	2	75	$	262,800		
						Subtotal	$	2,544,900

Sediment Excavation		**Cost**	**Quantity**	**Days**		**Extended Price**		
Labor								
Driver	$	95	6	8	$	54,720		
Laborer	$	86	8	12	$	99,072		
Operator (loader)	$	103	4	12	$	59,328		
Operator (excavation)	$	103	2	8	$	19,776		
Equipment								
Rock Truck	$	1,752	3	8				
Excavator	$	4,440	1	8	$	35,520		
Loader	$	1,140	2	12	$	27,360		
Pickup	$	140	1	12	$	1,680		
						Subtotal	$	297,456

Supersacking		**Cost**	**Quantity**	**Days**		**Extended Price**		
Labor								
Operator	$	103	4	61	$	301,584		
Operator (loader)	$	103	4	61	$	301,584		
Laborer	$	86	12	61	$	755,424		
Equipment								
Excavator	$	4,440	2	61	$	541,680		
Loader	$	1,142	2	61	$	139,324		
						Subtotal	$	2,039,596

Table C-6
Umiat Landfill
Alternative 7 - Excavation, On-Site Disposal of Clean Material,
Off-Site Disposal of Contaminated Material

Materials and Supplies	**Cost**	**Quantity**	**Unit**	**Extended Price**	
Gravel (230,000 CY)*	$ 64,071,840	1	EA	$ 64,071,840	
Diesel	$ 4.50	300000	gallons	$ 1,350,000	
PPE	$ 1,000	180	days	$ 180,000	
Geotextile	$ 1.95	30000	sf	$ 58,500	
Supersacks (8cy, zip top, double walled)	$ 500	5334	ea	$ 2,667,000	
Supersacking Hoppers	$ 3,000	4	ea	$ 12,000	
Lifting Frames	$ 5,000	4	ea	$ 20,000	
Sandbags	$ 0.35	20000	ea	$ 7,000	
Geotube	$ 600	500	ea	$ 300,000	
				Subtotal	$ 68,666,340
Housing/Personnel	**Cost**	**Quantity**	**Days**	**Extended Price**	
Contractor Supervisor	$ 110	2	180	$ 475,200	
Camp Rental	$ 7,850	1	180	$ 1,413,000	
Charter Flight	$ 13,500	24	1	$ 324,000	
				Subtotal	$ 2,212,200
Equipment (Shared by all steps and st	**Cost**	**Quantity**	**Months**	**Extended Price**	
Excavator	$ 70,000	3	9	$ 1,890,000	
Loader	$ 15,000	8	9	$ 1,080,000	
Dozer	$ 50,000	3	9	$ 1,350,000	
Rock Truck	$ 25,000	5	9	$ 1,125,000	
Water Truck	$ 20,000	2	9	$ 360,000	
Trimmer	$ 50,000	1	9	$ 450,000	
Pickup	$ 2,000	4	9	$ 72,000	
Heater	$ 5,000	4	9	$ 180,000	
Light Plant	$ 3,150	6	9	$ 170,100	
Fuel Truck	$ 15,000	1	9	$ 135,000	
Fuel Tank	$ 5,400	4	9	$ 194,400	
Job Trailer	$ 3,600	1	9	$ 32,400	
Van	$ 5,000	2	9	$ 90,000	
Porto-Potty	$ 6,750	2	9	$ 121,500	
				Subtotal	$ 7,250,400

Table C-6
Umiat Landfill
Alternative 7 - Excavation, On-Site Disposal of Clean Material,
Off-Site Disposal of Contaminated Material

Waste Loadout and Disposal								
Labor		**Cost**	**Quantity**	**Days**		**Extended Price**		
Driver	$	95	1	9	$	10,260		
Driver	$	95	1	67	$	76,380		
Operator (Loader)	$	103	2	67	$	165,624		
Crane Operator	$	106	2	9	$	22,896		
Laborer	$	86	6	67	$	414,864		
Equipment								
Loader	$	1,140	2	67	$	152,760		
Tractor/Trailer (Geotube)	$	1,620	5	9	$	72,900		
Crane	$	2,100	2	9	$	37,800		
Tractor/Trailer (Supersacks)	$	1,620	10	67	$	1,085,400		
						Subtotal	$	2,038,884
Disposal		**Cost**	**Quantity**	**Unit**		**Extended Price**		
Open Top Container Rental (per day)	$	11.50	170	82	$	160,310		
Nonhazardous Waste - From Deadhorse to TSDF - In Open Tops	$	13,775	170	EA Containe	$	2,341,750		
Nonhazardous Waste - From Deadhose to TSDF - In Bags	$	11,942	1334	Load	$	15,930,628		
Contaminated Soils	$	72.50	72000	Tons	$	5,220,000		
Prepare and Submit Complete Manifest Packages	$	55	340	EA Container	$	18,700		
Prepare and Submit Profiles	$	125	551	EA Group	$	68,875		
						Subtotal	$	23,740,263
Demobilization		**Cost**	**Quantity**	**Unit**		**Extended Price**		
Site Equipment/Materials	$	10,000	75	Load	$	750,000		
							$	750,000
						Subtotal	**$**	**126,373,343**

Project Management (10 percent)	$12,637,334
Remedial Design (12 percent)	$15,164,801
Construction Management (15 percent)	$18,956,001
Design Contingency (15 percent)	$18,956,001
Bid Contingency (25 percent)	$31,593,336
TOTAL ESTIMATED PROBABLE COST OF ALTERNATIVE 7	**$223,680,817**

* See text for detail on gravel extraction and placement

Table C-7
Umiat Landfill
Alternative 8 - Step-Wise Implementation of Interim Actions

Land Use Controls		**Cost**	**Quantity**	**Unit**		**Extended Price**		
Institutional Controls Plan	$	25,000	1	EA	$	25,000		
Agency Coordination	$	7,500	1	EA	$	7,500		
Administrative Restrictions	$	7,500	1	EA	$	7,500		
Sign Installation	$	94,930	1	EA	$	94,930		
Public Notification and Education	$	10,000	1	EA	$	10,000		
						Subtotal	$	144,930
						Subtotal	**$**	**144,930**
Hot Spot Sediment Removal								
Mobilization		**Cost**	**Quantity**	**Unit**		**Extended Price**		
Trail Establishment (2P to Umiat)	$	68,600	1	EA	$	68,600		
Site Equipment/Materials	$	12,000	20	EA	$	240,000		
Personnel (charter flights w/ RAVN)	$	18,500	1	EA	$	18,500		
						Subtotal	$	327,100
Processing Pad Construction		**Cost**	**Quantity**	**Unit**		**Extended Price**		
Gravel (75,000 CY)*	$	28,603,500	1	EA	$	28,603,500		
Labor	$	85,944	1	EA	$	85,944		
Equipment	$	32,240	1	EA	$	32,240		
Liner (3 layers)	$	1.95	750000	SF	$	1,462,500		
Timbers	$	125	100	EA	$	12,500		
						Subtotal	$	30,196,684
Excavation								
Labor		**Cost**	**Quantity**	**Days**		**Extended Price**		
Driver	$	95	6	8	$	54,720		
Laborer	$	86	4	12	$	49,536		
Operator (loader)	$	103	4	12	$	59,328		
Operator (excavation)	$	103	2	8	$	19,776		
						Subtotal	$	183,360
Equipment								
Rock Truck	$	1,752	3	8	$	42,048		
Excavator	$	4,440	1	8	$	35,520		
Loader	$	1,140	2	12	$	27,360		
						Subtotal	$	104,928
Materials and Supplies		**Cost**	**Quantity**	**Unit**		**Extended Price**		
Diesel	$	4.50	25,000	Gallons	$	112,500		
PPE	$	1,000	12	days	$	12,000		
Supersacking/Geotube Hoppers	$	3,000	4	EA	$	12,000		
Sandbags	$	0.35	20,000	EA	$	7,000		
Geotube	$	600	500	EA	$	300,000		
						Subtotal	$	443,500

Table C-7
Umiat Landfill
Alternative 8 - Step-Wise Implementation of Interim Actions

General Site Wide Equipment		**Cost**	**Quantity**	**Days**		**Extended Price**		
Camp Rental	$	7,850	1	32	$	251,200		
Contractor Supervisor	$	110	2	32	$	84,480		
Heater	$	450	3	22	$	29,700		
Light Plant	$	175	4	22	$	15,400		
Charter Flight	$	13,500	5	1	$	67,500		
Pickup	$	140	3	32	$	13,440		
Job Trailer	$	200	1	22	$	4,400		
						Subtotal	$	466,120
Oversummer Work								
		Cost	**Quantity**	**Days**		**Extended Price**		
Laborer	$	86	2	14	$	28,896		
Operator	$	103	1	14	$	17,304		
Charter Flight	$	9,500	1	7	$	66,500		
				Months				
Loader (monthly rental)	$	20,520	1	7	$	143,640		
Pickup (monthly rental)	$	2,520	1	7	$	17,640		
						Subtotal	$	273,980
Waste Load-out and Disposal								
Labor		**Cost**	**Quantity**	**Days**		**Extended Price**		
Driver	$	95	2	21	$	47,880		
Operator (Loader)	$	103	4	21	$	103,824		
Crane Operator	$	106	4	21	$	106,848		
Laborer	$	86	12	21	$	260,064		
Equipment								
Loader	$	1,140	2	21	$	47,880		
Umiat to 2P (per trip)	$	12,000	100		$	1,200,000		
Tractor/Trailer	$	1,620	1	21	$	34,020		
Crane	$	2,100	2	21	$	88,200		
						Subtotal	$	1,888,716
Disposal		**Cost**	**Quantity**	**Unit**		**Extended Price**		
Open Top Container Rental	$	12	170	61	$	119,255		
Nonhazardous Waste - From Deadhorse to TSDF - In Open Tops	$	13,775	170	EA Containei	$	2,341,750		
Contaminated Soils	$	73	8000	Tons	$	580,000		
Prepare and Submit Complete Manifest Packages	$	55	170	EA Containei	$	9,350		
Prepare and Submit Profiles	$	125	17	EA Group	$	2,125		
						Subtotal	$	3,052,480
Demobilization		**Cost**	**Quantity**	**Unit**		**Extended Price**		
Site Equipment/Materials	$	12,000	12	EA	$	144,000		
Personnel (charter flights w/ RAVN)	$	18,500	1	EA	$	18,500		
						Subtotal	$	162,500
						Subtotal	**$**	**37,099,368**

