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SPARREVOHN LRRS
ALASKA

ADMINISTRATIVE RECORD
COVER SHEET

AR File Number 104

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File: 17A-38-13
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AK 104

Record of Decision
Spill/Leak No. 1 and Lower Camp Area (ST005)

FINAL

Sparrevohn LRRS, Alaska

Prepared By

United States Air Force
Pacific Air Forces Command
611 CES, Alaska

December 2009

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Acronyms

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
amsl	above mean sea level
AR	Administrative Record
ARARs	Applicable or Relevant and Appropriate Requirements
AWQS	Alaska Water Quality Standards
BHC	Benzene hexachloride
BLRA	Baseline Risk Assessment
BTEX	benzene, toluene, ethylbenzene, and xylenes
CCC	criteria continuous concentration
CDI	chronic daily intake
CEOS	Civil Engineering Operations Squadron
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CES	Civil Engineering Squadron
CEVR	Civil Engineering Environmental Restoration Branch
CFR	Code of Federal Regulations
COC	chemical of concern
COPC	chemical of potential concern
CRP	Community Relations Plan
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DERP	Defense Environmental Restoration Program
DRO	diesel range organics
EPA	United States Environmental Protection Agency
EPC	exposure point concentration
ERA	ecological risk assessment
ERfD	Ecological Reference Dose
ERP	Environmental Restoration Program
°F	degrees Fahrenheit
FS	Feasibility Study
GRO	Gasoline Range Organics
HCG	Hoefler Consulting Group
HEAST	Health Effects Assessment Summary Tables
HI	Hazard Index
HQ	hazard quotient
IRIS	Integrated Risk Information System
IRP	installation restoration program
LNAPL	Light Non-aqueous Phase Liquid
LRRS	Long Range Radar Station
MAP	Management Action Plan
MCL	Maximum Contaminant Level
mg/Kg	milligrams per kilogram

MNA	Monitored Natural Attenuation
NCP	National Contingency Plan
ND	Non-Detect
NEPA	National Environmental Policy Act
NFA	No Further Action
NIOSH	National Institute for Occupational Safety and Health
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
PA	Preliminary Assessment
OWSER	Office of Solid Waste and Emergency Response
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PEL	probable effects level
POC	Point of Contact
POL	Petroleum, Oil, and Lubricants
PP	Proposed Plan
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RRO	Residual Range Organics
SAR	Sampling and Analysis Report
SARA	Superfund Amendments and Reauthorization Act
SF	slope factor
SI	Site Investigation
SQuiRT	Screening Quick Reference Table
SVOC	Semivolatile Organic Compound
TAH	Total Aromatic Hydrocarbons
TAqH	Total Aqueous Hydrocarbons
TCE	Trichloroethene
USAF	United States Air Force
U.S.C.	United States Code
VOC	Volatile Organic Compound
VHF	Very High Frequency
WACS	White Alice Communication System
WP	Work Plan

1.0 Declaration

1.1 Site Name and Location

Facility Name: Spill/Leak No.1 and Lower Camp Area (ST005), Sparrevohn Long Range Radar Station (LRRS)
Site Location: Sparrevohn, Alaska
CERCLIS ID Number: Not Applicable
Alaska Department of Environmental Conservation (ADEC) Contaminated Sites
Hazard ID: 689
Operable Unit/Site: Not Applicable

Sparrevohn LRRS is located approximately 200 miles west of Anchorage, Alaska and 18 miles south of Lime Village in the foothills of the Alaska Range, 61°10'N latitude and 155°58'W longitude (Figure 1-1 inset). Air travel provides the only access to the Sparrevohn LRRS. The Spill/Leak No.1 and Lower Camp Area is one of eight individual sites located at Sparrevohn LRRS being addressed under the U.S. Air Force (USAF) Environmental Restoration Program (ERP). Sparrevohn LRRS is not listed on the National Priorities List.

The Sparrevohn LRRS is situated on federal land bordered by Bureau of Land Management property to the east, north and west, and State of Alaska land to the south. Pursuant to the Defense Environmental Restoration Program (DERP), 10 United States Code (U.S.C.) 2701, and Executive Order 125801 (signed January 23, 1987), the USAF is responding to historical releases that occurred at its facilities, including Sparrevohn LRRS.

The Spill/Leak No.1 and Lower Camp Area (ST005) encompasses the petroleum, oil, and lubricant (POL) tank farm, the former power house on the lower hillside of Sparrevohn Mountain, the former Lower Camp facility, and the valley south of Lower Camp (Figure 1-2).

1.2 Statement of Basis and Purpose

This Record of Decision (ROD) presents the Final Selected Remedy for the source area listed above at Sparrevohn LRRS, Alaska. The selected remedy was chosen in accordance with the Alaska State Laws and Regulations, and in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and to the extent practicable, the National Oil and Hazardous Substances Contingency Plan (NCP).

1.2.1 CERCLA Statement of Basis and Purpose

There are two CERCLA hazardous substances identified as chemicals of concern (COCs) at ST005. The CERCLA soil COC at this site is polychlorinated biphenyls (PCBs), and the groundwater COC is trichloroethene (TCE). This ROD presents the selected remedy for ST005 at Sparrevohn LRRS, Alaska, in accordance with CERCLA as amended by SARA, and the NCP.

This ROD is issued by the USAF in accordance with and in satisfaction of the requirements of the DERP, 10 U.S.C. 2701, et seq.; CERCLA 42 U.S.C. 9601 et seq.; Executive Order 12580, 52

Federal Register 2923 (23 January 1987); and NCP, 40 *Code of Federal Regulations* (CFR) 300. The decision put forth in this document is also in accordance with and in satisfaction of the requirements of Title 18, Chapter 75, Article 3, of the Alaska Administrative Code (AAC) *Discharge Reporting, Cleanup, and Disposal of Oil and Other Hazardous Substances* regulations for the State of Alaska, revised as of October 9, 2008.

The United States Environmental Protection Agency (EPA) has been consulted consistent with the requirements of 10 U.S.C. 2705 and has chosen to defer to the ADEC for regulatory oversight of ST005. The ADEC agrees that successful implementation of the selected remedy (signage on the property noting the presence of PCBs and TCE in excess of ADEC cleanup levels, base general plan and other land records updated to indicate PCBs remain in the soil and TCE remains in groundwater, residential land use restrictions, groundwater use restrictions, implementation of USAF excavation permit system, monitoring for natural attenuation, and prior ADEC approval obtained before moving/disposing of soil which was subject to site cleanup rules) will meet state regulatory requirements.

1.2.2 Statement of Basis and Purpose under State of Alaska Regulations

In addition to PCBs and TCE, diesel range organics (DRO) have been identified as a COC under 18 AAC 75 (Shannon and Wilson 1999) for both soil and groundwater. GRO was also detected in soil at concentrations exceeding ADEC Method Two soil cleanup levels under 18 AAC 75.341(b), Table B2; however, these detections were from samples with high DRO concentrations (i.e., exceeding ADEC Method Two soil cleanup levels), and based on a review of chromatograms, the GRO content was determined to be the light end of the DRO contamination rather than a separate release (Shannon and Wilson 1999). As a result, GRO was not retained as a COC. Because chemicals have been identified at the site which are considered COCs under State of Alaska laws and regulations, the subject site is being addressed consistent with those applicable laws and regulations, including but not limited to Title 46 of the Alaska Statues promulgated there under.

This ROD is issued by the USAF in accordance with and in satisfaction of the requirements of the *Alaska Oil and Hazardous Substances Pollution Control Act*, 18 AAC 75, revised as of October 9, 2008 (ADEC 2008a).

1.3 Assessment of Site

1.3.1 Assessment under CERCLA

Response actions at the subject site selected in this ROD are necessary under CERCLA, 42 U.S.C. Sections 9601-9628, to protect public health or welfare or the environment.

The response actions were selected according to CERCLA, Section 120(f) and the NCP, Section 300.430(f)(4). These federal laws regulate the cleanup of old hazardous waste sites that contain substances covered under CERCLA.

1.3.2 Assessment under Alaska State Regulations

Response action at the site is necessary to meet 18 AAC 75 cleanup levels at the Sparrevohn LRRS site. Past activities at ST005 that may have generated hazardous substances during facility operation included fuel storage, equipment maintenance activities, use of transformers, and disposal of wastes and other discarded material containing hazardous substances.

1.4 Description of Selected Remedy

Remedial alternatives for ST005 were developed and evaluated through the remedial investigation (RI) (USAF 1999), and risk assessments (Shannon and Wilson 2000a; USAF 2002a), which considered site conditions as well as current and future risk scenarios, and the feasibility study (FS) (USAF 2002b). The selected remedy for ST005 will protect human health and the environment and allow for continued site use. The USAF has selected Natural Attenuation, as per EPA Office of Solid Waste and Emergence Response (OWSER) Directive 9200.4-17P (EPA 1999b) and Institutional Controls as the preferred alternative for ST005. The major components of the selected remedy are presented below:

Soil Specific Institutional Controls (PCB and DRO)

- Administrative restrictions on construction of structures at the Lower Camp in areas where chemical concentrations in soil exceed cleanup levels based on the future land use scenarios. Occupation of structures located within these areas could result in exposure to chemicals in excess of risk management standards via (1) incidental ingestion and dermal contact, and (2) vapor intrusion from soil to indoor air (VOCs). Areas of construction restrictions via institutional controls are shown on Figures 1-3 and 1-5.

- Administrative restrictions on excavation of soils within contaminated areas at the Lower Camp, where exposure to those soils could result in increased risk to human health. While not prohibiting such excavation, any work involving contaminated soil would be conducted in accordance with 18 AAC 75.360, Cleanup Operation Requirements. Areas of excavation restrictions via institutional controls are shown on Figures 1-3 and 1-5.

Groundwater Specific Institutional Controls (TCE and DRO)

- Administrative restrictions on groundwater use at the Lower Camp in areas where chemical concentrations exceed cleanup levels based on the future residential exposure scenario. Residential use of the Lower Camp groundwater would result in exposure to chemicals in excess of risk management standards. Therefore, changes in site use must be preceded by a review of the impacts of those changes on risks posed to human health and ecological receptors. Areas of groundwater use restrictions are shown on Figure 1-4.

Soil and Groundwater Institutional Controls

- Placement of warning signs as a precautionary measure to alert site visitors to areas where chemical contamination is present in exceedance of ADEC cleanup levels, regardless of whether or not risks associated with these chemicals exceed risk management standards. These signs could be placed at conspicuous access points to the ERP sites, or at a central location such as near the runway, intended to convey a warning regarding a general area rather than specific sample locations.

- Notations regarding residual contamination and land use restrictions will be recorded in the appropriate Sparrevohn LRRS land records, including the base general plan. As part of the update to the base general plan, the USAF will produce maps showing locations of residual contamination, and will provide these maps to ADEC.

- Institutional controls will remain in effect for as long as the contaminated media exceeds ADEC unrestricted residential use criteria. The USAF is responsible for enforcing institutional controls and the USAF will monitor the effectiveness of the institutional controls. The USAF will provide an annual report regarding institutional control monitoring to ADEC, with copies filed in the administrative record and information repository. A Five-Year Review is required under 42 U.S.C. 9621(c), since hazardous substances will remain at the site; the frequency of the annual report will be evaluated at the time of the first Five-Year Review.

- The USAF will provide prompt notification to the ADEC of institutional control deficiency/failure, along with corrective measures taken. The USAF will obtain regulatory concurrence of significant changes to use and activity restrictions. The USAF will provide prior notification to ADEC for transfer of property subject to institutional controls.

Groundwater Specific Remediation (TCE and DRO)

- Implementation of a long-term monitoring program in accordance with EPA guidance 600/R-98/128, *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents* (EPA 1998b) to evaluate naturally occurring degradation of TCE in groundwater at the Lower Camp, and evaluate water quality changes over time.

