Record of Decision

LF001, LF002, SS010, LF001a, ST006, SS009a, and SS009b

FINAL

OLIKTOK LONG RANGE RADAR SITE, ALASKA

Prepared By

United States Air Force

JOINT BASE ELMENDORF-RICHARDSON, ALASKA

November 2012

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Tables

Figures

Acronyms

%	percent
µg/L	micrograms per liter
AAC	Alaska Administrative Code
ABR	Alaska Biological Research, Inc.
ADEC	Alaska Department of Conservation
AR	Administrative Record
ARARs	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene and xylenes
CEM	conceptual exposure model
CEM	conceptual exposure model
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CES	Civil Engineering Squadron
CFR	Code of Federal Regulations
COC	chemical of concern
COPC	chemical of potential concern
cy	cubic yard
DERP	Defense Environmental Restoration Program
DEW	Distant Early Warning
DoD	Department of Defense
DRO	diesel range organics
EPA	Environmental Protection Agency
EPC	exposure point concentration
ERA	ecological risk assessment
FS	Feasibility Study
ft^2	square feet
GRO	gasoline range organics
HCG	Hoefler Consulting Group
HI	Hazard Index
HQ	hazard quotient
HRA	human health risk assessment
IC	Institutional Control
ICF	ICF Technologies Inc.
IRP	Installation Restoration Program
LOAEL	Lowest Observed Adverse Effect Level
LRRS	Long Range Radar Site
LUC	land use control
mg/kg	milligram per kilogram
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NOAEL	No Observed Adverse Effect Level
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyls

POC	point of contact
RAO	remedial action objective
RBC	Risk-Based Concentration
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RRO	residual range organics
SARA	Superfund Amendments and Reauthorization Act
TBC	to be considered
TCRA	Time Critical Response Action
TRV	toxicity reference value
U.S.	United States
USAF	United States Air Force
USFWS	United States Fish and Wildlife Services
USGS	United States Geological Service
VOC	volatile organic compound
WCC	Woodward-Clyde Consultants

1.0 Declaration

1.1 *Site Name and Location*

Facility Name: Oliktok Long Range Radar Site (LRRS)

Site Location: Section 5, Township 13 North, Range 9 East, Umiat Meridian.

Latitude and Longitude: 70° 30' North, 149° 53' West

Alaska Department of Environmental Conservation (ADEC) Hazard ID Number:

LF001 (Old Landfill) - 747
LF002 (Dump Site) - 799
SS010 (Garage Site) - 767
ST006 (Module Train Spill Sites) - 2656
SS009a (Diesel Storage Tanks Site) - 2654
SS009b (Fuel Farm Tank Site) - 2654

Operable Unit/Site: Oliktok LRRS

Facility Owner and Point of Contact (POC):

Colonel Robyn M. Burk
Commander, 611th Air Support Group
9480 Pease Ave, Ste 123
JBER, Alaska 99506-2101
Phone: (907) 552-3442

1.2 *Statement of Basis and Purpose*

This ROD presents the Selected Remedy for the sites LF001, LF002, SS010, LF001a, ST006, SS009a and SS009b, at Oliktok LRRS, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and to the extent practicable, the National Contingency Plan (NCP). This decision is based on the Administrative Record for this site.

This document is issued by the Department of the Air Force (USAF), as the lead agency. The USAF is managing remediation of contamination at sites LF001, LF002, SS010, LF001a, ST006, SS009a and SS009b, at Oliktok LRRS, in accordance with CERCLA as required by the Defense Environmental Restoration Program (DERP).

As the lead agency, the USAF has selected the remedy. ADEC agrees that, when properly implemented, the remedies comply with state law. ADEC has been given the opportunity to review this document for regulatory oversight of the DERP at Oliktok LRRS.

1.3 *Assessment of Site*

The response action selected in this Record of Decision (ROD) is necessary to protect public health or welfare or the environment from actual or threatened releases of pollutants or contaminants from this site which may present an imminent and substantial endangerment to public health or welfare. Areas within Oliktok LRRS cannot support unlimited use and unrestricted exposure due to pollutants or contaminants remaining in place after implementation of the selected remedy. Land use restrictions are required as part of this response action and will be achieved through imposition of land use controls (LUCs) that limit the use and/or exposure to those areas of the property, including water resources, that are contaminated.

Past activities at the Oliktok LRRS, including the management of diesel fuel, electrical equipment, batteries, aviation fuels, and facility operations, have resulted in the release of hazardous substances into the environment during facility operation. The Contaminants of Concern (COC) at the Oliktok LRRS sites addressed in this ROD are diesel-range organics (DRO), residual-range organics (RRO) polychlorinated biphenyls (PCB), chromium, lead and arsenic. The petroleum contaminants (DRO and RRO) are intermingled with the CERCLA hazardous substances. These COCs were previously identified in the soil above the State of Alaska cleanup levels. The State of Alaska cleanup levels for contaminants (18 Alaska Administrative Code [AAC] 75.341, Tables A2, B1 and B2) were used for the Oliktok LRRS. The State of Alaska specifies three separate cleanup levels depending on the exposure pathway of the contaminants at each site. In each case, ADEC cleanup levels were utilized when evaluating potential contamination at the Oliktok LRRS sites. The State of Alaska cleanup levels for Oliktok LRRS sites are depicted on Table 1-1.

Table 1-1 Oliktok LRRS COCs and Soil Cleanup Levels

Site	Chemical of Concern	Soil Cleanup Level (milligram per kilogram [mg/kg])
LF001	DRO	500*
	RRO	2,000*
	PCBs	1- 10 with a cap and ICs
	Lead	400
	Chromium	410
LF002	PCBs	1 – 10 with a cap and ICs
SS010	DRO	12,500
	RRO	13,700
	PCBs	1
	Lead	400
	Arsenic	6.1
ST006	PCBs	1

Notes:
*** Petroleum Hydrocarbon Method One Soil Cleanup Levels in the Arctic Zone utilized due to the site's proximity to the Beaufort Sea. Source of soil cleanup levels: 18 AAC 75.341 Arctic Zone), Table A2, B1 and B2. For definitions, see the Acronyms and Abbreviations section.**

The USAF is committed to implementing, monitoring, maintaining, and enforcing all components of the selected remedy to ensure that it remains protective of human health and the environment.

1.4 *Description of Selected Remedy*

Remedial alternatives for Oliktok LRRS were developed and evaluated through the following remedial investigations and feasibility studies, "*Remedial Investigation/Feasibility Study Report, Final, September 2003*", the "*Remedial Investigation/Feasibility Study Report, Final, October 2005*", and the "*Follow-on Remedial Investigation for Garage Site SS010, February 2007*". Based on the results of the remedial investigations and feasibility studies, the USAF selected the following as the preferred alternative for the Oliktok LRRS.

The chosen remedy for Sites LF001, LF002, SS010, LF001a, and ST006 is Institutional Controls (ICs). Because no contaminants were detected at levels above ADEC Method Two Soil Cleanup Levels for the Arctic zone at SS009a and SS009b, no further remedial action is necessary. These ICs will remain in place until the ADEC cleanup level specified in Table 1-1 are attained. The ICs at Sites LF001, LF002, SS010, LF001a, and ST006 will be reviewed annually, to ensure that land use has not changed and ICs remain effective in limiting exposure to the remaining presence of fuel, metals and PCB contamination in soil and groundwater. In the event the USAF decides to demolish the Garage at SS010, the contamination will be remediated. Future remedial activities will include an approved Work Plan and Remedial Action Report.

The USAF will remove the remaining PCB contamination at site ST006 to ADEC PCB soil cleanup standards of 1 mg/kg by December 31, 2013. Until PCB contamination has been removed, no construction or demolition activities will take place in the vicinity of the transformer stand that have the potential to disturb the contaminated soils. However, the USAF will ensure proper coordination of an approved Work Plan and provide a detailed Remedial Action Report for site closure when the remedial action has been completed.

The USAF is committed to implementing, monitoring, maintaining, and enforcing all components of the selected remedy to ensure that it remains protective of human health and the environment. ICs are legal or administrative measures taken to limit human exposure to contaminants or ecological risk by restricting use of the sites.

Under the selected soil remedy, contaminated subsurface soil will be allowed to remain in place, and potential exposure to subsurface soil limited through ICs. The major components of the selected remedy for soil are as follows:

- Visual monitoring of the top cover or clean backfill at each site for signs of settlement, subsidence, erosion, or other such events annually;
- Five year reviews will be completed and utilized to determine necessity for continued annual inspections;
- The annual inspections and five year reviews will continue until ADEC approves discontinuation of visual monitoring;
- Thermal and water quality monitoring will be conducted at Site LF001a to ensure contaminants have not leached away from the encapsulated area annually;
- The annual inspections and five year reviews will continue until ADEC approves discontinuation of visual monitoring;
- Maintaining the integrity of the top cover or clean backfill of each site to limit exposure to subsurface soils. Maintaining integrity includes:

    - Making repairs and preventing run-on or run-off from eroding or otherwise damaging the cover material;
    - Restricting excavation or disturbance of the final top cover at LF001, LF002, LF001a and ST006; and
- Restricting construction or demolition disturbance on top of LF001, LF002, SS010, LF001a and ST006 without prior concurrence from ADEC.
- Restricting access and excavation or disturbance of contaminated soil to prevent groundwater contamination, human exposure, or placement of contaminated soil in environmentally sensitive areas;
- Maintaining engineering controls to include the chain link fence underneath the Garage Building at SS010, the soil caps at LF001a and ST006, and Warning signs at SS010, LF001a and ST006;
- Inclusion and documentation of all ICs in the 611th Civil Engineer Squadron (CES) Installation Restoration Program (IRP) Records and record a Notice of Environmental Contamination (NEC) in the Alaska Department of Natural Resources land records in the appropriate recording district, including information about the following:
    - Current land uses and allowed uses of Sites LF001, LF002, LF001a, SS010, and ST006, SS009a and SS009b; and
    - Geographic extent of the IC boundaries, see Figure 1-1.
- Submittal of a Performance Report/Annual Inspection reports on ICs to ADEC annually. Five year review reports will be submitted once every five years after implementation of the remedial action;
- Prompt notification to ADEC of LUC deficiency/failure along with corrective measures taken or planned;
- ADEC concurrence for significant changes to use and activity restrictions and LUCs; and
- Prior notification to ADEC for transfer of property subject to LUCs.

The selected remedy satisfies the Remedial Action Objectives (RAOs) for the Oliktok LRRS sites of concern. These RAOs are as follows:

Prevent human ingestion of, or direct contact with contaminants in soil at concentrations in excess of ADEC Method One or Method Two cleanup criteria:

- Method One for petroleum contamination at LF001: DRO 500 milligram per kilogram (mg/kg), RRO 2,000 mg/kg;
- Method Two for LF002, LF001a, SS010 and ST006: DRO 12,500 mg/kg, RRO 13,700 mg/kg, PCBs 1 mg/kg, lead 400 mg/kg, chromium 410 mg/kg and arsenic 6.1 mg/kg).
- Prevent migration or erosion of COCs into ocean sediment.

1.5 *Statutory Determinations*

The selected remedy for sites LF001, LF002, SS010, LF001a, ST006, SS009a and SS009b, at Oliktok LRRS is protective of human health and the environment, complies with promulgated

requirements that are applicable or relevant and appropriate to the remedial action, and is cost effective.

The selected remedy represents the maximum extent to which permanent solutions can be used in a practicable manner at the site. It provides the best balance or trade-offs in terms of balancing criteria while also considering the bias against offsite treatment and disposal and considering state and community acceptance.

The NCP establishes the expectation that treatment will be used to address the principal threats posed by a site whenever practicable (40 Code of Federal Regulations [CFR] 300.430[a] [1] [iii] [A]).

The selected remedy for sites LF001, LF002, SS010, LF001a, and ST006 are protective of human health and the environment. Principal wastes are not present. PCB contamination remains on the natural surface, although is inaccessible to humans or wildlife due to soil caps and/or buildings over the surface and subsurface contamination. The selected remedies do not satisfy the statutory preference for treatment as a principal element. The selected remedies do not satisfy the statutory preference because the COCs do not pose a principal threat and the COCs are difficult and costly to treat at this location.

Because contaminants remain in the soil at LF001 at concentrations that exceed the State of Alaska Method One and Two Soil Cleanup Levels for the Arctic zone for unlimited use and unrestricted human exposure in 18 AAC 75.341, a statutory review will be conducted within five years to ensure that the remedy is, or will be, protective of human health until contaminant concentrations meet soil cleanup levels for unrestricted use and unlimited exposure.

Because site ***SS009a*** has no chemicals of concern (COCs) at concentrations exceeding Method Two Soil Cleanup Levels, no further action is required.

Because site ***SS009b*** has no COCs at concentrations exceeding Method Two Soil Cleanup Levels, no further action is required.

1.6 *Data Certification Checklist*

The following information is included in the Decision Summary section of this ROD (Section 2). Additional information can be found in the Administrative Record file for Oliktok LRSS, Alaska, which can be found at the Information Repository in the Trapper School in the Village of Nuiqsut or online at: http://www.adminrec.com/PACAF.asp

List of COCs and their respective concentrations (2.4, or 2.5.8)

Baseline risk represented by the COCs (2.7.1.3, or 2.7.1.4)

Cleanup levels established for COCs and the basis for these levels (2.12.4)

How source materials constituting principal threats will be addressed (2.11)

Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of ground water used in the baseline risk assessment and ROD (2.6.1)

Potential land and ground water use that will be available at the site as a result of the selected remedy (2.6.2)

Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (2.12.3)

1.7 *Authorizing Signatures*

This signature sheet documents the United States Air Force acceptance of the remedies selected in this Record of Decision for sites LF001, LF002, SS010, LF001a, ST006, SS009a, and SS009b, Oliktok Long Range Radar Site, Alaska. ADEC's signature indicates concurrence that the selected remedy, when properly implemented, will comply with State law. If new information becomes available that indicates the selected remedies are not effective or do not provide adequate protection of human health, safety, or welfare, or of the environment, the remedies may need to be revised.

20 Nov 12

ROBYN M. BURK, Colonel, U.S. Air Force
Commander, 611th Air Support Group

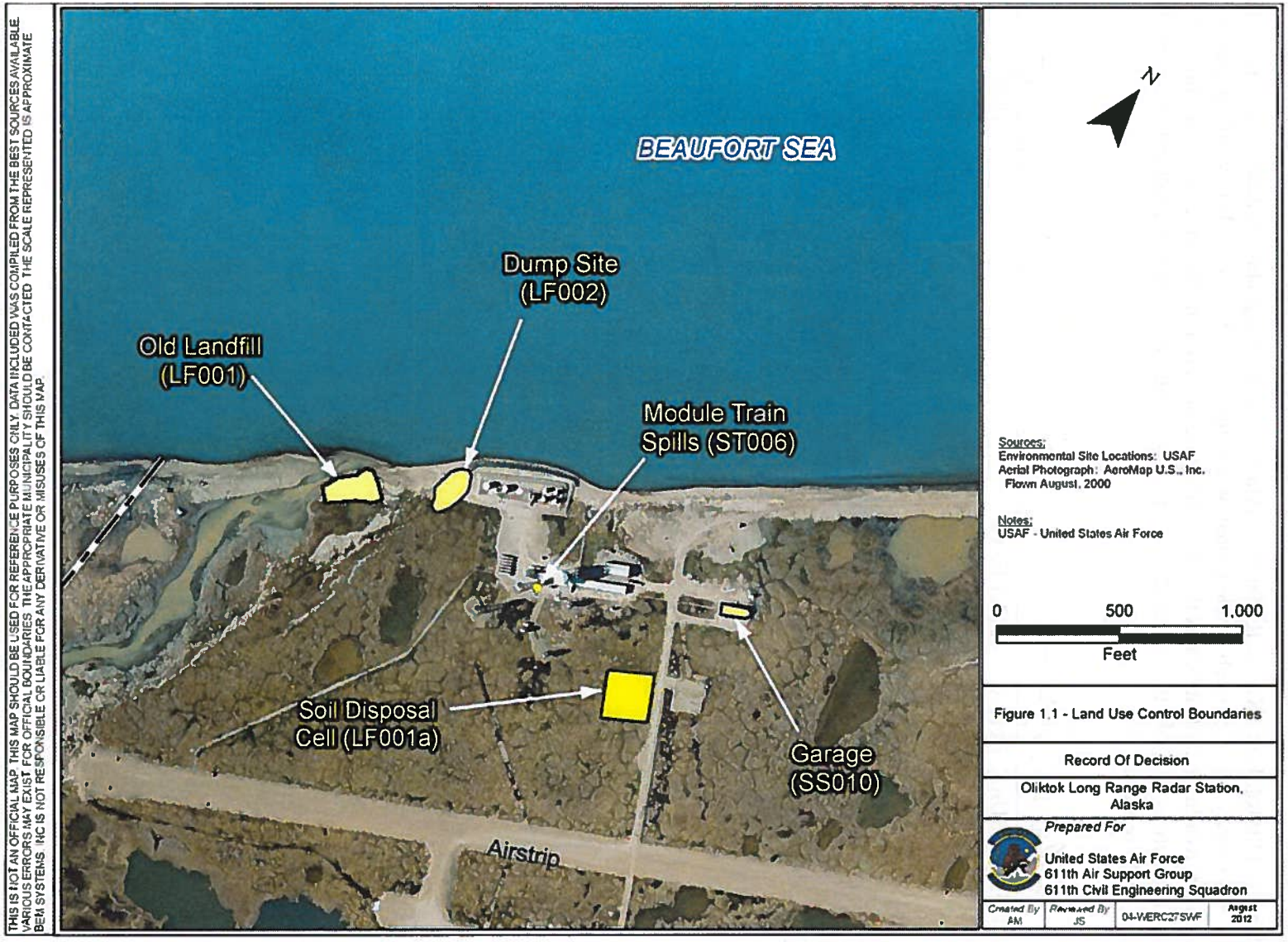
Date

11/16/2012

JOHN HALVERSON, Environmental Program Manager
Federal Facilities Section, Contaminated Sites Program
Alaska Department of Environmental Conservation

Date

Figure 1-1 Geographic Extent of the IC Boundaries



2.0 Decision Summary

The Decision Summary identifies the Selected Remedy, explains how the remedy fulfills statutory and regulatory requirements, and provides a substantive summary of the Administrative Record file that supports the remedy selection decision.

2.1 *Site Name, Location, and Description*

The Oliktok LRRS is an active long range radar site located near Oliktok Point, east of the

Colville River on the shore of Alaska's Arctic Coastal Plain at 70° 30'N latitude, 149° 53'W longitude, about 35 miles northeast of the Village of Nuiqsut and approximately 50 miles northwest of Deadhorse (Prudhoe Bay), Alaska, as shown on Figure 2-1 (USAF 2005; United States Geological Survey [USGS], 1979).

Figure 2-2 presents the locations of the main LRRS Camp Area and environmental sites. The LRRS Camp Area currently consists of a 22-unit module train containing living quarters, a power generation plant, sewage and water systems, and an incinerator. The module train is attached to the radome tower. The radome tower houses the rotating radar, which is supported on a steel-framed platform straddling the modular train. A 4,020-foot-long gravel runway is also part of the facility (USAF 2005).

The installation will continue to remain active in the future. It is located on property owned by the United States (U.S.) Government and managed by the USAF solely for industrial purposes as a radar installation. The property is secured and USAF permission must be obtained to enter. Unauthorized uses of the property are strictly prohibited now, including residential and subsistence use by unauthorized personnel. Adjacent property is used for oil field operations, subsistence, and recreational activities (USAF 2005).

As the lead agency for remedial activities, the USAF has conducted environmental restoration at Oliktok LRRS in accordance with CERCLA under the DERP which was established by Section 211 of the SARA of 1986.

As the support agency, ADEC provides primary oversight of the installation restoration actions at the site, in accordance with the Defense/State Memorandum of Agreement and State environmental regulations.

Funding for remedial activities is provided by the Defense Environmental Restoration Account; a funding source approved by Congress to clean up contaminated sites on U.S. Department of Defense (DoD) installations.

2.2 *Site History and Enforcement Activities*

This section provides background information and summarizes the series of previous site activities and investigations that led to the ROD. It describes the CERCLA response actions undertaken at Oliktok LRRS.

2.2.1 Site History

This section provides background information and summarizes previous site activities and investigations that led to the ROD. Section 2.5.5 provides a detailed description of the previous

investigations conducted at the Oliktok LRRS Sites LF001 (Old Landfill), LF002 (Dump Site), SS010 (Garage Site), LF001a (Soil Cell) and ST006 (Module Train Spill Sites).

Oliktok LRRS was originally constructed by the United States Air Force (Air Force) between 1954 and 1955 as a Distant Early Warning (DEW) Line Station known as POW-2. Contractor personnel have operated the installation since 1957. In the mid-1980s, a Minimally Attended Radar was installed, thus reducing the number of contractor personnel required for installation operation and maintenance. Generally, two contract personnel are stationed at Oliktok LRRS (USAF 2005).

For previous site characterization activities, refer to Section 2.3.6.

2.3 *Enforcement Activities*

No known notices of violation, lawsuits, or enforcement activities are pertinent to Oliktok LRRS.

2.4 *Community Participation*

An Administrative Record (AR) has been established for the Oliktok LRRS by the 611th CES Installation Restoration Section. The AR is the legal record for the IRP process at USAF installations and includes copies of all technical reports, regulatory correspondence, meeting minutes, and other documents relied upon for restoration decisions. The AR is located at:

Administrative Record: 611th Oliktok LRSS
10471 20th Street, Suite 302
JBER, Alaska 99506.

The USAF Community Relations Coordinator is the point of contact for the AR. For questions related to the AR contact:

Mr. Tommie Baker
Phone: (907) 552-4506 or 1-800-222-4137
E-mail:Tommie.Baker@elmendorf.af.mil.

Interested individuals are encouraged to use the toll-free number to obtain information about the activities at the Oliktok LRRS or the IRP process.

The AR is also available on the internet at http://www.adminrec.com, although the most recent documents may not yet be available. The AR contains the information that has been used to support USAF decision-making and is accessible to the public. A mailing list of interested parties in the community is maintained and updated regularly by the USAF Project Manager or the Community Relations Coordinator. The mailing list is used to provide interested parties copies of the newsletters, fact sheets, and public meeting notices pertaining to the environmental issues at Oliktok LRRS.

The USAF distributed the Final Proposed Plan LF001, LF002, SS010, LF001a, ST006, SS009a and SS009b for Oliktok LRRS to the local community and the public to solicit input. The plan was submitted as part of the NCP requirements for the CERCLA sites; however, comments were solicited on all sites in the Oliktok LRRS. The Proposed Plan was distributed on 25 March 2011 (USAF 2011). Two public meetings were held on 29 March 2011. The community submitted no written comments on the Proposed Plan; however, verbal comments were documented during the public meeting.

Although no written comments were received, the Nuiqsut community does place a high interest and value of the sites being restored consistently with cultural and historical conditions. Specifically the community would like to have debris along the shoreline and off-shore be cleaned up as it is identified. Nuiqsut residents are actively involved with the restoration process and have verbally expressed these concerns in ongoing Restoration Advisory Board (RAB) meetings. The community maintains an active presence in the Oliktok area for fishing and gaming.

None of the comments regarding the Proposed Plan related to any of the sites discussed in this ROD; therefore, the comments and responses will not be further detailed in this ROD.

2.5 *Scope and Role of Sites or Response Action*

As with many large sites, the environmental problems at Oliktok LRRS are complex. As a result, the USAF, with concurrence from ADEC, has organized the environmental restoration work at Oliktok LRRS into seven sites as described below.

LF001 – a former landfill approximately ¼-mile west of the Module Train, adjacent to the shoreline of the Beaufort Sea as depicted in Figure 2-3.

LF002 – a former dumpsite located northwest of the Module Train near the shoreline of the Beaufort Sea as depicted in Figure 2-4.

SS010 – a garage located approximately 200 feet east of the Camp Area consisting of an approximate 90-foot by 40-foot building that is elevated on wooden pilings approximately four feet above the tundra surface as depicted in Figure 2-5.

LF001a – a soil cell designed in accordance with the standards of a drilling or industrial waste monofill (18 AAC 60.430) containing contaminated soil from LF001, LF002, and SS010. See Figure 2-6.

ST006 – a gravel pad located near the western end of the Camp Are, adjacent to the active radar facility as depicted in Figure 2-7.

SS009a – former tank farm area where two 65,000-gallon tanks stored arctic-grade diesel fuel to supply the installation. SS009a is located near the Beaufort Sea shoreline, approximately one mile northeast of the Camp Area near the main entrance to the installation as depicted in Figure 2-2.

SS009b – a former tank farm where multiple aboveground storage tanks stored diesel fuel and gasoline to supply the installation. SS009b is located near the shoreline of the Beaufort Sea, approximately 300 feet west of the Camp Area as depicted in Figure 2-2.

2.6 *Site Characteristics*

This section includes the following information:

Sections 2.5.1 through 2.5.4 describe the site characteristics of Oliktok LRRS.

Section 2.5.5 summarizes previous site characterizations.

Section 2.5.6 presents the nature and extent of contamination.

2.6.1 Physiography and Climate

The weather station closest to the Oliktok LRRS is at Prudhoe Bay, approximately 40 miles southeast along the coast. Annual precipitation recorded at nearby Deadhorse for the period 1999 to 2008 was 3.77 inches, (Western Regional Climate Center 2009). Strong wintertime westerly winds are common and often occur with snowstorms, drifting new-fallen snow. Winds are generally milder in the summer and from the east.

Temperature minimums and maximums range from -50 degrees Fahrenheit (°F) to 82°F, respectively. The average July temperature is 46°F, and the average April temperature is 1.2°F (Western Regional Climate Center, 2009). Daily maximum temperatures are below freezing from October through May. The Beaufort Sea is usually frozen during that period. The ice pack generally breaks from shore ice in June, and the shore is typically free of ice from July until mid-September. In summer, the cold air mass associated with the Arctic Ocean rides over the Arctic Coastal Plain, creating temperature inversions with cold air below and warmer air above. Such inversions break up when winds from the south or west bring warmer air into the coastal areas.

Air quality data have not been collected at the Oliktok Point facility, but ambient conditions are expected to be even better than at Prudhoe Bay where pollutant concentrations are well below national standards.

2.6.2 Geology

Soils and the surficial geology at the Oliktok LRRS are typical of the Arctic Coastal Plain. The principal soils consist of a tundra mat underlain by 21 to 33 feet of poorly drained Holocene and Pleistocene sands, gravels, silts, clays, and organic silt and sand. These materials were deposited in marine, alluvial, fluvial, eolian, and lacustrine environments that comprise the Gubik Formation. The Gubik Formation overlies the consolidated Cretaceous sedimentary bedrock of the Nanushuk Group (Williams 1983). No bedrock outcrops occur due to the relatively thick (up to 150 feet) mantle of unconsolidated Quaternary sediments.