Table C-7
Umiat Landfill
Alternative 8 - Step-Wise Implementation of Interim Actions

Excavation of Landfill

Option 1 - Excavation and On Site Disposal

Mobilization		**Cost**	**Quantity**	**Unit**		**Extended Price**		
Trail Establishment (2P to Umiat)	$	68,600	1	EA	$	68,600		
Site Equipment/Materials	$	12,000	60	Load	$	720,000		
Personnel (charter flights w/ RAVN)	$	18,500	2		$	37,000		
						Subtotal	$	825,600
Excavation of Landfill		**Rate**	**Quantity**	**Days**		**Extended Price**		
Labor								
Operator (Excavator)	$	103	6	36	$	266,976		
Operator (Loader)	$	103	4	36	$	177,984		
Driver	$	95	6	36	$	246,240		
Laborer	$	86	8	36	$	297,216		
Equipment								
Excavator	$	4,440	3	36	$	479,520		
Rock Truck	$	1,752	3	36	$	189,216		
Loader	$	1,140	2	36	$	82,080		
						Subtotal	$	1,739,232
Backfill of Landfill		**Rate**	**Quantity**	**Days**		**Extended Price**		
Labor								
Operator (Loader)	$	103	2	19	$	46,968		
Operator (Dozer)	$	103	6	8	$	59,328		
Driver	$	95	8	19	$	173,280		
Equipment								
Rock Truck	$	1,752	4	19	$	133,152		
Loader	$	1,140	1	19	$	21,660		
D8 Dozer	$	2,976	3	8	$	71,424		
						Subtotal	$	505,812
Debris Processing		**Rate**	**Quantity**	**Days**		**Extended Price**		
Labor								
Laborer	$	86	8	75	$	619,200		
Driver	$	95	4	75	$	342,000		
Operator	$	103	8	75	$	741,600		
Equipment		**Rate**	**Quantity**	**Days**		**Extended Price**		
Water Truck	$	1,296	2	75	$	194,400		
Loader	$	1,140	4	75	$	342,000		
Rock Truck	$	1,752	2	75	$	262,800		
						Subtotal	$	2,502,000

Table C-7
Umiat Landfill
Alternative 8 - Step-Wise Implementation of Interim Actions

Containment Cell Construction		**Rate**	**Quantity**	**Unit**		**Extended Price**		
Labor	$	242,000	1	EA	$	242,000		
Materials	$	5,100,000	1	EA	$	5,100,000		
**Duration - 7 days to construct, 21 days to cap*						**Subtotal**	$	5,342,000
Materials and Supplies		**Cost**	**Quantity**	**Unit**		**Extended Price**		
Gravel (155,000 CY)*	$	46,909,740	1	EA	$	46,909,740		
Diesel	$	4.50	40000	gallons	$	180,000		
PPE	$	1,000	180	days	$	180,000		
Supersacking/Geotube Hoppers	$	3,000	4	EA	$	12,000		
Sandbags	$	0.35	20000	EA	$	7,000		
Geotube	$	600	500	EA	$	300,000		
						Subtotal	$	47,588,740
Equipment	**Cost**		**Quantity**	**Months**		**Extended Price**		
Excavator	$	70,000	3	9	$	1,890,000		
Loader	$	15,000	6	9	$	810,000		
Dozer	$	50,000	3	9	$	1,350,000		
Rock Truck	$	25,000	5	9	$	1,125,000		
Water Truck	$	20,000	2	9	$	360,000		
Trimmer	$	50,000	1	9	$	450,000		
Pickup	$	2,000	4	9	$	72,000		
Heater	$	5,000	4	9	$	180,000		
Light Plant	$	3,150	6	9	$	170,100		
Fuel Truck	$	15,000	1	9	$	135,000		
Fuel Tank	$	5,400	4	9	$	194,400		
Job Trailer	$	3,600	1	9	$	32,400		
Van	$	5,000	2	9	$	90,000		
Porto-Potty	$	6,750	2	9	$	121,500		
						Subtotal	$	6,980,400
Housing/Personnel		**Cost**	**Quantity**	**Days**		**Extended Price**		
Contractor Supervisor	$	110	2	180	$	475,200		
Camp Rental	$	7,850	1	180	$	1,413,000		
Charter Flight	$	13,500	24	1	$	324,000		
						Subtotal	$	2,212,200
Demobilization		**Cost**	**Quantity**	**Unit**		**Extended Price**		
Trail Establishment (2P to Umiat)	$	68,600	1	EA	$	68,600		
Site Equipment/Materials	$	12,000	50	Load	$	600,000		
Personnel (charter flights w/ RAVN)	$	18,500	2	EA	$	37,000		
						Subtotal	$	705,600
						Subtotal	**$**	**68,401,584**

Table C-7
Umiat Landfill
Alternative 8 - Step-Wise Implementation of Interim Actions

Option 2 - Excavation and Off Site Disposal

Mobilization		**Cost**	**Quantity**	**Unit**		**Extended Price**		
Trail Establishment (2P to Umiat)	$	68,600	1	EA	$	68,600		
Site Equipment/Materials	$	12,000	85	Load	$	1,020,000		
Personnel (charter flights w/ RAVN)	$	18,500	2	EA	$	37,000		
18 days total duration						**Subtotal**	$	1,125,600
Ice Road Construction		**Cost**	**Quantity**	**Unit**		**Subtotal**		
Mobilization/Demobilization	$	1,100,000	1	EA	$	1,100,000		
Ice Road Construction	$	70,000	89	Mile	$	6,230,000		
River Crossing Consturction	$	100,000	4	EA	$	400,000		
Ice Pad Construction	$	20,000	6	Acre	$	120,000		
Maintenance	$	30,000	90	Days	$	2,700,000		
						Subtotal	$	10,550,000
Excavation of Landfill		**Rate**	**Quantity**	**Days**		**Extended Price**		
Labor								
Operator (Excavator)	$	103	6	50	$	370,800		
Operator (Loader)	$	103	4	50	$	247,200		
Driver	$	95	6	50	$	342,000		
Laborer	$	86	12	50	$	619,200		
Equipment								
Excavator	$	4,440	3	50	$	666,000		
Rock Truck	$	1,752	3	50	$	262,800		
Loader	$	1,140	2	50	$	114,000		
						Subtotal	$	2,622,000
Backfill of Landfill		**Rate**	**Quantity**	**Days**		**Extended Price**		
Labor								
Operator (Loader)	$	103	8	26	$	21,424		
Operator (Dozer)	$	103	6	11	$	6,798		
Driver	$	95	8	26	$	19,760		
Equipment								
Rock Truck	$	1,752	4	26	$	182,208		
Loader	$	1,140	4	26	$	118,560		
D8 Dozer	$	2,976	3	11	$	98,208		
						Subtotal	$	446,958
Debris Processing		**Rate**	**Quantity**	**Days**		**Extended Price**		
Labor								
Laborer	$	86	4	75	$	25,800		
Driver	$	95	2	75	$	14,250		
Operator	$	103	8	75	$	61,800		
Driver	$	95	4	75	$	28,500		
Equipment								
Pickup	$	140	1	75	$	10,500		
Water Truck	$	1,296	1	75	$	97,200		

Table C-7
Umiat Landfill
Alternative 8 - Step-Wise Implementation of Interim Actions

Loader	$	1,140	4	75	$	342,000		
Rock Truck	$	1,752	2	75	$	262,800		
						Subtotal	$	842,850
Supersacking		**Rate**	**Quantity**	**Days**		**Extended Price**		
Labor								
Operator	$	103	6	107	$	793,512		
Operator (loader)	$	103	6	107	$	793,512		
Laborer	$	86	18	107	$	1,987,632		
Equipment								
Excavator	$	4,440	3	107	$	1,425,240		
Loader	$	1,142	3	107	$	366,582		
						Subtotal	$	5,366,478
Materials and Supplies		**Rate**	**Quantity**	**Units**		**Extended Price**		
Gravel (220,000 CY)*	$	61,783,560	1	EA	$	61,783,560		
Diesel	$	4.50	350000	gallons	$	1,575,000		
PPE	$	1,000	250	days	$	250,000		
Geotextile	$	1.95	300000	sf	$	585,000		
Supersacks (8cy, zip top, double walled)	$	500	14000	ea	$	7,000,000		
Supersacking Hoppers	$	3,000	4	ea	$	12,000		
Lifting Frames	$	5,000	4	ea	$	20,000		
Sandbags	$	0.35	20000	ea	$	7,000		
Geotube	$	600	500	ea	$	300,000		
						Subtotal	$	71,532,560
Housing/Personnel		**Cost**	**Quantity**	**Days**		**Extended Price**		
Contractor Supervisor	$	110	2	250	$	660,000		
Camp Rental	$	7,850	1	250	$	1,962,500		
Charter Flight	$	13,500	36	1	$	486,000		
						Subtotal	$	3,108,500
Equipment	**Cost**		**Quantity**	**Months**		**Extended Price**		
Excavator	$	70,000	3	9	$	1,890,000		
Loader	$	15,000	10	9	$	1,350,000		
Dozer	$	50,000	3	9	$	1,350,000		
Rock Truck	$	25,000	5	9	$	1,125,000		
Water Truck	$	20,000	2	9	$	360,000		
Pickup	$	2,000	4	9	$	72,000		
Heater	$	5,000	4	9	$	180,000		
Light Plant	$	3,150	6	9	$	170,100		
Fuel Truck	$	15,000	1	9	$	135,000		
Fuel Tank	$	5,400	4	9	$	194,400		
Job Trailer	$	3,600	1	9	$	32,400		
Van	$	5,000	2	9	$	90,000		
Porto-Potty	$	6,750	2	9	$	121,500		
						Subtotal	$	7,070,400
Waste Loadout		**Cost**	**Quantity**	**Days**		**Extended Price**		
Labor								