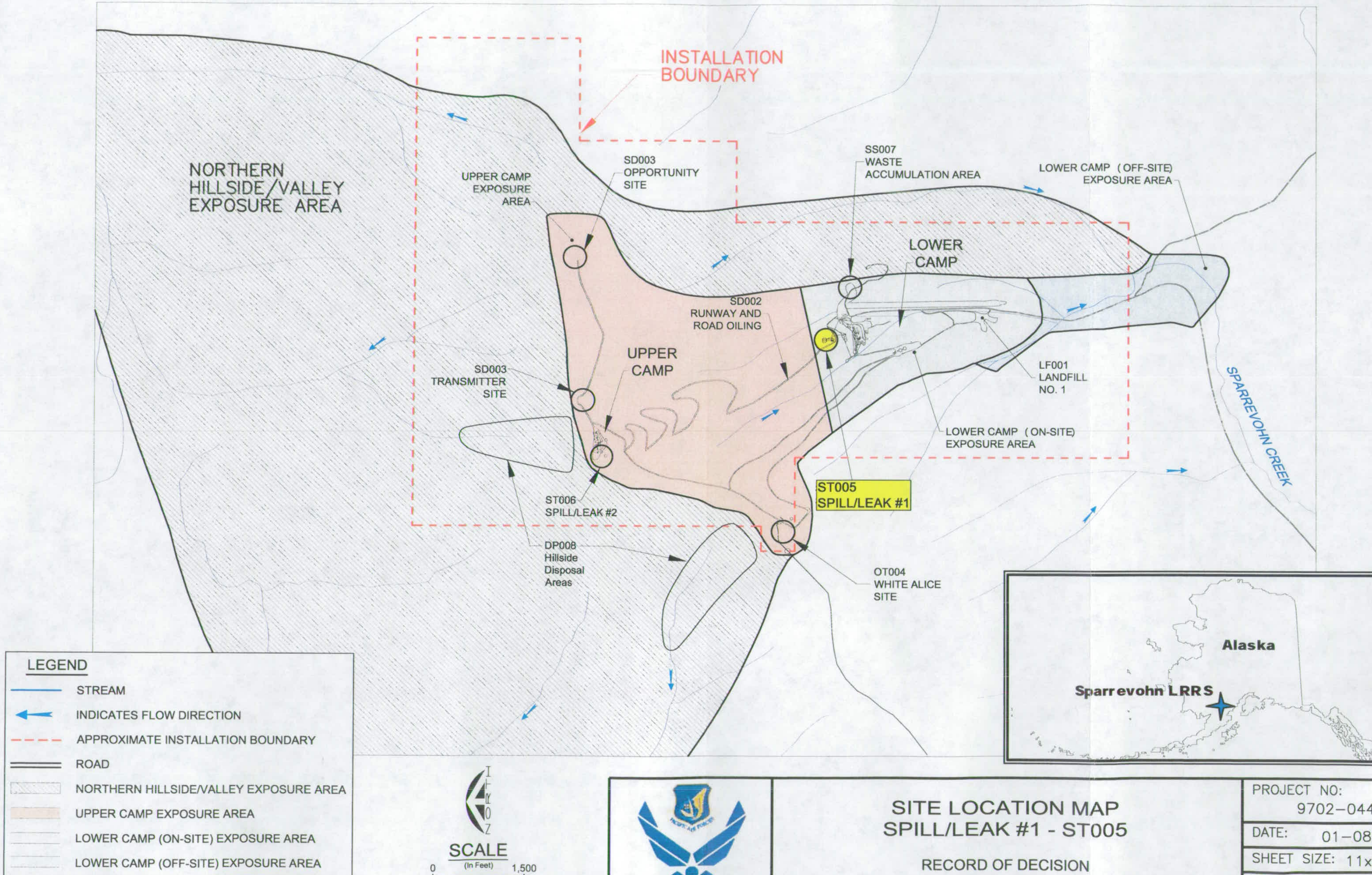
- Sampling events will occur no less that once per five years and will continue until concentrations decrease to below ADEC cleanup levels.

Existing roadways as well as the runway were addressed as part of the SD002 ROD (USAF 2009) in which the selected remedy was No Further Action. As a result, roadways running through ST005 are not included as part of the area of institutional controls for this site (Figures 1-3 through 1-5).

The selected remedy for ST005 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 and modifying criteria.

Based on the evaluation of alternatives discussed in the FS, institutional controls and monitored natural attenuation are the most cost-effective and readily implementable approach to reduce the risk posed by contaminants exceeding ADEC soil and groundwater cleanup levels.



SITE LOCATION MAP
SPILL/LEAK #1 - ST005

RECORD OF DECISION
SPARREVOHN LRRS, ALASKA

PROJECT NO: 9702-044
DATE: 01-08-09
SHEET SIZE: 11x17
FIGURE NO: 1-1

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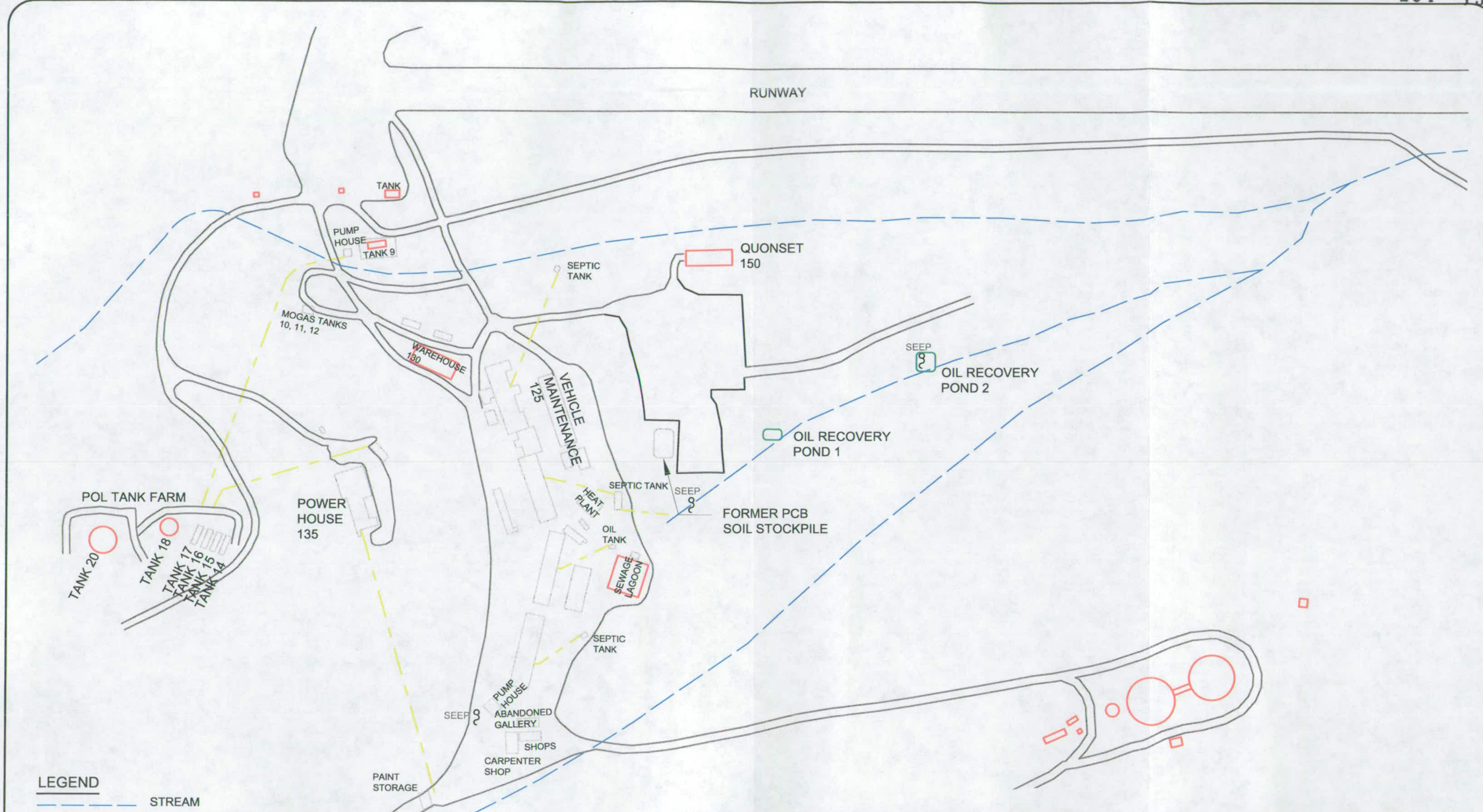
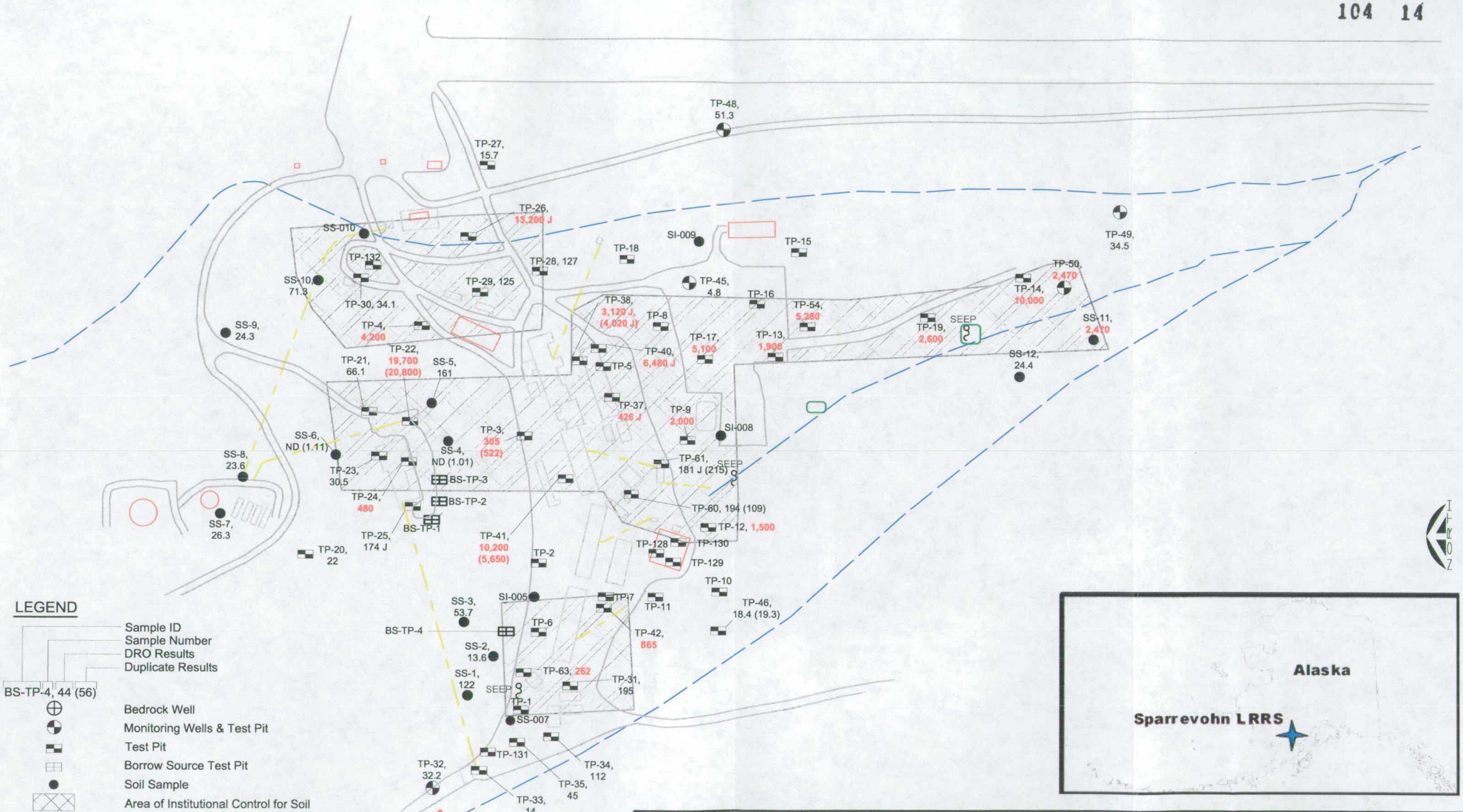