At the Oliktok LRRS, these unconsolidated surficial sediments consist of shallow-water marine materials deposited during periods of higher sea levels (Hopkins and Hartz 1978). Marine deposits are primarily sandy silts containing scattered pebbles and beds or lenses of clay, sand, and fine gravel. Marine sediments are mantled by six to ten feet of late Pleistocene and Holocene thaw-lake sediments, consisting of peat and muds, commonly with a mixture of coarser pebbles, cobbles, and boulders (Hopkins and Hartz 1978). Although surficial sediments are unconsolidated, they are perennially bounded by frozen interstitial pore water (i.e., permafrost).

The mainland coast and LRRS consist primarily of low, eroding tundra cliffs with associated fringing beaches. Accretional landforms occur locally and include small spits, barriers islands, and deltas. Tundra cliffs are low in height, approximately three to six feet, and contain

significant quantities of ice and peat. Coastal retreat rates of three to six feet per year are not uncommon on these cliffs (Cannon 1977; Dygas and Burrel 1976).

Coal, oil, and gas deposits may be present in the area. Significant oil exploration and production facilities have been constructed south of the installation at Kuparuk and Prudhoe Bay. Seismic activity in the installation area is low to negligible (Grantz et al. 1980, 1982; Fuelner and Michael 1984).

2.6.3 Hydrogeology and Permafrost

The Oliktok LRRS is located on an area of continuous permafrost up to 2,000 feet deep (Lachenbruch et al. 1982). The permafrost remains frozen year-round. Potable groundwater is not present beneath the continuous permafrost. Perched groundwater above the permafrost is found during the summer months when the surface layer thaws. This zone above permafrost is called the active zone because it freezes and thaws with seasonal temperature changes. During the 2004 remedial investigation (RI), the active zone at the Oliktok LRRS ranged from 3.5 to 5.5 feet below ground surface (bgs) at sample locations on gravel pads and from one to two feet bgs in inland tundra areas during late August (USAF 2005). A thin zone of water-saturated soil generally was present on top of the permafrost. Groundwater is not presently used as a drinking water source due to continuous permafrost. Permafrost acts as a barrier to vertical movement of groundwater because the pore spaces are ice-filled in the zone of saturation.

Surface features impact the subsurface distribution of permafrost because they influence heat transfer. Permafrost may be discontinuous or present at greater depths near large water bodies such as rivers and deep lakes. Therefore, shallow groundwater may be present in river gravel and in thaw bulbs beneath deep lakes. Permafrost is absent under the ocean except along the coastline and shallow shelf areas. The coastline is a transition zone at which the depth to permafrost gradually deepens and eventually becomes absent. During 2004 RI activities along the beach at LF001 at Oliktok Point, permafrost was encountered in six borings, with a maximum depth of 4.75 feet bgs (USAF 2005).

2.6.4 Surface Water Hydrology

Water conditions at the installation are similar to other Arctic coastal areas and include lagoons along the Beaufort coast, thaw lakes, and shallow streams. Oliktok Point and much of the area around the LRRS is dotted with many small lakes and wetlands. Larger thaw lakes exist approximately 0.5 to 1.5 miles south of the facility. String bogs are typical features of the flat thaw-lake plains (USAF 2005).

Drainage is poor, and most runoff occurs as supra-permafrost sheet flow. A small stream about three miles long flows into the Beaufort Sea and drains the area west of the runway. The mouth of the stream is best described as an estuarine environment (saltwater lagoon) where high tides and storm surges cause marine waters to intrude inland areas. The Ugnaravik River drains into Simpson Lagoon three miles east of the installation. The installation is moderately susceptible to coastal flooding due to its low elevation (USAF 2005).

2.6.5 Ecology

2.6.5.1 Vegetation

Three major vegetative habitats exist in the Oliktok Point area: coastal wetlands and beaches, wet sedge meadows, and tundra. The installation environment predominantly consists of low wet-sedge meadow. This habitat typically supports ponds dominated by Carex aquatilis and pendent grass. Other plants variously associated with these wetlands include cotton grass, tundra grass, buttercups, marsh marigold, and the mosses Calliergon and Drepanocladus. Drier sites along polygon rims and high-centered polygons support plant communities consisting of a variety of sedges, tundra grass, polar grass, saxifrages, arctic avens, louse warts, and the mosses Onchophorus, Tomenthypnum, and Pogonatum. Coastal wetlands and beaches range from barrens to wet saline associations. Characteristic plants are Cochlearia, Stellaria, Puccinellia, sedges, tundra grass, lyme grass, and Oysterleaf (Hart Crowser 1987).

2.6.5.2 Fish

The most abundant species of marine fish found in the Beaufort Sea include arctic cod, arctic flounder, fourhorn sculpin, and Pacific herring (Jones and Stout 1999). Anadromous and freshwater fish use nearshore waters of the Beaufort Sea for feeding and migration. Freshwater fish are usually found in association with fresh or brackish waters extending off shore from river deltas. Freshwater species may include arctic grayling, round whitefish, and burbot. Anadromous species found in the nearshore environment include arctic char, arctic cisco, least cisco, Bering cisco, inconnus, rainbow smelt, humpback whitefish, and broad whitefish. Smaller numbers of salmon (Chinook, sockeye, and coho), stickleback, and lamprey have been recorded along the Alaskan Beaufort seacoast. Small runs of salmon occur in the Colville and Sagavanirktok rivers, and Chinook and sockeye salmon have been reported in Simpson Lagoon.

2.6.5.3 Birds

Several million birds consisting of approximately 150 species are found on the North Slope, including seabirds, waterfowl, shorebirds, passerines, and raptors. Shorebirds and waterfowl disperse to nesting grounds on moist tundra and marshlands of the Arctic Slope. The Colville River Delta, just west of the Oliktok LRRS, is an important nesting area for waterfowl such as brants and yellow-billed loons (Jones and Stout 1999).

The wet tundra environment of the Oliktok LRRS region provides good nesting and foraging habitat for a wide variety of shorebirds, waterfowl, and passerines. Brants use the estuarine marsh east of the site and sites west of the LRRS for nesting and foraging (Woodward-Clyde Consultants [WCC] 1995). Several species of sandpipers, red-necked phalaropes, and plovers frequent the ponds and small lakes in and around the site (WCC 1995). Large influxes of passerine birds occur in the summer as a result of the hordes of insects that breed and hatch in wetlands. Loons, northern pintails, scaups, and eiders are some of the more commonly seen waterfowl species. Common eiders, arctic terns, glaucous gulls, and black guillemots use the barrier islands off shore for nesting. Sea ducks that frequent nearshore areas include oldsquaws, scoters, and red-breasted mergansers.

Predatory species, such as snowy owls and jaegers, are common in the area, particularly when lemming and ground squirrel populations are high. Arctic peregrine falcons are known to nest

on the Colville River but do not nest on USAF property. However, nonbreeding and migrating peregrines do occur in the area.

2.6.5.4 Marine Mammals

Marine mammals known or expected to occur in the Beaufort Sea in the vicinity of Oliktok Point include the endangered bowhead whale (Jones and Stout 1999; U.S. Fish and Wildlife Service [USFWS] 2011). Other summer residents include the gray whale, beluga whale, killer whale, harbor porpoise, bearded seal, and spotted seal. The polar bear is a winter resident of the Oliktok LRRS, and the ringed seal is a year-round resident (Wynne 1993). Although most marine mammals are under the jurisdiction of the National Marine Fisheries Service, polar bears are under the jurisdiction of the USFWS. The LRRS is within the range of the polar bear, a protected species under the provision of the Marine Mammal Protection Act (Sousa 1993). Species uncommon or rare in the area include the harbor porpoise, killer whale, Pacific walrus, and narwhal (WCC 1995).

2.6.5.5 Terrestrial Mammals

Small mammals, such as arctic ground squirrels, brown lemmings, and collared lemmings, are commonly seen around the installation (Jones and Stout 1999). Brown lemmings are the predominant rodent herbivore (Hart Crowser 1987). Wolves, polar bears and brown/grizzly bears are occasionally observed in the vicinity. The most conspicuous terrestrial mammal occurring in and around the Oliktok LRRS is caribou. The Central Arctic caribou herd moves across the installation periodically throughout the summer. Approximately 8,900 caribou moved through the area in 1993 (WCC 1995). An important calving area for the Central Arctic caribou herd is located just south of Oliktok Point (Shideler 1986). Arctic fox and short-tailed weasels are also occasionally seen in the area (WCC 1995).

2.6.5.6 Threatened and Endangered Species

No known endangered species occur within the boundaries of the Oliktok LRRS. The polar bear threatened species has been observed within the boundaries and in the vicinity of the Oliktok LRRS since the 1950's. The Integrated Natural Resources Management Plan, 2007 Revision—2009 Update, Annual Review, Alaska Radar System, Alaska Short and Long Range Radar Sites, Alaska 611th Air Support provides a benefit to polar bears occurring in habitats within or adjacent to these facilities (USFWS 2010). Therefore, lands within Oliktok LRRS are exempt from critical habitat designation under section 4(a)(3) of the Endangered Species Act of 1973. The Steller's eider and spectacled eider are threatened species potentially occurring within the vicinity of the Oliktok LRRS (USFWS 2011; Alaska Natural Heritage Program 1993). The spectacled eider may have nested on the marsh near the LRRS in 1992 (WCC, 1995). Day et al. (1995) surveyed for spectacled and Steller's eiders at remote USAF sites in 1994. This study did not locate either species of eider at the Oliktok LRRS. However, the possible remains of an old (1993) nest believed to be from a spectacled eider were found at the Oliktok LRRS, 165 feet southwest of the hangar pad. The Oliktok LRRS was identified as one of the four USAF sites with the greatest potential for nesting spectacled eiders and little potential for nesting Steller's eiders. Disturbance to nesting Steller's and spectacled eiders during soil remediation is unlikely so long as the work does not coincide with the nesting season (June through July). In addition, any operations at the Oliktok LRRS site would likely use existing roads and formerly impacted

areas. Ground surveys conducted in 2000 found no eider nests within 200 meters of the LRRS facilities (Alaska Biological Research, Inc. [ABR] 2000).

The North American lynx, a former Category 2 species, is also a potential user of the Oliktok LRRS area (Jones and Stout 1999). The bowhead whale, listed as endangered (USFWS, 2011) by the National Marine Fisheries Service, migrates off shore of the installation.

2.6.6 Previous Site Characterization Activities and Remedial Actions

Several studies and activities have been performed at the Oliktok LRRS:

IRP records search for Alaska DEW Line Stations; including Oliktok LRRS (USAF 1981);

IRP Phase II, Stage 1, Confirmation/Qualification for Alaska DEW Line Stations that addresses LF001 (USAF 1986);

IRP Phase II, Stage 2, Confirmation/Qualification for Alaska DEW Line Stations that addresses LF001 (USAF 1988a);

IRP Technical Support Document for Record of Decision POW-2 DEW Line Site that addresses LF001, LF002, and SS010 (USAF 1988b);

Environmental Baseline Survey Air Force Radar Stations, Alaska, including Oliktok LRRS (USAF 1995);

Risk Assessment at eight sites, including LF001, LF002, the ST003, ST004, SS005, ST008, SS010, and SS011 (subsequently divided into ST006 and SS007) (USAF 1996a);

1993 Remedial Investigation / Feasibility Study (RI/FS) that addressed LF001, LF002, ST003, ST004, SS005, ST008, SS010, and SS011 (USAF 1996b);

2001 Clean Sweep Environmental Survey Report (USAF 2002);

2002 Focused RI at the LF001, LF002, and ST003 (USAF 2003);

2003 RI/FS that addressed LF001, LF002, and ST003 (USAF 2004);

2005 RI/FS that addressed LF001, ST004, SS005, ST006, SS007, ST008, SS010, and SS009a (USAF 2005); and

2006 Ecological Risk Assessment (USAF 2007a).

2.6.6.1 Site LF001 (Old Landfill)

LF001 is the environmental designation for the Old Landfill. LF001 is located approximately ¼-mile west of the Module Train, near the shore of the Beaufort Sea as presented in Figure 2-3. LF001 is bordered on the west by a creek; a pond and tundra on the south and southeast; the Dock Storage Area (ST003) on the east and northeast; and the Beaufort Sea on the north and northwest.

LF001 received wastes from the installation from approximately 1956 until 1978. The landfill was never permitted under 18 Alaska Administrative Code (AAC) 60 (Alaska Solid Waste regulations), and is best classified as a dumpsite. The surface of the landfill was cleaned, covered, and reseeded between 1978 and 1980, after which it did not accept any more waste or debris.

The soils, sediments and water in and surrounding the landfill were initially sampled in 1993 (ICF Technologies Inc. [ICF] 1996a), 2002 (USAF 2002) and 2003 (Hoefler Consulting Group [HCG] 2004). Samples were analyzed for petroleum hydrocarbons (GRO, DRO, and RRO),

polynuclear aromatic hydrocarbons (PAHs), VOCs, PCBs, and metals. These results were summarized and evaluated in the 2003 RI/FS report (HCG 2004). DRO and RRO were found above ADEC Method One soil cleanup levels for the Arctic Zone. No petroleum-related compounds, including BTEX and PAHs, were detected above Method Two cleanup soil levels. Chlorinated solvents and other VOCs were either not detected or detected at levels less than one-tenth Method Two soil cleanup levels. Low-level PCBs were detected in the shallow subsurface soils at several locations. The detections of PCBs (specifically Aroclor 1254) were generally located near the trailer. Sampling in 2002 and 2003 did not detect any PCBs greater than the 18 AAC 75 soil cleanup level for PCBs (1 mg/kg). PCBs were not detected in sediment samples from the adjacent water bodies, including the creek and pond.

In the fall of 2000, a portion of the landfill was eroded during a storm event which exposed debris including drums and metal cable. In 2001, the USAF performed a time-critical removal action at LF001, near the stream at the west side of the landfill, to remove debris uncovered during the storm. During the cleanup of the debris, a small quantity of oil was spilled from a drum, which caused contamination of the beach sands. Some of the recovered oil contained PCBs at around 2 parts per million. All contamination associated with the storm event was excavated, containerized, manifested, and shipped off site for proper disposal.

The 2003 RI/FS (HCG 2004) concluded petroleum hydrocarbons and PCBs in the soils were Chemicals of Potential Concern (COPCs). The risk posed by these COPCs was deemed low because of their concentration and location. The contaminants were not migrating to the adjacent surface water and sediments, and at the documented concentrations in the soil, they do not pose a current risk to human health or the environment, including surface water (HCG 2004). However, the 2003 RI/FS determined the landfill would very likely erode into the Beaufort Sea within 50 years. This could occur, at least partially, in the near term (the next large storm event). The 2003 RI/FS was concerned that the erosion of the landfill would release the contaminated soil and debris, and would pose both chemical and physical hazards. Based on the risks posed by the erosion of the landfill and the release of its contents, the Old Landfill was recommended for remedial action in the 2003 RI/FS (HCG 2004).

In 2004, additional sampling was performed at LF001 to determine and confirm the horizontal and vertical extent of PCB and petroleum contamination within the landfill. Results indicated that the primary area of interest was the 2- to 6-foot depth range near the central portion of the landfill and this depth zone was not previously sampled in earlier investigations (USAF 2005).

The USAF pursued the recommended action and in May through June 2007, LF001 was excavated and its entire contents were removed. During excavation, confirmation soil sampling activities were conducted for the soils and the materials removed from the landfill at LF001 (USAF 2007a).

2.6.6.1.1 Remedial Action

LF001 removal consisted of three areas of excavation with individually identified levels and types of contamination. Excavation activities were completed in spring of 2007 and 2008. The contractor conducted the landfill removal without an approved work plan and did not characterize the nature of contaminated soil during the fieldwork, but instead based the segregation of the excavated soil solely on the results presented in the 2005 *Remedial Investigation/Feasibility Study Report for Eight Sites*. Within LF001, an approximately 420

square foot area (ft^2) known to contain PCB contaminated soil was excavated first. No confirmation samples were collected at that time. Next, an approximately 3,990 ft^2 area known to have POL contaminated soil was excavated. Again, no confirmation sampling was performed. Finally the outside Area, which encompassed the remainder of the landfill, was removed in its entirety consisting of an approximately 31,580 ft^2 area.

Impacted soil was excavated vertically to permafrost. The excavated soils from each of the areas were segregated and sampled inside the onsite Air Freight Terminal, with the exception of the soils from the Outside Area. These PCB and POL excavated soils, approximately 3,500 cubic yards (cy), were stockpiled in the southeast area of LF001. The remaining 910 cy excavated from LF001were staged in the Air Freight Terminal in both supersacks (PCB Area soils) and stockpiled on Anadromous liner (POL contaminated soil) in 2007. A total of 4,400 cy of soil were excavated from LF001 in 2007.

The laboratory samples for the segregated soils were analyzed for GRO, DRO, RRO, VOCs, BTEX, PAHs, PCBs, and metals. GRO, DRO, RRO, and PCBs were identified as COCs based upon the detection frequency and concentration. The detected concentrations of the containments exceeded the State of Alaska Method One and Method Two Soil Cleanup Levels for the Arctic zone in 18 AAC 75.341 Tables A2, B1, and B2, with the exception of GRO (USAF 2010).

Ninety-six percent of the soil samples collected and analyzed from the 3,500 cy stockpile in the Outside Area had concentrations of PCBs at levels exceeding ADEC Method Two Soil Cleanup Level. Therefore, in the fall of 2007, the USAF implemented a CERCLA Time Critical Removal Action (TCRA) for the stockpiled soils to prevent erosion into the Beaufort Sea over the winter months. The TCRA included the partial construction of an on-site Soil Cell for transfer and placement of the PCB-impacted soil identified during landfill removal activities at LF001 in May-June 2007 (USAF 2010).

Once the landfill contents were excavated in 2007, sample results indicated contamination remained. Therefore, an additional one foot lift of soil was removed from the entire floor of LF001 in 2008, resulting in the bottom of the excavation being at levels below sea level. Further sampling (multi-increment) analytical results from the floor of the LF001 excavation indicated that PCBs remain at concentrations greater than the ADEC Method Two Soil Cleanup Level for the Arctic zone. The table below shows the remaining contamination for DRO, RRO, lead and chromium prior to removal of the final one-foot lift of soil from the bottom of LF001, and the remaining PCB contamination after removal of the one-foot lift of soil (USAF 2010). Table 2-1 below only shows results of contaminants of concern that were above the applicable cleanup levels.

Table 2-1 LF001 Soil Contamination Remaining Following Landfill Excavation

Contaminant of Concern	Maximum Remaining Concentration (mg/kg)	Soil Cleanup Level (mg/kg)
DRO	**1,210**	500*
RRO	**8,410**	2000*
Lead	**420**	400
Chromium	**1,500**	410
PCBs	**4.36**	1 - 10 with a cap and ICs

Notes:
Concentrations exceeding ADEC Method One or Method Two Soil Cleanup Levels for the Arctic Zone are bolded
*** Petroleum Hydrocarbon Method One Soil Cleanup Levels in the Arctic Zone**
Source of soil cleanup levels: 18 AAC 75.341, Table A2 and B1.

Because the main COC became PCBs, soil samples (multi-increment) collected after the final one-foot lift was removed were analyzed for PCBs only. Some residual contamination remains on the floor of the excavation above cleanup levels for PCBs. The entire landfill contents, including liquid-containing drums, batteries, asbestos, and other contaminated materials, were removed in 2007 and staged within and just outside of the Air Freight Terminal over the 2007-2008 winter months. Additionally, the presumed-clean soil was sampled to determine suitability for use for backfill, but exceeded ADEC Clean-up standards.

In spring 2008, the debris and materials were packaged and transported to appropriate facilities for offsite disposal. The segregated soils in the Air Freight Terminal, some within supersacks and some stockpiled on visqueen liners, were transported for inclusion in the onsite soil cell (LF001a). Since the presumed-clean soil was sampled and determined to exceed ADEC Clean-up standards for PCBs, the soil was not suitable for use as backfill and therefore placed within the LF001a soil cell.

The bottom of the excavation, following the additional one-foot lift excavation in 2008, was determined to be below sea level. The remaining PCB contaminated soil at the site is located below sea level and is completely covered/secured by approximately 4,400 cy of clean backfill (USAF 2010).

2.6.6.2 Site LF002 (Dump Site)

The Dump Site (LF002) consists of a gravel-covered area (pad) west of the main station and east of ST003. The estimated boundary of the Dump Site is depicted on Figure 2-4. The Dump Site was active from the late 1970s to the 1980s. It was reportedly cleaned up in 1987 because the site was being eroded along its seaward side (Dames & Moore 1987). The debris was hauled to the "New Landfill", see Figure 2-2 titled Asbestos Landfill, located on the road between the installation and the runway.

The soils, sediments, and water were sampled during the 1993 RI/FS for variety of substances including petroleum hydrocarbons (GRO, DRO, and RRO), VOCs, BTEX, PCBs, pesticides, and metals (ICF 1996a). It was reported that "no significant contamination" was detected. Consequently, there did not appear to be the potential for contaminant migration from the site. The Human Health and Ecological Risk Assessment did not identify any COPCs or risk to human health or the environment at the site (ICF 1996b). Based on this analysis, the site was recommended for no further action.

The site was electromagnetically surveyed and sampled by the USAF in 2002 (USAF 2002). Conductive anomalies were found at two locations: the gravel pad near the south end of the site (parking area) and near the approximate bluff location along the Beaufort Sea. One soil sample was collected from the base of the bluff and analyzed for petroleum hydrocarbons, PCBs, VOCs, PAHs, and metals. The only soil sample collected from this area in 2002 had an arsenic concentration of 6.16 mg/kg, and a DRO concentration of 243 mg/kg.

The depth of gravel fill along the seaward side of the landfill appears to be 5 to 7 feet thick based on the height and composition of the bluff. The bluff face consists of coarse gravel and sand and does appear to be native material, except at its base where peat is exposed. The man-made pad is being eroded along its seaward side resulting in the visible bluff. In 2003, buried metallic debris was visible at the base of the bluff. Only metallic objects were visible, and there was no indication of other types of wastes being present. One drum was visible but it was empty and was free of staining or other signs of leakage. The metallic debris consisted primarily of scaffolding, pallets, and structural tubing. The metal debris may have been placed along the seaward side of the pad to mitigate erosion. The shoreline in front of the bulk fuel tanks directly east of LF002 has been stabilized with sandbags (supersacks) since the early 1990s (USAF 2004).

2.6.6.2.1 Remedial Action

During excavation activities of inert debris in 2007, a buried gravel disposal pit was discovered in the south central portion of LF002. This pit contained one liquid-filled drum, asbestos containing material and PCB impacted soil. These particular landfill wastes were removed from LF002 and staged in the Air Freight Terminal over the 2007-2008 winter. In 2008, the wastes were properly packaged and transported to appropriate facilities for offsite disposal.

Approximately 800 cy of impacted soil was removed from the discovered gravel pit in the south-central portion of LF002 and stockpiled adjacent to the pit but within LF002 boundaries in 2007. Sidewall, floor and stockpile soil samples were collected during excavation activities in 2007. These samples were analyzed for the presence of GRO, DRO, RRO, VOCs, BTEX, PAHs, PCBs, pesticides, and metals. GRO, DRO, RRO and PCBs were identified as COPCs based upon the detection frequency and concentration at this and other sites at Oliktok LRRS (USAF 2010). The compounds listed above were reported at the maximum concentrations shown in the table below.

Table 2-2 LF002 Soil Contamination Remaining Following Remedial Excavation (2007)

Contaminant of Concern	Maximum Detected Concentration (mg/kg)	ADEC Method Two Soil Cleanup Levels for Arctic Zone (mg/kg)
GRO	7.53	1,400
DRO	938	12,500
RRO	3,370	13,700
PCBs	2.82	1 – 10 with a cap and ICs

Notes:
Concentrations exceeding ADEC Method Two Soil Cleanup Levels for Arctic Zone are bolded
Source of soil cleanup levels: 18 AAC 75.341, Table B1 and B2.

As shown in the table, the detected concentrations do not exceed the State of Alaska Method Two Soil Cleanup Levels for the Arctic zone in 18 AAC 75.341 Tables B1 and B2, except for PCBs which exceeds the limit significantly.

Fifty-seven percent of the soil samples collected from the stockpile detected PCBs at levels above ADEC Method Two Soil Cleanup Levels. Due to the large quantity (originally estimated to be 400 cy) of PCB-impacted soil stockpiled in LF002, and its close proximity to the shoreline the USAF implemented a CERCLA TCRA at LF002 in October 2007. The TCRA included the partial construction of an on-site Soil Cell (LF001a) for transfer and placement of the PCB-impacted soil excavated during landfill removal activities at both LF001 and LF002 in May-June 2007. Additional excavations and multi-incremental sampling was completed at LF002 in 2008. The material excavated in 2008 was also added to the soil cell (site LF001a). Excavation at LF002 was made at depths ranging from five to seven feet within the area, below ground surface, resulting in the bottom excavation being below sea-level. The excavation area was backfilled with approximately 775 cy of clean gravel material obtained from the Oliktok runway (USAF 2010).

2.6.6.3 Site SS010 (Garage Site)

The Garage Site (SS010) consists of a gravel pad surrounding an active vehicle maintenance and storage building (garage) as depicted on Figure 2-5. The garage is currently an active facility used for vehicle maintenance. The facility is not scheduled for demolition. The gravel pad serves as a parking area for site personnel. The down gradient tundra area to the east is largely undisturbed marshy wetlands containing small ponds typical of the area. This site is located approximately 200 feet east of the module train on a gravel pad. The garage is an approximately 90-foot by 40-foot building. It is elevated on wooden piling approximately four feet above the ground surface. The garage is surrounded by a gravel pad on the north, east, and south sides. The gravel pad extends approximately 50 to 100 feet beyond the footprint of the garage, where it grades into largely undisturbed tundra.

Sampling and analysis during the 1993 RI determined that the Garage site (SS010) was contaminated with GRO, DRO, RRO, BTEX, PCBs, and low levels of VOCs and semivolatile organic compounds (ICF 1996a). Contaminated media at the site were soil and sediment. The soil beneath the building had the highest concentration of contaminants. The RI concluded that the closing of the floor drains and improved waste management practices will prevent future releases of contaminants to the environment.

Sampling and analysis during the 2004 RI/FS determined that the Site SS010 was contaminated with DRO, RRO, PCBs, arsenic, and lead which exceeded Method Two soil cleanup levels for the Arctic Zone. In addition to the spill(s) under the garage, there appeared to be another spill area on the southern edge of the gravel pad, as evidenced by samples exceeding ADEC Method Two cleanup levels for PCBs and RRO.

The *Follow On Remedial Investigation for Garage Site SS010* dated February 2007, identified an area approximately 286 ft^2 with a depth of approximately six inches as the extent of PCB contamination. This area of contamination is located within the down gradient tundra area to the east and adjacent to the southern edge of the gravel pad. The maximum PCB concentration detected in August 2006 during field activities was 8.09 mg/kg (USAF 2007).