Table C-7
Umiat Landfill
Alternative 8 - Step-Wise Implementation of Interim Actions

Driver (Geotubes)	$	95	10	9	$	102,600		
Driver (Supersacks)	$	95	40	88	$	4,012,800		
Driver (Maxis)	$	95	20	60	$	1,368,000		
Operator (Loader)	$	103	4	88	$	435,072		
Crane Operator	$	106	4	9	$	45,792		
Laborer	$	86	12	88	$	1,089,792		
Equipment								
Loader	$	1,140	2	88	$	200,640		
Tractor/Trailer (Geotube)	$	1,620	5	9	$	72,900		
Crane	$	2,100	2	9	$	37,800		
Tractor/Trailer (Supersacks)	$	1,620	20	88	$	2,851,200		
Maxi Haul - Double (Metal Debris)	$	2,676	10	60		1605600		
						Subtotal	$	11,822,196
Disposal		**Cost**	**Quantity**	**Units**		**Extended Price**		
NSB Landfill (Debris)	$	21	120000	CY	$	2,520,000		
Open Top Container Rental	$	11.50	170	60	$	117,300		
Nonhazardous Waste - From Deadhorse to TSDF - In Open Tops	$	13,775	167	EA Containe	$	2,300,425		
Nonhazardous Waste - From Deadhose to TSDF - In Bags	$	11,942	3500	Load	$	41,797,000		
Contaminated Soils	$	72.50	368000	Tons	$	26,680,000		
Prepare and Submit Complete Manifest Packages	$	55	3670	EA Containe	$	201,850		
Prepare and Submit Profiles	$	125	1417	EA Group	$	177,125		
						Subtotal	$	73,793,700
Demobilization		**Cost**	**Quantity**	**Unit**		**Extended Price**		
Site Equipment/Materials	$	10,000	75	Load	$	750,000		
						Subtotal	$	750,000
						Subtotal	**$**	**189,031,242**

Table C-7
Umiat Landfill
Alternative 8 - Step-Wise Implementation of Interim Actions

Option 3 - Excavation, On-Site Disposal of Clean Material,Off-Site Disposal of Contaminated Material

Mobilization		**Cost**	**Quantity**	**Unit**		**Extended Price**		
Trail Establishment (2P to Umiat)	$	68,600	1	EA	$	68,600		
Site Equipment/Materials	$	12,000	85	Load	$	1,020,000		
Personnel (charter flights w/ RAVN)	$	18,500	2	Load	$	37,000		
						Subtotal	$	1,125,600
Ice Road Construction		**Cost**	**Quantity**	**Unit**		**Extended Price**		
Mobilization/Demobilization	$	1,100,000	1	EA	$	1,100,000		
Ice Road Construction	$	70,000	89	Mile	$	6,230,000		
River Crossing Consturction	$	100,000	4	EA	$	400,000		
Ice Pad Construction	$	20,000	6	Acre	$	120,000		
Maintenance	$	30,000	90	Days	$	2,700,000		
						Subtotal	$	10,550,000
Excavation of Landfill		**Cost**	**Quantity**	**Days**		**Extended Price**		
Labor								
Operator (Excavator)	$	103	6	50	$	370,800		
Operator (Loader)	$	103	4	50	$	247,200		
Driver	$	95	6	50	$	342,000		
Laborer	$	86	12	50	$	619,200		
Equipment								
Excavator	$	4,440	3	50	$	666,000		
Rock Truck	$	1,752	3	50	$	262,800		
Loader	$	1,140	2	50	$	114,000		
						Subtotal	$	2,622,000
Backfill of Landfill		**Cost**	**Quantity**	**Days**		**Extended Price**		
Labor								
Operator (Loader)	$	103	8	26	$	257,088		
Operator (Dozer)	$	103	6	0	$	-		
Driver	$	95	8	26	$	237,120		
Equipment								
Rock Truck	$	1,752	4	26	$	182,208		
Loader	$	1,140	4	26	$	118,560		
D8 Dozer	$	2,976	3	0	$	-		
						Subtotal	$	794,976
Debris Processing		**Cost**	**Quantity**	**Days**		**Extended Price**		
Labor								
Laborer	$	86	4	75	$	309,600		
Driver	$	95	4	75	$	342,000		
Operator	$	103	8	75	$	741,600		
Driver	$	95	4	75	$	342,000		
Equipment								
Pickup	$	140	1	75	$	10,500		
Water Truck	$	1,296	2	75	$	194,400		
Loader	$	1,140	4	75	$	342,000		

Rock Truck	$	1,752	2	75	$	262,800		
						Subtotal	$	2,544,900
Supersacking		**Cost**	**Quantity**	**Days**	**Extended Price**			
Labor								
Operator	$	103	4	61	$	301,584		
Operator (loader)	$	103	4	61	$	301,584		
Laborer	$	86	12	61	$	755,424		
Equipment								
Excavator	$	4,440	2	61	$	541,680		
Loader	$	1,142	2	61	$	139,324		
						Subtotal	$	2,039,596
Materials and Supplies		**Cost**	**Quantity**	**Unit**	**Extended Price**			
Gravel (155,000 CY)*	$	46,909,740	1	EA	$	46,909,740		
Diesel	$	4.50	300000	gallons	$	1,350,000		
PPE	$	1,000	180	days	$	180,000		
Geotextile	$	1.95	30000	sf	$	58,500		
Supersacks (8cy, zip top, double walled)	$	500	5334	ea	$	2,667,000		
Supersacking Hoppers	$	3,000	4	ea	$	12,000		
Lifting Frames	$	5,000	4	ea	$	20,000		
Sandbags	$	0.35	20000	ea	$	7,000		
Geotube	$	600	500	ea	$	300,000		
						Subtotal	$	51,504,240
Housing/Personnel		**Cost**	**Quantity**	**Days**	**Extended Price**			
Contractor Supervisor	$	110	2	180	$	475,200		
Camp Rental	$	7,850	1	180	$	1,413,000		
Charter Flight	$	13,500	24	1	$	324,000		
						Subtotal	$	2,212,200
Equipment (Shared by all steps and st	**Cost**		**Quantity**	**Months**	**Extended Price**			
Excavator	$	70,000	3	9	$	1,890,000		
Loader	$	15,000	8	9	$	1,080,000		
Dozer	$	50,000	3	9	$	1,350,000		
Rock Truck	$	25,000	5	9	$	1,125,000		
Water Truck	$	20,000	2	9	$	360,000		
Trimmer	$	50,000	1	9	$	450,000		
Pickup	$	2,000	4	9	$	72,000		
Heater	$	5,000	4	9	$	180,000		

Table C-7
Umiat Landfill
Alternative 8 - Step-Wise Implementation of Interim Actions

Light Plant	$ 3,150	6	9	$ 170,100		
Fuel Truck	$ 15,000	1	9	$ 135,000		
Fuel Tank	$ 5,400	4	9	$ 194,400		
Job Trailer	$ 3,600	1	9	$ 32,400		
Van	$ 5,000	2	9	$ 90,000		
Porto-Potty	$ 6,750	2	9	$ 121,500		
				Subtotal	$	7,250,400
Waste Loadout and Disposal						
Labor	**Cost**	**Quantity**	**Days**	**Extended Price**		
Driver	$ 95	1	9	$ 10,260		
Driver	$ 95	1	67	$ 76,380		
Operator (Loader)	$ 103	2	67	$ 165,624		
Crane Operator	$ 106	2	9	$ 22,896		
Laborer	$ 86	6	67	$ 414,864		
Equipment						
Loader	$ 1,140	2	67	$ 152,760		
Tractor/Trailer (Geotube)	$ 1,620	5	9	$ 72,900		
Crane	$ 2,100	2	9	$ 37,800		
Tractor/Trailer (Supersacks)	$ 1,620	10	67	$ 1,085,400		
				Subtotal	$	2,038,884
Disposal	**Cost**	**Quantity**	**Unit**	**Extended Price**		
Open Top Container Rental (per day)	$ 11.50	170	82	$ 160,310		
Nonhazardous Waste - From Deadhorse to TSDF - In Open Tops	$ 13,775	170	EA Containe	$ 2,341,750		
Nonhazardous Waste - From Deadhose to TSDF - In Bags	$ 11,942	1334	Load	$ 15,930,628		
Contaminated Soils	$ 72.50	72000	Tons	$ 5,220,000		
Prepare and Submit Complete Manifest Packages	$ 55	340	EA Container	$ 18,700		
Prepare and Submit Profiles	$ 125	551	EA Group	$ 68,875		
				Subtotal	$	23,740,263
Demobilization	**Cost**	**Quantity**	**Unit**	**Extended Price**		
Site Equipment/Materials	$ 10,000	75	Load	$ 750,000		
					$	750,000
				Subtotal	**$**	**107,173,059**

Table C-7
Umiat Landfill
Alternative 8 - Step-Wise Implementation of Interim Actions

Option 1 Summary

Land Use Controls	$144,930
Hot Spot Sediment Removal	$37,099,368
Excavation and On Site Disposal	$68,401,584
Project Management (10 percent)	$10,564,588
Remedial Design (12 percent)	$12,677,506
Construction Management (15 percent)	$15,846,882
Design Contingency (15 percent)	$15,846,882
Bid Contingency (25 percent)	$26,411,471
5-year Reviews	$238,327
Minor Site Maintenance/Repairs	$500,000
TOTAL ESTIMATED PROBABLE COST OF ALTERNATIVE 8 - Option 1	**$187,731,538**