ST005 -LOWER CAMP FACILITIES

RECORD OF DECISION
SPARREVOHN LRRS, ALASKA

PROJECT NO:	9702-044
DATE:	02-25-09
SHEET SIZE:	11x17
FIGURE NO:	1-2



LEGEND

BS-TP-4, 44 (56) — Sample ID; Sample Number; DRO Results; Duplicate Results

- Bedrock Well
- Monitoring Wells & Test Pit
- Test Pit
- Borrow Source Test Pit
- Soil Sample
- Area of Institutional Control for Soil
- Stream
- Existing Building or Tank
- Former Building or Tank
- Pipeline
- Road
- Oil Recovery Pond

ST005 -LOWER CAMP

1999 RI DRO SOIL RESULTS & SOIL INSTITUTIONAL CONTROL BOUNDARIES

RECORD OF DECISION

SPARREVOHN LRRS, ALASKA

PROJECT NO:	9702-044
DATE:	08-25-09
SHEET SIZE:	11x17
FIGURE NO:	1-3

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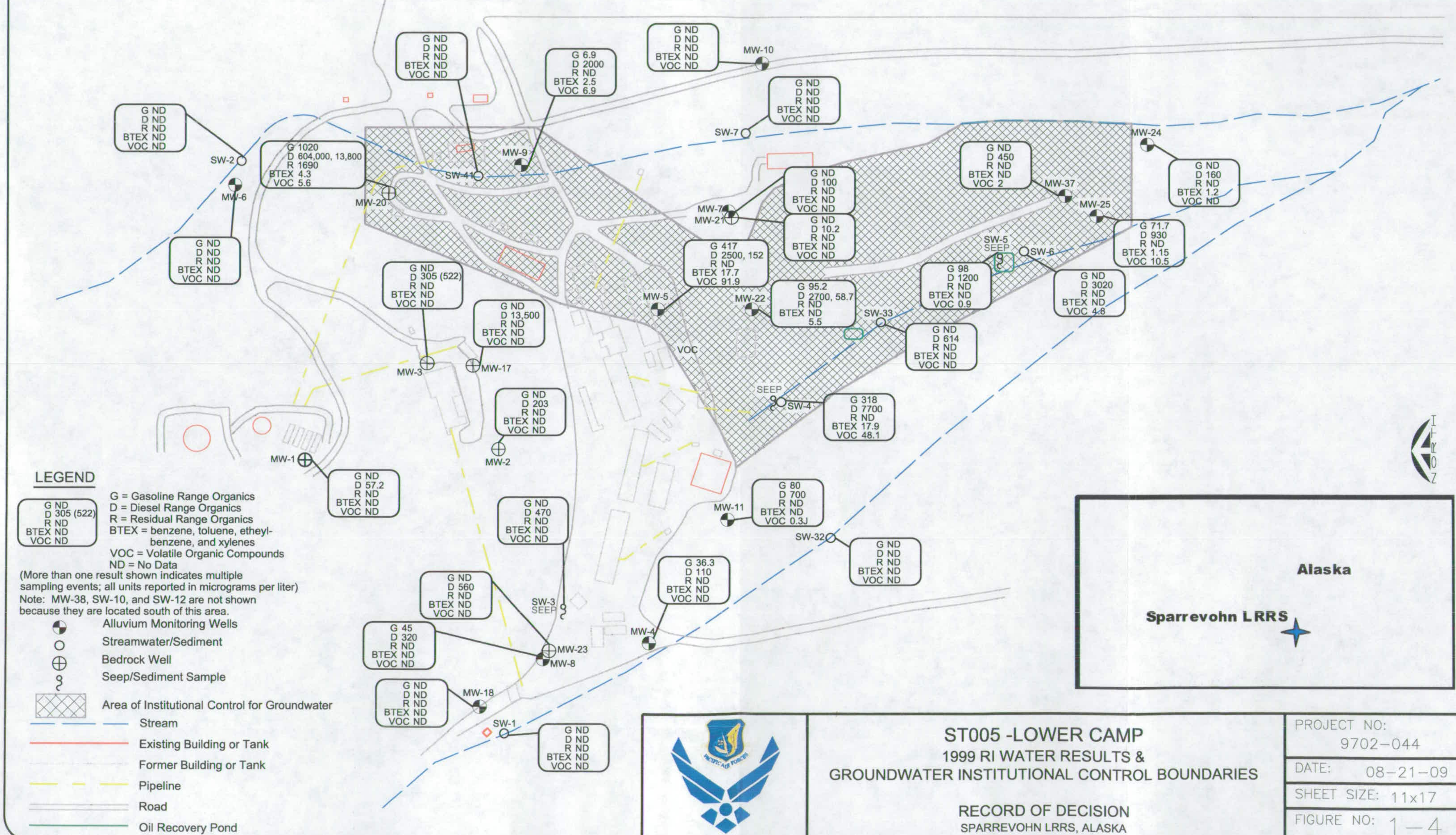

ST005 -LOWER CAMP
1999 RI WATER RESULTS &
GROUNDWATER INSTITUTIONAL CONTROL BOUNDARIES

RECORD OF DECISION
SPARREVOHN LRRS, ALASKA

PROJECT NO: 9702-044
DATE: 08-21-09
SHEET SIZE: 11x17
FIGURE NO: 1-4

Surface Soil Results

Sample ID	PCB Test Results (mg/Kg)
SS-140	0.734
SS-141	0.535
SS-142	6.56
SS-143	9.00
SS-144	3.9
SS-145	5.16
SS-152	ND
SS-156	ND
SS-157	0.813
SS-158	ND
SS-159	0.852
SS-160	28.6
SS-161	23.9
SS-162	22
SS-163	16.1

Notes
1. Refer to Figures 1-2, 1-3, & 1-4 for other Site sample locations and location of Power House.
2. Surface soil sample locations removed from site are not shown.

LEGEND
- Soil Sample
- PCB Sample Location
- Test Pit
- Area of Institutional Control
- Oil-stained spot
- Former Building or Tank
- Pipeline
- Road

SS-157 BS-TP-2 SS-156

NORTH
NOT TO SCALE

ST005 -POWER HOUSE DETAIL
1999 RI SAMPLE LOCATIONS AND PCB RESULTS
RECORD OF DECISION
SPARREVOHN LRRS, ALASKA

PROJECT NO:	9702-044
DATE:	09-11-09
SHEET SIZE:	11x17
FIGURE NO:	1-5

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If future property use includes disturbance of the PCB- and DRO-contaminated soil for any reason, or if other information becomes available which indicates that the site may pose an unacceptable risk to human health, safety, welfare or the environment, the land owner and/or operator are required under 18 AAC 75.300 to notify ADEC and evaluate the environmental status of the contamination in accordance with applicable laws and regulations. Further site characterization and cleanup may be necessary under 18 AAC 75.325-.390.

In the future, if soil is removed from the site, it must be characterized and managed following regulations applicable at that time. Pursuant to 18 AAC 75.325(i)(1) and (2), ADEC approval is required prior to moving or disposing of soil that is, or has been, subject to the cleanup rules found in 18 AAC 75.325-.370.

The USAF will submit an Institutional Control Performance Report to the ADEC on an annual basis for the first five years. The frequency of the Institutional Control Performance Report will be evaluated with the Five-Year Review under 42 U.S.C. 9621(c). This report shall include visual inspection of the site, replacement of signs on the property if necessary, any information pertaining to breaches of institutional controls, and corrective actions taken to prevent such breaches in the future.

1.4.1 Duration/Termination of Institutional Control Requirements

The Sparrevohn LRRS is not considered excess property. It is assumed that the site will be maintained for industrial use, and that ownership and site access will continue to be controlled by the USAF for the foreseeable future. Currently, there are no plans to remove contaminated soil or groundwater. As a result, the USAF will maintain institutional controls and long term monitoring at ST005 for as long as PCB concentrations in soil remain greater than 1 milligram per kilogram (mg/Kg), DRO concentrations in soil remain above 250 mg/Kg, and TCE concentrations exceed ADEC groundwater cleanup levels.

1.5 Statutory Determinations

The selected remedy for ST005 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. 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 CFR 300.430[a][1][iii][A]). The selected remedy for ST005 does not satisfy the statutory preference for treatment as a principal element of the remedy for contaminated soils. Based on the evaluation of alternatives discussed in the FS, institutional controls consisting of signage are the most cost-effective and readily implementable approach to reduce the risk.

Because there will be soil and groundwater contaminated with CERCLA hazardous substances above levels that allow for unrestricted use, there will be a statutory requirement for a Five-Year Review under 42 U.S.C. 9621(c) after commencement of the remedial action, to ensure the remedy continues to provide adequate protection of human health and the environment. Five-Year Reviews will continue as required by CERCLA. Additionally, ADEC approval shall be obtained before moving or disposing of soil which was subject to site cleanup rules.

The selected soil remedy for ST005 complies with State of Alaska Regulation requirements under 18 AAC 75.325 through 365.

1.6 Data Certification Checklist

The following information is included in the Decision Summary section of this ROD (Section 2).

- List of COCs and their respective concentrations (Sections 2.7.1.1 and 2.7.2.1, Tables 2-2 through 2-6)
- Baseline risk represented by the COCs (Section 2.7.1.4, Tables 2-7 through 2-14)
- Cleanup levels established for COCs and the basis for these levels (Section 2.12.4, Table 2-19)
- How source materials constituting principal threats will be addressed (Section 2.11)
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD (Section 2.6)
- Potential land and groundwater use that will be available at the site as a result of the selected remedy (Sections 2.6 and 2.12.4.1)
- Estimated capital, annual operation and maintenance, and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (Section 2.12.3, Table 2-17)
- Key factor(s) that led to selecting the remedy (i.e., description of how the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (Section 2.13).

Additional information can be found in the Administrative Record file for Sparrevohn LRRS, Alaska. The information repository for Sparrevohn LRRS is located at Elmendorf Air Force Base, Alaska.

1.7 Authorizing Signatures

This signature sheet documents the USAF approval of the remedy selected in this Record of Decision for the Spill/Leak No.1 and Lower Camp Area (ST005). By signing this document, the ADEC agrees that the selected remedy complies with State law.

This decision may be reviewed and modified in the future if new information becomes available that indicates the presence of contaminants or exposures that may cause unacceptable risk to human health or the environment. If additional contaminants are discovered, the USAF and ADEC will determine the compliance levels for soil cleanup actions.

ROBYN M. BURK, Colonel, USAF
Commander, 611th Air Support Group

2/2/10
Date

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

12/10/2009
Date

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2.0 Decision Summary

The Decision Summary identifies the Selected Remedy for the ST005 source area addressed in this ROD, 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

2.1.1 Site Name and Location

Facility: Sparrevohn LRRS, Alaska

The Sparrevohn Long Range Radar Station included the following CERCLA source areas as depicted on Figure 1-1:

- Landfill No. 1 (LF001) (Permitted Landfill Currently)
- Road and Runway Oiling (SD002)
- Transmitter Pad/Opportunity Site (SD003)
- White Alice Communication System (OT004)
- Spill/Leak No.1 and Lower Camp Area (ST005)
- Spill/Leak No. 2 (ST006)
- Waste Accumulation Area (SS007)
- Hillside Disposal Areas (DP008)

Site Location: Sparrevohn, Alaska

Latitude and Longitude: 61°10'N latitude and 155°58'W longitude

Point of Contact (POC): Mr. Steve Hunt – Project Manager

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The lead agency under CERCLA for the Sparrevohn LRRS cleanup is the USAF. The ADEC is the lead regulatory agency for petroleum and non-CERCLA contaminants at the installation. At this site, EPA has deferred regulatory authority for CERCLA contaminants to ADEC. The Sparrevohn LRRS is located in the western foothills of the Alaska Range, approximately 200 miles west of Anchorage, Alaska. Sparrevohn LRRS occupies parts of Sections 23, 24, 25, 26, and 36 of Township 12 N, Range 36 W and parts of Sections 19, 30, and 31 of Township 12 N and Range 35 W of the Seward Meridian.