2.6.6.3.1 Remedial Action

In June 2007, the Air Force excavated PCB-contaminated soils from the tundra located south of the gravel pad tundra area (USAF 2010). Confirmation samples collected from the sidewalls and

floor of the excavation confirmed that PCB-impacted soils exceeding the State of Alaska Method Two Soil Cleanup Level for the Arctic zone of 1 mg/kg were successfully removed from this site (18 AAC 75.341, Table B1).

Potential human exposure pathways to the remaining impacted soils located beneath the SS010 garage include incidental ingestion of soil, inhalation of dust, and dermal contact with soil. Ecological exposure pathways include dermal contact with the soil or sediment, ingestion of soil, prey species, surface water, terrestrial plants, soil invertebrates, and aquatic plants due to bioaccumulation, as well as inhalation of dust from impacted soils. However, these exposure pathways are extremely limited due to the installed fence intended to keep human and wildlife from accessing impacted soils beneath the garage (USAF 2010). The garage is still in use as a storage and repair area and would have required demolition to access remaining contamination.

In June 2007, the Air Force installed warning notification signs and constructed a fence around the bottom of the garage building to prevent potential human and ecological exposure to the contaminated soils located beneath the garage building (USAF 2010).

2.6.6.4 Site LF001a (Soil Cell)

The LF001a Soil Cell is approximately 15 feet in thickness and 200 feet in length and width as depicted on Figure 2-6. LF001a is located approximately 1,800 feet south of the Beaufort Sea shoreline, and is not subject to ocean erosion, the condition that had previously threatened LF001 and LF002.

LF001a was designed in summer 2007, in response to a CERCLA TCRA conducted by the Air Force to mitigate the potential for erosion of contaminated soil from LF001 and LF002 into the Beaufort Sea. As previously discussed, during the excavation and remedial activities at these two sites, it was discovered that the extent of contamination, and therefore the volume of contaminated soils, was much larger than what had been expected (USAF 2010).

The selection of the construction location for LF001a on the west side of the access road was determined to be the most appropriate site for the Soil Cell since surface water readily drains from this area and would minimize the potential for ponding of surface water around the toe of the Soil Cell. The LF001a Soil Cell is located across the road from an existing asbestos disposal cell, as shown in Figure 2-2, which is also maintained by the Air Force. The Soil Cell was designed in accordance with the standards of a drilling or industrial waste monofill per 18 AAC 60 Solid Waste Management regulations (18 AAC 60.430). In October 2007, the base of the LF001a Soil Cell was constructed; consisting of a chemical resistant geosynthetic liner and a one-foot thick layer of clean gravel fill material that was obtained from a borrow source located at the end of the Oliktok LRRS runway (USAF 2010).

LF001a was designed and planned for a one-time use to store PCB and POL contaminated soil and minor amounts of contaminated landfill wastes excavated from LF001, LF002 and SS010. Stockpiled contaminated soil from LF001 and LF002 was placed in LF001a in October 2007 and allowed to freeze in place over the winter. In spring 2008, additional contaminated soil from LF001, LF002, and SS010 staged in the Air Freight Terminal over the 2007-2008 winter months was added to the soil cell, and a cap of clean soils was placed on top of the impacted material. The cap of the soil cell was completed in summer 2008 with the installation of an erosion control blanket, and the Soil Cell was seeded with tundra grasses to prevent erosion and contaminant

migration (USAF 2010). Thermal monitoring points were installed within and around the Soil Cell to verify that freeze-back has taken place. Water quality points were installed surrounding the Soil Cell to monitor for leaching of contamination from the Soil Cell. Table 2-3, shown below gives amounts and contaminant concentrations within the cell.

Table 2-3 LF001a Soil Cell Waste Streams

Soil Origin	Volume (cubic yards)	Contaminant	Maximum Concentrations (mg/kg)
LF001 Soil	3,500	PCBs	7.72
		DRO	38,400
		RRO	5,590
LF002 Soil	800	PCBs	2.98
		RRO	3,200
LF001 and LF002 additional excavation	1,200 (estimated)	PCBs	36.4
		DRO	1,210
		RRO	8,410
LF001 POL Area	780	PCBs	8.4
		GRO	357
		DRO	2,040
		RRO	5,200
LF001 PCB Area	78	PCBs	2.98
LF001 (northeast corner)	52	PCBs	4.39
SS010	35	PCBs	18.6
		GRO	214
		DRO	11,900
		RRO	23,800

2.6.6.5 Site ST006 (Module Train Spills)

Site ST006 encompasses the gravel pad beneath and adjacent to the west end of the module train, the tundra directly north of the module train, and the transformer area southwest of the module train (Figure 2-7). The gravel pad in this area is generally three to four feet thick, but thins to only an inch or two beneath the module train. A culvert drains the area beneath the module train to the wetland area to the north. An active sanitary sewer line from the module train extends approximately 250 feet north to an outfall area, upgradient of the Beaufort Sea. The transformer platform is approximately five feet south of the module train on the gravel pad. Staining or evidence of a spill was not visible on the stand or ground surface (USAF, 2005).

During the 1993 RI soil, sediment, and water samples were analyzed from the module train diesel spill site for fuel-related compounds. During the 2004 RI/FS, soil samples were analyzed for GRO, BTEX, DRO, RRO, and PAHs beneath the module train, on the gravel pad, and in the tundra to characterize the diesel spill site. The maximum GRO, DRO, and RRO detected were 24.7, 3,730, and 686 mg/Kg, respectively. The maximum BTEX concentration was 0.6 mg/Kg. The maximum DRO concentration from the 2004 RI/FS was 4,700 mg/kg collected from beneath the module train. Soil samples collected east and downgradient of the maximum detected DRO concentrations in 2004 did not contain DRO in excess of 247 mg/kg. This indicates that the DRO contamination beneath the module train is localized and not migrating. Soil samples were collected from within the gravel and tundra to assess contaminant migration within the active layer. Contaminants were not detected above screening criteria at either of these sample locations. Only one sample at this location exceeded the ADEC Method One soil cleanup level of 500 mg/Kg for diesel spills (USAF, 2005).

Downgradient sediment and water samples were analyzed for lead, BTEX, and PAH compounds to assess contaminant migration. Very low levels of petroleum contamination were detected in these samples. Results in 1993 had indicated elevated concentrations of petroleum hydrocarbons and lead (110 micrograms per liter [µg/L]) in the surface water. Results from 2004 indicate low lead concentrations in the sediment (3.95 mg/kg), and low levels of petroleum hydrocarbons and lead (2.09 µg/L) in the surface water (USAF 2005).

During the 2004 RI/FS soil samples were analyzed from beneath the transformer stand for PCBs. PCB concentrations in the samples were 5.27 and 1.29 mg/kg. Only one type of PCBs was detected: Aroclor 1254. The 2005 RI/FS recommended removal of the PCB contaminated soil underneath the transformer platform consisting of excavation of the approximate seven (7) cy.

2.6.6.5.1 Remedial Action

During the May-June 2007 field activities, clean gravel material was obtained from the east end of the Oliktok runway. The material was first placed directly on top of the gravel pad underneath the transformer stand to provide a smooth surface. A permeable liner was then placed on top of the clean gravel and was capped with six inches of additional clean gravel obtained from the runway. Additionally, a warning sign was installed on the Module Train just above the impacted area, which read: "Warning Contaminated Soil Present Beneath Transformer Platform Do Not Disturb Area Without Contacting 611 CES/CEVR 1-800-222-4137." The USAF intends to include information regarding the environmental quality of the soils at ST006 within the base master plan, register and maintain the property under the ADEC Notice of Environmental Contamination (NEC) program for Contaminated Sites.

2.6.6.6 Site SS009a (Diesel Storage Tanks)

SS009a, the Diesel Storage Tank site, is the designation for the environmental site associated with a former tank farm where two 65,000-gallon tanks stored arctic-grade diesel fuel to supply the installation. SS009a is located near the Beaufort Sea shoreline, approximately one mile northeast of the Camp Area near the main entrance to the installation. The fuel tanks, underlying concrete tank pads, and pipelines have been removed. Only the gravel pad remains. Currently the site is unused and undeveloped and will remain undeveloped in the future. Current and planned future land use for SS009a is designated as an industrial setting.

SS009a is less than one acre in size and consists of a gravel pad set upon a low-lying natural gravel spit. The gravel pad slopes down to native tundra to the south and toward the Beaufort Sea shoreline to the east and west. Surface water runoff from the site drains to the Beaufort Sea. In the past, the shoreline northwest of the site may have been susceptible to erosion; however, construction of a new oilfield pad off the shore in this area is expected to eliminate erosion in the vicinity of SS009a.

No areas of archeological or historical importance are known to exist at the SS009a.

Soil samples were analyzed for BTEX, GRO, DRO, RRO, and PAHs during previous investigations conducted by the Air Force. No constituents were reported at concentrations that exceeded the Method Two Soil Cleanup Levels for the Arctic zone for unrestricted use in 18 AAC 75.341 Tables B1 and B2, see Table 2-4.

2.6.6.6.1 Remedial Action

Method Two Cleanup Levels are protective of human health and the environment at SS009a. Sampling and analysis during the 2004 RI/FS for BTEX, GRO, DRO, RRO, and PAHs determined that no constituents were reported at concentrations that exceeded the Method Two Soil Cleanup Levels for the Arctic zone for unrestricted use in 18 AAC 75.341 Tables B1 and B2, see Table 2-4. Based on these results, no further action is necessary at SS009a to address human health or the environment.

Although all property within the installation boundary is controlled by the Air Force solely for the operation of the radar installation, the site would be suitable for unrestricted use in its current condition. Residual soil contamination at SS009a could potentially result in a water quality violation if moved off site to an area that is subject to ocean erosion or inundation by surface water. Therefore, the USAF intends to include information regarding the environmental quality of the soils at SS009a within the base master plan, register and maintain the property under the ADEC Notice of Environmental Contamination (NEC) program for Contaminated Sites, and ADEC contaminated sites database to inform site users that ADEC approval will be obtained prior to moving or reuse of any soil from SS009a.

2.6.6.7 Site SS009b (Fuel Storage Area)

SS009b, the Fuel Tank Farm site, is the designation for the environmental site associated with a former tank farm where multiple aboveground storage tanks stored diesel fuel and gasoline to supply the installation. SS009b is located near the shoreline of the Beaufort Sea, approximately 300 feet west of the Camp Area (Figure 2-2). The fuel tanks, underlying concrete tank pads, and pipelines were removed by the Air Force in 2006. Only the gravel pad remains at SS009b. Currently the site is unused and undeveloped and will remain undeveloped in the future. Current and planned future land use is industrial.

SS009b is approximately two acres in size and consists of a gravel pad that slopes down to native tundra to the south and the Beaufort Sea shoreline to the north. In the past, the shoreline to the northwest of the site may have been susceptible to erosion during storm events; however, erosion barriers installed on the beach face have stabilized the shoreline.

No areas of archeological or historical importance are known to exist at SS009b.

2.6.6.7.1 Remedial Action

Method Two Cleanup Levels are protective of human health and the environment at SS009b. Sampling and analysis during the 2004 RI/FS for BTEX, GRO, DRO, RRO, and PAHs determined that no constituents were reported at concentrations that exceeded the Method Two Soil Cleanup Levels for the Arctic zone for unrestricted use in 18 AAC 75.341 Tables B1 and B2, see Table 2-4. Based on these results, no further action is necessary at SS009b to address human health or the environment.

Although all property within the installation boundary is controlled by the USAF solely for the operation of the radar installation, the site would be suitable for unrestricted use in its current condition.

Residual soil contamination at SS009b could potentially result in a water quality violation or result in risk if moved off site to an area that allows residential use or inundation by surface

water. Therefore, the USAF intends to include information regarding the environmental quality of the soils at SS009b within the base master plan, register and maintain the property under the ADEC Notice of Environmental Contamination (NEC) program for Contaminated Sites, and ADEC contaminated sites database to inform site users that ADEC approval will be obtained prior to moving or reuse of any soil from SS009b.

2.6.7 Nature and Extent of Contamination

Table 2-4 below provides the remaining maximum concentrations of COCs in soil following remedial actions performed in 2007 and 2008 at Oliktok LRRS.

Table 2-4 Maximum Contaminant Concentrations at Oliktok LRRS Post Remedial Actions

Site	Contaminant	Carcinogen (c/nc)	Maximum Concentration (mg/kg)	Soil Cleanup Level (mg/kg)
LF001	DRO	nc	**1,210**	500*^
	RRO	nc	**8,410**	2000*
	PCBs	c	**4.36**	1 – 10 with a cap and ICs
	Lead	c	**420**	400
	Chromium	nc	**1,500**	410
LF002	GRO	nc	7.53	1,400
	DRO	nc	938	12,500
	RRO	nc	3,370	13,700
	PCBs	c	**2.82**	1 – 10 with a cap and ICs
SS010	DRO	nc	**34,500**	12,500
	RRO	nc	**41,300**	13,700
	PCBs	c	**18.6**	1
	Lead	c	**830**	400
	Arsenic	c	**23.8**	6.1
ST006	DRO	nc	3,730	12,500
	GRO	nc	24.7	1,400
	RRO	nc	686	13,700
	PCBs	c	**5.27**	1
SS009a	DRO	nc	7,810	12,500
	GRO	nc	485	1,400
	RRO	nc	396	13,700
	Naphthalene	nc	9.4	42
SS009b	DRO	nc	1,200	12,500
	GRO	nc	130	1,400
	Benzene	c	0.01	17
	Ethylbenzene	c	0.055	110
	Xylenes (Total)	nc	6.8	63

Notes: Source of soil cleanup levels: 18 AAC 75.341, Table A2, B1 and B2.
"c" means carcinogenic, and "nc" means noncarcinogenic.
Concentrations exceeding ADEC Method One or Method Two Soil Cleanup Levels for the Arctic Zone are bolded
*** Petroleum Hydrocarbon Method One Soil Cleanup Levels in the Arctic Zone utilized due to the site's proximity to the Beaufort Sea.**
^ a less stringent cleanup level of 500 mg/kg for DRO is utilized when levels of BTEX are less than 15 mg/kg and benzene levels are less than 0.5mg/kg level

Soil samples collected from Sites LF001, LF002, SS010, LF001a and ST006 exceeded concentrations above the ADEC Method One or Method Two cleanup criterion.

2.6.8 Conceptual Exposure Model

Conceptual exposure models were developed for human health and ecological receptors to depict the potential relationship or exposure pathways between chemical sources and receptors. An exposure pathway describes the means by which a receptor can be exposed to contaminants in environmental media. These pathways are presented in Figure 2-8, and are based upon current and reasonably likely future land use scenarios. For purposes of evaluating human health exposure pathways, it was assumed there are no current permanent residents at the Oliktok LRRS. Current site use is limited to periodic site workers. Future exposure pathway scenarios assume the Oliktok LRRS facility will maintain a staff of periodic resident workers.

The primary exposure pathway for both human health and ecological risk at sites LF001, LF002, SS010, LF001a, and ST006 is via direct contact with contaminated soil (Figures 2-8). Inhalation via volatilization to outdoor air is also considered a complete pathway, but due to the low concentration of volatiles detected in the soil and the low ambient air temperature, it is a minor pathway. Although future residential land use is considered unlikely at Oliktok LRRS sites, the human health risk assessment determined whether the site would be suitable for unrestricted use or unlimited exposure, as described in Section 2.8.

2.7 *Current and Potential Future Land Use and Resource Uses*

2.7.1 Land Use

2.7.1.1 Site LF001 (Old Landfill)

The current land use of LF001 is industrial; however the site is no longer used for waste disposal and the buried wastes have been removed. As the lead agency, the USAF has the authority to determine the future anticipated land use of LF001. After considering input from ADEC and public comments, the USAF has determined that the most likely future land use of LF001 for the foreseeable future is industrial land use. Although the current use is industrial, the USAF may, in the future, close the installation and potentially transfer the land.

2.7.1.2 Site LF002 (Dump Site)

The current land use of LF002 is industrial; however the site is no longer used for waste disposal and the buried wastes have been removed. As the lead agency, the USAF has the authority to determine the future anticipated land use of LF002. After considering input from ADEC and public comments, the USAF has determined that the most likely future land use of LF002 for the foreseeable future is industrial land use. Although the current use is industrial, the USAF may in the future close the installation and potentially transfer the land.

2.7.1.3 Site SS010 (Garage Site)

The current land use of SS010 is an active vehicle maintenance facility. As the lead agency, the USAF has the authority to determine the future anticipated land use of SS010. After considering input from ADEC and public comments, the USAF has determined that the most likely future land use of SS010 for the foreseeable future is an automotive garage under an industrial setting. Although the current use is industrial for the current land use, the AF may, in the future close the installation and potentially transfers the land.

2.7.1.4 Site LF001a (Soil Cell)

The current land use of LF001a is industrial. As the lead agency, the USAF has the authority to determine the future anticipated land use of LF001a. After considering input from ADEC and public comments, the USAF has determined that the most likely future land use of LF001a for the foreseeable future is industrial land use. Although the current use is industrial for the current land use, the AF may, in the future close the installation and potentially transfers the land.

2.7.1.5 Site ST006 (Module Train Spill Site)

The current land use of ST006 is industrial. ST006 is located adjacent to an active radar facility. As the lead agency, the USAF has the authority to determine the future anticipated land use of ST006. After considering input from ADEC and public comments, the USAF has determined that the most likely future land use of ST006 for the foreseeable future is industrial land use. Although the current use is industrial for the current land use, the AF may, in the future close the installation and potentially transfers the land.

2.7.1.6 Site SS009a (Diesel Storage Tanks)

The current land use of SS009a is industrial; however the site is currently unused and undeveloped. As the lead agency, the USAF has the authority to determine the future anticipated land use of SS009a. After considering input from ADEC and public comments, the USAF has determined that the most likely future land use of SS009a for the foreseeable future is industrial land use; however, the soil meets Method 2 arctic zone cleanup levels and therefore meets the standards suitable for residential use.

2.7.1.7 Site SS009b (Fuel Storage Area)

The current land use of SS009b is industrial; however the site is currently unused and undeveloped. As the lead agency, the USAF has the authority to determine the future anticipated land use of SS009b. After considering input from ADEC and public comments, the USAF has determined that the most likely future land use of SS009b for the foreseeable future is industrial land use; however, the soil meets Method 2 arctic zone cleanup levels and therefore meets the standards suitable for residential use.

2.7.2 Ground and Surface Water Beneficial Uses

No aquifer is present at the Oliktok LRRS at a depth deemed to be potentially affected by current or future contamination due to the presence of permafrost. Groundwater is not presently used as a drinking water source due to continuous permafrost. Permafrost acts as a barrier to vertical movement of groundwater because the pore spaces are ice-filled in the zone of saturation.

2.8 *Summary of Site Risks*

This section summarizes the human health and ecological risk assessments currently applicable to Oliktok LRRS. The 2005 RI/FS was used to identify COCs and evaluate risk based on chemical-specific ARARs for sites LF001, ST006, and SS010.

Interim clean-up actions were performed in 2007 through 2008. This section presents risks from the 2005 RI/FS for LF001, ST006, and SS010. The updated evaluation of risks is based on conditions following interim actions for these sites and presents cumulative risks for remaining COCs relative to ADEC Method Two risk-based cleanup levels.

The 2005 RI/FS did not include LF002; therefore cumulative risks are presented and based on current site conditions relative to ADEC Method Two risk-based cleanup levels.

Soil contaminants were not screened against ecological risk-based screening criteria because appropriate and recognized criteria for the Arctic are not available, and the ADEC Method One and Method Two cleanup levels are considered sufficiently conservative to be protective of human health and the environment.

Sites SS009a and SS009b have no contamination which exceeds Method Two State of Alaska cleanup levels for the Arctic Zone (18 AAC 75.340, Table B1 & B2). Additionally SS009a and SS009b have no CERCLA hazardous substances, pollutants, or contaminants on-site above levels that allow for unlimited use and unrestricted exposure. The USAF has determined that no action is necessary at SS009a and SS009b to protect public health or welfare or the environment. Therefore SS009a and SS009b are not discussed in this section.

LF001a was designed as a monofill under the solid waste regulations; therefore cumulative risks are not presented.

2.8.1 Summary of Human Health Risk Assessment

The 2005 *RI/FS* estimates what risks the site poses if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes COCs and corresponding risk evaluation for sites LF001, SS010, and ST006. LF002 was not originally included in the 2005 RI/FS, but is included in this section of the ROD. Evaluation of risks is based on current site conditions and concentration levels, utilizing the 2005 RI/FS Cumulative Risk Parameters (USAF 2005; Appendix H). The human health risk assessment (HRA) is divided into the following sections: identification of COCs (hazard assessment) presenting the 2005 RI/FS results and post interim actions results for exposure , toxicity, and risk characterizations. Potential risks for both current and future site occupants are discussed. Key assumptions and uncertainties associated with the HRA are also identified. The chemicals, exposure pathways, and populations associated with unacceptable risk are highlighted, as they served as the primary basis for remedial action.

The primary soil ARARs are derived based on screening COCs against State of Alaska cleanup levels (18 AAC 75.340, Tables A2, B1 and B2). The Method One cleanup levels (Table A2) are conservative, non-risk-based levels for petroleum hydrocarbons. Method Two cleanup levels (Tables B1 and B2) are human health, risk-based cleanup levels. They are based on a cancer risk management standard of 1 in 100,000 (1×10^{-5}), and a non-carcinogenic risk standard of 1, set forth in 18 AAC 75.325(h). The noncarcinogenic risk standard is referred to as the hazard index (HI). Soils with contaminants below Method Two cleanup levels are considered protective of human health under conditions of long-term exposure in a residential setting.

Method Two soil cleanup levels for the Arctic Zone exist for "direct contact" and "inhalation" exposure pathways, or in some cases both, depending upon the characteristics of the contaminant. Direct contact means exposure both through incidental ingestion of soil and through dermal absorption of the contaminant from soil. In screening for COCs and identifying exceedances, the most conservative (lowest) of the two cleanup levels was used (i.e., inhalation based cleanup levels was used if it was lower than the direct contact cleanup level).

When applying ADEC Method Two cleanup levels, 18 AAC 75.325(g) states that the cumulative risk from hazardous substances at a site must not exceed ADEC's risk management standard (i.e., contaminants must not exceed a cumulative carcinogenic risk standard of 1 in 100,000 and a cumulative HI of 1 across all exposure pathways). Per 18 AAC 75.340 (k), a chemical that is detected at one-tenth or more of the Method Two ingestion or inhalation cleanup level must be included when calculating cumulative risk under 18 AAC 75.325(g). Therefore, cumulative risk calculations were calculated for soil contamination at a site whenever more than one contaminant was greater than or equal to (≥) one-tenth the Method Two cleanup level for the Arctic Zone. The 2005 *RI/FS* cumulative risk determinations were performed following the ADEC's Cumulative Risk Guidance document (ADEC 2002). This guidance is also consistent with the 2008 update to this guidance. Per this guidance, gasoline range organics (GRO), diesel range organics (DRO), residual range organics (RRO), and lead were not included in cumulative risk calculations.

Applying Method Two cleanup levels and calculating cumulative risk based on residential exposure scenarios overestimates the current risk and potential future risk posed by the contaminants at Oliktok. Site workers are present and may reside for an extended period of time, however, there are no permanent residents residing at Oliktok LRSS. However, 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.

2.8.1.1 Identification of Chemicals of Concern

This section identifies those chemicals associated with unacceptable risk at the site and that were presented in the 2005 RI/FS. Although other chemicals were detected at the site, these COCs were the primary risk-driving chemicals. The data used in the 2005 RI/FS was deemed to be of sufficient quality and quantity for its intended use. The detection frequency (number of samples in which the chemical was detected divided by the total number of samples analyzed), range of detected concentrations (maximum concentrations detected), and the exposure point concentrations (the calculated or assumed concentration of the chemical at the assumed location of exposure), for chemicals and media of concern are presented in Table 2.5 from the 2005 RI/FS.

Table 2-5 Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations from the 2005 RI/FS; LF001, SS010, and ST006

Site	Media	Chemical of Concern	Soil Cleanup Level (milligram per kilogram [mg/kg])	Maximum Concentration Detected (mg/kg)*	Frequency Of Detection Above Cleanup Level	Exposure Point Concentration*
LF001[1]	Soil On-Site - Direct Contact	DRO	500*	7,610	11 of 23	7,610
		RRO	2,000*	24,200	3 of 23	24,200
		Lead	400	420	1 of 40	420
		Chromium	410	1,500	1 of 40	1,500
		PCBs	1	4.74	3 of 23	4.74
SS010[1]	Soil On-Site - Direct Contact	DRO	12,500	34,500	17 of 17	34,500
		RRO	13,700	41,300	17 of 17	41,300
		PCBs	1	18.6	7 of10	18.6
		Lead	400	830	1 of 6	830
ST006[1]	Soil On-Site - Direct Contact	PCBs	1	5.27	2 of 2	5.27

Notes: The maximum detected concentrations were used as the exposure point concentrations. , *Petroleum Hydrocarbon Method One Soil Cleanup Levels in the Arctic Zone utilized due to the site's proximity to the Beaufort Sea. Source of soil cleanup levels: 18 AAC 75.341, Table A2, B1 and B2. For definitions, see the Acronyms and Abbreviations section. 1 – Data concluded from 2005 *RI/FS* prior to any remedial activities.

2.8.1.1.1 Site LF001 (Old Landfill)

The 2005 RI/FS identified GRO, DRO, RRO, and PCBs in the soil as COCs at this site. Following interim remedial actions, the COCs remaining at the site are petroleum hydrocarbons (DRO and RRO) and PCBs in the subsurface soil. PCBs exceed the ADEC Method Two soil cleanup level for the Arctic Zone of 1 mg/kg. DRO and RRO do not exceed Method Two cleanup criteria but exceed Method One soil cleanup levels. ADEC Method Two Arctic Zone cleanup levels for petroleum hydrocarbons are not considered sufficiently protective of surface water due to the proximity of the contaminated soils to the Beaufort Sea.

Benzene, total xylenes, toluene, and arsenic exceeded one-tenth the Method Two Arctic Zone cleanup levels and were potential COCs due to cumulative risk. However, arsenic was not retained as a COC because arsenic was detected at concentrations consistent with natural background conditions.

See Table 2-6 for current detected concentrations and frequency of detection for LF001.