Option 2 Summary

Land Use Controls	$144,930
Hot Spot Sediment Removal	$37,099,368
Excavation and On Site Disposal	$189,031,242
Project Management (10 percent)	$22,627,554
Remedial Design (12 percent)	$27,153,065
Construction Management (15 percent)	$33,941,331
Design Contingency (15 percent)	$33,941,331
Bid Contingency (25 percent)	$56,568,885
TOTAL ESTIMATED PROBABLE COST OF ALTERNATIVE 8 - Option 2	**$400,507,706**

Option 3 Summary

Land Use Controls	$144,930
Hot Spot Sediment Removal	$37,099,368
Excavation and On Site Disposal	$107,173,059
Project Management (10 percent)	$14,441,736
Remedial Design (12 percent)	$17,330,083
Construction Management (15 percent)	$21,662,604
Design Contingency (15 percent)	$21,662,604
Bid Contingency (25 percent)	$36,104,339
TOTAL ESTIMATED PROBABLE COST OF ALTERNATIVE 8 - Option 3	**$255,618,722**

* See text for detail on gravel extraction and placement

APPENDIX D

COMMENTS TO INTERIM FINAL FEASIBILITY STUDY

From: Kemnitz, Richard [rkemnitz@blm.gov]
Sent: Tuesday, June 30, 2015 6:55 AM
To: Scola, Craig POA
Subject: [EXTERNAL] landfill comments
Attachments: colville_stats.txt; 2003hydrograph.jpg

Craig,

I'm running out of time to be able to spend much more time looking at your feasibility study since I leave for Umiat tomorrow morning. It appears to me that alternatives 5-7 are the best options from which to choose. The location of the new landfill on BLM lands near Seabee pad is out of the 100 year floodplain and is in an already disturbed plot. Provided a land transfer can be worked out this would allow you a few more cost-effective options.

I gave a good look at the hydrology section, pages 6-7. The mean annual surface-water runoff is .72 cfs per mi2, not 1.0 as stated in the document. Peak flows from 2002-2015 have ranged from 108,000 cfs to 271,000 cfs. I'm not sure where the 261,000 cfs came from which was cited in (USACE,2011a). I contact Matt Schellekens USGS for confirmation of the 2015 peak. matts@usgs.gov 479-5645 x222

I'm unclear when the excavation will occur. All scenarios mention March and May/June. May/June will not work since the landfill will be flooded for about 13 days between late May and mid-June. It is unlikely there will be flooding the rest of the season high enough to enter the landfill. It is possible to install some sort of gabion for a distance of 200-300 ft DS of the gage during the excavation to block flow which will decrease the amount and velocity of water entering the landfill. However once the swale takes water it will flow down the road and into the lower portion of the landfill. I have enough photos and info to determine that flow and that might be helpful if that can be blocked off as well with a gabion, though it would need to be done in March. I have hundreds of aerial photos to look at and its just a matter of looking up the GHT/discharge for the photos of interest.

It appears the landfill is flooded at flows of 80,000 to 100,000 cfs or more. Water enters the landfill by the river gage and via the swale to the west. A late summer excavation would provide the maximum thaw depth and speed up the excavating.

My Otuk creek gage at Ivotuk gives me a 36 hr heads up for flood events coming down the Colville although it is difficult to predict the magnitude. In 2003 there was a mid-summer peak and a very unusual peak in Oct. You can see there is not much change in flow for the entire summer when you look at averages.

If there are more questions i can answer, let me know. I'm needing to head out pretty soon to assemble gear for my trip. I'll have time in the evenings to look at anything else.

Also, there was verbage that BLM leases from DOT. not true. BLM reserved a plot where the hut is at. ADFG I believe is still paying rent to DOT for their hut. I also do not think FAA is paying to lease space. tom.kowalczyk@alaska.gov is whom I have spoken with regarding airport leasing. 451-5229

best,

Richard

--

Bureau of Land Management

1150 University Ave; Fairbanks,AK 99709
rkemnitz@blm.gov (office); 907-474-2225 office; 907-474-2281 fax
richard.kemnitz@gmail.com (home); 907-978-8923 cell

REVIEW **PROJECT: Umiat Landfill Interim Final Feasibility Study, May 2015** **Location: Umiat, Alaska**

Bureau of Land Management	**DATE: 6/30/2015** **REVIEWER: Richard Kemnitz** **PHONE:**	**Action taken on comment by:**

Item No.	Drawing Sheet No., Spec. Para.	COMMENTS	REVIEW CONFERENCE A - comment accepted W - comment withdrawn (if neither, explain)	CONTRACTOR RESPONSE	USAED/ADEC RESPONSE ACCEPTANCE (A-AGREE) (D-DISAGREE)
1.	P. 6, Section 1.2.4.4	Mean annual surface-water runoff is .72 cfs per square mile.		Accept. We will correct the statement.	
2.	P. 7, Section 1.2.4.4	Peak flows from 2002 to 2015 have ranged from 108,000 cfs to 271,000 cfs. I'm not sure where the 261,000 cfs came from which was cited in (USACE, 2011a). I contact Matt Schellekens USGS for confirmation of the 2015 peak. matts@usgs.gov. 907-479-5645 x222.		Accept. We will correct the statement.	
3.	Section 4	General comment on scheduling. May/June will not work for excavation or other site prep. The landfill will be flooded for about 13 days between late May and mid-June. It is unlikely there will be flooding the rest of the season high enough to enter the landfill.		Accept. We will review the proposed mobilization and site work schedules and sequencing to ensure we do not assume site work occurs during the known annual flooding period.	
4.	Section 4	General comment on scheduling. It appears the landfill is flooded at flows of 80,000 to 100,000 cfs or more. Water enters the landfill by the river gage and via the swale to the west. A late summer excavation would provide the maximum thay depth and speed up the excavating.		Accept. We will review this information and revise alternative scheduling and sequencing accordingly.	
5.	Page 3, Section 1.2.2	There is verbage that BLM leases from DOT. Not true. BLM reserved a plot where the hut is at. ADFG I believe is still paying rent to DOT for their hut. I also do not think FAA is paying to lease space. tom.kowalczyk@alaska.gov is whom I have spoken with regarding airport leasing. 907-451-5229.		Accept. We will review the land ownership section in light of this information and revise the text as necessary. We will also contact Mr. Kowalczyk for clarification on land ownersip issues that could affect the analysis of remedial alternatives discussed in the FS report.	
		----- End of Comments ----			

Alaska Department of Environmental Conservation August 3, 2015

Contaminated Sites Program Comments on: *Interim Final Feasibility Study Report, Umiat Air Force Station Landfill, Umiat, Alaska*, May 2015

Document Author: Shannon & Wilson, Inc., on behalf of the U.S. Army Engineer District Alaska

Comments provided by: John Carnahan and Fred Vreeman

Comment No.	Page	Sect	Comment / Recommendations	Response
Comments provided by John Carnahan				
1.	Viii	2	The statement that Alternative 4 meets threshold criteria may be questionable in that it is unclear that there is no connectivity between the groundwater beneath the landfill and the contributing waters to the adjacent Coleville River.	We will review the assumptions and engineering aspects of this alternative and, in consultation with the commenter, revise the text as appropriate.
2.	28	Var	The ARAR references to Tables 'A' in Appendix A should be referred to tables and appendix 'B,'	Accept. Will correct this error.
3.	29	3.1.3	Any landfill sited in the State of Alaska requires permitting through AK 18 AAC 60, which would be an Action-specific ARAR. This ARAR is identified as a Chemical-specific ARAR.	Accept. Will correct this error.
4.	33	1	PREVIOUS COMMENT: Please delete the last sentence referring to potential difficulty of the use of ICs, since section only lists the potential alternatives without providing an evaluation. The response to comments indicated that it would be removed.	Accept. We will delete the last sentence.
5.	34	4.2	The initial action item for Alternative 8 should be a component of all alternatives, to establish land use controls to restrict access to the landfill and 'hot-spot' sediment areas.	Acknowledged. Alternative 8 was developed with the assumption that the time required to obtain project funding for full landfill removal would be sufficiently long as to warrant these interim measures. The assumption for other alternatives is that they would be funded and implemented without a delay that would justify implementing LUCs as an initial action item.
6.		4.3.4	This alternative does not address continual leaching of contaminants to the sediments.	We will add a discussion of the potential for continued leaching of contaminants from the landfill.
7.	37	4.3.5	Last Para – The statement that "at conclusion of construction activities, these obstructions will be removed…" The need for 'temporary' slough blocks is unclear. If construction will be completed in April, and peak water flow is typically in late May-early June, why install 'temporary' slough blocks if the purpose is to limit water velocity that likely will occur until after construction? Please clarify if these are designed for temporary or permanent placement, and the rationale for their use.	We will review the assumptions and engineering aspects of this alternative and, in consultation with the commenter, revise the text as appropriate.
8.	38	4.3.5	Reference to Figure 4-4 is made referring to Alternative 4, but the figure is for Alternative 5. The figure is missing from the document.	We will provide the missing figure.
9.	38	4.3.5	Para 3 – the reference to the elevation of the slough blocks is made that they would be set at an elevation of 270 feet; however, the top of the landfill is at about 95 feet, and the slough channel base would be lower than that. With a height of 15 feet, at the most you would expect the slough block to be 110 to 115 feet in elevation. Please clarify or explain this discrepancy.	The stated slough block elevation of 270 feet is incorrect. We will verify site elevations and correct the text.
10.	38	4.3.5	Last Para – the previous figure for this alternative included an armored erosion control blanket, while this proposed alternative relies on large diameter aggregate to prevent erosion. It is uncertain if	We will review the assumptions and engineering aspects of this alternative and,