The installation occupies 1,180 acres on the top ridge and south slope of what is informally referred to as Sparrevohn Mountain. Sparrevohn LRRS is operated as a military installation with access restricted by the USAF. The Sparrevohn LRRS is bordered by Bureau of Land Management property to the east, north and west, and State of Alaska land to the south. There is no road access to Sparrevohn LRRS. The only way to travel to Sparrevohn LRRS is by plane with special permission from the USAF. The nearest town is Lime Village, located approximately 18 miles to the north. There are two mountains between the main installation at Sparrevohn LRRS and Lime Village, and there is no road access to Sparrevohn LRRS from Lime Village. Radar, telecommunications, and aviation equipment are installed on the mountain ridge at Sparrevohn LRRS.

2.1.2 Site Description

The single source area (ST005) addressed in this ROD is shown on Figure 1-2 and described briefly below:

The Spill/Leak No.1 and Lower Camp Area (ST005) encompasses the POL tank farm, the former power house on the lower hillside of Sparrevohn Mountain, the former Lower Camp facility, and the valley south of Lower Camp.

2.1.3 Facility ERP History

Table 2-1 provides a summary of the investigations that have been conducted at the Sparrevohn LRRS since 1985.

Initially, 14 potential areas of concern were discussed in the *Installation Restoration Program Phase I Records Search* (Engineering Science 1985). From these, eight were identified for additional investigation, and RODs are currently being prepared for all sites except LF001. The eight ERP sites identified in 1985 and shown on Figure 1-1 are:

- Landfill No. 1 (LF001) (currently the permitted landfill);
- Road and Runway Oiling (SD002);
- Transmitter Pad/Opportunity Site (SD003);
- White Alice Communication System (OT004);
- Spill/Leak No.1 and Lower Camp Area (ST005);
- Spill/Leak No. 2 (ST006);
- Waste Accumulation Area (SS007); and
- Hillside Disposal Areas (DP008).

The Sparrevohn LRRS sites were used for a variety of industrial purposes. Past activities potentially resulting in contaminant release being addressed include the following:

- Spills during the transfer of fuels into and out of storage tanks;
- Leaks from fuel lines and tanks;
- Leaks or spills of oil or cleaning solvents from vehicle and equipment maintenance activities at the garage and other areas; and
- Disposal of wastes and other discarded material containing hazardous substances.

Table 2-1 Summary of Sparrevohn LRRS Investigations

Investigation	Deliverable Title	Year	Author
Phase I	Phase I - Records Search	1985	Engineering-Science
Phase II	Phase II Investigation	1989	Woodward-Clyde Consultants
RI/FS	RI/FS, Stage II, NFA Decision and Technical Document to Support NFA, LF-01, ST-05, SS-07.	1991	Woodward-Clyde Consultants
SI	Site Investigation Final Report, LF-01, ST-05, SS-07.	1993	Woodward-Clyde Consultants
PA	Preliminary Assessment, Final Report	1993	11th CEOS/CEVR
EBS	Draft Environmental Baseline Survey	1995	HQ AFCEE
SI	Site Investigation Final Report, ST-05	1995	Shannon and Wilson
RA	Remedial Action, PCB Soil Remediation, SD-03	1997	Linder Construction
SI	Final Site Characterization Report, ST-05	1997	611th CES/CEVR
CRP	Community Relations Plan	1997	Shannon and Wilson, Inc.
MAP	Management Action Plan	1998	Hart Crowser, Inc.
MNA	Monitored Natural Attenuation Report, ST-05	1999	Shannon and Wilson, Inc.
RI	Remedial Investigation, Final Report	1999	Shannon and Wilson, Inc.
MAP	Management Action Plan	2000	Shannon and Wilson, Inc.
HHERA	Final Baseline Human Health and Ecological Risk Assessment Report	2000	Shannon and Wilson, Inc.
LTM	Long Term Monitoring, Final Report, ST-05	2001	Montgomery Watson
RI/FS	RI/FS, Final Baseline Risk Assessment Report Addendum	2002	611th CES/CEVR
FS	Feasibility Study, Final Report	2002	611th CES/CEVR
Fact Sheet	Fact Sheet, All Around Alaska	2003	611th CES/CEVR
WP	Work Plan for Water Sampling and Sign Installation	2006	HCG, Inc.
SAR	2006 Sampling and Analysis Report for ST005	2007	HCG, Inc.
PP	Proposed Plan for Seven ERP Sites at Sparrevohn Long Range Radar Site	2008	HCG, Inc.

Note: All reports listed were prepared for the USAF.

Acronyms and Abbreviations

AFCEE	Air Force Center for Engineering and the Environment
CEOS	Civil Engineering Operations Squadron
CES	Civil Engineer Squadron
CEVR	Environmental Restoration Branch
CRP	Community Relations Plan
EBS	Environmental Baseline Survey
ERP	Environmental Restoration Program
FS	Feasibility Study
HCG	Hoefler Consulting Group, Inc.
HQ	Headquarters
LRRS	Long Range Radar Station
HHERA	Human Health and Ecological Risk Assessment
LTM	Long Term Monitoring
MAP	Management Action Plan
MNA	Monitored Natural Attenuation
NFA	No Further Action
PA	Preliminary Assessment
PCB	Polychlorinated biphenyl
PP	Proposed Plan
RI	Remedial Investigation
RA	Remedial Action
SAR	Sampling and Analysis Report
SI	Site Investigation
USAF	United States Air Force
WP	Work Plan

Contaminants encountered during investigations at Sparrevohn LRRS are gasoline range organics (GRO); polynuclear aromatic hydrocarbons (PAHs); PCBs; POL; DRO; residual range organics (RRO); semivolatile organic compounds (SVOCs); TCE; metals; and VOCs, including benzene, toluene, ethylbenzene, and xylenes (BTEX). Most of these contaminants are the result of fuel or oil spills.

2.2 Site History and Enforcement Activities

This section provides background information and summarizes the series of investigations that led to the ROD.

Sparrevohn LRRS was activated in 1952 to close a gap in the radar coverage of interior Alaska. Between 1952 and 1958 an experimental very high frequency (VHF) communications linked Sparrevohn LRRS and Anchorage. The VHF facility is believed to have been operated from the Opportunity Site on the ridge top. The White Alice Communication System (WACS) was constructed at Upper Camp in 1957 and the VHF facility was deactivated in 1958. The WACS was replaced in 1977 by an Alascom satellite earth terminal. During the period of operation of the WACS, approximately 130 military personnel were stationed at Sparrevohn LRRS. Dismantling of the WACS was begun in 1980. In 1982, a Minimally Attended Radar was put into operation. By 1984, the number of personnel operating the LRRS had been reduced to approximately ten. The number of personnel has since been reduced to approximately four.

ST005 was originally defined as an area contaminated by a January 1980 release of diesel fuel from the pipeline between the POL tank farm and the power house fuel tank (Woodward-Clyde 1993) (Figure 1-2). There is also evidence that fuel spills occurred prior to the 1980 release, as site records indicate that the original water gallery had to be replaced in the 1960s when the water became contaminated by an undocumented release of fuel from the pipeline connecting the Power House and Upper Camp (USAF 1997). Other potential sources of contamination in the area are two floor drains in the vehicle maintenance building that discharged directly to the ground surface.

Cleanup actions were taken to recover fuel seeping into a tributary of Hook Creek in the early 1980s (Figure 1-2). Fuel recovery was accomplished with product skimming devices placed in two ponds downstream of the seep. The recovery system was in operation during the summers between 1979 and 1981, although the quantity of product recovered is unknown (Shannon and Wilson 1999).

ST005 was included as part of the 1992 site investigation (SI). The SI identified several contaminants in soil, sediment, groundwater, and surface water (Woodward-Clyde 1993). ST005 was then included in the Sparrevohn LRRS RI (Shannon and Wilson 1999) in order to characterize the nature and extent of contamination. COPCs identified for ST005 included PCBs, petroleum fuel compounds, pesticides, and VOCs. A summary of site investigations is provided in Table 2-1.

As the lead agency for remedial activities, the USAF has conducted environmental investigations at the Sparrevohn LRRS under the ERP since 1985. These activities were conducted in accordance with CERCLA under the DERP, which was established by Section 211 of the SARA of 1986.

As the support agency, the ADEC provides primary oversight of the environmental restoration actions, in accordance with State of Alaska contaminated sites regulations (18 AAC 75, Article 3, *Discharge Reporting Cleanup and Disposal of Oil and Other Hazardous Substances[October 9, 2008]*). Funding is provided by the Defense Environmental Restoration Account, a funding source approved by Congress to clean up contaminated sites on United States Department of Defense installations.

There are no Federal Facility Agreements or state agreements for the Sparrevohn LRRS. None of the Sparrevohn LRRS sites are listed on the National Priorities List. To date, there have been no regulatory enforcement activities at ST005, although hazardous substances regulated under CERCLA (e.g., PCBs and TCE) have been detected at the site.

2.3 Highlights of Community Participation

2.3.1 Community Participation

NCP Section 300.430(f)(3) establishes a number of public participation activities that the lead agency (the USAF) must conduct following preparation of the Proposed Plan and review by the support agency (ADEC).

In accordance with NCP requirements, the USAF distributed the *Proposed Plan for Seven ERP Sites at Sparrevohn Long Range Radar Site* (Hoefler Consulting Group [HCG] 2008) for public review to solicit public input. The Proposed Plan was distributed on 6 October 2008. The USAF offered to hold a public meeting if requested. However, no request for a public meeting was received regarding the Proposed Plan. One person submitted comments to the Proposed Plan. The USAF received no request to extend the public comment period. Responses to comments received during the public comment period are included in the Responsiveness Summary, which is provided in Section 3.

2.3.2 Sparrevohn LRRS Community Relations Activities

As required by CERCLA, an Administrative Record (AR) has been established for Sparrevohn LRRS by the 611th Civil Engineering Squadron (CES) Environmental Restoration Section. The AR is the legal record for the ERP 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 the 611 CES office at 10471 20th Street, Suite 302, Elmendorf AFB, Alaska. Documents relevant to this ROD are listed in Table 2-1, and references directly cited are included in Section 4.0. A website with some of the documents is available to the public at: http://www.adminrec.com/PACAF.asp?Location=Alaska.

A Management Action Plan (MAP) report is updated periodically and made available to the public in order to provide a summary of all restoration activities in one document. A MAP is prepared to promote communication between the USAF and the general public during environmental restoration activities at Sparrevohn LRRS. The most recent MAP for the Sparrevohn LRRS was published in 2000 (Shannon and Wilson 2000b).

The USAF Community Relations Coordinator is the POC for the Administrative Record and can be reached at 1-800-222-4137.

A mailing list of interested parties in the community is maintained and updated regularly by 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 Sparrevohn LRRS.

A statewide toll-free telephone number (800-222-4137) is available throughout Alaska to enable interested individuals to contact the Air Force 611 CES Community Relations Coordinator at Elmendorf AFB. Interested individuals are encouraged to use this toll-free number to obtain information about the activities at the Sparrevohn LRRS or the ERP process.