Table 2-6 Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations Post Interim Remedial Action; LF001

Site	Media	Chemical of Concern	Soil Cleanup Level (milligram per kilogram [mg/kg])	Maximum Concentration Detected (mg/kg) *	Frequency Of Detection Above Cleanup Level	Exposure Point Concentration*
LF001	Soil On-Site -Direct Contact	DRO	500*	1,210	8 of 83	1,210
		RRO	2,000*	8,410	7 of 83	8,410
		Lead	400	420	1 of 40	420
		Chromium	410	1,500	1 of 40	1,500
		PCBs	1	4.36	34 of 104	4.36

Notes: The maximum detected concentrations were used as the exposure point concentrations.
, *Petroleum Hydrocarbon Method One Soil Cleanup Levels in the Arctic Zone utilized due to the site's proximity to the Beaufort Sea. Source of soil cleanup levels: 18 AAC 75.341, Table A2, B1 and B2. For definitions, see the Acronyms and Abbreviations section.

2.8.1.1.2 Site LF002 (Dump Site)

The current COC is PCBs in the subsurface soil which exceeds Method Two soil cleanup levels for the Arctic Zone. When the 2005 RI/FS was completed, at that time LF002 was believed to only include inert debris. However, during the interim remedial actions, PCBs were discovered during excavation and post characterization. LF002 is adjacent to LF001. Due to the close proximity and similar characteristics, it has been presumed to have comparable exposure pathways and similar erosion characteristics with close proximity to the Beaufort Sea. Table 2-6 provides a summary of the COC and medium exposure concentrations for LF002 based on post interim remedial action and confirmation sampling.

See Table 2-7 for current detected concentrations and frequency of detection for LF002.

Table 2-7 Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations for LF002; Post Interim Remedial Actions

Site	Media	Chemical of Concern	Soil Cleanup Level (milligram per kilogram [mg/kg])	Maximum Concentration Detected (mg/kg)*	Frequency Of Detection Above Cleanup Level	Exposure Point Concentration*
LF002[1]	Soil On-Site - Direct Contact	PCBs	1	2.82	9 of 17	2.82

Notes: The maximum detected concentrations were used as the exposure point concentrations.
, *Petroleum Hydrocarbon Method One Soil Cleanup Levels in the Arctic Zone utilized due to the site's proximity to the Beaufort Sea. Source of soil cleanup levels: 18 AAC 75.341, Table A2, B1 and B2. For definitions, see the Acronyms and Abbreviations section. 1 – Data based on post remedial activities.

2.8.1.1.3 Site SS010 (Garage Site)

The current COCs are DRO, RRO, PCBs, arsenic, and lead which exceed Method Two soil cleanup levels for the Arctic Zone. Since no other activities were performed to reduce the concentrations of COC beneath the garage, the 2005 RI/FS conclusions and detected concentrations and frequency of detection remains the same.

2.8.1.1.4 Site LF001a (Soil Cell)

LF001a, a monofill, was constructed during the interim remedial activities to contain contaminated soil from both LF001 and LF002. The monofill is included in this section since

COC removal actions were placed in the monofill as a remedy for LF001 and LF002. Although there are no current risks evaluated for LF001a, annual monitoring is performed for the monofill conditions, surface water and freezeback conditions of the monofill to ensure there are no risk to the active water zone or ecological impacts from the monofill. The current COCs are petroleum hydrocarbons (DRO and RRO) and PCBs within the monofill, derived from LF001 and LF002. Current concentrations for DRO, RRO and PCBs exceed the ADEC Method Two soil cleanup level for the Arctic Zone. Table 2-8 provides exposure point concentrations based on the maximum detected levels, based on post confirmation sampling of stockpiles from LF001a; post interim remedial actions.

Table 2-8 Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations for LF001a Monofill; Post Interim Remedial Actions

Site	Media	Chemical of Concern	Maximum Concentration Detected (mg/kg)	Exposure Point Concentration
LF001a	Soil On-Site -Direct Contact	DRO	38,400	38,400
		RRO	23,800*	23,800*
		PCBs	18.6*	18.6

2.8.1.1.5 Site ST006 (Module Train Spills)

The single COC for the Module Train Spills site (ST006) is PCBs in the soil. Total PCBs at the transformer stand exceed the ADEC Method Two soil cleanup level for the Arctic Zone of 1 mg/kg, based on the maximum concentration for PCBs detected (5.27 mg/kg), from the 2005 RI/FS. Post remedial actions were performed by in 2007 through 2008, which capped the contaminated soil. Since no other activities were performed to reduce the concentration, the 2005 RI/FS conclusions and detected concentrations and frequency of detection remain the same.

2.8.1.2 Exposure Assessment

This section documents the populations and exposure pathways that were quantitatively evaluated in the risk assessment. A conceptual exposure model (CEM) was developed to aid in determining reasonable exposure scenarios and pathways of concern; this CEM is shown in Figure 2-8. As described in this section, both current and future populations have been evaluated based on current and reasonably anticipated future land use. The contaminated media to which people may be exposed is also discussed. Resources other than land may be involved.

The primary exposure pathway for human health at sites LF001, LF002, SS010, LF001a, and ST006 is ingestion via direct contact with contaminated soil. The incidental ingestion of contaminated soil is considered the most probable exposure pathway at most sites. In some cases, there is the potential for contaminants to migrate from the soils to the surrounding surface water. Subsurface (vertical) migration is limited by the presence of permafrost. ADEC cumulative risk calculations are based on a residential exposure scenario. The human health risk assessment, as presented in the 2005 *RI/FS* (USAF, 2005), evaluated current and future risks for subsistence users, site workers, and residents.

2.8.1.3 Risk Characterization

The carcinogenic and noncarcinogenic impacts for each COC identified at Oliktok LRRS are presented for a residential exposure scenario, for sites included within the 2005 RI/FS, prior to any interim remedial action. These risk estimates are summarized in Tables 2-6 and 2-7. The

results of the human health risk assessment are interpreted within the context of the CERCLA acceptable risk range and ADEC risk management standards (ADEC 2002 Guidance), in accordance with 18 AAC 75.325(g) for PCBs. Per this guidance, DRO, RRO, and lead were not included in cumulative risk calculations.

Method Two soil cleanup levels for the Arctic Zone exist for "direct contact" and "inhalation" exposure pathways. "Direct contact" means exposure through both incidental ingestion of soil and through dermal absorption of the contaminant from soil. "Inhalation" means a potential exposure pathway through volatilization of substances in the soil. In screening for COCs and identifying exceedances, the 2005 RI/FS utilized the most conservative (lowest) of the two cleanup levels (i.e., inhalation based cleanup level was used if it was lower than the ingestion based cleanup level). When applying ADEC Method Two cleanup levels, 18 AAC 75.325(g) states that the cumulative risk from hazardous substances at a site must not exceed ADEC's risk management standard (i.e., contaminants must not exceed a cumulative carcinogenic risk standard of 1 in 100,000 and a cumulative HI of 1 across all exposure pathways). Per 18 AAC 75.340 (k), a chemical that is detected at one-tenth or more of the Method Two ingestion or inhalation cleanup level must be included when calculating cumulative risk under 18 AAC *75.325(g).* Therefore, cumulative risk calculations were calculated for soil contamination at a site whenever more than one contaminant was greater than or equal to (≥) one-tenth the Method Two cleanup level for the Arctic Zone.

The cumulative risk determinations were performed following the ADEC's *Cumulative Risk Guidance* document (ADEC 2002 and 2008 update), and are consistent with the 2008 guidance update. Per this guidance, gasoline range organics (GRO), diesel range organics (DRO), residual range organics (RRO), and lead were not included in cumulative risk calculations. The primary input parameters used to calculate cumulative risk are the risk-based concentrations (RBC) and the maximum concentration of each contaminant at the site. The *Cumulative Risk Guidance* document (ADEC 2002 and 2008 update) provides a list of RBCs for the analytes listed in Method Two cleanup levels with several exceptions. An RBC for PCBs is not published. PCBs were detected at several sites; therefore, an RBC for the carcinogenic and non- carcinogenic risks was developed with guidance from the ADEC's risk assessor (personal communication with L. Smith, ADEC, December 2004). The input parameters used to calculate the ingestion RBC for PCBs in the Arctic Zone are based on a conservative residential exposure scenario where an individual is exposed to PCB-contaminated soil during a 200-day annual exposure period over their lifetime. These are the same default exposure parameters used to calculate Method Two cleanup levels in the Arctic Zone. Tables H- I and H-2 in Appendix H of the 2005 RI/FS summarize this RBC calculation, including the input parameters and default values. The resulting carcinogenic and noncarcinogenic RBC for the ingestion of PCBs in the Arctic Zone is 5.603 1 mg/kg and 2.738 mg/kg, respectively. Table H-3 in Appendix 11 of the 2005 RI/FS summarizes the cancer risk RBC calculation for the inhalation of PCBs. The inhalation RBC is high (1,085.7 mg/kg) because PCBs are relatively nonvolatile. Table 11-4 in Appendix H of the 2005 RI/FS provides information on the derivation of the volatilization factor used in the RBC calculation. The RBC for PCBs may not account for all potential risk because it does not quantify the potential for bioaccumulation and biomagnifications of PCBs in the food chain, which could ultimately lead to human exposure through consumption of fish and animals. The ADEC Method Two soil cleanup level for PCBs is 1 mg/Kg (lower than the calculated RBC) which provides contingency given the uncertainty regarding potential for biomagnifications.

Applying Method Two cleanup levels and calculating cumulative risk based on residential exposure scenarios overestimates the current risk and potential future risk posed by the contaminants at Oliktok. No people currently reside at Oliktok LRRS or have remained there for 200 days a year. However, 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.

To aid in the evaluation of risk, cumulative risk calculations were also performed using an industrial (site worker) exposure scenario for some of the sites where the human health risk exceeded the ADEC risk management standards based on the standard (residential) exposure scenario. The two sites for which this was performed were the Module Train Spills site (ST006) and the Garage site (SS010). At ST006, PCBs were the only COC. At SS010, the COCs were PCBs, and in 2005 were xylenes, arsenic, tetrachloroethene, and benzo(a)pyrene (DRO and RRO were also COCs but are excluded from the cumulative risk calculations). ADEC risk management standards were also exceeded at LF001 (Old Landfill) but an industrial exposure scenario was not considered appropriate for evaluation based on current and projected site use. The industrial exposure scenario was based on modifications to the ADEC residential exposure scenario used for the cumulative risk calculations (ADEC 2002). The changes to the default exposure parameters were initiated with the help of ADEC's risk assessor (personal communication with L. Smith, ADEC (April 2005). In the residential scenario, a child is the most apt to be exposed to the highest amount of soil, so the most conservative estimate of risk uses a child's characteristics (e.g., average body weight and ingestion rate). At an industrial site, it is assumed that all workers are adults. Assuming all those exposed are adults alters several of the default parameters. The average body weight is raised from 15 to 70 kg. The ingestion rate is decreased from the default of 200 mg/day to 50 mg/day. In addition, the exposure duration is changed from 6 to 25 years to determine the non-cancer risk in an industrial setting. The exposure duration for cancerous risk remains at 70 years. (USAF, 2005)

Table 2-9 presents the carcinogenic PCB risk characterization summary from the 2005 RI/FS for LF001, SS010, and ST006.

Table 2-9 PCB Risk Characterization Summary from the 2005 RI/FS; LF001, SS010, and ST006 – Carcinogens

Site	Medium	Chemical of Concern	Maximum Site Concentrations (mg/kg)	RBC[2] (mg/kg)		
				Ingestion[1]	Inhalation[1]	Cumulative Risk At Site Concentration[3,4]
LF001	Soil	PCBs	4.74	5.603	1,085.70	9×10^{-6}
					Soil Risk Total =	**9×10^{-6}**
SS010	Soil	PCBs	18.6	5.603	1,085.70	3×10^{-5}
					Soil Risk Total =	**3×10^{-5}**
ST006	Soil	PCBs	5.27	5.603	1,085.70	9×10^{-6}
					Soil Risk Total =	**9×10^{-6}**

Notes: NA – Not Applicable as LF001a was constructed post remediation and was not included within the 2005 RI/FS.
1 - Methodology and Risk Based Concentration (RBC) per Cumulative Risk Guidance (ADEC 2002)
2 - Default and industrial scenario exposure parameters are outlined in Appendix H. (USAF, 2005)
3 - Cumulative Risk at site concentration = (site concentration/RBC) x $1\ 0^{-5}$
4 - Carcinogenic risk is rounded to one significant figure (shown in parenthesis). (ADEC 2002, pg 13)

Table 2-10 presents the carcinogenic PCB risk characterization summary post interim remedial action for LF001, LF002, SS010, and ST006.

Table 2-10 PCB Risk Characterization Summary Post Interim Remedial Action; LF001, LF002, SS010, and ST006 – Carcinogens

Site	Medium	Chemical of Concern	Maximum Site Concentrations (mg/kg)	RBC[2] (mg/kg)		
				Ingestion[1]	Inhalation[1]	Cumulative Risk At Site Concentration[3,4]
LF001	Soil	PCBs	4.36	5.603	1,085.70	8×10^{-6}
					Soil Risk Total =	**8×10^{-6}**
LF002[1]	Soil	PCBs	2.82	5.603	1,085.70	5×10^{-6}
					Soil Risk Total =	**5×10^{-6}**
SS010	Soil	PCBs	18.6	5.603	1,085.70	3×10^{-5}
					Soil Risk Total =	**3×10^{-5}**
ST006[5]	Soil	PCBs	5.27	5.603	1,085.70	9×10^{-6}
					Soil Risk Total =	**9×10^{-6}**

Notes: NA – Not Applicable as LF001a was constructed post remediation and was not included within the 2005 RI/FS.
1 - Methodology and Risk Based Concentration (RBC) per Cumulative Risk Guidance (ADEC 2002)
2 - Default and industrial scenario exposure parameters are outlined in Appendix H. (USAF, 2005)
3 - Cumulative Risk at site concentration = (site concentration/RBC) x $1\ 0^{-5}$
4 - Carcinogenic risk is rounded to one significant figure (shown in parenthesis). (ADEC 2002, pg 13)
5 – The interim remedial action performed at ST006 did not affect PCB concentration levels noted in the 2005 RI/FS

At Oliktok LRRS, the non-carcinogenic hazard and excess cancer risk were calculated for soil exposure by a residential receptor as the most conservative exposure scenario. The maximum detected concentrations were used as the exposure point concentrations, relative to 2005 RI/FS or the post interim remedial actions.

Table 2-11 presents the non-carcinogenic PCB risk characterization summary from the 2005 RI/FS for LF001, SS010, and ST006.

Table 2-11 PCB Risk Characterization Summary from 2005 RI/FS; LF001, SS010, and ST006 – Non-Carcinogens

Site	Medium	Chemical of Concern	Maximum Site Concentrations (mg/kg)	RBC[2]		(Site Conc/RBC)
				Ingestion[1]	Inhalation[1]	Cumulative Hazard Index
LF001	Soil	PCBs	4.74	2.738	NA	2
					Soil Risk Total =	**2**
SS010	Soil	PCBs	18.6	2.738	NA	7
		Arsenic	23.8	41.1	N/A	1
					Soil Risk Total =	**8**
ST006	Soil	PCBs	5.27	2.738	NA	2
					Soil Risk Total =	**2**

Notes: NA – No effects through the specified exposure route (ADEC 2008 - Appendix B).
1- Methodology and Risk Based Concentration (RBC) per Cumulative Risk Guidance (ADEC 2002)
2- Default and industrial scenario exposure parameters are outlined in Appendix H. (USAF, 2005)
3- LF002 was not included in any previous risk assessments and concentrations are based on concentrations levels for current site conditions following remedial activities.

Table 2-12 presents the non-carcinogenic PCB risk characterization summary post interim remedial action for LF001, SS010, and ST006.

Table 2-12 PCB Risk Characterization Summary Post Interim Remedial Action; LF001, LF002, SS010, and ST006 – Non-Carcinogens

Site	Medium	Chemical of Concern	Maximum Site Concentrations (mg/kg)	RBC[2]		(Site Conc/RBC)
				Ingestion[1]	Inhalation[1]	Cumulative Hazard Index
LF001	Soil	PCBs	4.36	2.738	NA	2
					Soil Risk Total =	**2**
LF002[3]	Soil	PCBs	2.82	2.738	NA	1
					Soil Risk Total =	**1**
SS010	Soil	PCBs	18.6	2.738	NA	7
		Arsenic	23.8	41.1	N/A	1
					Soil Risk Total =	**8**
ST006[4]	Soil	PCBs	5.27	2.738	NA	2
					Soil Risk Total =	**2**

Notes: NA – No effects through the specified exposure route (ADEC 2008 - Appendix B).
1- Methodology and Risk Based Concentration (RBC) per Cumulative Risk Guidance (ADEC 2002)
2- Default and industrial scenario exposure parameters are outlined in Appendix H. (USAF, 2005)
3- LF002 was not included in any previous risk assessments and concentrations are based on concentrations levels for current site conditions following remedial activities.
4 – The interim remedial action performed at ST006 did not affect PCB concentration levels noted in the 2005 RI/FS.

2.8.1.3.1 Site LF001 (Old Landfill)

Cumulative PCB risk calculations from the 2005 *RI/FS*, following ADEC guidance (ADEC 2002) and using the 2004 soil data, indicated a human cancer risk of 9×10^{-6} (Table 2-9) and the non-carcinogenic HI is 2 (Table 2-11).

Following interim remedial actions, the human cancer risk changed to 8 x 10^{-6} (Table 2-10) and the non-cancer HI is now 2 (Table 2-12) utilizing the same methodology. These cumulative risk calculations are based on a conservative (residential) exposure scenario and overestimate the current risk. The HI exceeds the ADEC risk management criterion of 1 set forth in 18 AAC 75.325(h).

The risk drivers are primarily PCBs. Human Health RBCs are not defined in ADEC (2008) for non-carcinogenic direct contact and inhalation pathways in the Arctic Zone for PCBs; however, an HI value of 2.738 mg/kg value was calculated using the RfD from IRIS for Aroclor 1254, as described in Appendix H of the 2005 RI/FS (HCG 2005). Note that the RBC does not account for the future risk if the landfill is eroded, which would release the contaminated soils into the adjacent wetlands and the Beaufort Sea. If released, the PCBs in the soil may enter the food chain and potentially bioaccumulate and biomagnify. This could result in an increased risk to high level predators, and people engaged in subsistence activities. As indicated in the cumulative risk calculation (Tables 2-9 and 2-11) most of the potential risk at the site is due to PCBs in the soil. Benzene, toluene, and xylenes contribute minimally to the calculated cancerous and non-cancer risk.

Although LF001 has remaining contamination above ADEC Method two levels for PCBs of 1 mg/kg, material was excavated to the extent practical based on site conditions and proximity to open water.

Based on the level of contaminants and risk calculations and contamination remaining subsurface, potentially disturbed subsurface soil at site LF001, without a protective remedy, would not be sufficiently protective of human health.

2.8.1.3.2 Site LF002 (Dump Site)

At site LF002 the total cumulative maximum cancer risk is 5 x10^{-6} (Table 2-10) and the cumulative non-carcinogenic risk is 1 (Table 2-11). The HI exceeds the ADEC risk management criterion of 1 set forth in 18 AAC 75.325(h).

Risks were not evaluated in the 1996 RI/FS or the 2005 RI/FS for LF002. However, the approved methodology and calculations were applied to LF002, similar to LF001, but the maximum concentration is based on post remedial action concentrations. Cleanup action levels were based on ADEC Method Two soil cleanup level for the Arctic Zone, which are risk-based standards.

The risk drivers are primarily PCBs. Human Health RBCs are not defined in ADEC (2008) for non-carcinogenic direct contact and inhalation pathways in the Arctic Zone for PCBs; however, an HI value of 2.738 mg/kg value was calculated using the RfD from IRIS for Aroclor 1254, as described in Appendix H of the 2005 RI/FS (HCG 2005). Note that the RBC does not account for the future risk if the landfill is eroded, which would release the contaminated soils into the adjacent wetlands and the Beaufort Sea. If released, the PCBs in the soil may enter the food chain and potentially bioaccumulate and biomagnify. This could result in an increased risk to high level predators, and people engaged in subsistence activities. As indicated in the cumulative risk calculation (Tables 2-10 and 2-12) most of the potential risk at the site is due to PCBs in the soil. Benzene, toluene, and xylenes contribute minimally to the calculated cancerous and non-cancer risk.

Although LF002 has remaining contamination above ADEC Method two levels for PCBs of 1 mg/kg, material was excavated to the extent practical based on site conditions and proximity to open water.

Based on the level of contaminants and risk calculations and contamination remaining subsurface, potentially disturbed subsurface soil at site LF002, without a protective remedy, would not be sufficiently protective of human health.

2.8.1.3.3 Site SS010 (Garage Site)

At site SS010 the total cumulative maximum cancer risk is 3×10^{-5} and the cumulative non-carcinogenic risk HI is 7. The cancer risk drivers were primarily PCBs and arsenic. Human Health RBCs are not defined in ADEC (2008) for non-carcinogenic direct contact and inhalation pathways in the Arctic Zone for PCBs; however, an HI value of 2.738 mg/kg was calculated using the RfD from IRIS for Aroclor 1254, as described in Appendix H of the 2005 RI/FS (HCG 2005). Based on the level of contaminants and risk calculations, potentially disturbed subsurface soil at site SS010, without a protective remedy, would not be sufficiently protective of human health.

2.8.1.3.4 Site LF001a (Soil Cell)

Site LF001a is managed under the ADEC Solid waste regulations, therefore a risk assessment of the Monofill is not included. .

2.8.1.3.5 Site ST006 (Module Train Spills)

Cumulative risk calculations from the 2005 *RI/FS*, following ADEC guidance (ADEC 2002) and using the 2004 soil data, indicate a human cancer risk of 9×10^{-6} and an HI of 2. Human Health RBCs are not defined in ADEC (2008) for non-carcinogenic direct contact and inhalation pathways in the Arctic Zone for PCBs; however, an HI value of 2.738 mg/kg was calculated using the RfD from IRIS for Aroclor 1254, as described in Appendix H of the 2005 RI/FS (HCG 2005). Although the cancer risk is below the ADEC risk management criteria of 1×10^{-5} the HI exceeds the ADEC 18 AAC 75.325(h) standard of 1. In addition, there could be future risks due to the ability of PCBs to bioaccumulate and biomagnify in the food chain. These risks are not accounted for in the cumulative risk calculations.

2.8.2 Summary of Ecological Risk Assessment

This section summarizes the approaches and findings of the ecological risk assessment (ERA) that has been performed for sites LF001, LF002, ST006, and SS010. Ecological risk conclusions are based on the 1996 risk assessment (RA). (ICF, 1996) Site ST006 was not included within the 1996 RA, however, the analysis for SS010 (for PCBs) is considered a suitable qualitative analysis for ST006 because the two sites are in close proximity, have comparable environments and exposure pathways. Higher concentrations of PCBs were present at SS010 than were found at ST006.

An ecological risk assessment estimates the likelihood that adverse ecological effects (e.g., mortality, reproductive failure) will occur as a result of a release of a hazardous substance at a Superfund site. The purpose for conducting the ERA is to 1) identify and characterize the current and potential threats to the environment from hazardous substance release, 2) evaluate the ecological impacts of alternative remediation strategies, and 3) establish clean-up levels that will

protect the natural resources at risk. It's a qualitative and/or quantitative appraisal of the actual or potential effects of site releases on plants and animals.

The potential risks to ecological receptors are summarized in Table 2-13. The table shows the COCs associated with potential risks (if any) on a site-by site basis for 1996 site conditions, current site conditions, and future site conditions

The available risk information includes chemical data, exposure estimates, and literature-based toxicity information from the 1996 RA and remains applicable to current site conditions. The ecological risk assessment did not find any significant ecological risks; however the cumulative PCB human health risks, as identified in Section 2.8.1, were significant and are greater than the risks to ecological receptors. Therefore, the human health standards are adequately protective of the environment.

Table 2-13 Summary of Ecological Risk Estimates for Sites; LF001, LF002, SS010, and ST006

Site	COC Contributing to Risk	Current Risk Potential	Future Risk Potential
LF001	None	Not Significant	Future risk may increase because of potential bioaccumulation of Aroclor 1254
LF002	None	Not Significant	Future risk may increase because of potential bioaccumulation of Aroclor 1254
ST006[1]	None	Not Significant	Future risk may increase because of potential bioaccumulation of Aroclor 1254
SS010	None	Not Significant	Future risk may increase because of potential bioaccumulation of Aroclor 1254

Notes: 1 - Risks are inferred from the 1996 risk assessment conclusions for SS010.

2.8.2.1 Identification of Chemicals of Concern

This section identifies those chemicals associated with unacceptable risk at the site and that were presented in the 1996 risk assessment and the 2005 RI/FS. Although other chemicals were detected at the site in 2005, these COCs were the primary risk-driving chemicals for post interim cleanup actions performed in 2007 through 2008. The data presented in the 1996 risk assessment, in addition to the 2005 RI/FS was deemed to be of sufficient quality and quantity for its intended use.

The 1996 risk assessment concluded that DRO was the only COC in surface water (ICF, 1996). DRO, GRO, RRO, BTEX, benzyl alcohol, PCBs, and lead were considered COCs within soil at LF001, LF002, and SS010. Although ST006 was not included in the 1996 risk assessment, the analysis for SS010 (for PCBs) is considered suitable due to the comparable environments, where the PCB concentration at SS010 was much greater, and close proximity to one another.

2.8.2.2 Exposure Assessment

This section describes the ecological setting on and near the site and types of habitat present, including any ecologically sensitive areas that have been identified, based on the 1996 risk

assessment and current literature available. The key species at the site are identified, including any Federal or State designated rare, endangered, or threatened species.

2.8.2.2.1 Potential Ecological Receptors

The Oliktok LRRS area is a wet tundra environment that provides good nesting and foraging habitat for a wide variety of passerines (songbirds), shorebirds, waterfowl, and others. Sandpipers, red-necked phalaropes, and plovers have been observed in the ponds and lakes near the site (HCG, 2004). Waterfowl that utilize the freshwater and marine environment in the area include Brant geese, loons, northern pintails, scaups, oldsquaws, scoters, red-breasted mergansers, and eiders. The barrier islands offshore are used for nesting by common eiders, arctic terns, glaucous gulls, and black guillemots (HCG, 2004). A large influx of passerine birds occurs in summer.

Raptors, including snowy owls and jaegers, are common, although populations of these predatory birds fluctuate with the local rodent (i.e., lemming and ground squirrel) populations (HCG, 2004). Arctic peregrine falcons do not nest on USAF property (HCG, 2004). However, there are nonbreeding and migrating arctic peregrines that occur in the area. This species was determined to have recovered and was removed from the list of federally endangered species in 2004. No threatened or endangered species are known or expected to occur on-site (HCG, 2004).