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			aggregate will be sufficient, if the slough blocks do not alter water flow and the surface of the cap is subject to the erosional capacity of the Coleville River.	in consultation with the commenter, revise the text as appropriate.
11.	Gen	4.3.5	It is difficult to determine the reasonableness of the engineer estimate for Alternative 4. Prior to final selection, a more detailed cost estimate would be required to determine if the proposed costs in this FS are sufficiently reasonable and accurate.	We will work with our cost-estimating subcontractor to provide additional detail as requested.
12.	Gen	4.3.5	Long term effectiveness is questionable for the auger-cast piles due to the dynamic nature of the river, and the potential connectivity of the groundwater beneath the site to the river through the hyporheic zone. A monitoring program within the landfill to observe and document potential leachate concentrations within the confines of the containment, and monitor potential changes to the depth of permafrost, may be required.	Please see our response to comment 6.
13.	43	4.3.7	Last para – the statement, "the sediment will be suction dredged," is inconsistent with excavation of frozen sediment material during March. This term is used throughout.	Acknowledge. We will review the assumptions and engineering aspects of this alternative and, in consultation with the commenter, revise the text as appropriate.
14.	46	4.3.9	The reference to implementing land use controls as described in Alternative 2 would tend to be a reasonable interim measure regardless of the final selected remedy and should be considered, during the period that funding is sought and field work takes place.	Acknowledged. Please refer to our response to comment 5.
15.	58	5.2.1	First sentence should remove the word 'does' or insert 'because it does not involve' within the bracketed area in the sentence, "No short-term risks exist as a result of this alternative [because it does involves no] construction or implementation."	Accept. We will revise the text as recommended.
16.	63	5.2.4	Para 2 – Alternative 4 may also be leaving residual chemicals in vessels (i.e., within drums, transformers, equipment) on site, in addition to solid waste, contaminated soil, and contaminated sediment.	Accept. We will include this possibility.
17.	63	5.2.4	Para 4 – Clarify that the assumption that material for the slough blocks and landfill cap is available is based on readily available material on lands within a reasonable proximity.	Accept. We will provide a basis for the assumption.
18.	65	5.2.5	First Para – Reference to potential ARAR 14 CFR, Part 77 is identified, but not included in Table B-2 Location-Specific ARARs.	Accept. We will include this ARAR in Table B-2.
19.	81	6.0	Recommend updating the reference to 18 AAC 75 – current date is now June 17, 2015; Water Quality Standards 18 AAC 70 are amended through April 8, 2012	Accept. We will update the dates of the regulations.
20.		Figs 1-5, 1-6	A previous request to clarify the reference in the figures to 'groundwater' as to the type of groundwater was not addressed, since section 1.2.4.5 references groundwater and suprapermafrost groundwater.	Accept. References to "groundwater" in this report refer to the suprapermafrost groundwater present in the unconsolidated alluvial deposits around the landfill. We will correct the reference in the figures to read "suprapermafrost groundwater."
21.		Fig 4-1	Previous comment from March 2014 draft: Under 'Process Options' - It is unclear how the 'landfill cell' and the 'modified landfill cell' differ in their design and implementation and how each was evaluated in the Feasibility Study. Figures 4-1 and 4-2 reference 'On-site Disposal' using the 'Process Options' of 'Landfill Cell' and 'Modified Landfill Cell' accompanied with the further description of "an armored treatment cell."	The distinction between "landfill cell" and "modified landfill cell" is that the latter would be constructed with greater resistance to potential erosion than the former. We had envisioned that a landfill

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			Text in section 4.3.6 and general specifications depicted on Figure 4-4 include 'containment cell details' designed to meet 18 AAC 60 standards and requirements, presumed to be the 'Landfill Cell' design. No further information on the 'Modified Landfill Cell' are apparent. Please clarify.	cell "modified" to be more resistant to erosion could be placed in an area more susceptible to flooding. Upon further evaluation, it is our opinion that the difference between "landfill cell" and "modified landfill cell" is too small to consider them as separate process options.
22.		Table C-3	It is unclear in the document if the plan is to deconstruct the slough blocks upon completion of the containment wall. If so, it does not appear that the costs are included.	We will review the assumptions and engineering aspects of this alternative and, in consultation with the commenter, revise the text as appropriate.

Comments provided by Fred Vreeman				
23.	28	3.1	New Comment: Table A-1 and all sections should include requirements in 18 AAC 60.020 and .025 for disposal of materials in any permitted landfill, including an on-site landfill. Each alternative should be revised as well.	Accept. We will include these requirements for disposal in Table A-1, all relevant sections, and each alternative.
24.	29	3.1.4 3.1.5	New Comment: Add DEC potential requirements under 18 AAC 75.345(c) to TBC section, and potential DEC ARAR waivers under 18 AAC 75 or 18 AAC 60. Add requirement for DEC concurrence with any EPA waivers under CERCLA section .300	Accept. We will include these requirements.
25.	29-30	3.2	Add discussion of eco-risk to the RAO section. Last paragraph is a run-on sentence and should be revised.	We will add a discussion of the ecological risks to the RAO section. We will revise the run-on sentence to read "Subsurface contaminants or buried debris, potentially containing hazardous substances, could continue to be exposed by seasonal flooding. Without the implementation of appropriate remedial actions, ongoing erosion of the landfill surface will continue to present an exposure risk."
26.		App B	State regulations need to be added to B2 and B3, not just B1. Also	Accept. State ARARs will be added to Table B2 and B3. We understand the second sentence is a typo and should be ignored.
27.	36, 59	4.3.4 5.2.3	New Comment: Site characterization work during the RI was not sufficient to accomplish this alternative without additional characterization. Figure 4-3 shows only the one area that is known to be contaminated and may be representative of some of the other debris areas. Contamination in these	We will add costs for a mobile laboratory and additional characterization work to Section 5.2.3 and Table C-2. We will add a

		Table C-2	areas has not been fully delineated. Full excavation is the only way to fully delineate all "hot spots". ADEC recommends discussing this uncertainty in section 5.2.3. In addition the mobile lab and additional characterization work required to investigate for hot spots is not included in Table C-2. Recommend adding a site characterization phase to Table C-2 Alternative 3, and adding costs for sampling crew and mobile lab to all phases of the cost estimates.	site characterization phase to Table C-2 Alternative 3 and associated costs to all phases of the cost estimates
28.	Costs	Table C-1	The costs in this table are more than 1 order of magnitude lower than likely costs for this alternative. Annual inspections will be required during the first 5 years and will likely continue thereafter. 5 year reviews will require sampling and inspections, and cannot be completed for $30K per event. Infrastructure placed in Year 1 will need to be replaced periodically. Public education and agency coordination will continue.	We will review the assumptions and engineering aspects of this alternative and, in consultation with the commenter, revise the text and tables as appropriate.
29.	Costs	Table C3-4	Add seasonal inspections years 1 – 3, and annual years 4 – 10. 5 year reviews OK thereafter. 12% design estimate appears low for this type of project. Design will likely require at least one geo-tec mobilization prior to finalizing design for the slough blocks and cap, requiring a drill rig and crew.	We will review the assumptions and engineering aspects of this alternative and, in consultation with the commenter, revise the text as appropriate.
30.	Cover	App C	General comment on section: All cost estimates appear to be significantly lower than actual expenses experienced during similar mobilizations in this area. For a project of this magnitude a second cost estimate by another firm experienced in mobilizations to arctic Alaska. If the costs are uniformly low then the objective of the FS can be met, however a second estimate by a firm in addition to Shannon and Wilson would be prudent. See also specific section cost comments.	Shannon & Wilson subcontracted with Peak Oilfield Services, a North Slope construction company with experience in excavation and ice-road construction and maintenance, to develop costs and sequencing for the various remedial alternatives. We will review the assumptions and engineering aspects of this alternative and, in consultation with the commenter, revise the text as appropriate.
31.		ARAR	State of Alaska ARARs are provided on separate table.	Accept. We will include the State of Alaska ARARs in the appropriate tables. See response to 26.

THE STATE
of ALASKA
GOVERNOR BILL WALKER

Department of Environmental Conservation

Division of Spill Prevention and Response
Contaminated Sites Program

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August 26, 2015

Ms. Lisa Geist
Alaska District Corps of Engineers
P.O. Box 6898
JBER, Alaska 99506-6898

Re: Review of Shannon & Wilson's: *Response to DEC Comments* for *Interim Final and Draft Feasibility Study Report, Umiat Air Force Station Landfill, Umiat, Alaska*, May 2015

Dear Ms. Geist:

The Alaska Department of Environmental Conservation (DEC) has completed a review of the referenced comments provided by your contractor, Shannon & Wilson, Inc. (S&W). The S&W comments were in response to a review made by the DEC specific to both the Draft and Interim Feasibility Study Reports for the Umiat Air Force Station, Alaska.

Two sets of S&W responses were provided addressing each of the following:

1. *March 2014 Draft Development* - DEC provided an acceptance or request for clarification specific to the manner in which its original comments to the March 2014 *Draft Feasibility Study Report* were acknowledged in writing and incorporated into the development of the May 2015 Interim Final Feasibility Study Report; and

2. *May 2015 Interim Final Feasibility Study Report Development* – DEC provided 31 comments on the resulting May 2015 Interim Final draft document.

As for the first set of comments following the March 2014 draft, S&W responded to all requests for clarification posed by DEC and acknowledged that they will be addressed in the next draft. We have no further comment on this response table.

The S&W responses to the second set of comments specific to the latest May 2015 Draft were generally accepted, acknowledged, or slated for clarification in the pending draft. However, many of the S&W responses included the following statement:

> "We will review the assumptions and engineering aspects of this alternative and, in consultation with the commenter, revise the text as appropriate."

We realize that it is important to step back and review thoroughly, and evaluate the details of our inquiry prior to committing to a solution. As such, we recommend that we meet to allow S&W to 'consult with the commenter' in order to revise the text as appropriate.