2.4 Scope and Role of Operable Unit or Response Action

There are no operable units at the Sparrevohn LRRS. The selected remedy is appropriate for the projected future land use of the site, satisfies the USAF mission requirements, and is consistent with other remediation activities at the Sparrevohn LRRS facility.

2.5 Sparrevohn LRRS Environmental Characteristics

2.5.1 Topography

ST005 includes areas from the relatively flat valley floor at approximately 1,500 to 1,750 feet above mean sea level (amsl) to midway up the surrounding ridge tops.

2.5.2 Climate

Sparrevohn LRRS is located within the Alaska continental climate zone. Climate data at Sparrevohn were collected from May 1953 until January 1985. The recording station was located in the Lower Camp, at an elevation of 1,580 feet amsl. The average annual precipitation over the period of record was 24.2 inches, including 98.1 inches of snow. The lowest monthly mean precipitation occurs in February (0.83 inches), and the greatest mean precipitation occurs in August (4.39 inches). The mean annual temperature is 30.1 degrees Fahrenheit (°F), with average summer temperatures ranging from 40°F to 60°F, and average winter temperatures between 0°F and 20°F. Climate data are provided by the Western Regional Climate Data Center (2009).

2.5.3 Geology

In the valley, bedrock is overlain by alluvial valley fill material consisting of silty, sandy gravel with trace clay. The alluvial fill material is typically about 15 feet thick in the Lower Camp area and tends to become thicker to the south. Talus of variable thickness, consisting of broken bedrock, is found covering the slope areas.

2.5.4 Surface and Subsurface Hydrogeology

The ridgeline above the Waste Accumulation Area (SS007) (Figure 1-1) forms a drainage divide between the Stink River to the north and Hook Creek to the south. Tributaries draining the valley and the Lower Camp area (including SS007) are drained by Hook Creek, approximately 3 miles to the southwest. Hook Creek flows approximately 30 miles west, where it enters the Hoholitna River. The Hoholitna flows west and eventually enters the Kuskokwim River approximately 70 miles northwest of Sparrevohn LRRS (Shannon and Wilson 1999).

The Waste Accumulation Area (SS007) is located in the valley, where groundwater occurs as a shallow water table aquifer within the alluvial cover, and as a deeper aquifer within fractured bedrock. Groundwater in the valley discharges to seeps and streams (Shannon and Wilson 1999).

Drinking water at Sparrevohn LRRS is supplied from a gallery that collects water from the gravels underneath a stream on the west side of the valley.

2.5.5 Ecology

Four vegetative habitats occur at Sparrevohn LRRS. The ridge top and the Upper Camp are largely devoid of vegetation, with the exception of mosses and lichen on rocks, and small patches of dwarf scrub dominated by mountain-avens and/or ericaceous species, and graminoid grasses including sedges and alpine holygrass. The hillside vegetation communities are largely transitional as a function of elevation. The higher elevation communities contain dwarf scrub, which gradually changes to low scrub, and eventually tall scrub at the valley floor. The forested lowlands near the Lower Camp and valley bottom areas consist of a mosaic of black spruce in moderately-drained soil, and mixed white spruce, paper birch, and balsam poplar in wetter soil. Tamarack is also found amongst the black spruce. The understory is dominated by Labrador tea, prickly rose, blueberry and cranberry, and resin birch with a ground cover of near-continuous mat moss and lichen. Bog wetlands, located south of the runway, support open low or scrub-graminoid communities.

The upper slopes and ridge top at Sparrevohn LRRS offer limited foraging and no cover for mammals. Permanent residents of the upper slopes are limited to small mammals such as marmot, arctic ground squirrel, vole, and possibly pica. Avian species likely to forage on the upper slopes include peregrine falcon, spruce grouse, golden crowned-sparrow, and common redpoll. Rough-legged hawk, golden eagle, willow and rock ptarmigan, black bellied plover, western and rock sandpiper, horned lark, hermit thrush, lapland longspur, and rosy finch are likely to breed on the upper slopes.

The lower slopes and valley bottom , which include the Lower Camp, provide forage and cover for a variety of mammals, including black and brown bear, lynx, cross and red fox, timber wolf, moose, snowshoe hare, vole, shrew, field mouse, marten, short-tailed and least weasel, and mink. Mulchatna caribou, wolverine and coyote are also found in the area. Beavers reside in the bogs and ponds downstream of the LRRS, and river otters occupy Hook Creek. The range of many of these species, including caribou, may result in their transient occupation of the upper slope habitats.

A variety of avian species reside in or are seasonal inhabitants of the forested lowland. Permanent residents include the boreal owl and gyrfalcon. Seasonal species include Harlan and sharp-shinned hawks, great grey owls, great horned owls, short eared owls, long tailed jaegers, and ravens. Bald eagles and kingfishers are found on Hook Creek close to the Kuskokwim River. Lakes and ponds in the drainage area provide habitat for trumpeter swans, sandhill cranes, and white-fronted geese.

Surface water channels to the north and south of the ridge top are intermittent. These channels are not likely to contain fish, but are likely to contain aquatic invertebrates. Fish surveys on Hook Creek, approximately 5 miles downstream of Sparrevohn LRRS, reported chinook, sockeye, coho, and chum salmon. Other fish species may also include arctic char, Dolly Varden, white fish, northern pike, and grayling.

The drainage off the northern slope is also intermittent, containing aquatic invertebrates but not fish species. The surface water from the northern slope drains to Tundra Lake, which contains lake trout, blackfish, sheefish, sucker, and lamprey. Tundra Lake surface water drains to the Stink, Stony, and Kuskokwim Rivers, which contain chinook, sockeye, coho, and chum salmon.

Based on a records search conducted by the Environmental and Natural Resources Institute at the University of Alaska Anchorage, there are no state- or federally-listed sensitive plant or animal communities in the vicinity of Sparrevohn LRRS (Shannon and Wilson 1999).

2.5.6 Summary of Characterization Activities at ST005

A September 1985 Phase I, *Initial Assessment Records Search* (Engineering-Science 1985) identified ST005 as one of 8 ERP sites recommended for further evaluation. From 1986 to 1993, USAF ERP studies were conducted by Woodward-Clyde Consultants, and focused on the characterization of the sites identified during the Phase I study. Field investigations were conducted at ST005 in 1986, 1987, and 1988. Samples collected during these investigations were from the water gallery only. As a result of these studies, ST005 was classified as a no further action site (Woodward-Clyde 1993).

The USAF submitted a Preliminary Assessment for the Sparrevohn facility to the EPA in 1992 (USAF 1992). However, because the EPA found that the site could score high when evaluated using the hazard ranking system, they required sampling at all sources, including water sampling from the water gallery and sediment sampling from all surface water located near sources and wetlands.

An SI was completed at ST005 in 1995. As part of a 1995 site investigation, six surface soil samples were collected based on visual observations and historical information (Figure 1-3). Samples were analyzed for GRO, DRO, VOCs, SVOCs, and PCBs. Soil sample contaminant concentrations from this investigation exceeded the ADEC Method Two Migration to Groundwater cleanup levels under 18 AAC 75.341(c) for DRO, GRO, and PCBs (USAF 1995). During this investigation, the maximum DRO value (49,000 mg/Kg) for the site was detected, which exceeds the Method Two Migration to Groundwater cleanup value of 250 mg/Kg. The sample with the maximum DRO concentration was collected in an oily ditch at the base of the hill below the Power House. Only four VOC compounds (vinyl chloride, 1,1-dichloroethene, tetrachloroethylene, and cis-1,2-dichloroethene) were detected in soil at concentrations exceeding Method Two soil cleanup levels during the SI (Shannon and Wilson 1999). In addition, SVOCs (2-methylnapthalene and naphthalene), and PCBs (Aroclor-1260) were detected in SI soil samples at concentrations exceeding Method Two soil cleanup levels (Shannon and Wilson 1999).

RI activities were conducted in September and December 1996, April 1997 (USAF 1997), and August 1998 (Shannon and Wilson 1999). Sampling was conducted throughout the Lower Camp area, downstream of Lower Camp, in the vicinity of the former Power House, and near the sewage lagoon (Figure 1-4). RI samples were collected from rock borings, soil borings, test pits, surface soil, surface water, sediment, and groundwater monitoring wells. Groundwater, surface water, and sediment were sampled and analyzed for GRO, DRO, RRO, VOCs, SVOCs, PCBs, and metals. Soil samples were analyzed for GRO, DRO, RRO, VOCs, PCBs, pesticides, and metals (USAF 1997). RI characterization activities also included surface soil sampling (for PCBs) in the vicinity of the former Power House, surface water and sediment sampling, test pit sampling at the sewage lagoon, groundwater samples, and sediment samples. Additional sampling was required in 1998 as the result of laboratory quality control problems associated with the 1997 results. As a result, most stream water, sediment, and groundwater samples were recollected in 1998 and reanalyzed for DRO, RRO, PCBs, and pesticides. One-quarter of the 1997 DRO and RRO soil samples were recollected, 20 percent of the 1997 PCB and pesticide soil samples were recollected, and a limited number of SVOC soil samples were recollected (Shannon and Wilson 1999). The data from the 1997 and 1998 sampling events is collectively referred to as the RI data within this document.

Eight of the 15 RI soil samples collected in the vicinity of the former Power House contained PCB (Aroclor-1260) concentrations exceeding the ADEC Method Two soil cleanup level (1 mg/Kg) under in 18 AAC 75.341(c) (Figure 1-5) (Shannon and Wilson 1999). The maximum PCB concentration was 28.6 mg/Kg. Excavation of PCB-contaminated soil removed soil with a maximum PCB concentration of 210 mg/Kg. PCBs were not detected above ADEC Method Two soil cleanup levels in the alluvium or bedrock samples collected throughout the Lower Camp area. DRO exceeding the ADEC Method Two soil cleanup level was detected at all potential source areas tested as part of the RI (e.g., the Vehicle Maintenance Building, septic tanks, and fuel tanks). GRO concentrations were reported in soil at levels greater than the ADEC Method Two soil cleanup level of 300 mg/Kg; however, these results were associated with DRO contamination and were interpreted as the light end fraction of diesel fuel rather than a separate product spill, based on review of sample chromatograms (Shannon and Wilson 1999). Other contaminants in source area soil such as PCBs and pesticides were generally below Method Two Soil cleanup levels, or in the case of metals, below background levels.

Four groundwater samples had DRO concentrations that exceeded the ADEC groundwater cleanup level of 1,500 µg/L (18 AAC 75.345(b) (1)) (Figure 4). The highest concentration of DRO reported was 604,000 µg/L at the Truck Fill Stand; however, this concentration exceeds maximum DRO solubility and likely represents LNAPL in the sample (Shannon and Wilson 1999). Lower concentrations of DRO were detected at targeted source areas throughout the Lower Camp (Shannon and Wilson 1999) (Figure 4). Although no benzene was detected in groundwater, low concentrations (i.e., below ADEC Method Two groundwater cleanup levels) of toluene, ethylbenzene, and xylene compounds were detected in groundwater from the Lower Camp area (Figure 4) (Shannon and Wilson 1999). One groundwater sample at MW05 had a TCE concentration of 5 µg/L, which equaled the groundwater cleanup level. Subsequent groundwater sampling in 2006 at the same monitoring well resulted in TCE concentrations exceeding the groundwater cleanup level. Other contaminants identified in groundwater at concentrations exceeding cleanup levels included naphthalene, 2-methylnaphthalene, bis-(2-

ethylhexyl) phthalate, PCBs, cadmium, and lead. PCBs were not detected in groundwater after June 2006. Although 2-methylnaphthalene and bis-(2-ethylhexyl) phthalate were detected at concentrations exceeding screening levels, both were attributed to laboratory contamination (Shannon and Wilson 1999).