2.8.2.2.2 Potentially Complete Exposure Pathways

Current contaminants occur in the subsurface soil at sites LF001, LF002, ST006, and SS010 and in surface soils beneath the garage; SS010). Erosion or human disturbance could cause subsurface soils at these sites to be brought to the surface. The garage at SS010 is currently skirted with chain link fencing; damage to the fencing could allow exposure to contaminants in surface soil beneath the building. In addition, migration due to erosion of soils into the creek or Beaufort Sea could result in potential exposure by bird, mammals, plants, or aquatic life. The following exposure pathways were identified in the 1996 RA as being complete or potentially complete:

- Ingestion of COCs in soil by terrestrial receptors
- Inhalation of COCs in air by terrestrial receptors
- Direct contact with COCs in surface water by aquatic receptors
- Ingestion of COCs in surface water by aquatic and terrestrial receptors
- Ingestion of COCs in biota by aquatic and terrestrial receptors
- Ingestion of COCs in sediments by aquatic and terrestrial receptors
- Direct contact with COCs in sediments by aquatic and terrestrial receptors

Concentrations of site-related contaminants were minimal in sediment and surface water, despite the fact that erosion of LF001 and LF002 into nearby water-bodies had been ongoing for years.

While dermal and inhalation exposure by birds and mammals are also potentially complete exposure pathways, they are rarely quantified (EPA, 2005a) and were not included within the 1996 RA.

Because soil/sediment samples indicate the presence of PCBs (Aroclor 1254) at LF001, LF002, ST006, and SS010, future risk estimates at these sites may be greater than the current estimates because of the high potential for PCBs to bioaccumulate. PCBs have very high chemical, thermal, and biological stability in addition to low vapor pressure (Manahan 1994). Conversion of highly substituted PCBs to molecules with one or two chlorine is done relatively slowly by anaerobic bacteria (Manahan 1994). Therefore, natural biodegradation is not an effective process for significantly reducing the PCBs to concentrations that are protective of the environment. In addition, PCBs have a high potential for bioaccumulation which may result in a magnification of PCB concentrations and resultant exposure to PCBs by ecological receptors through the food chain.

2.8.2.3 Ecological Risk Characterization

This section presents a brief summary of the environmental risks identified at the site, the basis for the risks, how the risks were determined, and COC concentrations that are expected to protect ecological receptors.

2.8.2.3.1 Site LF001 (Old Landfill)

Table 2-13 shows there is not current potential ecological risk at LF001. The cumulative PCB human health risks, as identified in Section 2.8.1, were significant and are greater than the risks to ecological receptors. Therefore, the human health standards are adequately protective of the environment. Based on the level of contaminants and risk calculations and contamination remaining subsurface, potentially disturbed subsurface soil at site LF002, without a protective remedy, would not be sufficiently protective of human health.

2.8.2.3.2 Site LF002 (Dump Site)

Table 2-13 shows there is not current potential ecological risk at LF002. The cumulative PCB human health risks, as identified in Section 2.8.1, were significant and are greater than the risks to ecological receptors. Therefore, the human health standards are adequately protective of the environment. Based on the level of contaminants and risk calculations and contamination remaining subsurface, potentially disturbed subsurface soil at site LF002, without a protective remedy, would not be sufficiently protective of human health.

2.8.2.3.3 Site SS010 (Garage Site)

Table 2-13 shows there is not current potential ecological risk at SS010. The cumulative PCB human health risks, as identified in Section 2.8.1, were significant and are greater than the risks to ecological receptors. Therefore, the human health standards are adequately protective of the environment. Based on the level of contaminants and risk calculations and contamination remaining subsurface, potentially disturbed subsurface soil at site SS010, without a protective remedy, would not be sufficiently protective of human health.

2.8.2.3.4 Site ST006 (Module Train Spills)

Table 2-13 shows there is not current potential ecological risk at ST006. The cumulative PCB human health risks, as identified in Section 2.8.1, were significant and are greater than the risks to ecological receptors. Therefore, the human health standards are adequately protective of the environment. Based on the level of contaminants and risk calculations and contamination

remaining subsurface, potentially disturbed subsurface soil at site ST006, without a protective remedy, would not be sufficiently protective of human health.

Although ST006 was not included in the 1996 risk assessment, the analysis for SS010 (for PCBs) is considered suitable due to the comparable environments, where the PCB concentration at SS010 was much greater, and close proximity to one another.

2.8.3 Basis for Action

The response action selected in this ROD is necessary to protect public health or welfare or the environment from actual or threatened releases of pollutants or contaminants from this site which may present an imminent and substantial endangerment to public health or welfare.

2.9 *Remedial Action Objectives*

RAOs provide a general description of what the cleanup will accomplish. These goals typically serve as the design basis for the remedial alternatives which will be presented in the next section.

These RAOs were developed based on the currently and reasonably anticipated future land use of under and industrial setting as described in Section 2.6.

These RAOs address the risks identified in the risk assessment and are presented for each site as follows:

2.9.1 Site LF001 (Old Landfill)

The RAOs for site LF001 are:

- Protect human health and the environment;
- Prevent human exposure to or direct contact with contaminants in soil containing DRO and RRO concentrations in excess of ADEC Soil cleanup levels for Arctic Zone (18 AAC 75.341, Table A2, B1 and B2) : DRO 500 mg/kg, RRO 2,000 mg/kg, PCBs 1 mg/kg lead 400 mg/kg, chromium 410 mg/kg and arsenic 8 mg/kg;
- Prevent migration or erosion of COCs into ocean sediment.

2.9.2 Site LF002 (Dump Site)

The RAOs for site LF002 are:

- Protect human health and the environment;
- Prevent human exposure to or direct contact with PCB-contaminated soil with concentrations in excess of ADEC Soil cleanup levels for Arctic Zone (18 AAC 75.341, Table B2) : PCBs 1 mg/kg;
- Prevent migration or erosion of COCs into ocean sediment.

2.9.3 Site SS010 (Garage Site)

The RAOs for site SS010 are:

- Protect human health and the environment;

- Prevent human exposure to or direct contact with PCB-contaminated soil with concentrations in excess of ADEC Soil cleanup levels for Arctic Zone (18 AAC 75.341, Table B1 and B2): DRO 12,500 mg/kg; RRO 13,700 mg/kg; Arsenic 6.1 mg/kg; Lead 400 mg/kg; PCBs 1 mg/kg;
- Prevent migration of COCs.

2.9.4 Site LF001a (Soil Cell)

The RAOs for site LF001a are:

- Protect human health and the environment;
- Prevent human exposure to or direct contact with contaminants in soil containing DRO and RRO concentrations in excess of ADEC Method Two Soil cleanup levels for Arctic Zone (18 AAC 75.341, Table B1 and B2) : DRO 10,250 mg/kg, RRO 10,000 mg/kg and PCBs 1 mg/kg;
- Prevent migration of COCs.

2.9.5 Site ST006 (Module Train Spills)

The RAOs for site ST006 are:

- Protect human health and the environment;
- Prevent human exposure to or direct contact with PCB-contaminated soil with concentrations in excess of ADEC Soil cleanup levels for Arctic Zone (18 AAC 75.341, Table B2) : PCBs 1 mg/kg (until removal);
- Prevent migration of COCs.

2.10 *Description of Alternatives*

The remedial alternatives considered for each of the six sites at Oliktok LRRS were presented in the *Final Proposed Plan LF001, LF002, SS010, LF001a, ST006, SS009a and SS009b* (USAF 2011), and are summarized in Tables 2-14 to 2-18 below.

Table 2-14 Summary of Remedial Alternatives Evaluated for LF001

Alternative Designation	Alternative Description
1	No further action
2	Soil Removal and Off-Site Disposal
3	Land Use Controls

Table 2-15 Summary of Remedial Alternatives Evaluated for LF002

Alternative Designation	Alternative Description
1	No further action
2	Soil Removal and Off-Site Disposal
3	Land Use Controls

Table 2-16 Summary of Remedial Alternatives Evaluated for SS010

Alternative Designation	Alternative Description
1	No further action
2	Source Removal and Off-Site Disposal
3	Land Use Controls and Future Source Removal and Off-Site Disposal

Table 2-17 Summary of Remedial Alternatives Evaluated for LF001a

Alternative Designation	Alternative Description
1	No further action
2	Source Removal and Off-Site Disposal
3	Land Use Controls

Table 2-18 Summary of Remedial Alternatives Evaluated for ST006

Alternative Designation	Alternative Description
1	No further action
2	Soil Removal and Off-Site Disposal
3	Land Use Controls

Each alternative evaluated is described in more detail including: remedy components, common elements and distinguishing features, and expected outcomes in the following sections.

2.10.1 Description of Remedy Components

For each site a total of three alternatives were developed to address remediation at Oliktok LRRS sites LF001, LF002, SS010, LF001a, ST006, SS009a, and SS009b. This section provides a summary overview of the components of those alternatives.

Because no contaminants were detected at levels above Method Two Soil Cleanup Levels for the Arctic zone at SS009a and SS009b, no remedial action is necessary. Three alternatives were evaluated for the remaining sites LF001, LF002, SS010, LF001a, and ST006, as detailed below:

2.10.1.1 Alternative 1:

No Further Action; under this remedial alternative, the Air Force would take no action at all sites to cleanup or prevent exposure to the contaminated substances. No monitoring would be conducted. A no action alternative is required under the National Contingency Plan and establishes a baseline for comparison.

2.10.1.2 Alternative 2:

2.10.1.2.1 Site LF001 (Old Landfill); Soil Removal and Off-Site Disposal

Under this remedial alternative, the Air Force would remove the clean backfill to access the contaminated soil at the bottom of the former excavation and remove any residual contaminated soil exceeding the regulatory cleanup levels. The soil would then be transported offsite and disposed at an approved facility. A monitoring program would not be required for LF001 upon the completion of Remedial Alternative #2.

2.10.1.2.2 Site LF002 (Dump Site); Soil Removal and Off-Site Disposal

Under this remedial alternative, the Air Force would remove contaminated soil exceeding regulatory cleanup levels. The soil would then be transported offsite and disposed at an approved facility. A monitoring program would not be required for LF002 since implementation of Remedial Alternative 2 would remove the remaining impacted soils from the site. In order to implement this Alternative, all backfill material would need to be removed in order to access the remaining residual contamination left in place.

2.10.1.2.3 Site SS010 (Garage Site); Soil Removal and Off-Site Disposal

Under this remedial alternative, the existing garage would be demolished and contaminated soil with concentrations exceeding State of Alaska Method Two Soil Cleanup Levels for the Arctic zone would be excavated for off-site disposal. Under this alternative, the site would be suitable for unrestricted use and no long term monitoring would be necessary.

2.10.1.2.4 Site LF001a (Soil Storage Cell); Soil Removal and Off-Site Disposal

This alternative includes removing and transporting the impacted soils via land and sea to an authorized waste disposal facility located in the lower 48 states.

2.10.1.2.5 Site ST006 (Module Train Spills); Soil Removal and Off-Site Disposal

Under this remedial alternative, the Air Force would remove PCB-contaminated soil with concentrations exceeding 1 mg/kg. The impacted soil would then be transported to an approved off-site facility for disposal. A monitoring program would not be required for ST006 upon the completion of Remedial Alternative #2.

2.10.1.3 Alternative 3:

2.10.1.3.1 Site LF001 (Old Landfill); Land Use Control

Under this remedial alternative, the Air Force would implement a land use control at the site to inspect and maintain the clean soil cover/backfill and monitor erosion of the residual PCB contamination. Environmental monitoring would be conducted as specified through an approved monitoring program to verify the controls are maintained to prevent the development of a complete exposure pathway. Specific monitoring and ICs for LF001 would include the following:

- Visual monitoring of the top cover or clean backfill for signs of settlement, subsidence, erosion, or other such events annually;
- Five year reviews will be completed and utilized to determine necessity for continued annual inspections;
- The annual inspections and five year reviews will continue until ADEC approves discontinuation of visual monitoring;
- Maintaining the integrity of the top cover or clean backfill over each site to limit exposure to subsurface contaminated soils. Maintaining integrity includes:
    - Making repairs and preventing run-on or run-off from eroding or otherwise damaging the cover material;
    - Restricting excavation or disturbance of the final top covers; and

    - Restricting construction or demolition disturbance on top of LF001without prior concurrence from ADEC.
- Inclusion and documentation of all ICs in the 611th Civil Engineer Squadron (CES) Installation Restoration Program (IRP) Records, Base Master Plan and appropriate real estate files, including information about the following:
    - Current land uses and allowed uses of IRP Site LF001; and
    - Geographic extent of the IC boundaries, see Figure 1-1
- Record a Notice of Environmental Contamination (NEC) in the state land records at the appropriate Department of Natural Resources recording district;
- Submittal of a Performance Report/Annual Inspection report on ICs to ADEC annually;
- Five year review reports will be submitted once every five years after implementation of the remedial action as long as contaminant levels on-site do not allow for unrestricted land use;
- Prompt notification to ADEC of LUC deficiency/failure along with corrective measures taken or planned;
- ADEC concurrence for significant changes to use and activity restrictions and LUCs and for significant changes; and
- Prior notification to ADEC for transfer of property subject to LUCs.

2.10.1.3.2 Site LF002 (Dump Site); Land Use Control

Under this remedial alternative, the Air Force would implement a land use control at the site to inspect and maintain the cap over and monitor erosion of the residual PCB contamination. Environmental monitoring would be conducted in accordance with an approved monitoring program to verify that the land use controls are maintained to prevent the development of potential exposure pathways. Specific monitoring and ICs for LF002 would include the following:

- Visual monitoring of the top cover or clean backfill for signs of settlement, subsidence, erosion, or other such events annually;
- Five year reviews will be completed and utilized to determine necessity for continued annual inspections;
- The annual inspections and five year reviews will continue until ADEC approves discontinuation of visual monitoring;
- Maintaining the integrity of the top cover or clean backfill over each site to limit exposure to subsurface contaminated soils. Maintaining integrity includes:
    - Making repairs and preventing run-on or run-off from eroding or otherwise damaging the cover material;
    - Restricting excavation or disturbance of the final top covers; and
    - Restricting construction or demolition disturbance on top of LF001without prior concurrence from ADEC.

- Inclusion and documentation of all ICs in the 611th Civil Engineer Squadron (CES) Installation Restoration Program (IRP) Records, Base Master Plan and appropriate real estate files, including information about the following:
    - Current land uses and allowed uses of Sites LF002; and
    - Geographic extent of the IC boundaries, see Figure 1-1.
- Record a Notice of Environmental Contamination (NEC) in the state land records at the appropriate Department of Natural Resources recording district;
- Submittal of a Performance Report/Annual Inspection report on ICs to ADEC annually;
- Five year review reports will be submitted once every five years after implementation of the remedial action as long as contaminant levels on-site do not allow for unrestricted land use;
- Prompt notification to ADEC of LUC deficiency/failure along with corrective measures taken or planned;
- ADEC concurrence for significant changes to use and activity restrictions and LUCs and for significant changes; and
- Prior notification to ADEC for transfer of property subject to LUCs.

2.10.1.3.3 Site SS010 (Garage Site); Land Use Control and Future Source Removal and Off-Site Disposal

Under this remedial alternative, the Air Force would implement land use controls to prevent unrestricted site use in an effort to reduce potential human exposure risks. In 2007, a fence and warning signs were installed at the garage building. The fence prevents access to the contaminated area beneath the building and signs warn of the contamination that is present. The fence and signs will be inspected annually and any needed repairs will be completed immediately. As long as the garage remains as an active facility with similar operations, Remedial Alternative 3 is feasible and protective. Once the garage is demolished, contaminated soil underneath the garage will be removed and treated or disposed of properly.

Specific monitoring and ICs for SS010 would include the following:

- Annual inspections will be conducted to ensure the signs and fencing remain in place and potential exposure to contaminated soil is limited;
- Five year reviews will be conducted as long as contaminants remain on-site at levels that do not allow for unrestricted land use;
- Maintaining integrity of the site by restricting construction or demolition disturbance of SS010 without prior concurrence from the Air Force and ADEC;
- Restricting excavation or disturbance of contaminated soil to prevent groundwater contamination or placement of contaminated soil in environmentally sensitive areas;
- Maintaining engineering controls to include the chain link fence around the Garage Building at SS010;
- Inclusion and documentation of all ICs in the 611th Civil Engineer Squadron (CES) Installation Restoration Program (IRP) Records, Base Master Plan and appropriate real estate files, including information about the following:

    - Current land uses and allowed uses of Sites SS010; and
- Geographic extent of the IC boundaries, see Figure 1-1.
- Record a Notice of Environmental Contamination (NEC) in the state land records at the appropriate Department of Natural Resources recording district;
- Submittal of a Performance Report/Annual Inspection report on ICs to ADEC annually;
- Five year review reports will be submitted once every five years after implementation of the remedial action as long as contaminant levels on-site do not allow for unrestricted land use;
- Prompt notification to ADEC of LUC deficiency/failure along with corrective measures taken or planned;
- ADEC concurrence for significant changes to use and activity restrictions and LUCs and for significant changes; and
- Prior notification to ADEC for transfer of property subject to LUCs.

2.10.1.3.4 Site LF001a (Soil Cell); Containment, Land Use Controls, and Long-Term Monitoring

Under this alternative, the LF001a Soil Cell would be managed in place as a monofill in accordance with 18 AAC 60.430. Soils would be left in place at LF001a and Environmental monitoring would be conducted in accordance with an approved monitoring program to verify that the land use controls are maintained to prevent the development of potential exposure pathways. Maintenance and repairs will be performed to the cell as necessary, to prevent deterioration from subsidence, erosion or other causes.

Specific monitoring and ICs for LF001a would include the following:

- Annual visual monitoring of the top cover for signs of settlement, subsidence, erosion, or other damage; thermal and water quality monitoring to ensure the disposal cell remains frozen and contaminants are not leaching, until otherwise agreed to by DEC and the Air Force;
- Five year reviews will be completed to ensure the remedy remains protective as long as contaminant levels at the site do not allow for unrestricted land use.
- Maintaining the integrity of the top cover or clean backfill of LF001a to limit exposure to subsurface soils. Maintaining integrity includes:
    - Making repairs and preventing run-on or run-off from eroding or otherwise damaging the cover material;
    - Restricting excavation or disturbance of the final top cover at LF001a;
    - Maintaining warning signs, and
    - Restricting construction or demolition disturbance on top of LF001a without prior concurrence from the Air Force and ADEC.
- Inclusion and documentation of all ICs in the 611th Civil Engineer Squadron (CES) Installation Restoration Program (IRP) Records, Base Master Plan and appropriate real estate files, including information about the following:
    - Current land uses and allowed uses of Sites LF001a; and

- Geographic extent of the IC boundaries, see Figure 1-1.
- Record a Notice of Environmental Contamination (NEC) in the state land records at the appropriate Department of Natural Resources recording district;
- Submittal of a Performance Report/Annual Inspection report on ICs to ADEC annually;
- Five year review reports will be submitted once every five years after implementation of the remedial action as long as contaminant levels on-site do not allow for unrestricted land use;
- Prompt notification to ADEC of LUC deficiency/failure along with corrective measures taken or planned;
- ADEC concurrence for significant changes to use and activity restrictions and LUCs and for significant changes; and
- Prior notification to ADEC for transfer of property subject to LUCs.

2.10.1.3.5 Site ST006 (Module Train Spills); Land Use Control

Under this remedial alternative, the Air Force would implement land use controls at the site to prevent exposure to the PCB-impacted soils. Environmental monitoring would be conducted as specified through an approved monitoring program to inspect the site and verify the controls are maintained to prevent the development of a complete exposure pathway.

Specific monitoring and ICs for ST006 would include the following:

- Visual monitoring of the top cover or clean backfill for signs of settlement, subsidence, erosion, or other such events annually;
- Five year reviews will be completed to ensure the remedy remains protective as long as contaminant levels do not allow for unrestricted land use;
- Maintaining the integrity of the top cover of ST006 (until removal) to limit exposure to subsurface soils. Maintaining integrity includes:
    - Maintaining warning signs;
    - Making repairs and preventing run-on or run-off from eroding or otherwise damaging the cover material;
    - Restricting excavation or disturbance of the final top cover atST006; and
    - Restricting construction or demolition disturbance on top of ST006 without prior concurrence from the Air Force and ADEC.
- Inclusion and documentation of all ICs in the 611th Civil Engineer Squadron (CES) Installation Restoration Program (IRP) Records, Base Master Plan and appropriate real estate files, including information about the following:
    - Current land uses and allowed uses of Sites ST006; and
- Geographic extent of the IC boundaries, see Figure 1-1.
- Record a Notice of Environmental Contamination (NEC) in the state land records at the appropriate Department of Natural Resources recording district;
- Submittal of a Performance Report/Annual Inspection report on ICs to ADEC annually;

- Five year review reports will be submitted once every five years after implementation of the remedial action as long as contaminant levels on-site do not allow for unrestricted land use;
- Prompt notification to ADEC of LUC deficiency/failure along with corrective measures taken or planned;
- ADEC concurrence for significant changes to use and activity restrictions and LUCs and for significant changes; and
- Prior notification to ADEC for transfer of property subject to LUCs.

2.11 *Summary of Comparative Analysis of Alternatives*

In accordance with the NCP, the alternatives for sites LF001, LF002, SS010, LF001a, ST006, SS009a and SS009b, at Oliktok LRRS were evaluated using the nine criteria described in Section 121(a) &(b) of CERCLA and 40 CFR Section 300.430 (e) (9) (i) as cited in NCP §300.430(f)(5)(i). These criteria are classified as threshold criteria, balancing criteria, and modifying criteria.

Threshold criteria are standards that an alternative must meet to be eligible for selection as a remedial action. There is little flexibility in meeting the threshold criteria—the alternative must meet them or it is unacceptable. The following are classified as threshold criteria:

- Overall protection of human health and the environment
- Compliance with, or waiver of an applicable ARAR

Balancing criteria weigh the tradeoffs between alternatives. These criteria represent the standards upon which the detailed evaluation and comparative analysis of alternatives are based. In general, a high rating on one criterion can offset a low rating on another balancing criterion. Five of the nine criteria are considered balancing criteria:

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, and volume through treatment
- Short-term effectiveness
- Implementability
- Cost

Modifying criteria which may be considered to the extent that information is available during the FS, but can be fully considered only after public and regulator comments, are as follows:

- Community acceptance
- State/support agency acceptance

This section summarizes how well each alternative satisfies each evaluation criterion and indicates how it compares to the other alternatives under consideration.

2.11.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

Alternative 1 is not protective of human health and the environment for LF001, LF002, LF001a, ST006, and SS010 because it does not reduce the toxicity, mobility, or volume of the COCs on site to acceptable levels of risk, or prevent exposure. However, this alternative is protective for SS009a and SS009b because no contaminants exceed ADEC Method Two cleanup levels. Alternative 2 is protective of human health and the environment because removes the contaminants from the site and eliminates potential exposure.

Alternative 3 is protective of human health and the environment because it reduces the potential for exposure to contaminants that would remain on-site. As presented in Section 2.5, 2.6 and 2.9, Land Use Controls presented in alternative 3 with institutional controls, are protective of human health and the environment.

2.11.2 Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4).

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility citing laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. State standards that are identified by a state in a timely manner and that are more stringent than Federal requirements may be applicable.

Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility citing 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 (relevant) that their use is well-suited (appropriate) to the particular site. Only those State standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate.

Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statutes or provides a basis for invoking a waiver.

All of the alternatives presented for sites LF001, LF002, SS010, LF001a, and ST006, except Alternative 1, are compliant with ARARs.

The ARARs are presented in Table 2-19.