DEC additionally reserves the right to further comment on engineering and construction cost estimates upon submittal of the next draft.

Please direct any questions pertaining to this letter to my attention at john.carnahan@alaska.gov, or by phone at (907) 451-2166.

Sincerely,

John Carnahan
Environmental Program Specialist

cc: David Jadhon, USACE (email)
Craig Scola, USACE (email)
Susan Flora, BLM (email)
Stacie McIntosh, BLM (email)
Donna Wixon, BLM (email)
John Halverson, DEC (email)
Fred Vreeman (email)
Melody Debenham, DEC (email)
Penny Adler, DOT (email)

Alaska Department of Environmental Conservation August 3, 2015

Contaminated Sites Program Comments on: Response to 'Response to Comments' (RTC) for *Draft Feasibility Study Report, Umiat Air Force Station Landfill, Umiat, Alaska*, March 2014

Document Author: Shannon & Wilson, Inc., on behalf of the U.S. Army Engineer District Alaska

Response to RTC provided by: John Carnahan

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160	Figure 1-3	0	Melody Debenham	Please clarify which "groundwater" is being referred to in the figures 1-3 and 1-4. Section 1.2.4.5 discusses suprapermafrost and subpermafrost groundwater.	Will clarify.	Clarification was not apparent.	We will clarify that groundwater referenced in Figures 1-3 and 1-4 is supra/subpermafrost groundwater.
161	3.0 - General	0	John Halverson	Institutional Controls will need to be a component of any remedy that leaves waste onsite, and does not provide for Unrestricted Use and Unrestricted Exposure (UU/UE).	Will modify as necessary.	ACCEPT - Land Use Controls (LUCs) were identified as a part of Alternatives 2, 3, 4, and 5. They were not required for Alt. 1 (No Action), Alt. 6 (Excavation and Off-site Disposal/Treatment, and Alt. 7 (Excavation, On-site disposal of clean material, off-site disposal/treatment of contaminated material). All alternatives that leave contamination onsite are acknowledged to require LUCs.	
176	Figure 3-1	0	John Halverson	Sheet 3 of 3, Under 'Process Options' - It is unclear how the 'Landfill Cell' and the 'Modified Landfill Cell' differ in their design and implementation and how each was evaluated in the Feasibility Study.	Will clarify.	Figures 4-1 and 4-2 reference 'On-site Disposal' using the 'Process Options' of 'Landfill Cell' and 'Modified Landfill Cell' accompanied with the further description of "an armored treatment cell." Text in section 4.3.6 and general specifications depicted on Figure 4-4 include 'containment cell details' designed to meet 18 AAC 60	The distinction between "landfill cell" and "modified landfill cell" is that the latter would be constructed with greater resistance to potential erosion than the former. We had envisioned that a landfill cell "modified" to be more resistant to erosion could be placed in an area more susceptible to flooding. Upon further evaluation, it is our opinion

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						standards and requirements, presumed to be the 'Landfill Cell' design. No further information on the 'Modified Landfill Cell' are apparent.	that the difference between "landfill cell" and "modified landfill cell" is too small to consider them as separate process options. We propose to eliminate the reference to "modified landfill cell" in the referenced figures and text.
177	Figure 3-2	0	John Halverson	The General Response Action of 'Institutional Controls' would not be 'Effective' in that they ICs do not reduce ecological risk and would not prevent erosion and spread of contaminants; however, ICs may be a necessary component of other alternatives.	IC also are used for land use restriction and public notification.	ACCEPT - Section 5.2 addresses the Individual Analysis of Alternatives. Under S. 5.2.2 the Overall Protectiveness of Alt. 2 (Land Use Controls) is addressed whereby the statement is made, "It provides no protection for ecological receptors." The analysis also points out that this alternative "fails to comply with chemical-specific ARARs as contamination above PRGs would remain on site." The objective of this alternative is protection of human health from exposure to COPCs in the landfill and at identified 'hot-spot' sediment areas only.	
178	Figure 3-4	0	John Halverson	What was the basis for the design used in this figure?	Figure will be modified to meet DEC solid waste landfill specifications.	ACCEPT - Text in section 4.3.6 and general specifications depicted on Figure 4-4 include 'containment cell details' designed to meet 18 AAC 60 standards and requirements, presumed to be the 'Landfill Cell' design.	

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179	Figure 3-5	0	Melody Debenham	How was the potential location for the containment cell determined (perhaps discuss in the appropriate section of the text). Who owns the land here? Provide information in figures or text pertaining to current land ownership.	Will comply. An ownership figure will be added.	ACCEPT - The proposed location for on-site disposal was identified on BLM land and is depicted in Figure 4-5. The siting considered the desire to minimize impacts to wetlands, enable easy access from an existing roadway, and be in close proximity to the location of the temporary processing pad (p. 41). Further statements are made that implementability will ultimately require BLM approval (p. 66). Figure 1-3 depicts the approximate boundaries of State of Alaska and BLM property, intersecting the landfill area with about 1/4 of the perceived landfill area residing on State land.	
180	Figure 3-5	0	John Halverson	On-site disposal will need to meet DEC landfill siting criteria.	Will clarify.	ACCEPT - Text in section 4.3.6 and general specifications depicted on Figure 4-4 include 'containment cell details' designed to meet 18 AAC 60 standards and requirements, presumed to be the 'Landfill Cell' design. Mention of Solid Waste Management Regulations as a 'Potential Chemical-Specific ARAR' is made in Table B-1, p. 2 of 2, referencing it as applicable for the standards and requirements for solid waste management to ensure that landfills are designed, built, and	

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						operated to minimize health and safety threats, if solid waste from the site is disposed onsite or at an off-site landfill. Consequently, there is reference under 'Action Specific ARARs' that calls out federal requirements for landfill siting under RCRA Subtitle D (non-hazardous waste management), but does not mention 18 AAC 60. Any locating of a landfill within the State of Alaska will require a permit with DEC Solid Waste.	
183	4.0 - Implementability - General	0	Melody Debenham	The proposed alternatives require varying degrees of permitting, agency coordination and community involvement, and acknowledging such is appropriate. Costs and protracted timelines for this should be a part of your evaluation.	Will include.	ACCEPT - Reference is made that 'administrative costs' include coordination with state agencies to address institutional controls and such. As an example, for Alt. 5, Project Management includes $2.3M, Design $2.8M, with a $5.8M contingency.	
154	1.2.2	3	Melody Debenham	¶3 – please include a figure showing the current land ownership.	Will comply.	ACCEPT - Figure 1-3 depicts the approximate boundaries of State of Alaska and BLM property, intersecting the landfill area with about 1/4 of the perceived landfill area residing on State land.	

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155	1.2.3	4	John Carnahan	¶6 – The inclusion of a figure (such as 3-6) in this section would be helpful to the reader to better understand the referenced six individual cells of buried debris.	Will comply.	ACCEPT - Figure 1-4 was included and referenced in this section.	
156	1.3	7	Melody Debenham	Please cite the source for the statement that the contaminants detected in the fish are from long-range atmospheric transport/historic spraying rather than the landfill.	Will comply.	ACCEPT - Reference to 'long-range atmospheric transport or historic spraying of pesticides' was removed from the text. In Section 2.3, the following statement is made: [No PRGs for contaminants in fish tissue were developed for this site. Based on its 2003 Health Consultation, the ATSDR found that "while PCBs, DDT, and DDT derivatives were detected in fish collected from multiple areas of the Colville River, the levels were very low and exposures to them are not expected to cause harmful health effects." Thus, the ATSDR determined it is safe to eat the fish. Additionally, PCB Aroclor 1260 and Aroclor 1016/1242 were only detected in fish tissue but none were found in soil, sediment, surface water, or groundwater at the Umiat Site (only Aroclor 1254 was detected in site soil and sediment). This suggests fish	

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						may be affected by contaminant sources other than the landfill.] This statement, although accurate in the reference to other potential sources, may be misleading in that and the conclusions from the E&E report titled, *Evaluation of the PCBs and DDTs in the Coleville River,* March 2003, clearly state that the evaluation of the fish tissue results clearly show that PCBs and DDTs from the slough are impacting the burbot and water resident in the slough. Aroclor 1254 was found in elevated concentrations in fish samples. Still, the evaluation of the fish tissue and data indicate that PCBs and DTs present in the Umiat slough sediment are affecting burbot in both the slough and Colville River; however, the dissolved fraction of organochlorines in the water column from Umiat Slough does not appear to be a significant factor for increasing contaminant levels in fish tissue in the Coleville River.	
157	1.4	8	Melody Debenham	1st bullet – please clarify if the COPCs are contaminants detected at the site above the cleanup level, at 1/10th of the cleanup level, or are they	Will clarify.	ACCEPT - Section 1.3.1 provided providing clarification. Historical analytical results were evaluated and COPCs identified using two basic approaches. Soil, sediment, surface-	

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				contaminants that have been detected at any level.		water, and groundwater results were compared to potential cleanup levels (PCLs) from Alaska statutes (Appendix A, Table A-1). Additionally, the highest results for soil and sediment were compared to one-tenth the Method Two Table B1 soil cleanup levels for the Arctic Zone, and surface-water and groundwater results to one-tenth the Table C groundwater cleanup levels, in accordance with the Alaska Department of Environmental Conservation's (ADEC's) 2008 Cumulative Risk Guidance. Fish-sample results were compared to calculated site-specific risk-based fish-screening levels (see Section 1.3.5). Results were also compared to "to-be-considered" (TBC) criteria, namely the National Oceanic and Atmospheric Administration (NOAA) Screening and Quick Reference Table (SQuiRT) values. Though TBCs have no enforceable requirements, they may be relevant for consideration by stakeholders or other interested parties reviewing the accumulated chemical data. The PCLs and risk-based screening levels used to identify COPCs are listed in	

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						Tables A-2 through A-6 along with the highest detected analyte concentrations for each media. Table F-1, in Appendix F, of the RI provides a list of PCL and TBC concentrations.	
158	1.4	8	Melody Debenham	3rd bullet – please clarify – cumulative risk includes each contaminant detected above one-tenth of the Table B1 inhalation or direct contact or Table C cleanup level. This paragraph implies just the COPCs were used to calculate cumulative risk. (This should also be clarified in the executive summary and possibly Section 2.2, page 16).	Will clarify.	ACCEPT - Section 1.3.5 states that the highest analytical results for soil/sediment were compared to one-tenth the Method Two cleanup levels for Arctic Zone, and maximum analytical results for water to 1/10th Table C levels. Petroleum was not included. The conclusion was that corrective action should be implemented. PRGs are MTGW for soil which are shown to be protective for both cancerous and non-cancerous COCs.	
159	2.1.2 – 2.1.3	15	John Carnahan	The applicable State of Alaska regulations ARARs should include the following: Chemical-Specific ARARs	Will address applicable State of Alaska ARAR.	ARARs are incorrectly identified in Sect 3.1 as being summarized in Appendix A. The ARARs are located in Append B. In addition to Chemical-Specific ARARs, DEC has provided additional State ARARs for inclusion.	We will correct the text to read that ARARs are summarized in Appendix B. We will review the ADEC-provided State ARARs and include them as applicable in Appendix B.