In RI surface water samples, the total aqueous hydrocarbons (TAH), the sum of detected BTEX compounds, exceeded the Alaska Water Quality Standard (AWQS) of 0.01 mg/L in 18 AAC 70.020(b)(5), although no individual compound exceeded AWQS. In addition, surface water had concentrations of pesticides (4,4'-dichlorodiphenyldichloroethane [DDD] and 4,4'-dichlorodiphenyltrichloroethane [DDT]), benzo(a)anthracene, and lead that exceeded the National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Table (SQuiRT) levels. DRO was also detected in surface water exceeding AWQS, but only in areas of hydrocarbon seep (Shannon and Wilson 1999).

Contaminants in sediment identified as exceeding NOAA SQuiRT levels included arsenic, chromium, copper, nickel, Aroclor-1260, 4,4'-DDD, and 4,4'-dichlorodiphenyldichloroethylene [DDE].

In 2000, seven groundwater, six surface water, and two water gallery samples were collected to assess natural attenuation processes (USAF 2001). Samples were analyzed for GRO, DRO, and VOCs, as well as methane, ethene, and ethane. Analytical results indicated a general decrease in the GRO and VOC concentrations, and nearly stable concentrations of DRO. However, the maximum DRO (1,800 μg/L) and TCE (6.42 μg/L) concentrations in MW5 exceeded the 18 AAC 75.345(b)(1) ADEC groundwater cleanup levels of 1,500 and 5 μg/L, respectively. No surface water or water gallery samples exceeded NOAA SQuiRT or ADEC Method Two groundwater cleanup levels. Based on the natural attenuation parameters measured, it was determined that biodegradation of petroleum hydrocarbon contaminants was occurring (USAF 2001).

In 2006, groundwater, surface water, and sediment samples were collected, some from the same locations sampled in 2000 (HCG 2006). Groundwater samples were analyzed for DRO and VOCs, while surface water and sediment samples were analyzed for VOCs and PAHs. Groundwater in one well, MW5 (Figure 1-4), exceeded the ADEC Method Two Table C cleanup levels for DRO (1,500 μg/L) and TCE (5 μg/L), with concentrations of 1,700 and 7.15 μg/L, respectively. An evaluation of historical trends at MW5 indicated that DRO concentrations have been decreasing since sampling began in 1996. However, the TCE concentrations at MW5 have increased over the same time period. Well MW5 is located directly downgradient of the vehicle maintenance shop, where floor drains originally discharged to the ground surface, and the TCE observed at this location may be attributed to that practice. No surface water or sediment samples contained VOCs or PAHs at concentrations exceeding 18 AAC 70 AWQS or NOAA SQuiRT criteria continuous concentrations (CCC) or probable effects levels (PEL).

2.5.7 Nature and Extent of Contamination

Soil sample concentrations of DRO, GRO, and PCBs from the 1995 SI exceeded the ADEC cleanup levels in 18 AAC 75.341(c) at ST005. The maximum DRO concentration of 49,000 mg/Kg was detected in an oily ditch below the Power House. The GRO concentration of 880 mg/Kg was detected near the PCB-contaminated soil stockpile west of the former Quonset hut (Figure 1-2). In the Lower Camp area, PCBs primarily occurred in the vicinity of the former Power Plant and in a soil stockpile west of the Quonset Hut (Figure 1-2) (Shannon and Wilson 1999). PCBs from these areas were partially removed prior to the RI. The extent of contamination was further delineated during the follow-up RI.

Results from the RI investigations showed widespread subsurface petroleum contamination, primarily associated with diesel fuel, approximately 700 feet in width at its north end near the Vehicle Maintenance building (Figure 1-2) and narrowing as to the south-southeast. Although a measurable layer of LNAPL was not commonly observed, LNAPL sheens were noted at monitoring well locations as far south as the midpoint of the runway (Figure 1-2). Four groundwater samples, MW5 and MW22 (south of the Vehicle Maintenance Building), MW20 (near the Truck Fill Stand), and MW9 (south of the Truck Fill Stand) (Figure 1-4), had DRO concentrations that exceeded the ADEC groundwater cleanup level of 1,500 µg/L in 18 AAC 75.345(b)(1). One groundwater sample, MW5, located near the Vehicle Maintenance Building, had a TCE concentration equal to the ADEC groundwater cleanup level 5 µg/L. Eight of 15 soil samples collected on the south side of the former Power House contained PCB concentrations exceeding the ADEC Method Two cleanup levels (18 AAC 75.341(c)) (Figure 1-5).

Five of the seven groundwater wells sampled in 2000 were within the previously identified contaminant plume south of the Vehicle Maintenance building (Figure 1-2). DRO was detected above the ADEC groundwater cleanup level in only two wells, MW22 and MW5 from the Lower Camp area (Figure 1-3). Groundwater from both wells previously had exceedances of DRO. TCE was also detected above the ADEC groundwater cleanup level (5 µg/L) at MW5. Based on the natural attenuation parameters measured, it was determined that biodegradation of petroleum hydrocarbon contaminants was occurring.

In 2006, the only compound concentrations exceeding cleanup levels in any of the tested media were for DRO and TCE in groundwater at MW5 (Figure 1-3). An evaluation of historical trends at MW5 indicated that DRO concentrations have been decreasing since sampling began in 1996. However, the TCE concentrations at MW5 have increased from 6.42 to 7.15 µg/L over the same time period. Well MW5 is located directly downgradient of the vehicle maintenance shop, where floor drains discharged to the ground surface, and the TCE observed at this location may be attributed to that practice.

Based on the concentrations of PCBs and DRO in soil, and the levels of TCE in groundwater, these compounds have been identified as COCs for this site. These COCs are discussed in further detail in sections 2.7.1.1 and 2.7.2.1.

2.5.8 Conceptual Site Model

Conceptual site models were developed to depict the potential relationship or exposure pathway 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 2-1 for human health, and Figure 2-2 for ecological receptors. For purposes of evaluating human health exposure pathways, it was assumed there were no current site residents at Sparrevohn LRRS. Current site use is limited to periodic site workers. Future exposure pathway scenarios assume that the Sparrevohn LRRS facility will be active, as the USAF intends to continue operations at the installation.

The 1980 petroleum release affected soil, groundwater, and surface water at ST005. Evidence of the impacts to groundwater, surface water, and sediment has been identified in downgradient monitoring wells, seeps, streams, and ponds. As such, complete exposure pathways exist for each of these media, plus biota. Several of the complete exposure routes to these media are insignificant, including inhalation via volatilization to indoor and outdoor air, and ingestion of sediments, surface water and groundwater. Exposure routes that are complete and significant include dermal contact with soil, sediment, groundwater and surface water, and ingestion of soil and meat. The primary exposure pathway for both human health and ecological risk at ST005 is via direct contact with contaminated soil and/or sediment (Figures 2-1 and 2-2).

Although future residential land use is considered unlikely at ST005, it has been included in the human health risk assessment to determine whether the site would be suitable for unrestricted use or unlimited exposure, as described within this ROD.

2.6 Current and Potential Future Land and Resource Uses

2.6.1 Land Use

The current land use at ST005 is industrial, as the Sparrevohn LRRS is only used by USAF personnel and their contractors. As the lead agency, the USAF has the authority to determine the future anticipated land use of ST005. After considering input from ADEC, the USAF has determined that the most likely future land use of ST005 for the foreseeable future is as an industrial site. This determination is made considering the following assumptions:

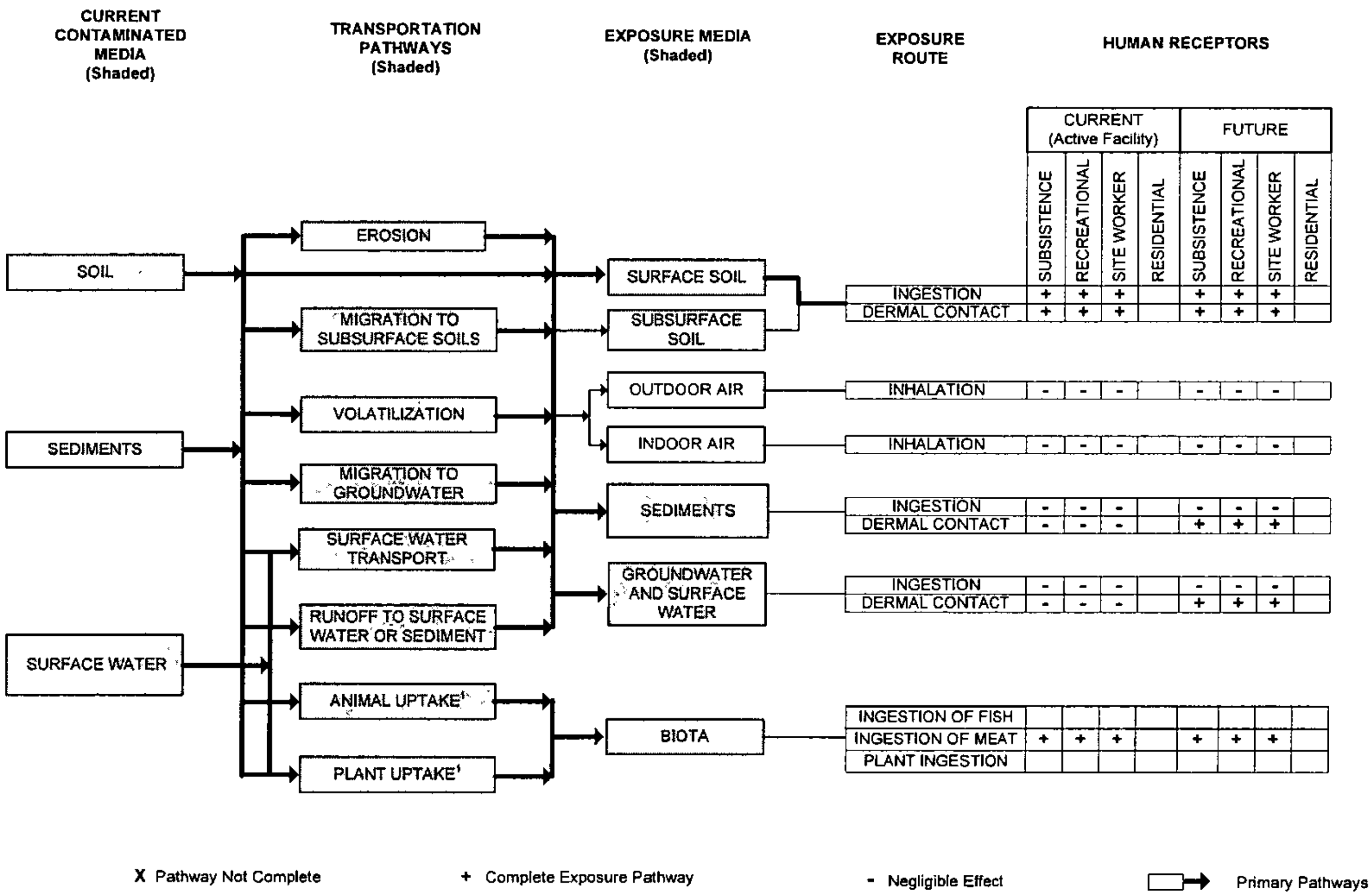
- The USAF plans to retain control of the property for the foreseeable future;
- The USAF has no plans to change current land use;
- Transfer of property is unlikely;
- Sparrevohn LRRS is remote and only accessible by air with special permission by the USAF; and
- Prior approval from ADEC will be obtained for any disturbance, movement or disposal of soil which is subject to 18 AAC 75.325(i).

Because there are no settlements within 18 miles of the Sparrevohn LRRS and all site industrial activities occur within the facility boundaries, the current land use for the surrounding area is generally limited to occasional recreational and subsistence activities. The current use of adjacent/surrounding land is expected to remain the same over the foreseeable future.