Table 2-19 Common Elements and Distinguishing Features of Alternatives for Each Site

LF001			
Elements/Features	ALTERNATIVES		
	No Action	Soil Removal and Off-Site Disposal	Land Use Control
Key Applicable or Relevant and Appropriate Requirements (ARARs) associated with each remedy.	Oil and Hazardous Substances Pollution Control Regulations (18 AAC 75.300 -18 AAC 75.396), PCB Manufacturing, Processing, Distribution, in Commerce and Use Prohibitions (40 CFR 761)	Identification and listing of Hazardous Waste s (40 CFR Part 261), Resource Conservation and Recovery Act (RCRA_ Standards (55 FR 30798), RCRA (40 CFR 268. 35, 263), PCB Manufacturing, Processing, Distribution, in Commerce and Use Prohibitions (40 CFR 761), Solid Waste Management Regulations (18 AAC 60)	Oil and Hazardous Substances Pollution Control Regulations (18 AAC 75.300 -18 AAC 75.396), PCB Manufacturing, Processing, Distribution, in Commerce and Use Prohibitions (40 CFR 761), Solid Waste Management Regulations (18 AAC 60)
Long-term reliability of remedy	No Long Term reliability, COC's are present in the soil.	Permanent long-term reliability for soil – Permanent removal of metal, PCB, and POL contaminated soils from Oliktok LRRS.	Long-term reliability provided controls are maintained. Contamination would remain below sea level. Site use is limited to industrial and access is controlled. Metal and PCB contamination do not readily degrade and POL contamination remains frozen to prevent migration. Monitoring and maintenance of the cap material would be maintained as part of an ADEC approved LTM program in perpetuity.
Quantity of untreated waste and treatment residuals to be disposed of off-site or managed onsite in a containment system and the degree of hazard remaining in such material	An unknown quantity of contaminated soil would remain on-site and not be monitored or managed.	An unknown quantity of contaminated soil remaining would be characterized for nature and extent, but remains below sea level. Due the close proximity of open water, special consideration and engineering controls would be required for complete excavation.	The unknown quantity of contaminated soil would be capped with clean backfill material, graded to natural conditions and contamination would remain below sea level. LUCs would restrict excavation or disturbance or residual contamination.
Estimated time for design and construction	N/A	Achievable within one construction season with accurate characterization and engineering controls.	Achievable within in one construction season.
Estimated time to reach remediation goals	Metal and PCB-contaminated soil is not likely to degrade in place. POL's would degrade over time or dilute through erosion.	Removal of contaminated soils above ADEC Method Two clean-up levels would be achievable in one construction season.	Metal and PCB-contaminated soil is not likely to degrade in place. Metals, POL's and low level PCBs would remain frozen below sea level.
Estimated capital cost	$0	$2,710,000	$110,000
Estimated Annual Operations and Maintenance Cost (30 years)	$0	$0	$210,000
Estimated total present worth	$0	$2,710,000	$330,000
Discount Rate	N/A	N/A	N/A
Number of years over which the cost is projected	N/A	< 1 year	30 years
Use of presumptive remedies and/or innovative technologies	N/A	N/A	N/A

LF002			
Elements/Features	ALTERNATIVES		
	No Action	Soil Removal and Off-Site Disposal	Land Use Control
Key Applicable or Relevant and Appropriate Requirements (ARARs) associated with each remedy.	Oil and Hazardous Substances Pollution Control Regulations (18 AAC 75.300 -18 AAC 75.396), PCB Manufacturing, Processing, Distribution, in Commerce and Use Prohibitions (40 CFR 761)	Identification and listing of Hazardous Waste s (40 CFR Part 261), Resource Conservation and Recovery Act (RCRA_ Standards (55 FR 30798), RCRA (40 CFR 268. 35, 263), PCB Manufacturing, Processing, Distribution, in Commerce and Use Prohibitions (40 CFR 761), Solid Waste Management Regulations (18 AAC 60)	Oil and Hazardous Substances Pollution Control Regulations (18 AAC 75.300 -18 AAC 75.396), PCB Manufacturing, Processing, Distribution, in Commerce and Use Prohibitions (40 CFR 761), Solid Waste Management Regulations (18 AAC 60)
Long-term reliability of remedy	No Long Term reliability, COC's are present in the soil.	Permanent long-term reliability for soil – Permanent removal of metal, PCB, and POL contaminated soils from Oliktok LRRS.	Long-term reliability provided controls are maintained. Contamination would remain below sea level. Site use is limited to industrial and access is controlled. Metal and PCB contamination do not readily degrade and POL contamination remains frozen to prevent migration. Monitoring and maintenance of the cap material would be maintained as part of an ADEC approved LTM program in perpetuity.
Quantity of untreated waste and treatment residuals to be disposed of off-site or managed onsite in a containment system and the degree of hazard remaining in such material	No Management. Approximately 800 cy of PCB and POL contaminated soil would remain at the site.	Approximately 800 cy of untreated soils would be disposed of offsite. An additional unknown quantity of contaminated soil remains would be characterized for nature and extent, but remains below sea level. Due the close proximity of open water, special consideration and engineering controls would be required for complete excavation	Long-term reliability provided controls are maintained. PCB Contamination would remain below sea level. Site use is limited to industrial and access is controlled. PCB contamination does not readily degrade. Monitoring and maintenance of the cap material would be maintained as part of an ADEC approved LTM program in perpetuity.
Estimated time for design and construction	N/A	Achievable within one construction season with accurate characterization and engineering controls.	Achievable within in one construction season.
Estimated time to reach remediation goals	Metal and PCB-contaminated soil is not likely to degrade in place. POL's would degrade over time or dilute through erosion.	Removal of contaminated soils above ADEC Method Two clean-up levels would be achievable in one construction season.	PCB-contaminated soil is not likely to degrade in place. PCB's would remain frozen below sea level. ICs/LUCs would need to be maintained indefinitely.
Estimated capital cost	$0	$591,000	$80,000
Estimated Annual Operations and Maintenance Cost (30 years)	$0	$0	$210,000
Estimated total present worth	$0	$591,000	$290,000
Discount Rate	N/A	N/A	N/A
Number of years over which the cost is projected	N/A	< 1 year	30 years
Use of presumptive remedies and/or innovative technologies	N/A	N/A	N/A

SS010			
Elements/Features	ALTERNATIVES		
	No Action	Soil Removal and Off-Site Disposal	Land Use Control
Key Applicable or Relevant and Appropriate Requirements (ARARs) associated with each remedy.	Oil and Hazardous Substances Pollution Control Regulations (18 AAC 75.300 -18 AAC 75.396), PCB Manufacturing, Processing, Distribution, in Commerce and Use Prohibitions (40 CFR 761)	Identification and listing of Hazardous Waste s (40 CFR Part 261), Resource Conservation and Recovery Act (RCRA_ Standards (55 FR 30798), RCRA (40 CFR 268. 35, 263), PCB Manufacturing, Processing, Distribution, in Commerce and Use Prohibitions (40 CFR 761), Solid Waste Management Regulations (18 AAC 60)	Oil and Hazardous Substances Pollution Control Regulations (18 AAC 75.300 -18 AAC 75.396), PCB Manufacturing, Processing, Distribution, in Commerce and Use Prohibitions (40 CFR 761), Solid Waste Management Regulations (18 AAC 60)
Long-term reliability of remedy	*No Long Term reliability, COC's are present in the soil.*	Permanent long-term reliability for soil – Permanent removal of metal, PCB, and POL contaminated soils from Oliktok LRRS.	Long-term reliability provided controls are maintained. Site use is limited to industrial and access is controlled. Metal and PCB contamination do not readily degrade and POL contamination remains beneath the garage. Monitoring and maintenance of the cap material would be maintained as part of an ADEC approved LTM program in perpetuity.
Quantity of untreated waste and treatment residuals to be disposed of off-site or managed onsite in a containment system and the degree of hazard remaining in such material	No Management. Approximately 1,986 cy of contaminated soil would remain at the site.	Approximately 1,986 cy of untreated soils would be disposed of offsite.	Contamination would remain on-site until the garage is demolished, at which time contaminated soils will be removed and dispositioned properly. Institutional controls would restrict excavation or disturbance of residual contamination until the garage and the contaminated soils are removed.
Estimated time for design and construction	N/A	Achievable within one construction season with accurate characterization and engineering controls.	Achievable within in one construction season.
Estimated time to reach remediation goals	Metal and PCB-contaminated soil is not likely to degrade in place. POL's would degrade over time or dilute through erosion.	Removal of contaminated soils above ADEC Method Two clean-up levels would be achievable in one construction season.	Metal and PCB-contaminated soil is not likely to degrade in place. Metals, PCB, and POL's contaminated soil would remain beneath the garage until some future point in time when the building and soil would be removed.
Estimated capital cost	$0	$609,000	$449,000
Estimated Annual Operations and Maintenance Cost (30 years)	$0	$0	$220,000
Estimated total present worth	$0	$609,000	$1,278,000
Discount Rate	N/A	N/A	N/A
Number of years over which the cost is projected	N/A	< 1 year	30 years
Use of presumptive remedies and/or innovative technologies	N/A	N/A	N/A

LF001a			
Elements/Features	ALTERNATIVES		
	No Action	Soil Removal and Off-Site Disposal	Land Use Control
Key Applicable or Relevant and Appropriate Requirements (ARARs) associated with each remedy.	Oil and Hazardous Substances Pollution Control Regulations (18 AAC 75.300 -18 AAC 75.396), PCB Manufacturing, Processing, Distribution, in Commerce and Use Prohibitions (40 CFR 761)	Identification and listing of Hazardous Waste s (40 CFR Part 261), Resource Conservation and Recovery Act (RCRA_ Standards (55 FR 30798), RCRA (40 CFR 268. 35, 263), PCB Manufacturing, Processing, Distribution, in Commerce and Use Prohibitions (40 CFR 761), Solid Waste Management Regulations (18 AAC 60)	Oil and Hazardous Substances Pollution Control Regulations (18 AAC 75.300 -18 AAC 75.396), PCB Manufacturing, Processing, Distribution, in Commerce and Use Prohibitions (40 CFR 761), Solid Waste Management Regulations (18 AAC 60)
Long-term reliability of remedy	No Long Term reliability, COC's are present in the soil cell.	Permanent long-term reliability for soil – Permanent removal of metal, PCB, and POL contaminated soils from Oliktok LRRS.	Long-term reliability provided controls are maintained. Contamination would remain in the monofill. Site use is limited to industrial and access is controlled. Metal and PCB contamination do not readily degrade and POL contamination remains frozen to prevent migration. Monitoring and maintenance of the cap material would be maintained as part of an ADEC approved LTM program in perpetuity.
Quantity of untreated waste and treatment residuals to be disposed of off-site or managed onsite in a containment system and the degree of hazard remaining in such material	No Management. Approximately 6,445 cy of contaminated soil would remain at the site.	Approximately 6,445 cy of untreated soils would be disposed of offsite.	Approximately 6,445 cy of untreated soils would remain in an on-site soil cell.
Estimated time for design and construction	N/A	Achievable within one construction season with accurate characterization and engineering controls.	Achievable within in one construction season.
Estimated time to reach remediation goals	Metal and PCB-contaminated soil is not likely to degrade in place. POL's would degrade over time or dilute through erosion.	Removal of contaminated soils above ADEC Method Two clean-up levels would be achievable in one construction season.	Metal and PCB-contaminated soil is not likely to degrade in place. POL's would remain frozen below sea level. ICs/LUCs would be maintained indefinitely.
Estimated capital cost	$0	$7,300,000	$30,000
Estimated Annual Operations and Maintenance Cost (30 years)	$0	$0	$360,000
Estimated total present worth	$0	$7,300,000	$390,000
Discount Rate	N/A	N/A	N/A
Number of years over which the cost is projected	N/A	< 1 year	30 years
Use of presumptive remedies and/or innovative technologies	N/A	N/A	N/A

ST006			
Elements/Features	ALTERNATIVES		
	No Action	Soil Removal and Off-Site Disposal	Land Use Control
Key Applicable or Relevant and Appropriate Requirements (ARARs) associated with each remedy.	Oil and Hazardous Substances Pollution Control Regulations (18 AAC 75.300 -18 AAC 75.396), PCB Manufacturing, Processing, Distribution, in Commerce and Use Prohibitions (40 CFR 761)	Identification and listing of Hazardous Waste s (40 CFR Part 261), Resource Conservation and Recovery Act (RCRA_ Standards (55 FR 30798), RCRA (40 CFR 268. 35, 263), PCB Manufacturing, Processing, Distribution, in Commerce and Use Prohibitions (40 CFR 761), Solid Waste Management Regulations (18 AAC 60)	Oil and Hazardous Substances Pollution Control Regulations (18 AAC 75.300 -18 AAC 75.396), PCB Manufacturing, Processing, Distribution, in Commerce and Use Prohibitions (40 CFR 761)
Long-term reliability of remedy	No Long Term reliability, COC is present in the soil.	Permanent long-term reliability for soil – Permanent removal of PCB contaminated soils from Oliktok LRRS.	Long-term reliability provided controls are maintained. Contamination would remain on-site. Site use is limited to industrial and access is controlled. PCB contamination does not readily degrade. Monitoring and maintenance of the cap material would be maintained as part of an ADEC approved LTM program in perpetuity.
Quantity of untreated waste and treatment residuals to be disposed of off-site or managed onsite in a containment system and the degree of hazard remaining in such material	No Management. Approximately 7 cy of PCB contaminated soil would remain at the site.	Approximately 7 cy of untreated soils would be disposed of offsite.	Approximately 7 cy of untreated soils would be characterized and placed within an on-site soil cell. The additional unknown quantity of contaminated soil would be capped with clean backfill material, graded to natural conditions and contamination would remain below sea level.
Estimated time for design and construction	N/A	Achievable within one construction season with accurate characterization and engineering controls.	Achievable within in one construction season.
Estimated time to reach remediation goals	Metal and PCB-contaminated soil is not likely to degrade in place. POL's would degrade over time or dilute through erosion.	Removal of contaminated soils above ADEC Method Two clean-up levels would be achievable in one construction season.	Metal and PCB-contaminated soil is not likely to degrade in place. POL's would remain frozen below sea level.
Estimated capital cost	$0	$33,000	$3,000
Estimated Annual Operations and Maintenance Cost (30 years)	$0	$0	$160,000
Estimated total present worth	$0	$33,000	$163,000
Discount Rate	N/A	N/A	N/A
Number of years over which the cost is projected	N/A	< 1 year	30 years
Use of presumptive remedies and/or innovative technologies	N/A	N/A	N/A

2.11.2.1 Site LF001 (Old Landfill)

Remedial Alternative 1 would not meet chemical-specific ARARs since impacted soils are present at the bottom of the former excavation. Remedial Alternative 2 would meet the ARARs since all of the soils exceeding standards would be excavated, transported and disposed at an offsite facility. Remedial Alternative 3 would comply with ARARs because soil remaining at the site contains < 10 mg/kg PCBs, is capped with clean soil and institutional controls will be established to maintain the cap.

2.11.2.2 Site LF002 (Dump Site)

Remedial Alternative 1 would not meet chemical-specific ARARs since impacted soils are present at the bottom of the former LF002 excavation. Remedial Alternative 2 would meet the ARARs since all of the exceeding soils would be excavated, transported and disposed at an offsite facility. . Remedial Alternative 3 would comply with ARARs because soil remaining at the site contains < 10 mg/kg PCBs, is capped with clean soil and institutional controls will be established to maintain the cap .

2.11.2.3 Site SS010 (Garage Site)

Remedial Alternative 1 would not meet chemical-specific ARARs based upon the exceeding soil concentrations remaining at the site for an unrestricted property. Remedial Alternative 2 would meet the ARARs since all of the exceeding soils would be excavated, transported and disposed at an offsite facility. Remedial Alternative 3 would not comply with ARARs, however would provide reductions in the risk to humans and the environment through maintenance and monitoring and limiting access to contaminated soil beneath the garage which contains > 10 mg/kg PCBs; however, long-term effectiveness will be maintained though established institutional controls, and maintained in perpetuity until the garage is removed. .

2.11.2.4 Site LF001a (Soil Cell)

Remedial Alternative 1 would not meet chemical-specific ARARs since impacted soils are present at within the LF001a soil cell. Remedial Alternative 2 would meet chemical-specific ARARs through the implementation of land use controls for industrial use and maintenance as a monofill designed for storage of polluted waste under the ADEC Solid Waste regulations 18 AAC 60.430. Remedial Alternative 3 would meet the ARARs since all of the exceeding soils would be excavated, transported and disposed at an offsite facility.

2.11.2.5 Site ST006 (Module Train Spills)

Remedial Alternative 1 would not meet chemical-specific ARARs since impacted soils are present beneath the liner located under the transformer stand. Remedial Alternative 2 would meet the ARARs since all of the exceeding soils would be excavated, transported and disposed at an offsite facility. Remedial Alternative 3 would meet chemical-specific ARARs through the implementation of land use controls and maintaining a cap over the PCB soil.

2.11.3 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once

clean-up levels have been met. This criterion includes the consideration of residual risk that will remain onsite following remediation and the adequacy and reliability of controls.

2.11.3.1 Site LF001 (Old Landfill)

Remedial alternatives 2 and 3 provide long-term effectiveness and permanence for the current and anticipated industrial use, as Remedial Alternative 1 is not protective of human health for unrestricted uses and would result in a higher level of potential risk exposure to contaminated soil and potential surface water and sediment impacts due to erosion.

Remedial Alternatives 2 and 3 would result in PCB contaminated soil remaining on site and the need for the landowner to properly manage land use controls indefinitely under Alternative 3.

Remedial Alternative 2 would provide the best long-term effectiveness and permanence since the exceeding soils would be removed from the site. LF001 would then become acceptable for future unrestricted land use.

2.11.3.2 Site LF002 (Dump Site)

Remedial alternatives 2 and 3provide long-term effectiveness and permanence for the current and anticipated industrial use, as Remedial Alternative 1 is not protective of human health for unrestricted uses and would result in a higher level of potential risk exposure to contaminated soil than would occur under an industrial setting. Alternative 1 would not be protective of ecological receptors if the site were to erode.

Remedial Alternatives 2 and 3 would result in contaminated soil remaining on site and the need for the landowner to properly manage land use controls indefinitely.

Remedial Alternative 2 would provide the best long-term effectiveness and permanence since the exceeding soils would be removed from the site. LF002 would then become acceptable for future unrestricted land use.

2.11.3.3 Site SS010 (Garage Site)

Remedial alternatives 2 and 3provide long-term effectiveness and permanence for the current and anticipated industrial use, as Remedial Alternative 1 is not protective of human health for unrestricted uses and would result in a higher level of potential risk exposure to contaminated soil than would occur under an industrial setting.

Remedial Alternatives 2 and 3 would result in contaminated soil remaining on-site, which would need to be managed in accordance with applicable regulations indefinitely.

Remedial Alternative 2 would provide the best long-term effectiveness and permanence since the exceeding soils would be removed from the site for offsite disposal. SS010 would then become acceptable for future unrestricted land use.

2.11.3.4 Site LF001a (Soil Cell)

Alternative 1 is not effective and carries risk since the erosion/condition of soil cell would not be monitored. Alternative 2 will ensure long-term effectiveness and early detection of failure of migration prevention. Alternative 3 has the best long-term effectiveness since contamination will be removed from the Oliktok facility and placed in a specialized hazardous waste storage facility.

2.11.3.5 Site ST006 (Module Train Spills)

Remedial alternatives 2 and 3 provide long-term effectiveness and permanence for the current and anticipated industrial use. Remedial Alternative 1 is not protective of human health for unrestricted uses.

2.11.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

2.11.4.1 Site LF001 (Old Landfill)

None of the proposed remedial alternatives involves treatment.

2.11.4.2 Site LF002 (Dump Site)

None of the proposed remedial alternatives involves treatment.

2.11.4.3 Site SS010 (Garage Site)

None of the proposed remedial alternatives involves treatment.

2.11.4.4 Site LF001a (Soil Cell)

None of the proposed remedial alternatives involves treatment.

2.11.4.5 Site ST006 (Module Train Spills)

None of the remedial alternatives involves treatment.

2.11.5 Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved.

2.11.5.1 Site LF001 (Old Landfill)

All three remedial alternatives provide reasonable short-term effectiveness.

2.11.5.2 Site LF002 (Dump Site)

All three remedial alternatives provide reasonable short-term effectiveness.

2.11.5.3 Site SS010 (Garage Site)

All three remedial alternatives provide reasonable short-term effectiveness.

2.11.5.4 Site LF001a (Soil Cell)

All three remedial alternatives provide reasonable short-term effectiveness.

2.11.5.5 Site ST006 (Module Train Spills)

All three remedial alternatives provide reasonable short-term effectiveness.

2.11.6 Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

2.11.6.1 Site LF001 (Old Landfill)

All three remedial alternatives are implementable. Remedial Alternative 2 would require disturbance of the area by specialized heavy machinery to excavate the remaining soils exceeding standards and should be completed in late fall in order to avoid water flowing into the excavation from surrounding water bodies. However, the frozen soil would present a technical obstacle and may require highly specialized equipment and materials. Conducting these activities in late fall months will provide the necessary daylight hours and frozen conditions. Additionally, maintenance of cover materials would become weather dependent. Alternative 3 will require administrative and institutional control monitoring is conducted as specified through an ADEC approved monitoring program to inspect the site and verify the institutional controls are maintained to prevent the development of a complete exposure pathway.

2.11.6.2 Site LF002 (Dump Site)

All three remedial alternatives are implementable. Remedial Alternative 2 would require disturbance of the area by specialized heavy machinery to excavate the remaining soils exceeding standards and should be completed in late fall in order to avoid water flowing into the excavation from surrounding water bodies. However, the frozen soil would present a technical obstacle and may require highly specialized equipment and materials. Conducting these activities in late fall months will provide the necessary daylight hours and frozen conditions. Additionally, maintenance of cover materials would become weather dependent. Alternative 3 will require administrative and institutional control monitoring is conducted as specified through an ADEC approved monitoring program to inspect the site and verify the institutional controls are maintained to prevent the development of a complete exposure pathway.

2.11.6.3 Site SS010 (Garage Site)

All three remedial alternatives are implementable. Remedial Alternative 2 would require disturbance of the area, including demolition of the garage structure, which is currently in use and planned to remain in use. Alternative 3 will require administrative and institutional control monitoring is conducted as specified through an ADEC approved monitoring program to inspect the site and verify the institutional controls are maintained to prevent the development of a complete exposure pathway; contaminated soil would be removed when the building is no longer needed and is removed.

2.11.6.4 Site LF001a (Soil Cell)

All three remedial alternatives are implementable. Alternative 1 is easiest to implement. Alternative 2 will require an extensive amount of effort, mobilization of equipment and coordination, however could be completed within one year. Alternative 3 will require administrative environmental, and institutional control monitoring is conducted as specified through an ADEC approved monitoring program to inspect the site and verify the institutional

controls are maintained to prevent the development of a complete exposure pathway over a 30-year or longer period.

2.11.6.5 Site ST006 (Module Train Spills)

All three remedial alternatives are implementable. Alternative 2 would require disturbance of the area and a potential temporary shutdown of electrical equipment served by the transformers. Alternative 3 will require administrative and institutional control monitoring is conducted as specified through an ADEC approved monitoring program to inspect the site and verify the institutional controls are maintained to prevent the development of a complete exposure pathway.

2.11.7 Cost

Costs are provided below for each alternative based on criteria presented for technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered which influence costs.

2.11.7.1 Site LF001 (Old Landfill)

Remedial Alternatives 1 and 3 are the lesser cost options. Remedial Alternative 2 would cost more because of the need to mobilize staff and machinery to conduct the excavation, transportation and disposal of contaminated soil along with any subsequent restoration efforts. During the contract award process of this project, different scenarios were examined and the associated costs were evaluated. The basic costs of the three alternatives are as follows:

- Remedial Alternative 1 - $0.
- Remedial Alternative 2 – total cost would be approximately $2,710,000 including mobilization, excavation and disposal at a rate of about $1,300 per cubic yard of contaminated soil. This includes an additional one-foot lift that would be removed from the floor of LF001 plus the bottom six inches of the clean fill material to account for any contact soil, for a total of 1,700 cubic yards. This material would be transported offsite and disposed at an approved facility.
- Remedial Alternative 3 – Cost going forward is minimal as ICs are relatively easy to implement at the site and monitoring will be conducted in conjunction with other site activities. Recent monitoring costs were approximately $35,000 (for all sites) and will likely remain the same over the next 30 years. The total estimated present value cost of the alternative is $330,000 ($5,000 per year over 30 years), estimating an additional $60,000 for any maintenance/repair costs over the 30-year period.

2.11.7.2 Site LF002 (Dump Site)

Remedial Alternatives 1 and 3 are the lesser cost options. Remedial Alternative 2 would cost more because of the need to mobilize staff and machinery to conduct the excavation, transportation and disposal of contaminated soil and along with any subsequent restoration efforts. During the contract award process of this project, different scenarios were examined and the associated costs were evaluated. The basic costs of the three alternatives are as follows:

- Remedial Alternative 1 - $0.

- Remedial Alternative 2 – total cost would be approximately $591,000, including mobilization, excavation and disposal at a rate of about $1,300 per cubic yard of contaminated soil. This includes an additional one-foot lift that would be removed from the floor of LF002, plus the bottom six inches of the clean fill material to account for any contact soil, for a total of 70 cubic yards. This material would be transported offsite and disposed at an approved facility.
- Remedial Alternative 3 –Cost going forward is minimal due to excavation completed and monitoring to be conducted in conjunction with other site activities, specifically the periodic monitoring at LF001a. Recent monitoring costs were approximately $35,000 (for all sites) and will likely remain the same over the next 30 years. The total estimated present value cost of the alternative is $290,000 ($5,000 per year over 30 years), estimating an additional $60,000 for any maintenance/repair costs over the 30-year period.

2.11.7.3 Site SS010 (Garage Site)

Remedial Alternatives 1 and 3 would cost the least to implement. Remedial Alternative 2 is the most expensive corrective measure to implement due to the mobilization of staff and machinery to conduct the building demolition, excavation of the impacted soils and off-site disposal of the impacted media (soil) and reconstruction of the garage building. During the contract award process of this project, different scenarios were examined and the associated costs were evaluated. The basic costs of the three alternatives are as follows:

- Remedial Alternative 1 - $0.
- Remedial Alternative 2 - $609,000 This is based on estimates of $85,000 for demolition of the garage, $70,000 for excavating remaining contaminated soil, $200,000 for the offsite disposal of contaminated soil, and $150,000 for reconstruction of the garage.
- Remedial Alternative 3 –Cost going forward for the foreseeable future is minimal. Monitoring will be conducted in conjunction with other site activities. Recent monitoring costs were approximately $35,000 (for all sites) and will likely remain the same over the next 30 years. The total estimated present value cost of the alternative is $150,000 ($5,000 per year over 30 years), estimating an additional $70,000 for maintenance/repair costs over the 30-year period. These may include, but are not limited to, repairs and replacement to the fencing and signage. Additionally, should the Air Force decide in the future to vacate the property, the garage building will, at that time, be demolished and the contamination beneath the garage building will be excavated at an estimated cost of $345,000. Therefore the entire cost of Remedial Alternative 3 would be approximately $1,278,000, which includes future demolition and excavation/disposal of contamination, but without reconstruction.

2.11.7.4 Site LF001a (Soil Cell)

Actual total costs of each of the Remedial Alternatives are as follows:

- Remedial Alternative 1 - $0.
- Remedial Alternative 2 - $7,300,000 (for transportation and disposal in conjunction with offsite disposal at other Oliktok sites).
- Remedial Alternative 3 - This remedy could be implemented immediately and would have a capital cost of approximately $30,000. Monitoring will be conducted in conjunction with other site activities. Recent monitoring costs were approximately $35,000 (for all sites) and will likely remain the same over the next 30 years. The total estimated present value cost of

the alternative is $150,000 ($10,000 per year over 30 years), estimating an additional $60,000 for maintenance/repair costs of the soil cell cover over the 30-year period. The total estimated present value cost of the alternative is $390,000, plus any repair costs, to be determined.

2.11.7.5 Site ST006 (Module Train Spills)

During the contract award process of this project, different scenarios were examined and the associated costs were evaluated. The basic costs of the three alternatives are as follows:

- Remedial Alternative 1 - $0.
- Remedial Alternative 2 - ~$33,000 (includes excavation, offsite disposal and sampling).
- Remedial Alternative 3 – Initial estimated cost - ~$10,000. Cost going forward is minimal due to the cap already being in place and warning sign having been installed. The total estimated present value cost of the alternative is $150,000 ($5,000 per year over 30 years), estimating an additional $10,000 for maintenance/repair costs over the 30-year period.

2.11.8 State/Support Agency Acceptance

The ADEC has determined that the remedies meet the requirements in 18 AAC 75 Article 3 site cleanup rules for each site and respective alternatives as defined below.

2.11.8.1 Site LF001 (Old Landfill)

Determination has been made by ADEC that Remedial Alternatives 2 and 3, but not Remedial Alternative 1, would meet requirements in Alaska's site cleanup rules.

2.11.8.2 Site LF002 (Dump Site)

Determination has been made by ADEC that Remedial Alternatives 2 and 3, but not Remedial Alternative 1, would meet requirements in Alaska's site cleanup rules.

2.11.8.3 Site SS010 (Garage Site)

Determination has been made by ADEC that Remedial Alternatives 2 and 3, but not Remedial Alternative 1 would meet requirements in Alaska's site cleanup rules for SS010.

2.11.8.4 Site LF001a (Soil Cell)

Determination has been made by ADEC that Alternatives 2 and 3 meet regulatory requirements in 18 AAC 75 Article 3.

2.11.8.5 Site ST006 (Module Train Spills)

Determination has been made by ADEC that Remedial Alternatives 2 and 3, but not Remedial Alternative 1, would meet requirements in Alaska's site cleanup rules for ST006. ADEC has indicated its preference would be to excavate and dispose the soils off-site.

2.11.9 Community Acceptance

The USAF distributed the Final Proposed Plan LF001, LF002, SS010, LF001a, ST006, SS009a and SS009b for Oliktok LRRS to the local community and the public to solicit input. The plan was submitted as part of the NCP requirements for the CERCLA sites; however, comments were solicited on all sites in the Oliktok LRRS. The Proposed Plan was distributed on 25 March 2011 (USAF 2011). On 29 March 2011, a public meeting and a Restoration Advisory Board meeting

were held. The community submitted no written comments on the Proposed Plan; however, verbal comments were documented during the public meeting.