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162	3.1	17	John Halverson, John Carnahan	¶2, first sentence – the definition of the site should be clarified such that it is clear to the understanding regarding the four primary areas of interest: the Umiat AFS in its entirety; the aerial extent of the landfill debris; the area of impacted sediments; and the proposed location of a newly constructed landfill resides. The use of 'offsite' has also been used to reference the location of contaminated sediments that were derived from the landfill location; however, the landfill and the impacted slough may be thought of as the 'site,' in that they are to be addressed as part this Feasibility Study. Further, the Umiat AFS is sometimes referred to as the site.	Will clarify in text and in figures where appropriate.	ACCEPT - Section 1.2.1 clarifies that the 'Umiat AFS' includes all areas occupied by the USAF. The 'Umiat Site' (for purposes of this work) is the landfill area associated with and southeast of the Umiat AFS, as well as the contaminated sediments downstream of the landfill, for which the landfill is the presumed source.	
163	3.2	19	Melody Debenham	2nd bullet – Please delete the last sentence referring to potential difficulty of the use of ICs, since section only lists the potential alternatives without providing an evaluation.	Will comply.	Did not remove sentence from second bullet (Alternative 2: LUC, p. 33).	We will delete the last sentence from the second bullet.

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164	3.2	19	John Carnahan	It may be appropriate to consider a combination of alternatives, potentially to include: Excavation and local/onsite disposal of non-hazardous materials, coupled with excavation and off-site treatment/disposal of hazardous materials; Include dredging and proper disposal of PCB sediments (potentially locally or offsite) as part of a selected landfill management action and strategy. Use of reinforced cap coupled with slough blocks or river diversion barriers to limit flooding and erosion. Onsite treatment of targeted contamination as a form of offsite waste stream reduction. Etc.	A meeting will be arranged with the USACE to discuss actions moving forward, including finalizing the list of ARARs, evaluating technologies and alternatives, selection and ranking of recommended alternatives, and resolution of these comments. These potential alternatives will be included for consideration.	ACCEPT - the alternatives that were included address each of the recommended methodologies, including: LUCs with hot-spot removal; containment and capping; excavation and onsite disposal; excavation and offsite disposal/treatment; excavation and onsite disposal of clean material and offsite disposal of contaminated material; stepwise implementation of interim actions.	

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165	3.3.2	20	John Halverson	Fencing is prescribed as part of the controls for this alternative to prevent exposure by site residents and visitors to the areas where COPC concentrations are present exceeding the PRGs. Is this is meant primarily to provide protection from current or future exposure? Please clarify.	Will clarify.	ACCEPT - The reference to fencing was removed, and the use of Land Use Controls as part of this Alternative include deed restrictions, warning signs, and public notification (p. 35).	
166	3.3.3	20	John Halverson	The first bullet states "obtain permits". If the response is done under CERCLA, permits are not required on on-site activities; however, they would need to comply with all substantive requirements of permits that would normally be required. Such substantive requirements should be identified in the ARARs section(s).	A meeting will be arranged with the USACE to discuss actions moving forward, including finalizing the list of ARARs.	ACCEPT - No reference to permitting is included with the 'Containment and Capping' alternative, but it does reference the need to adhere to the requirements of 18 AAC 60, SW permit criteria for landfills within a floodplain.	
167	3.3.3	21	Melody Debenham	Please double check the steps listed here. The 3rd bullet lists construction of a permanent dam, which does not seem to be part of this alternative, and the 6th bullet includes the installation of fencing, neither of which is	Will review and clarify.	ACCEPT - any reference to the permanent damn and fencing are removed as they were remnants form previous draft.	

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				identified in Figure 3-4.			
168	3.3.3	21	Melody Debenham	¶2 – please reference how the 500-year flood elevation was determined.	Will comply.	ACCEPT - all reference to 500-year flood is removed and replaced with 100-year flood criteria. The USACOE 2011 hydrologic analyses is used as a design event, the peak performance measured flow over its dataset (2003-2009) from 2004. The proposed landfill is located 1.2 miles north of the 2004 floodplain boundaries.	
169	3.3.3	21	Melody Debenham	¶2 – Is there an alternative if no locally sourced aggregate material is suitable?	Will evaluate.	ACCEPT - assumed that the source area is within 1.5 miles of the site.	
170	3.3.3	21	John Carnahan	Potential typo regarding statement regarding the placement of the slough blocks at an elevation of 270 feet if they are only 15 feet in height, and the ground elevation of the landfill cap will be at about 100 feet.	Will review and clarify.	NOT CLARIFIED - This was not changed. On p. 38 there is reference to the size of the slough blocks, and the set elevation of 270 feet, or 3 feet above the current Umiat Airport Runway. Further down the page, the referenced elevation of the ground surface of the dumpsite is between 98 and 92 feet. As such, the slough block would be as much as 17 stories in height.	The stated slough block elevation of 270 feet is incorrect. We will verify site elevations and correct the text.

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171	3.3.3	22	John Carnahan	It would be beneficial to the reader to provide the estimated length of the augercast piles that will be advanced, say between 7 feet to the north and 13 feet in length to the south, based on the elevation information that is provided. The referenced elevations rather than depths may make this confusing to the reader.	Will comply.	ACCEPT - Better description was provided, but this is not critical (p. 38).	
172	3.3.4	22	Melody Debenham	Please clarify the first paragraph. From reading further on, it sounds like the contaminated and the non-contaminated material will be disposed of in a new 'on-site' landfill, however this paragraph discusses segregating the material but does not state what will happen with the non-contaminated material.	Will clarify.	ACCEPT - statement that 'non-contaminated material will be reused onsite, if appropriate.' Solid waste encountered will be segregated and disposed in the on-site containment cell. Discrete cells will be established for varying waste streams, with liquid wastes contained for transport and disposal at permitted waste facility.	

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173	3.3.4	22	John Carnahan	¶1 should more clearly articulate that the landfill contents will be excavated, and 'hot-spot' areas suction dredged, with all contaminated material and solid waste disposed of in a newly constructed local/onsite landfill. Any material that is determined to be non-contaminated is intended to be re-used in some capacity, but it would be reasonable to not reintroduce soils, fines, sands or sediments derived from the landfill area to a potentially sensitive environment.	Will clarify.	ACCEPT - The individual management strategies are discussed in sufficient detail and describe how it will be processed and disposed.	
174	3.3.4	22	Melody Debenham	¶1 (and 2nd bullet on page 22) – Please clarify the type of treatability study that will be required. There's already a list of COPCs, and it would be hard to characterize the landfill until it has been removed. Alternatives 4 (and 5) will require waste characterization and segregation of any hazardous waste, coupled with proper disposal.	Will clarify.	ACCEPT - the reference to treatability study was removed from the document.	

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175	3.3.4	24	Melody Debenham	¶5 – Does the description in this paragraph meet DEC solid waste landfill specifications? Please state that the final on-site containment cell design will meet requirements.	Will state.	ACCEPT - this was acknowledged throughout the document, including in the Chemical Specific ARARs. On. P. 41, "the containment cell will be designed in general accordance with 18 AAC 60, Solid Waste Management and meets the following permit criteria for landfills within a floodplain..."	
182	3.3.5	25	John Halverson	Offsite disposal should also consider final disposal options that are closer and not limited to only those outside Alaska, for appropriate waste streams.	Will include.	ACCEPT - reference to disposal of materials at the NSB landfill is made. No specific location is determined, but a TSDF may be required for some material.	
184	4.1.5	33	John Halverson	Short-Term Effectiveness should also take into account how effective the alternative is expected to be at reducing risk in the short term, and not just during the construction and implementation.	Will comply.	ACCEPT - the statement, "as well as the reduction of risk in the short term," was added into the description.	
185	4.2	34	John Carnahan	It could be construed that the No Action Alternative could lead to an increase rather than a reduction in toxicity, mobility, or volume, should documented erosion and flooding lead to a future catastrophic release due to unearthing of a vessel, drum, transformer, etc., that could	Will comply.	ACCEPT - the statement, "there is a likelihood that ongoing erosion and flooding could result in an increase in the toxicity, mobility, and/or volume of COPCs if the No Action alternative is implemented at the site."	