2.6.2 Groundwater and Surface Water Uses

Water from the shallow alluvial aquifer is used as drinking water at the Sparrevohn LRRS. Drinking water is currently supplied by a collection gallery located west of the Lower Camp on a tributary to Sparrevohn Creek, upgradient of known contaminant sources. The shallow aquifer is

Figure 2-1 Human Health Conceptual Site Model



[1] Concentrations may increase due to bioaccumulation.

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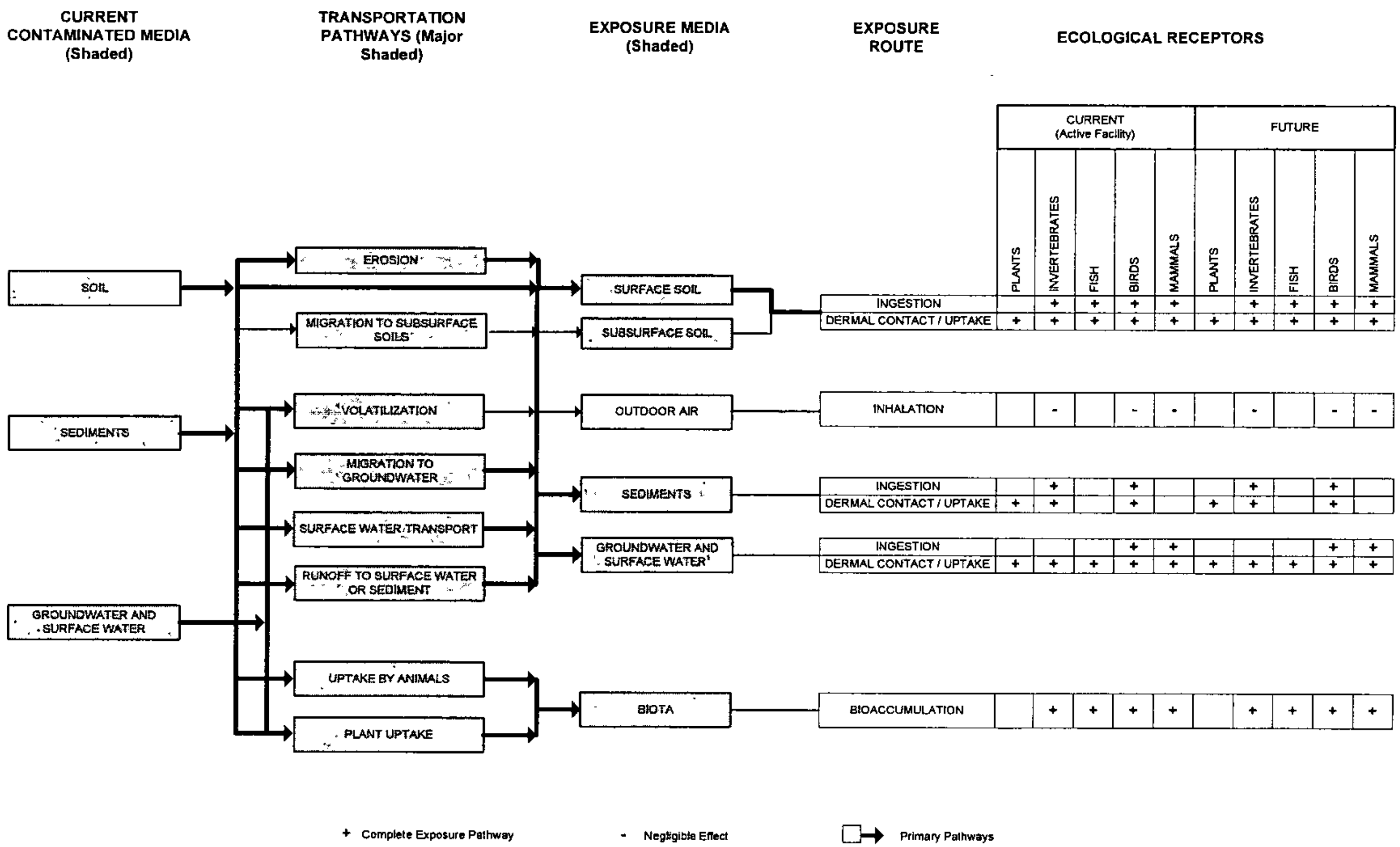
Figure 2-2 Ecological Conceptual Site Model



[1]This pathway only considers surface water. Groundwater is not considered as an exposure pathway for ecological receptors.

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not important regionally other than for the installation (i.e., no downgradient users). The gallery was installed approximately 20 feet below the streambed, and provides drinking water to the residential facility year-round. No drinking water is currently provided to the Upper Camp. No other groundwater or surface water is currently used at the Sparrevohn LRRS.

2.7 Summary of Site Risks

This section summarizes the baseline human health and ecological risk assessments that have been completed for Sparrevohn LRRS. In accordance with the NCP's requirement for baseline risk assessment (40 CFR §300.400(d)) to characterize current and potential threats to human health and the environment, risk due to contamination at the Sparrevohn LRRS was evaluated in the RI/FS report.

The baseline human health and ecological risk assessment (BLRA) was completed in 2000 (Shannon and Wilson 2000a), and based on ADEC comments, an addendum was completed in 2002 (USAF 2002a). The objectives of the risk assessment addendum were to include the sediment-to-fish contaminant pathway for bioaccumulative chemicals, and evaluate six additional residential exposure scenarios for the Lower Camp (USAF 2002a). The modifications made to the baseline risk assessment in the addendum were applicable to Lower Camp sites, including ST005.

The objectives of the BLRA were to determine which chemicals, media, and areas of the eight ERP sites posed unacceptable risks to human and ecological receptors and, if necessary, to develop alternative cleanup levels for remediation of these areas. The baseline human health and ecological risk assessments were not conducted on a site-by-site basis (i.e., no risk assessment was completed specifically for ST005). Rather, the risk assessments were completed for five exposure areas that potentially were impacted by the eight ERP sites. The five exposure areas are the Lower Camp (on-site), Lower Camp (off-site), Northern Hillside/Valley, Upper Camp, and Hook Creek (Shannon and Wilson 2000a) (Figure 1-1). Exposure areas were evaluated (instead of individual ERP sites) because they were considered to be more representative of typical exposure patterns at Sparrevohn LRRS. However, because the risk for the Lower Camp (on-site) was calculated by combining several ERP sites, the calculated risk values overestimate the risk associated with any individual ERP site. Risk assessments conducted for the Sparrevohn LRRS used data collected in 1996, 1997, and 1998 (Shannon and Wilson 2000a).

As part of the BLRA, a more detailed (i.e., Tier II) ecological risk assessment (ERA) was also conducted to more accurately characterize the potential for risks to benthic invertebrate species due to site-related chemicals. This Tier II ERA involved measurement and correlation of sediment chemical concentrations, sediment toxicity, and benthic invertebrate abundance and diversity. A weight-of-evidence approach based on these three measures and an assessment of habitat quality was used to provide a more thorough assessment of the potential for ecological effects to benthic invertebrate species.

The USAF conducted additional work in 2001 to address the outstanding issues at the site, and submitted an Addendum to the BLRA in 2002 (USAF 2002a). The risk assessment addendum included the sediment-to-fish contaminant pathway for bio-accumulative chemicals, and evaluated six additional residential exposure scenarios for the Lower Camp (USAF 2002a).

2.7.1 Summary of Human Health Risk Assessment

The BLRA estimates the risks posed by the sites 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 the approaches used and the results of the baseline risk assessment of the subject site.

There are many uncertainties in assessing risks to people from chemicals occurring in the environment. Uncertainty reflects limitations in knowledge and assumptions that must be made in order to quantify health risks. Risk assessments involve several components, including analysis of toxicity and exposure, each with inherent uncertainty.

2.7.1.1 Identification of Chemicals of Concern

This section identifies the COCs to human health that require remediation. The data used in the risk calculations were deemed to be of sufficient quality and quantity for their intended use.

COPCs were identified in the RI (Shannon and Wilson 1999), based on chemical concentrations exceeding applicable screening or cleanup values. COPCs were then evaluated as part of the human health risk assessment (i.e., BLRA and addendum). In some cases, evaluation resulted in the elimination of chemicals that had only been reported at low frequencies, at concentrations below analytical detection limits in a given medium, or at concentrations less than the average background concentration (Shannon and Wilson 2000a). Additionally, the list of COPCs was further refined by eliminating compounds that were detected at concentrations below human health risk-based screening concentrations, or that were assumed not to bioaccumulate or bioconcentrate.

For this ROD, soil COPCs were determined using the risk-based values for screening from 18 AAC 75, specifically Method Two soil cleanup levels for Migration to Groundwater. Method Two soil cleanup levels have been established for specific chemicals (listed in 18 AAC 75.341, Tables B1 and B2) and are protective of long-term exposures under residential land use scenarios. Method Two soil cleanup levels are risk-based cleanup levels based on a cancer risk management standard of 1 in 100,000 ($1x10^{-5}$) and a noncarcinogenic risk standard or hazard index of 1.0, set forth in 18 AAC 75.325(h). The primary groundwater screening criteria are derived from 18 AAC 75.345 Table C groundwater cleanup levels. Where groundwater is a potential drinking water source or a source to surface water (seeps), the primary screening criteria are derived from 18 AAC 80 Alaska Drinking Water Standards, or NOAA SQuiRT limits for fresh surface water, respectively. The primary sediment screening criteria are derived from the PEL for freshwater listed in the NOAA SQuiRTs. The primary surface water screening criteria are derived from the 18 AAC 70 Alaska Water Quality Standards and the criteria continuous concentration (CCC) NOAA SQuiRT limits.

COPCs identified in the BLRA and addendum were based on compound concentrations occurring within an exposure area (e.g. Northern Hillside/ Valley, Upper Camp, Lower Camp [off-site], Lower Camp [on-site], and Hook Creek), and not necessarily concentrations associated with specific ERP sites. As a result, some compounds were eliminated as COPCs because although they were identified in an exposure area, they were not identified at a specific ERP site. Because ST005 is only a portion of the Lower Camp (on- and off-site) exposure areas, not all of the COPCs identified were applicable to ST005. Some examples of compounds that were detected in soil from the Lower Camp exposure areas but not detected within ST005 include benzo(a)pyrene, benzo(b)fluoranthene, and alpha-alpha-benzene hexachloride (BHC) (Table 2-2) (Shannon and Wilson 2000a). In some cases, compound concentrations were compared with calculated site-specific human health risk-based concentrations to determine if a compound significantly contributed to risk at the site.

The screening criteria used are protective of human health. They were selected to be conservative and are in accordance with the current and projected land use at the site as described in Section 2.6. Criteria protective of people using the site for residential purposes were used to screen the data, even though there is no current or planned residential land use at the site.

COPCs from the BLRA and addendum are listed in Tables 2-3 and 2-4. Compounds are designated with an "R" to indicate that the compound was identified as a COPC in the BLRA (Shannon and Wilson 2000a), an "A" to indicate that the compound was identified as a COPC in the addendum (USAF 2002a) or a "B" to indicate that the compound was identified as a COPC in the both the BLRA and addendum. The human health COCs identified in this section provide the basis for the remedial action objectives and remedy selection.

Soil

Twenty-eight compounds exceeded one-tenth the ADEC Method Two soil cleanup level under 18 AAC 75.341 at ST005 (Table 2-2) (Shannon and Wilson 2000a). Of these, 13 compounds exceeded the ADEC Method Two Migration to Groundwater soil cleanup levels.

Concentrations of GRO and DRO in soil samples collected in 1996 as part of the RI exceeded the ADEC Method Two soil cleanup levels. GRO detections coincided with samples with high DRO concentrations (i.e., exceeding ADEC Method Two soil cleanup levels). Based on a review of chromatograms, GRO content was determined to be the light end of the DRO contamination rather than the result of separate releases (Shannon and Wilson 1999). As a result, only DRO was retained as a COC for soil.