Although no written comments were received, the community does place a high interest and value of the sites being restored consistently with cultural and historical conditions. Specifically the community would like to have debris along the shoreline cleaned up as it is identified and off-shore debris cleaned up because it presents a boating hazard. The community maintains an active presence in the Oliktok area for fishing and harvesting game.

2.11.9.1 Site LF001 (Old Landfill)

Community acceptance of the preferred remedial alternative for LF001 was evaluated based on comments received during the public comment period. No comments were received.

2.11.9.2 Site LF002 (Dump Site)

Community acceptance of the preferred remedial alternative for LF002 was evaluated based on comments received during the public comment period. No comments were received.

2.11.9.3 Site SS010 (Garage Site)

Community acceptance of the preferred remedial alternative for SS010 was evaluated based on comments received during the public comment period. No comments were received.

2.11.9.4 Site LF001a (Soil Cell)

Community acceptance of the preferred remedial alternative for LF001a was evaluated based on comments received during the public comment period. No comments were received.

2.11.9.5 Site ST006 (Module Train Spills)

Community acceptance of the initial preferred remedial alternative for ST006 was evaluated based on comments received during the public comment period. No comments were received.

2.12 *Principal Threat Wastes*

The NCP expects that treatment that reduces the toxicity, mobility, or volume of the principal threat wastes will be used to the extent practicable. The principal threat concept refers to the source materials at a CERCLA site considered to be highly toxic or highly mobile that generally cannot be reliably controlled in place, or present a significant risk to human health or the environment should exposure occur. A source material is a material that contains hazardous substances, pollutants, or contaminants that acts as a reservoir for migration of contamination to groundwater or air, or that acts as a source for direct exposure. Pursuant to the EPA Fact Sheet, *A Guide to Principal Threat and Low Level Threat Wastes* (Publication 9380.3-O6FS, November 1991 [EPA 1991]), principal threat wastes typically have a potential cancer risk of 1×10^{-3} or greater, while low toxicity source material presents an excess cancer risk near the acceptable risk range. There are no principal threat wastes as indicated by the maximum cancer risk attributed to a single carcinogenic COC's summarized in Table 2-6.

2.13 *Selected Remedies*

The primary indicator of remedial action performance will be satisfying the RAOs for sites LF001, LF002, SS010, LF001a, ST006, SS009a and SS009b, at Oliktok LRRS and protecting

human health and the environment. Performance measures are defined herein as the RAOs (see Section 2.8 – Remedial Action Objectives) plus the required actions to achieve the objectives, as defined in this section. It is anticipated that successful implementation, operation, maintenance, and completion of the performance measures will achieve protective and legally compliant remedies for sites LF001, LF002, SS010, LF001a, ST006, SS009a and SS009b, at Oliktok LRRS.

The USAF is responsible for implementing, maintaining, and monitoring the remedial action[s] identified herein for the duration of the remedies selected in this ROD. The USAF will exercise this responsibility in accordance with CERCLA, the NCP, and state law.

2.13.1 Site LF001 (Old Landfill)

The Selected Remedial Alternative for LF001 is **Remedial Alternative 3: Land Use Controls**. This remedial alternative was selected because it is protective of human health, welfare, and the environment; is compliant with ARARs, is effective in the long and short term, is implementable for a future industrial land use setting and costs less than Remedial Alternative 2. Remedial Alternative 1 was not selected because this option does not include land use restrictions and, therefore, will not comply with chemical-specific ARARs for unrestricted use.

2.13.2 Site LF002 (Dump Site)

The Selected Remedial Alternative for LF002 is **Remedial Alternative 3: Land Use Controls**. This remedial alternative was selected because it is protective of human health, welfare, and the environment; is compliant with ARARs, is effective in the long and short term, is implementable for a future industrial land use setting and costs less than Remedial Alternative 2. Remedial Alternative 1 was not selected because this option does not include use of land restrictions and therefore will not comply with chemical-specific ARARs for unrestricted use.

2.13.3 Site SS010 (Garage Site)

The Selected Remedial Alternative is **Remedial Alternative 3: Land Use Controls and Future Source Removal and Off-Site Disposal**. This remedial alternative was selected because it is protective of human health, welfare, and the environment, is compliant with ARARs, is effective in the long and short term, is implementable for the proposed future industrial land use setting and costs less to implement than Remedial Alternative 2. Remedial Alternative 1 was not selected because it does not provide adequate protection of human health and the environment to prevent potential exposure to the impacted soils.

2.13.4 Site LF001a (Soil Cell)

The Selected Remedial Alternative for LF001a is **Remedial Alternative 3: Containment, Land Use Controls, and Long-Term Monitoring**. This remedial alternative was selected because it is protective of human health, welfare, and the environment; is compliant with ARARs, is effective in the long and short term, is implementable for a future industrial land use setting and costs less than Remedial Alternative 3. Remedial Alternative 1 was not selected because this option does not include use of land restrictions and therefore will not comply with chemical-specific ARARs for unrestricted use.

2.13.5 Site ST006 (Module Train Spills)

The Selected Remedial Alternative is **Remedial Alternative 2: Soil Removal and Off-Site Disposal**. This alternative was selected because it is protective of human health, welfare, and the environment, is compliant with ARARs, is effective in the long and short terms, is implementable, and the cost is reasonable. Remedial Alternative 1 was not selected because this option does not include use of land restrictions and therefore will not comply with chemical-specific ARARs for unrestricted use. The USAF will monitor the existing cap in accordance with Remedial Alternative 3: Land Use Control until the soil has been removed. At the completion, a monitoring program would not be required for ST006.

2.14 *Summary of the Rationale for the Selected Remedies*

The USAF believes that the selected remedies meet the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. The remedies are expected to satisfy the following selection criteria as defined by CERCLA § 121(b):

- Threshold criteria
  - Protection of human health and the environment
  - Compliance with ARARs
- Balancing criteria
  - Long-term effectiveness and permanence
  - Toxicity, mobility or volume reduction through treatment
  - Short-term effectiveness
  - Implementability
  - Cost
- Modifying criteria
  - State agency acceptance
  - Community acceptance

The selected remedial alternatives for sites LF001, LF002, SS010, LF001a, and ST006, are defined below:

2.14.1 Site LF001 (Old Landfill): Alternative 3 - Land Use Control.

The RAOs for site LF001 are:

- Protect human health and the environment;
- Prevent human exposure to or direct contact with contaminants in soil containing DRO and RRO concentrations in excess of ADEC Soil cleanup levels for Arctic Zone (18 AAC 75.341, Table A2, B1 and B2) : DRO 500 mg/kg, RRO 2,000 mg/kg, PCBs 1 mg/kg lead 400 mg/kg, chromium 410 mg/kg;
- Prevent migration or erosion of COCs into ocean sediment.

2.14.2 Site LF002 (Dump Site): Alternative 3 - Land Use Control

The RAOs for site LF002 are:

- Protect human health and the environment;

- Prevent human exposure to or direct contact with PCB-contaminated soil with concentrations in excess of ADEC Soil cleanup levels for Arctic Zone (18 AAC 75.341, Table B2) : PCBs 1 mg/kg; and
- Prevent migration or erosion of COCs into ocean sediment.

2.14.3 Site SS010 (Garage Site) – Alternative 3: Land Use Control

The RAOs for site SS010 are:

- Protect human health and the environment;
- Prevent human exposure to or direct contact with petroleum, metals, and PCB-contaminated soil with concentrations in excess of ADEC Soil cleanup levels for Arctic Zone (18 AAC 75.341, Table B1 and B2): DRO 12,500 mg/kg; RRO 13,700 mg/kg; Arsenic 6.1 mg/kg; Lead 400 mg/kg; and PCBs 1 mg/kg;
- Prevent migration of COCs.

2.14.4 Site LF001a (Soil Cell): Alternative 3: Containment, Land Use Controls, and Long-Term Monitoring

The RAOs for site LF001a are:

- Protect human health and the environment;
- Prevent human exposure to or direct contact with contaminants in soil containing DRO and RRO concentrations in excess of ADEC Method Two Soil cleanup levels for Arctic Zone (18 AAC 75.341, Table B1 and B2) : DRO 12,500 mg/kg, RRO 13,700 mg/kg and PCBs 1 mg/kg; and
- Compliance with applicable Federal and state laws and regulations; and
- Prevent migration of COCs.

2.14.5 Site ST006 (Module Train Spills): Alternative 3: Land Use Control

The RAOs for site ST006 are:

- Protect human health and the environment;
- Prevent human exposure to or direct contact with PCB-contaminated soil with concentrations in excess of ADEC Soil cleanup levels for Arctic Zone (18 AAC 75.341, Table B2) : PCBs 1 mg/kg (until removal); and
- Prevent migration of COCs.

2.15 *Description of the Selected Remedies*

The overall remedy selected for contaminated soil with concentrations above applicable State of Alaska cleanup levels (18 AAC 75.345, Tables A2, B1 and B2) at Sites LF001, LF002, SS010, LF001a, is ICs. These ICs will remain in place until the ADEC cleanup levels specified in Table 1-1 and Table 2-5, or subsequent amendments to those levels, are attained. The remedy for ST006 is removal and off-site disposal of soil containing > 1 mg/kg PCB.

ICs will remain in place until the ADEC cleanup levels specified in Table 1-1 are attained. The ICs at Sites LF001, LF002, SS010 (until the building and contaminated soil are removed), and LF001a will be reviewed annually, to ensure that land use has not changed and ICs remain effective in limiting exposure to the remaining presence of fuel, metals and PCB contamination in soil and groundwater. The USAF will remove the remaining PCB contamination at site ST006 to ADEC PCB soil cleanup standards of 1 mg/kg by December 31, 2013. Until PCB contamination has been removed, no construction or demolition activities will take place in the vicinity of the transformer stand that have the potential to disturb the contaminated soils. The USAF will ensure proper coordination of an approved Work Plan and provide a detailed Remedial Action Report for site closure.

Under the selected soil remedy, contaminated subsurface soil will be allowed to remain in place, with potential exposure to subsurface soil limited through ICs.

The major components of the selected remedy for soil are as follows:

- Visual monitoring of the top cover or clean backfill at each site for signs of settlement, subsidence, erosion, or other such events annually;
- Five year reviews will be completed to ensure the remedies remain protective and to determine necessity for continued annual inspections;
- The annual inspections will continue until ADEC approves reduction or discontinuation of visual monitoring;
- Thermal and water quality monitoring will be conducted at Site LF001a to ensure contaminants have not leached away from the encapsulated area annually;
    - In the event thermal monitoring results do not indicate freezeback, additional water quality monitoring will be required to monitor for PCB migration, as agreed upon by ADEC, and additional remedial action may be necessary.
    - In the event water quality monitoring indicate the presence of Total PCBs at or above 0.5 micrograms per liter (ug/L) (Groundwater and Surface Water Clean Up Levels 18 AAC 75.345, (AAC, 2008), corrective action will be triggered to prevent further migration.
- Maintaining the integrity of the top cover or clean backfill over each site to limit exposure to subsurface soils. Maintaining integrity includes:
    - Making repairs and preventing run-on or run-off from eroding or otherwise damaging the cover material;
    - Restricting excavation or disturbance of the final top cover at LF001, LF002, LF001a and ST006 (until removal); and
- Restricting construction or demolition disturbance on top of LF001, LF002, SS010, LF001a and ST006 (until removal) without prior concurrence from ADEC.
- Restricting access and excavation or disturbance of contaminated soil to prevent groundwater contamination or placement of contaminated soil in environmentally sensitive areas;
- Maintaining engineering controls to include the chain link fence underneath the Garage Building at SS010, the soil caps at LF001a and ST006, and Warning signs at SS010, LF001a and ST006; Maintaining integrity includes:

    - Maintaining warning signs;
    - Making repairs and preventing run-on or run-off from eroding or otherwise damaging the cover material;
    - Restricting excavation or disturbance of the final top cover atST006; and
    - Restricting construction or demolition disturbance on top of ST006 without prior concurrence from the Air Force and ADEC.
- Inclusion and documentation of all ICs in the 611th Civil Engineer Squadron (CES) Installation Restoration Program (IRP) Records, Base Master Plan and appropriate real estate files, including information about the following:
    - Current land uses and allowed uses of Sites LF001, LF002, LF001a, SS010, and ST006, SS009a and SS009b; and
    - Geographic extent of the IC boundaries, see Figure 1-1.
- Record a Notice of Environmental Contamination (NEC) in the state land records at the appropriate Department of Natural Resources recording district;
- Submittal of a Performance Report/Annual Inspection reports on ICs to ADEC annually.
- Five year review reports will be submitted once every five years after implementation of the remedial action as long as contaminant levels on site do not allow for unrestricted land use and unlimited exposure;
- Prompt notification to ADEC of LUC deficiency/failure along with corrective measures taken or planned;
- ADEC concurrence for significant changes to use and activity restrictions and LUCs and for significant changes; and
- Prior notification to ADEC for transfer of property subject to LUCs.

The USAF is responsible for implementing, maintaining, and monitoring the remedial action selected and identified in this ROD for the duration of the remedy. Concurrence by ADEC is required for any modification of the remedy.

2.16 *Expected Outcomes of Selected Remedy*

After the implementation of the remedies, human health and the environment will be protected from the risks of exposure to COCs at Sites LF001, LF002, SS010, LF001a, ST006, SS009a, and SS009b. The remedial action objectives will be attained immediately after the selected remedy is implemented.

The cleanup levels utilized when evaluating potential contamination at the Oliktok LRRS sites are presented in Table 2-20.

The USAF is committed to implementing, monitoring, maintaining, and enforcing all components of the selected remedy to ensure that it remains protective of human health and the environment.

Table 2-20 Oliktok LRRS Cleanup Levels in Soil

Site	Chemical of Concern	Soil Cleanup Level (milligram per kilogram [mg/kg])
LF001	DRO	500*
	RRO	2,000*
	PCBs	1-10 w/ a cap and ICs
	Lead	400
	Chromium	410
LF002	PCBs	1-10 w/ a cap and ICs
SS010	DRO	12,500
	RRO	13,700
	PCBs	1
	Lead	400
	Arsenic	6.1
ST006	PCBs	1

Notes:
*** Petroleum Hydrocarbon Method One Soil Cleanup Levels in the Arctic Zone utilized due to the site's proximity to the Beaufort Sea. Source of soil cleanup levels: 18 AAC 75.341 Arctic Zone, Table A2, B1 and B2. For definitions, see the Acronyms and Abbreviations section.**

2.17 *Statutory Determinations*

Under CERCLA §121 (as required by NCP §300.430(f)(5)(ii)), the lead agency must select a remedy that is protective of human health and the environment, complies with ARARs, is cost-effective, and uses permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, periodic five-year reviews are required if after the remedy hazardous substances will remain in place above levels allowing for unlimited use and unrestricted exposure. CERCLA also includes: 1) a preference for remedies that employ treatment which permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element; and 2) a bias against offsite disposal of untreated wastes. The following sections discuss how the selected remedy meets these statutory requirements.

2.17.1 Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

All of the selected alternatives presented for sites LF001, LF002, SS010, LF001a, and ST006, are protective of human health and the environment by eliminating, reducing, or controlling risks posed by the site through institutional controls limiting intrusive activities and requiring maintenance of clean soil covers over residual subsurface contaminated soil, or signs and fences around surface soil beneath the garage (SS010), thereby mitigating direct contact and/or migration. As presented in Section 2.8 and 2.9, with institutional controls, the selected alternatives prevent migration of and direct contact with COCs through management of IC's.

2.17.2 Compliance with ARARs

Remedial actions must comply with both Federal and State ARARs. ARARs are legally applicable or relevant and appropriate requirements, standards, criteria, or limitations of Federal and State environmental laws and regulations. Table 2-21 summarizes the ARARs and criteria to be considered (TBC) for the selected remedies for sites LF001, LF002, SS010, LF001a, and ST006, and describes how the selected remedy addresses each one.

ARARs fall into three categories: chemical-specific, location-specific, and action-specific. Chemical-specific ARARs are health-based or risk-management-based numbers that provide concentration limits for the occurrence of a chemical in the environment at agreed-upon points of compliance. Location-specific ARARs restrict activities in certain sensitive environments. Action-specific ARARs are activity-based or technology-based, and typically control remedial activities that generate hazardous wastes (such as with those covered under the RCRA). Offsite shipment, treatment and disposal of excavated contaminated soil invoke action-specific ARARs. Criteria TBC, are non-promulgated advisories or guidance issued by federal or state government that are not legally binding and do not have the status of potential ARARs. However, in many circumstances, TBCs are considered along with ARARs.

The selected remedies comply with the chemical-specific, location-specific, and action-specific ARARs. The implementation of the remedy is required to meet the substantive portions of these requirements at agreed-upon points of compliance and is exempt from administrative requirements such as permitting and notifications.

2.17.3 Cost Effectiveness

In the USAF's judgment, the selected remedy is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness" (40 CFR 300.430[f][1][ii][D]). This determination was accomplished by evaluating the "overall effectiveness" of those alternatives that satisfy the threshold criteria (that is, is protective of human health and the environment and ARAR-compliant).

Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination: long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness. Overall effectiveness was then compared to costs to determine cost-effectiveness. The overall effectiveness of the selected remedies for Sites LF001, LF002, SS010, LF001a, and ST006 was demonstrated in the comparative analysis of alternatives, Section 2.10 – Summary of Comparative Analysis of Alternatives.

It is important to note that more than one cleanup alternative can be cost-effective, and that CERCLA does not mandate the selection of the most cost-effective cleanup alternative. In addition, the most cost-effective remedy is not necessarily the remedy that provides the best balance of tradeoffs with respect to the remedy selection criteria nor is it necessarily the least-costly alternative that is both protective of human health and the environment and ARAR-compliant. Rather, cost-effectiveness is concerned with the reasonableness of the relationship between the effectiveness afforded by each alternative and its costs compared to other available options.

2.17.4 Utilization of Permanent Solutions and Alternative Treatment Technologies

The USAF has determined that the selected remedy provides the best balance of trade-offs among the alternatives with respect to the five balancing criteria set out in NCP 300.430(f)(1)(i)(B), such that it represents the maximum extent to which permanence and treatment can be practicably utilized at Sites LF001, LF002, SS010, LF001a, and ST006. NCP 300.430(f)(1)(ii)(E) provides that the balancing shall emphasize the factors of "long-term effectiveness" and "reduction of toxicity, mobility or volume through treatment," and shall consider the preference for treatment and bias against off-site disposal.

The USAF has determined that the selected remedies represent the maximum extent to which permanent solutions and treatment technologies can be used in a practicable manner at the site. Of those alternatives that are protective of human health and the environment and comply with ARARs, the USAF has determined that the selected remedy provides the best balance of trade-offs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element and bias against offsite treatment and disposal and considering state and community acceptance.

The selected remedies monitors potential migration or erosion and direct contact through management of IC's to mitigate potential risks to human health and the environment. As presented in Section 2.8 and 2.9, with institutional controls, the selected alternatives are protective of human health and the environment. Alternative treatment technologies or resource recovery technologies are not utilized or a part of the preferred alternative because high cost and implementability problems.

2.17.5 Preference for Treatment as a Principal Element

The NCP establishes the expectation that treatment will be used to address the principal threats posed by a site wherever practicable (40 CFR 300.430[a][1][iii][A]). The selected remedies selected under CERCLA for Oliktok LRSS (stockpile of contaminated soil and soil capping and LUCs of PCB soil) do not satisfy the statutory preference for treatment as a principle element of the remedy. The volume and relatively low levels of PCB-contaminated soil at the Oliktok LRSS make the active treatment and destruction of PCBs within the soil not cost effective. Furthermore there are technical difficulties to treat PCB's.

2.17.6 Five-Year Review Requirements

Pursuant to CERCLA §121(c) and NCP §300.430(f)(5)(iii)(C), because the selected remedy, at completion, will result in hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for unlimited use and unrestricted exposure, a statutory review will be required within five years after initiation of the remedial action to verify that the remedy is, or will be, protective of human health and the environment.

CERCLA Five-Year Reviews will be conducted until concentrations of hazardous substances, pollutants, or contaminants remaining onsite are reduced to levels that allow for unlimited use and unrestricted exposure.

Table 2-21 Description of ARARs and TBCs

Type	Authority	Medium/ Applicable Oliktok Site	Requirement	Status	Synopsis of Requirement	Action to be Taken to Attain Requirement
Action and chemical	Alaska Administrative Code	Soil LF001, LF002, SS010, and, ST006,	18 AAC 75, Alaska Oil and Cleanup Other Hazardous Substance Pollution Control Regulations	Applicable	Established cleanup methods for PCBs and petroleum hydrocarbons in soil	LUC to prevent contact with PCB contaminated soil
Action and chemical	Alaska Administrative Code	Soil LF001a	18 AAC 60.430	Applicable	Protection of active zone water	LUC for soil. Continual monitoring to prevent active water zone contamination.
Location and chemical	Alaska Administrative Code	Surface Water LF001a	18 AAC 70, Alaska Water Quality Standards	Applicable	Prohibits degradation of surface water	LUC for soil. Prevent removal of soil without ADEC approval to prevent movement of soil to environmentally sensitive areas.
Location and chemical	Federal	Surface water and sediment LF001a	40 CFR 6.302 (a) Executive Order 11990	Applicable	Protection of wetlands	LUC for soil. Prevent removal of soil without ADEC approval to prevent movement of soil to environmentally sensitive areas.
Action	16 USC 1531 et seq. 50 CFR 402, 50 CFR Part 200, 50 CFR Part 402	LF001, LF002, SS010, ST006, and LF001a	Establishes requirement to protect species threatened by extinction and habitats critical to their survival	Applicable	During the course of remedial activities may want to avoid encounter endangered species. (August monitoring is recommended)	Applicable if endangered, threatened, and/or species of special concern are present on site. Spectacled Aiders or polar bears could be in the vicinity of the installation.

2.18 *Documentation of Significant Changes*

Since the issuance of the proposed plan, the USAF has selected Remedial Alternative 2 for site ST006. This change has been included within this ROD. There are no other significant documented changes to this ROD from issuance of the Proposed Plan.

Figure 2-1 Location of Oliktok Long Range Radar Site

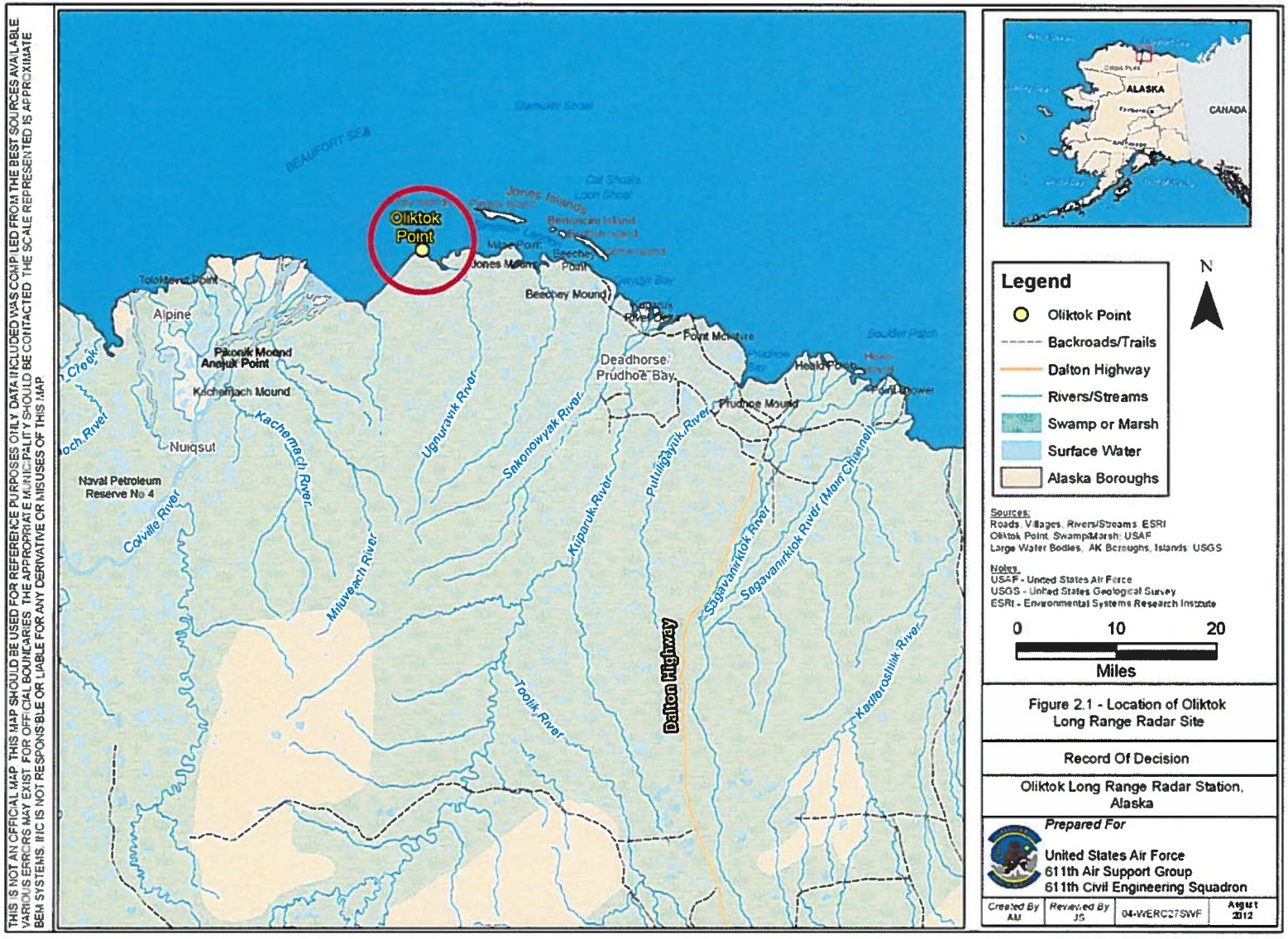


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Figure 2-2 Location of Environmental Sites within Oliktok LRRS