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				contain an unknown chemical.			
186	4.2.2	35	John Carnahan	¶4 – Please provide clarification on which referenced institutional controls would be more difficult to enforce and why.	Will clarify.	ACCEPT - the statement was modified to state that, "*administrative restrictions* at such a remote site are difficult to enforce..."	
187	4.2.2	36	Melody Debenham	Implementability – How would maintenance of the fencing be addressed? If the slough floods seasonally, would the fence need to be replaced every year?	Will clarify.	ACCEPT - the installation of fencing was removed from the Land Use Control alternative.	
188	4.2.2	36	John Halverson	Another challenge under implementability is the manner in which 'restrictions on the consumption of fish' would be managed.	Will address.	ACCEPT - there is no specific address of this comment, but the fish have been determined to be safe to eat, and therefore no controls (or restrictions) are placed on the consumption of fish.	
190	4.2.3	36	John Halverson	Under 'Overall Protectiveness,' contaminated sediments would not remain downstream of the landfill if targeted removal was part of the alternative. Options could	Will revise.	ACCEPT - Hot spot removal and sediment management was addressed as part of multiple proposed alternatives.	

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				include moving them back into the landfill and cap in place, or ship off-site for disposal.			
191	4.2.3	37	Melody Debenham	Short Term – Is 3 months a reasonable estimate of time to complete the proposed work? This comment applies to Alternatives 3, 4, and 5, and Section 4.3.5	Will reevaluate.	ACCEPT - New general timelines have been proposed.	
192	4.2.3	37	John Halverson	Under 'Long-Term Effectiveness,' it should be noted that damage to any of the engineering controls would have to be repaired, and not just to the cap. Also, it is reasonable to assume that the meandering river will eventually move around the proposed flood control structures; the question is how far into the future will that be?	Will evaluate.	ACCEPT - the barriers that are proposed are identified as temporary and to be removed upon completion of the barrier and cap. Further, the design would tie the structures into the higher ground, whereby flooding would only occur over the landfill, minimizing impacts to site work. Reference to LUCs and site visits is made to ensure long-term viability of the soil cap.	
194	4.2.4	38	John Carnahan	¶1 in this section: Please clarify if the placement of the dredged contaminated material that focuses primarily on PCB contamination, will or could be placed separately from	Will clarify.	ACCEPT - Clarification regarding how the placement of solid waste and contaminated soil/sediment was provided for each alternative. Solid waste will be placed in the center of the containment area, with contaminated soil and sediment used	

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				other material removed from the landfill?		as cover material to create a smooth surface, on which a new geotextile fabric will be placed to fully contain the material.	
193	4.2.4	39	Melody Debenham	Reduction in Toxicity, Mobility, or Volume – please correct the grammatical errors in this paragraph.	Will comply.	ACCEPT - corrected on p. 65.	
195	4.2.4	39	John Halverson	Under 'Implementability,' it will be necessary to identify a suitable 'onsite' location that meets the substantive requirements of the Solid Waste Disposal Permit requirements. It is unclear if BLM has been engaged as of this time on the potential for locating a new landfill on BLM lands as proposed in the figure.	Will comply. Landowners will be consulted during the document revision and their positions will be evaluated as part of the feasibility process.	ACCEPT - a location has been identified on BLM property. On p. 42, the FS states that, "the USACE has the authority and responsibility under DERP, established by Section 211 of SARA in 1986, to conduct remediati9on pursuant to the CERCLA to address contamination as a result of DoD activities. In conducting FUDs cleanups, the Corps is required to comply with the NCP, and ensure that the cleanup complies with ARARs. As owner, BLM is expected to coordinate ongoing land management activities at this site with the USACE in a manner that promotes clean-up, as they have demonstrated recently..." A 'land withdrawal' for construction of a landfill, pursuant to 43 USCS Sect. 1714(a) allows the Secretary of the Interior to make such a withdrawal pursuant to the Federal	

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						Land Policy and Management Act.	
196	4.2.4	40	Melody Debenham	Cost – Please clarify the following sentence: "Potential for cost escalation is considered moderate, as additional material could be stockpiled by increasing the thickness in the containment cell". What additional material? Why would it be "stockpiled"? Why would that impact cost?	Will clarify.	ACCEPT - the phrase was removed and was changed to, "the potential for cost escalation is considered moderate, as the cost of mobilization/ demobilization could be affected by the cost of fuel."	
197	4.2.5	41	Melody Debenham	Cost – The cost evaluations for the other alternatives include a discussion of potential cost escalation. Please include in this section.	Will include.	ACCEPT - the section now includes, "the potential for cost escalation is considered moderate, as the cost of mobilization/ demobilization could be affected by the cost of fuel."	

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198	4.3.1	42	John Halverson	¶2 - The last sentence in the second paragraph is incorrect. It should state, "Because Alternatives 1 and 2 would not provide overall protection of human health and the environment, they cannot be selected as the remedy."	Will comply.	ACCEPT - text was modified accordingly.	
199	4.3.1	42	John Carnahan	¶3 – The reference to 'cap and dam' when a dam is not an option proposed for Alternative 3, should likely be changed to cap and 'slough block.'	Will revise.	ACCEPT - references to dams were removed.	
200	4.3.1	42	John Carnahan	¶4 - this option also relies on the availability of an appropriate site that will not be subject to future erosion.	Will evaluate. Landowners will be consulted during the document revision and their positions will be evaluated as part of the feasibility process.	ACCEPT - issue addressed throughout the document.	

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201	4.3.4	42	John Halverson	Under 'Reduction of Toxicity, Mobility, or Volume Through Treatment,' another sentence should be added stating that none of the alternatives considered in the FS involved treatment.	Will comply.	The section was modified to simply state, "No on-site treatment is proposed for any of the alternatives." The removal and/or containment of material would lead to a reduction in mobility, and the removal and placement would lead to a reduction in volume (from perceived), but whether this constitutes an action through 'treatment' is the question. They elected to acknowledge no treatment was taking place, with the inference that no reduction would be the result of treatment, even if reductions were obtained through their actions.	We provide additional detail in our alternatives analysis sections. Based on DEC's review of our initial response, we will clarify whether reductions in toxicity, mobility, and/or volume are achieved through actions other than on-site or off-site treatment.
202	4.3.5	44	John Halverson	General – It should be considered as part of the Short-Term Effectiveness, how soon Alt 3, 4 or 5 could realistically be implemented and how that effects impacts the short term effectiveness of each. For example, Alternative 5 wouldn't be effective in the short term if there is no way it would be funded in the foreseeable future.	Will reevaluate.	ACCEPT - The section 5.1.5 that describes Criterion 5 'Short Term Effectiveness' included a phrase to address this comment. The sentence was modified to include that in bold: "The potential health effects and environmental impacts of each alternative action during construction and implementation, as well as the reduction of risk in the short term, are evaluate by this criterion. Overall, it is not possible to make a determination that any funding will be forthcoming for any cleanup alternative, making each one equal in terms of the amount of risk	

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						posed, equivalent to the short term risks associated with the 'No Action Alternative,' until a funding mechanism is identified, and will be consistent with those described in the CRE in Section 1.3.5.	
181	Sect. 3.3.4	23-24	John Carnahan	Is there any intent to separate the dredged sediment that is more likely to have residual PCB contamination, from the rest of the contaminated soils, fines and gravels that are more likely to be POL contaminated? Would it be practical to segregate this material during the final disposal in the event that this material requires future handling for reasons unbeknownst at this time?	Will evaluate.	ACCEPT - the basic methodology for managing the soil and sediment is described. Depending on the resulting overall concentrations, this can likely be incorporated into the final management and design.	
189	4.2.3	36-38	Melody Debenham	This entire section includes references to a permanent dam, however Figure 3-1 shows the permanent dam as being screened out. Should this be referencing the slough blocks instead?	Yes, will revise.	ACCEPT - all references to 'permanent dams' have been removed.	

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203	4.4	46, 47	John Carnahan	The costs associated with Alternative 5 is $254M in Table 4-1 and $605M in Table 4-2. It is unclear as to why these two amounts differ significantly and assume it may be a typo	Yes, the larger number did not get revised.	ACCEPT - corrected.	
149	General	General	Fred Vreeman	The FS does not provide sufficient detail to adequately review the technical details or evaluate the estimated short term and long term cost of the alternatives.	Will comply. Sufficient data will be incorporated based on the resolution to all comments.	ACCEPT - the overall methodologies provided more information specific to each alternative.	
150	General	General	Fred Vreeman	DEC recommends evaluating an additional alternative that is a combination of Alternative 4 and 5, involving excavating the contents of the landfill and disposing of the contaminated material offsite, and non-contaminated material onsite.	The alternative will be considered.	ACCEPT - Excavation and disposal of material both onsite and off-site are proposed.	
151	General	General	Fred Vreeman	The FS does not discuss the disposal of RCRA and TSCA regulated wastes. Based on the DEC's experience with other landfill projects, lead, PCBs and other COCs found have often exceeded RCRA and TSCA action levels.	Will comply. Disposal of RCRA and TSCA regulated wastes will be discussed.	ACCEPT - Excavation and disposal of PCB material is addressed. Based on previous sampling results, the sediment material is expected to be below TSCA criteria (e.g., below 50 mg/kg). However, for planning purposes, liquid wastes and heavily contaminated soils that exceed TSCA criteria are assumed to be	

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						present within the landfill contents as a percentage of the total volume.	
152	ES	vii	John Carnahan	¶2 - Clarify the use of 'contamination has migrated offsite' to imply that contamination has migrated from the presumed landfill aerial extent. The extent of the 'site' should be clarified.	Will clarify.	ACCEPT - Section 1.2.1 clarifies that the 'Umiat AFS' includes all areas occupied by the USAF. The 'Umiat Site' (for purposes of this work) is the landfill area associated with and southeast of the Umiat AFS, as well as the contaminated sediments downstream of the landfill, for which the landfill is the presumed source.	
153	ES	vii	John Carnahan	The alternatives may want to consider the use of a combination of removal and onsite and offsite disposal.	This will be considered as a separate alternative.	ACCEPT - Alternatives 5, 6, and 7 address onsite disposal, offsite disposal, and a combination of onsite (clean) and offsite (contaminated).	