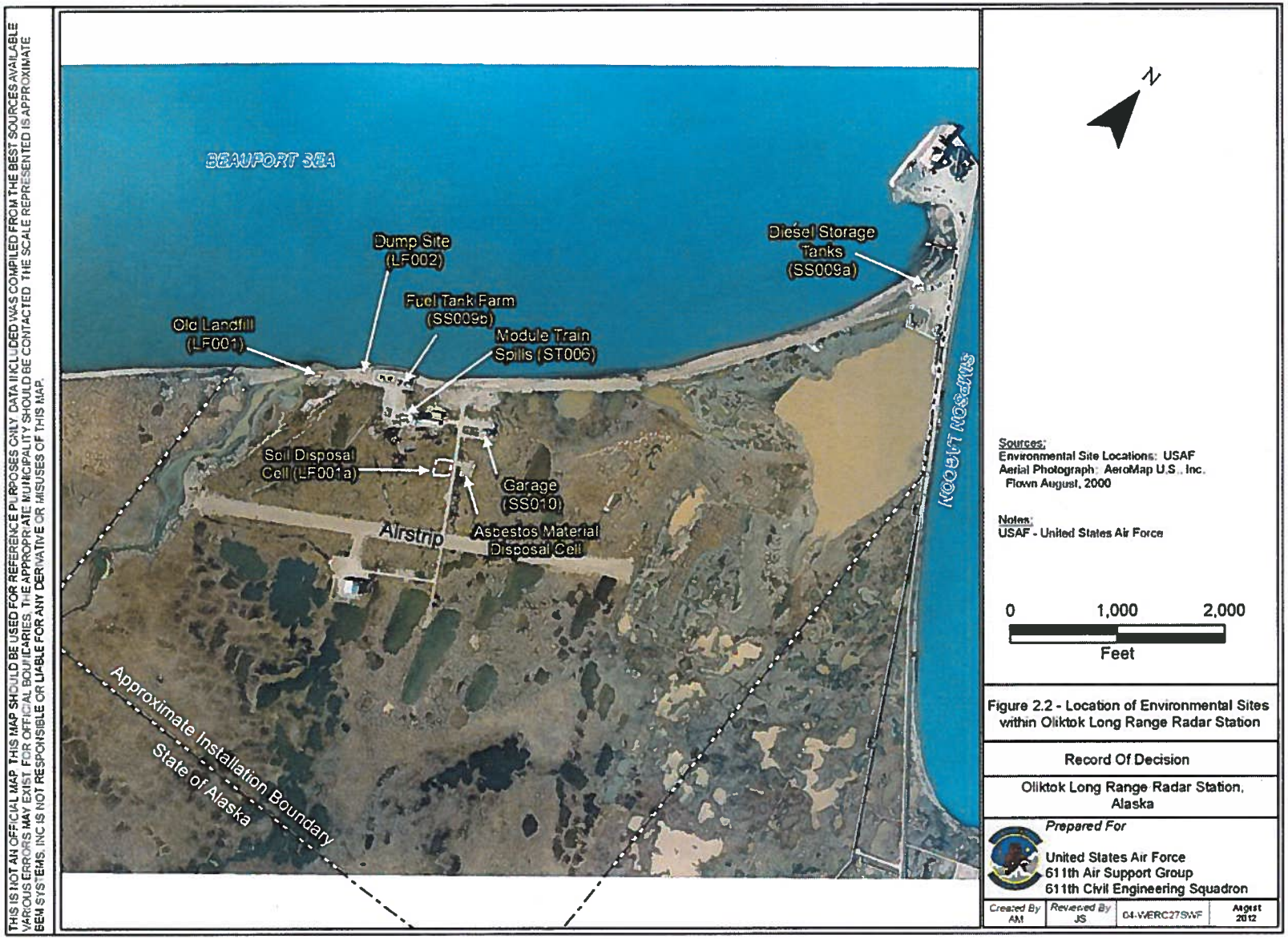

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Figure 2-3 Location of Site LF001 and Excavation Areas

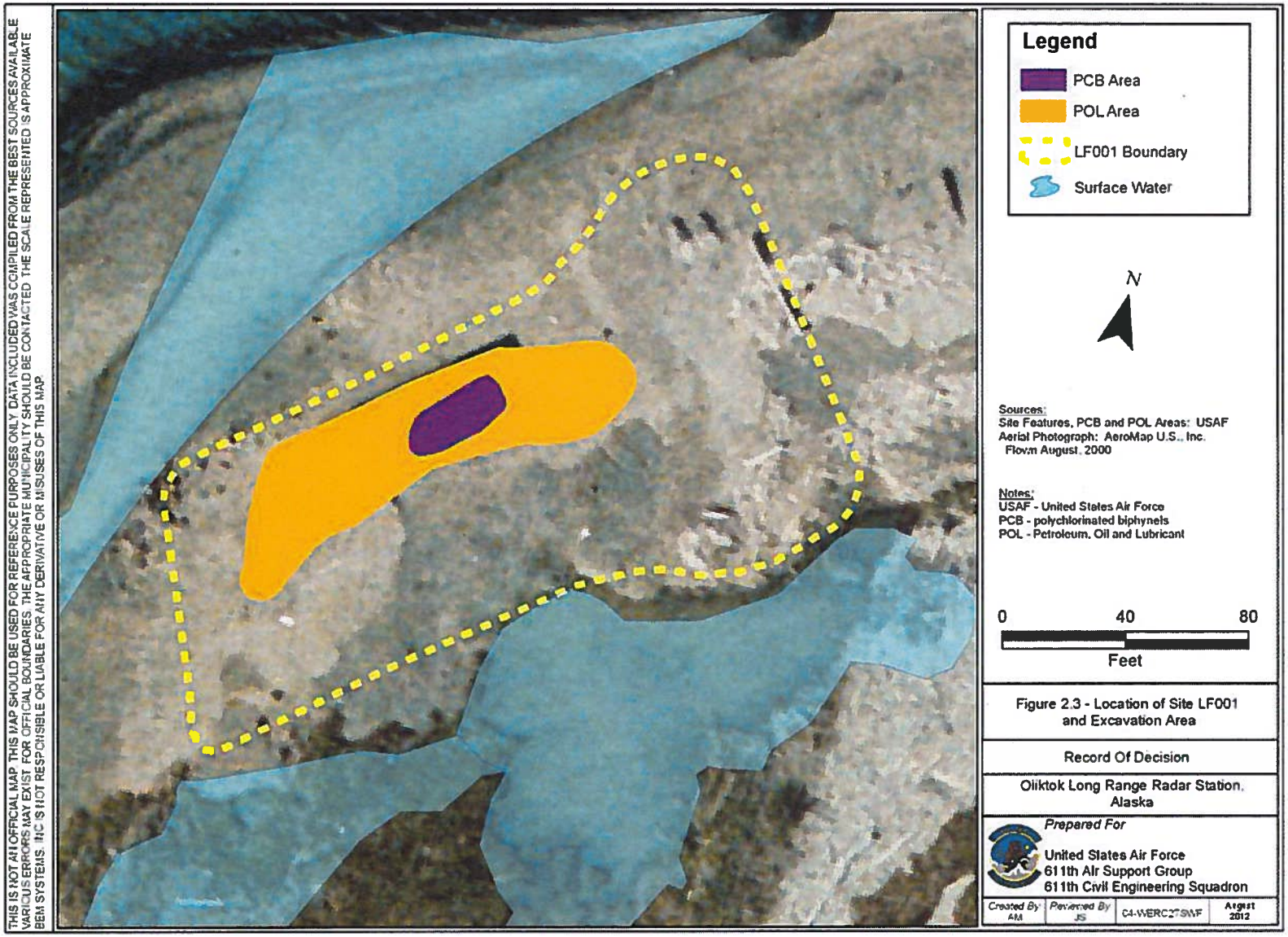

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Figure 2-4 LF002 Excavation Area

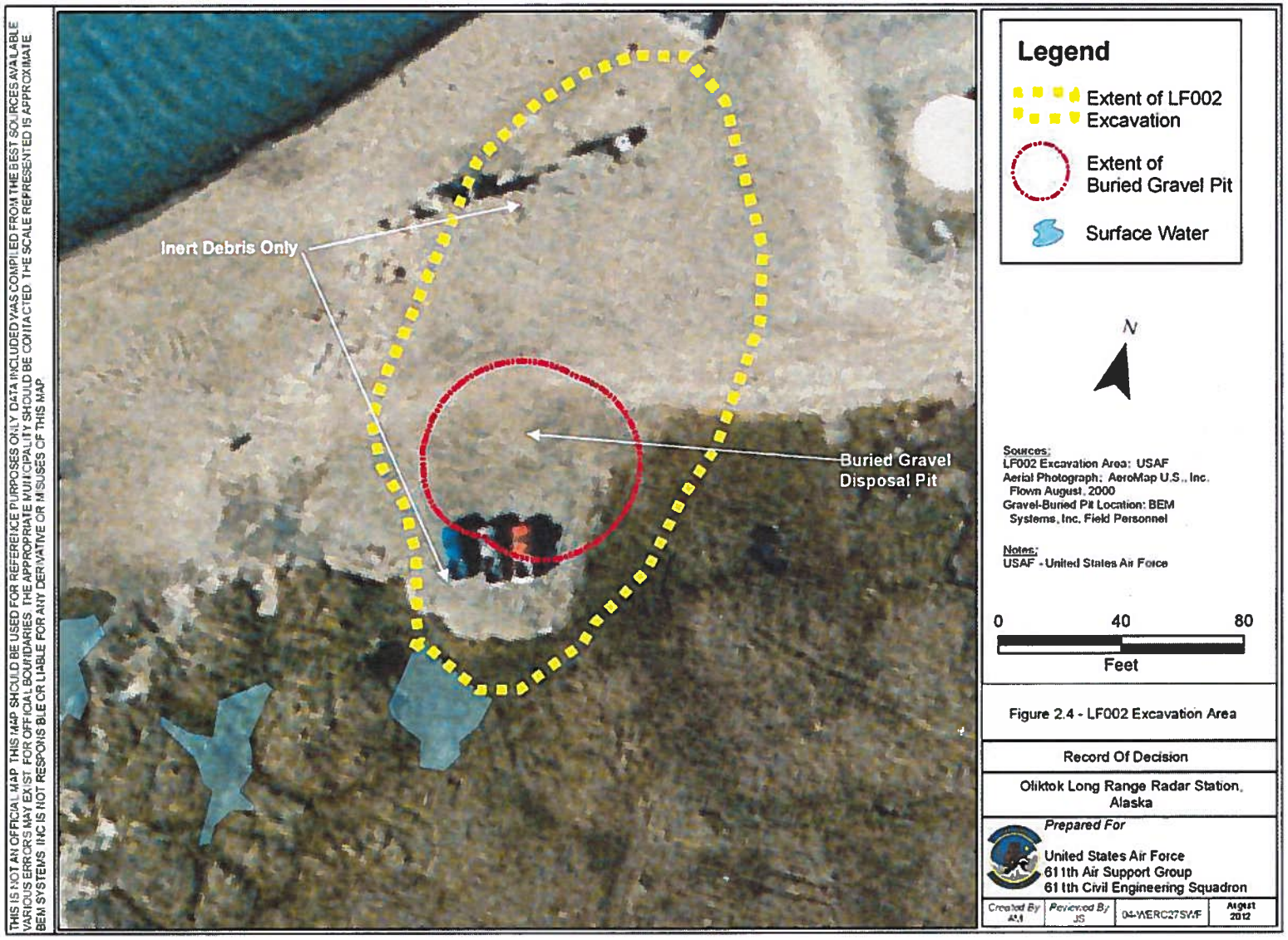

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Figure 2-5 Location of SS010

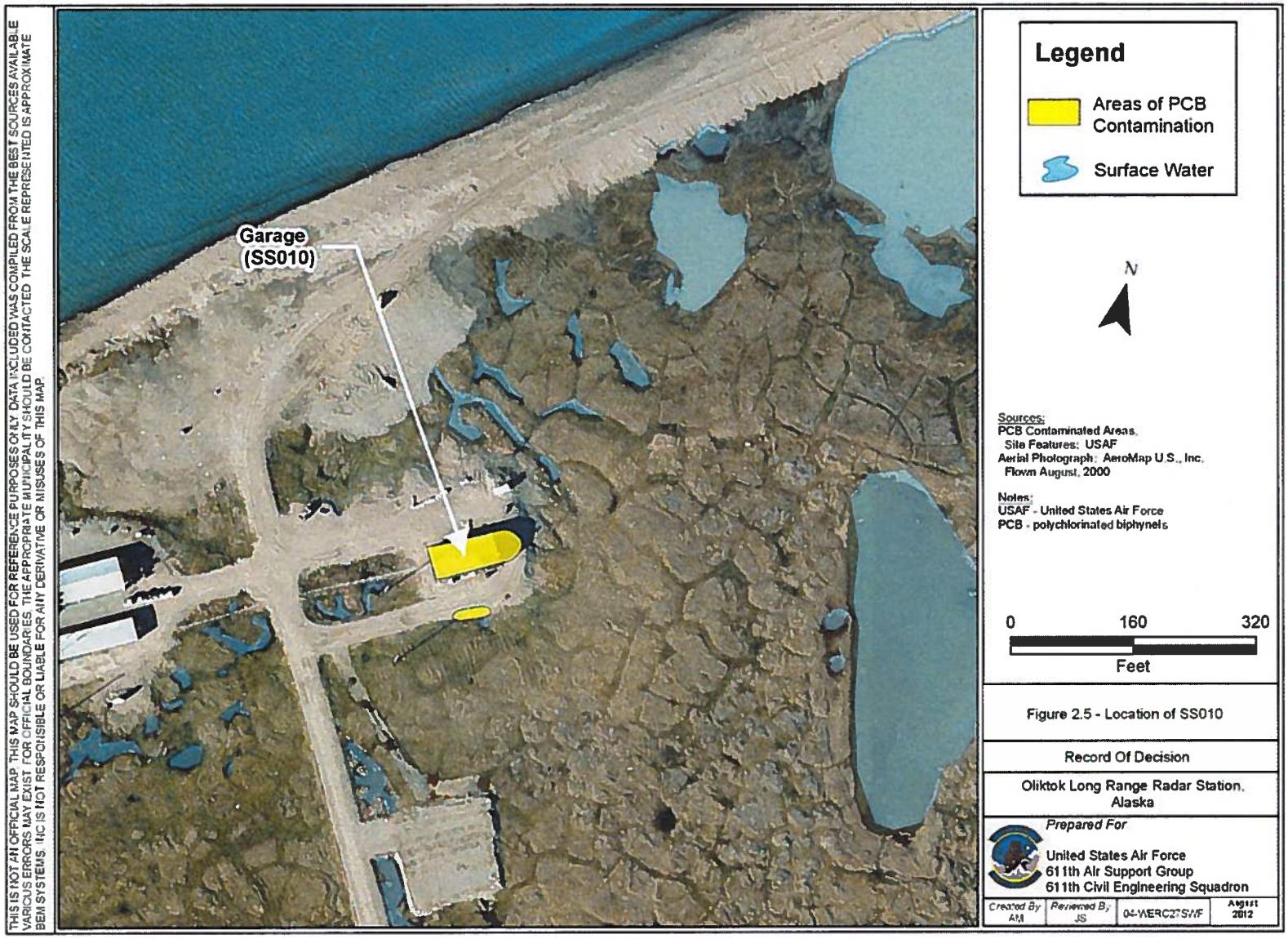

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Figure 2-6 Location of LF001a

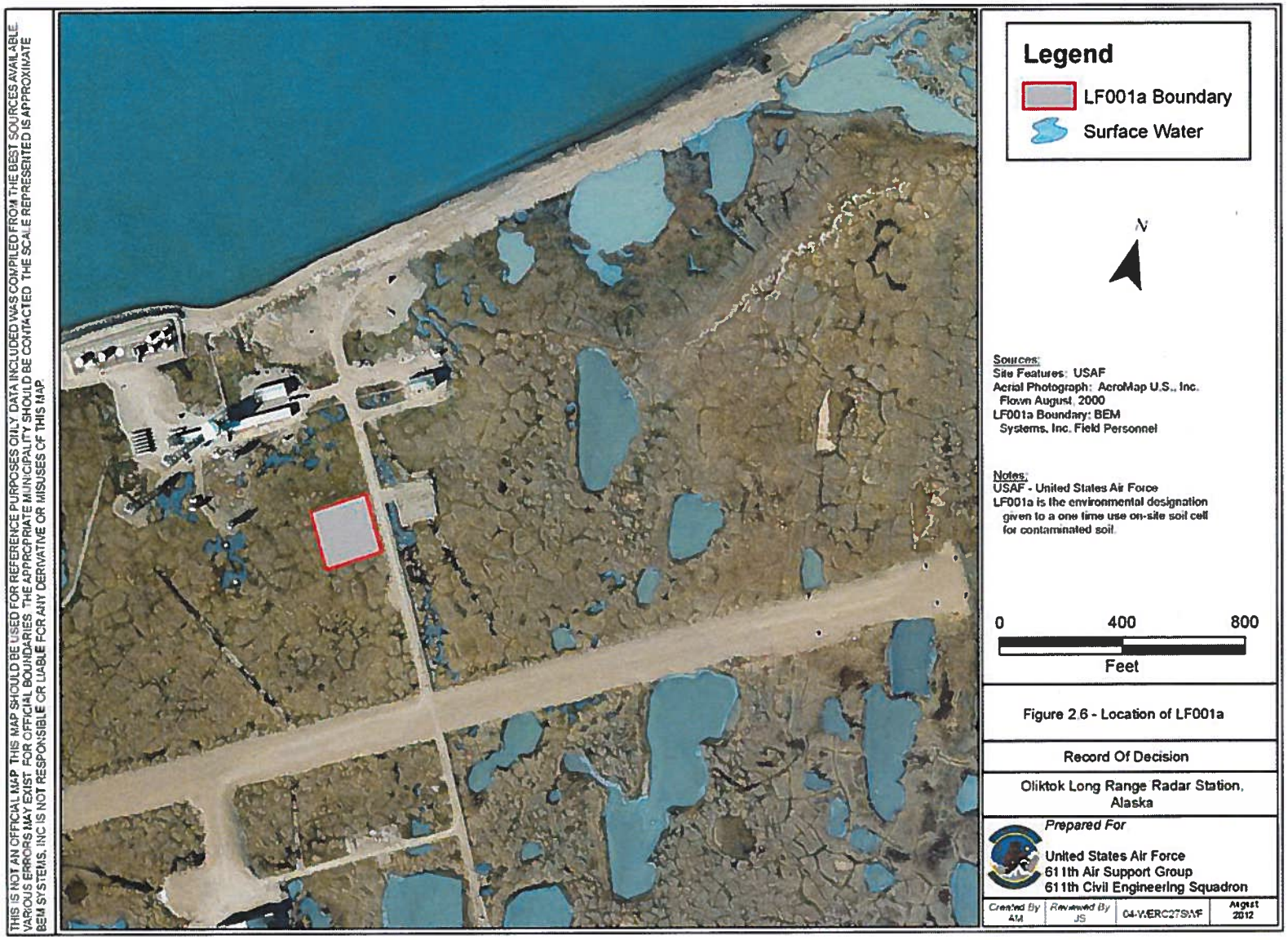

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Figure 2-7 Location of Module Train Spills

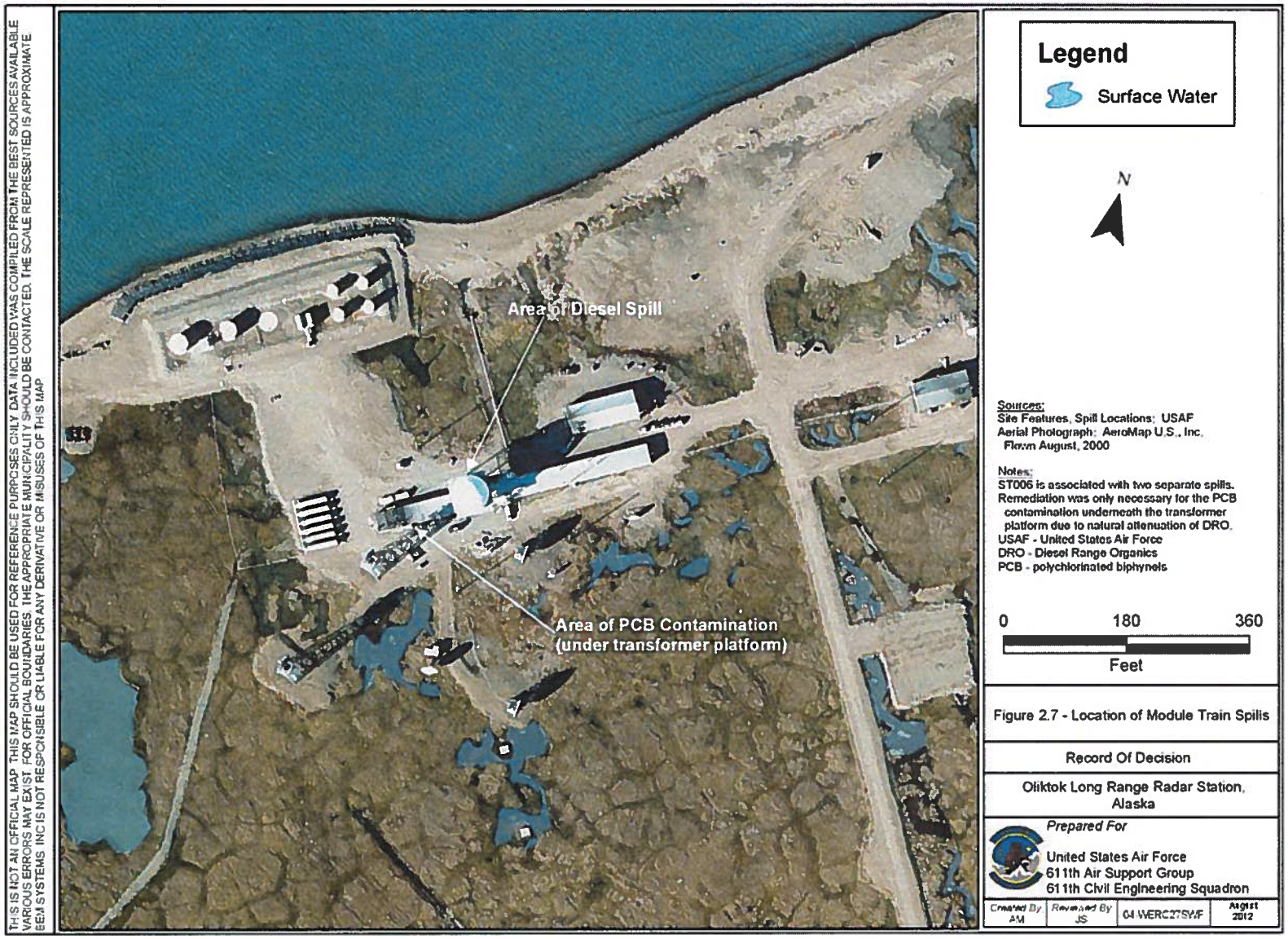

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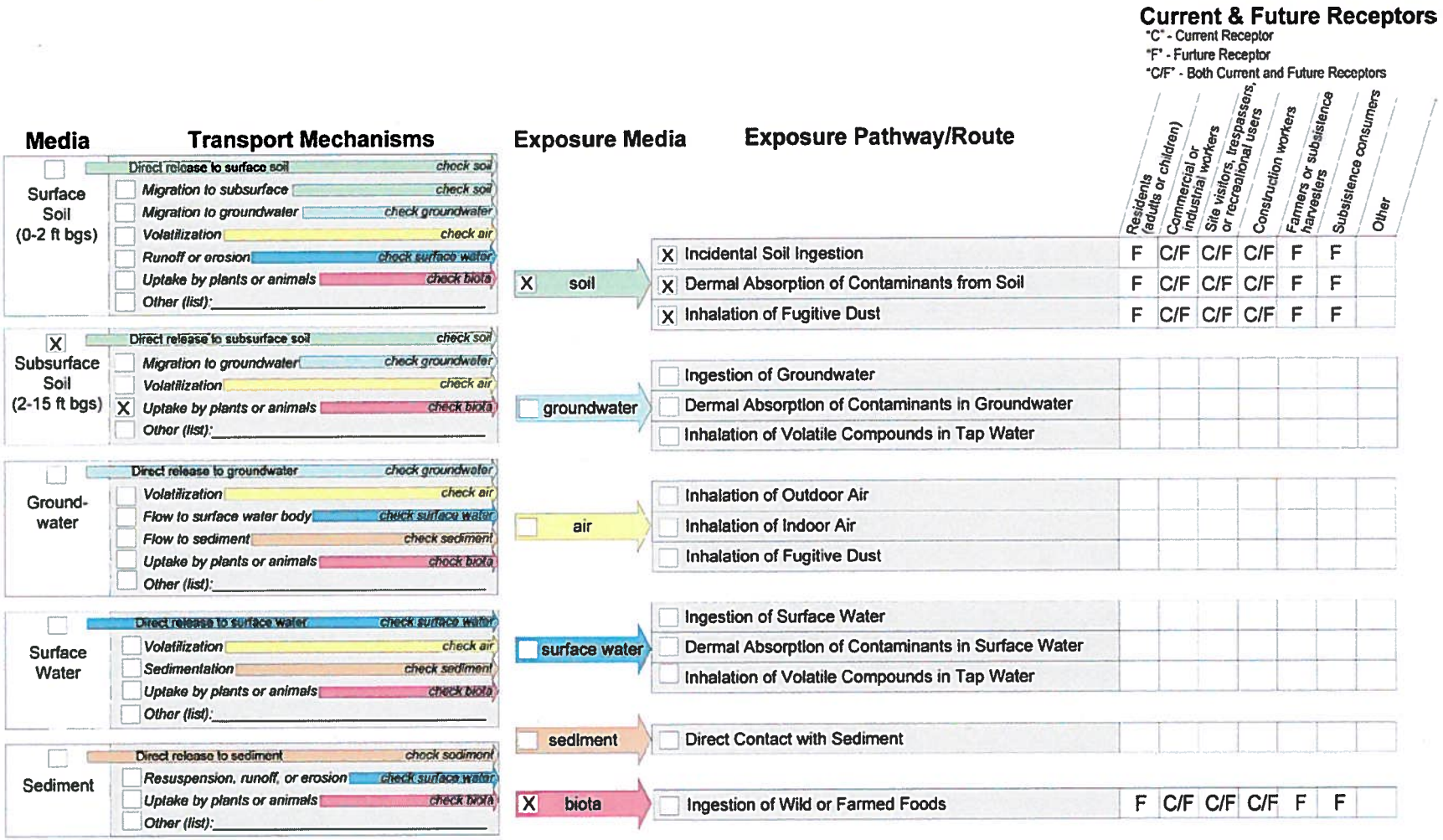
Figure 2-8 Conceptual Exposure Model for Oliktok LRR



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3.0 Responsiveness Summary

This section provides a summary of the public comments regarding the Proposed Plan for remedial action at Sites LF001, LF002, SS010, LF001a, ST006, SS009a, and SS009b and the Air Force response to comments. At the time of the public review period, the USAF had selected Alternatives as indicated within this ROD and the Proposed Plan.

No written comments were received during the public comment period.

3.1 *Stakeholder Comments and Lead Agency Responses*

No written comments or issues were raised or received during the public comment period for the selected remedies at Sites LF001, LF002, SS010, LF001a, ST006, SS009a, and SS009b.

3.2 *Technical and Legal Issues*

No technical or legal issues were identified during the public review period of the Proposed Plan.

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4.0 References

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