Lead was detected, but only at concentrations below the soil cleanup level of 400 mg/Kg, and therefore was not retained as a COC. All Resource Conservation and Recovery Act (RCRA) metals exceeded the 1/10th Method Two screening criteria and were considered to be COPCs for risk assessment; however, only antimony and chromium exceeded both background concentrations and the unadjusted ADEC Method Two soil cleanup level (Shannon and Wilson 2000a). Antimony and chromium were determined not to be significant contributors to human health risk (i.e., the actual concentration was several orders of magnitude lower than the site-specific human health risk-based concentration) (Shannon and Wilson 2000a). Because the overall risk for soil does not exceed ADEC Risk Management levels, and no metal exceeded background and site-specific human health risk-based concentrations, no metals were retained as human health COC for soil.

Six VOCs and three SVOCs exceeded 1/10th the ADEC Method Two soil cleanup criteria and were considered COPCs for soil risk assessment (Shannon and Wilson 1999; 2000a). Three VOCs, 1,2,4-trimethylbenzene, benzene, and tetrachloroethene, exceeded the ADEC Method Two soil cleanup level. Two SVOCs, 2-methylnaphthalene and naphthalene, also exceeded ADEC Method Two soil cleanup levels. The 1,2,4-trimethylbenzene maximum concentration was below the site-specific human health risk-based concentration, and was not considered a significant factor to human health risk; as a result, this compound was not retained as a human health COC. Benzene was detected in less than five percent of the samples, and as a result, was not retained as a human health COC (Table 2-2). Although tetrachloroethene was detected above the ADEC Method Two soil cleanup level for Migration to Groundwater, it was not detected in any groundwater samples; therefore, the soil contamination is not affecting other media. Because tetrachloroethene does not bioaccumulate, it was not carried forward as a human health COC. As a result, no VOCs, SVOCs, or chlorinated solvents were retained as human health COCs.

PCBs (Aroclors 1254 and 1260) exceeded the Method Two cleanup level of 1 mg/Kg in the vicinity of the Power Plant, and as a result, PCBs were retained as a COC for soil at ST005 (Shannon and Wilson 1999; 2000a).

Pesticides were detected at low concentrations in soil samples throughout the Lower Camp area. One pesticide, 4,4'DDD, was detected slightly above (less than 5 percent) the ADEC Method Two soil cleanup level of 7.2 mg/Kg (Table 2-2) (Shannon and Wilson 1999). Pesticides were considered COPCs for the risk assessment. The wide distribution and low concentration of pesticides in the Lower Camp exposure area indicates that their presence is likely related to use rather than release (Shannon and Wilson 1999), and therefore pesticides were not retained as COCs for ST005.

Following evaluation of all compounds which exceeded 1/10th the Method Two Migration to Groundwater soil cleanup level for the Under 40-Inch Zone, two compounds, DRO and PCBs, were retained as human health COCs in soil (Shannon and Wilson 1999).

<u>Groundwater</u>

In groundwater, DRO, RRO, TCE, 2-methylnaphthalene, bis-(2-ethylhexyl) phthalate, PCBs (only detected once during the June 1997 sampling event), arsenic, cadmium and lead exceeded the ADEC 18 AAC 75.345 Table C Groundwater cleanup levels (Table 2-5) (Shannon and Wilson 1999). GRO, other VOCs and SVOCs, pesticides, and metals were also identified in groundwater, but did not exceed the cleanup levels.

RRO was detected at a frequency of less than five percent (Table 2-5) and was not retained as a COPC for groundwater risk assessment, or as a COC. 2-methylnaphthalene was retained as a COPC for risk assessment; however, because the maximum concentration was orders of magnitude lower than the human health risk-based concentration, 2-methylnaphthalene was not retained a human health COC. Bis-(2-ethylhexyl) phthalate detections were attributed to laboratory contamination (Shannon and Wilson 1999); as such, the compound was not retained

Table 2-2 Risk Assessment and Addendum Soil and Sediment COPCs for the Lower Camp

Media	Chemical of Concern	Reference	Concentration Detected [1]		Units	Frequency Of Detection [1]	Exposure Point Concentration [2]	Statistical Measure [2]
			Min	Max				
Soil On-Site - Direct Contact	1,1,1-Trichloroethane	R	0.0016	0.058	mg/Kg	6/141	0.058	Max
	1,1-Dichloroethene	R	0.0027	2	mg/Kg	4/141	0.189	UCL
	1,2,4-Trimethylbenzene	B	0.0011	43.3	mg/Kg	17/140	43.3	Max
	1,3,5-Trimethylbenzene	B	0.0017	15.1	mg/Kg	17/141	15.1	Max
	2-Butanone	R	0.0022	0.065	mg/Kg	12/137	0.065	Max
	2-Hexanone	R	0.0024	0.0062	mg/Kg	3/67	0.0062	Max
	2-Methylnapthalene	B	0.0386	74.1	mg/Kg	13/137	74.1	Max
	4,4'DDD	B	0.000009	7.41	mg/Kg	81/178	7.41	Max
	4,4'DDE	A	0.0002	0.35	mg/Kg	69/178	0.35	Max
	4,4'DDT	B	0.000004	5.13	mg/Kg	101/178	0.89	UCL
	4-Isopropyltoluene	B	0.0011	2	mg/Kg	15/63	2	Max
	4-Methyl-2-pentanone	R	0.0045	0.0049	mg/Kg	2/137	0.005	Max
	4-Methylphenol	R	1.5	1.5	mg/Kg	1/33	0.431	UCL [3]
	Antimony	B	0.196	10.6	mg/Kg	17/119	10.6	Max
	Arsenic	B	2.63	19	mg/Kg	111/118	19	Max
	Benzo(a)pyrene	B	0.165	0.165	mg/Kg	1/137	0.165	Max
	Benzo(b)fluoranthene	A	0.18	0.175	mg/Kg	1/137	0.175	Max
	Beryllium	R	0.16	1.69	mg/Kg	109/118	0.656	UCL [3]
	bis(2-ethylhexyl)phthalate	A	0.1	6.72	mg/Kg	13/135	6.72	Max
	Bromomethane	R	0.0026	0.0026	mg/Kg	1/141	0.003	Max [3]
	Chloroethane	R	0.0027	0.0037	mg/Kg	2/141	0.004	Max [3]
	Chloromethane	R	0.0016	0.0031	mg/Kg	2/141	0.003	Max [3]
	Chromium	B	5.66	168	mg/Kg	118/118	168	Max
	Copper	R	6.1299	95.5	mg/Kg	118/118	52.898	UCL [3]
	DRO	B	4.8	20,800	mg/Kg	159/194	20,800	Max
	Endosulfan Sulfate	A	0.0005	0.0154	mg/Kg	14/178	0.0154	Max
	Fluorene	A	0.2	1.32	mg/Kg	4/137	1.32	Max
	GRO	B	0.974	1,700	mg/Kg	57/152	1,700	Max
	Lead	R	4.7999	77	mg/Kg	113/118	16.078	UCL [3]
	n-Butylbenzene	B	0.0011	5	mg/Kg	14/63	5	Max
	n-Propylbenzene	B	0.0013	2	mg/Kg	12/63	2	Max
	Napthalene	A	0.2	41.4	mg/Kg	10/137	41.4	Max
	PCB (Aroclor-1016)	B	2.4	2.4	mg/Kg	1/207	2.4	Max
	PCB (Aroclor-1254)	A	0.016	0.167	mg/Kg	2/207	0.167	Max
	PCB (Aroclor-1260)	B	0.0037	210	mg/Kg	84/206	210	Max
	Phenanthrene	A	0.1	0.4	mg/Kg	4/137	0.4	Max
	RRO	B	26	2,680	mg/Kg	124/186	2,680	Max
	sec-Butylbenzene	B	0.0012	3	mg/Kg	12/63	3	Max
	Selenium	A	0.366	2.92	mg/Kg	17/118	2.92	Max
	tert-Butylbenzene	B	0.0014	2	mg/Kg	6/63	2	Max
	Tetrachloroethene	A	0.0014	1	mg/Kg	25/141	1	Max
	Thallium	B	0.1187	1.53	mg/Kg	19/118	1.53	Max
	Trichlorofluoromethane	R	0.9	0.9	mg/Kg	1/13	0.9	Max
	Vinyl chloride	R	0.0042	1	mg/Kg	4/141	1	Max
Sediment – Direct Contact	1,3,5-Trimethylbenzene	B	20	20	mg/Kg	1/22	20	Max
	2-Methylnapthalene	B	0.007	0.234	mg/Kg	2/21	0.234	Max
	4,4'DDD	A	0.0012	1.51	mg/Kg	10/20	1.19	UCL
	4,4'DDT	A	0.0033	1.53	mg/Kg	13/20	0.551	UCL
	Antimony	B	0.16	10	mg/Kg	8/21	10	Max
	Arsenic	B	1.91	31.5	mg/Kg	19/20	13.4	UCL
	Benzo(b)fluoranthene	A	0.00368	0.0085	mg/Kg	3/23	0.0085	Max
	Benzo(g,h,i)perylene	A	0.00171	0.0074	mg/Kg	5/23	0.0074	Max
	Chromium	B	22.4	96.4	mg/Kg	21/21	70.4	UCL
	DRO	B	9.58	49,000	mg/Kg	23/23	49,000	Max
	Endosulfan sulfate	A	0.0008	0.0008	mg/Kg	1/20	0.0008	Max
	GRO	B	4.3	1,400	mg/Kg	4/21	1,400	Max
	Lead	R	5.34	69.8	mg/Kg	20/21	27	UCL [3]
	Napthalene	A	0.00196	6	mg/Kg	6/24	6	Max
	PCB (Arochlor-1260)	B	0.0058	11	mg/Kg	11/23	8.93	UCL
	Phenanthrene	A	0.00308	0.026	mg/Kg	3/23	0.026	Max
	RRO	B	40	3,900	mg/Kg	16/21	816	UCL
	Thallium	B	1.97	12.4	mg/Kg	3/21	12.4	Max

mg/Kg milligrams per Kilogram
µg/L: micrograms per Liter
95% UCL: 95% Upper Confidence Limit
ND (0.0041): Analyte not detected above the analytical detection limit (in parenthesis)
Max: Maximum Concentration
J: Estimated Value
R: COC identified in the Baseline Risk Assessment (Shannon & Wilson 2000)
A: COC identified in the Baseline Risk Assessment Addendum (USAF 2002)
B: COC identified in both the Baseline Risk Assessment and the Addendum

Notes:
1 - Concentration and Frequency of Detection data came from the Baseline RA Addendum (USAF 2002), Appendix B, Tables B-1 to B-6.
According to the Addendum, only surface soil data were used to calculate the EPC values.
Soil data from the 2002 Risk Assessment Addendum is for soil with depths below ground surface to 15 feet.
2 - Exposure Point Concentrations (EPCs) and Statistical Measure are based on samples within the combined Lower Camp Exposure Area (including other IRP sites) from the Sparrevohn LRRS Baseline Risk Assessment Addendum (USAF 2002).
EPCs were taken from the Sparrevohn Baseline RA Addendum (USAF 2002), Appendix C, Tables C-1 to C-6.
3 - EPCs were taken from the Sparrevohn LRRS Baseline RA (Shannon & Wilson 2000), Appendix B, Table B-2

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Table 2-3 Risk Assessment and Addendum Groundwater and Surface Water COPCs for the Lower Camp

Media	Chemical of Concern	Reference	Concentration Detected [1]		Units	Frequency Of Detection [1]	Exposure Point Concentration [2]	Statistical Measure [2]
			Min	Max				
Groundwater – Direct Contact	1,1,2,2-Tetrachloroethane	R	1.2	1 5	µg/L	2/46	1.5	Max[3]
	1,2,4-Trimethylbenzene	B	3.7	57 3	µg/L	4/46	57 3	Max
	1,3,5-Trimethylbenzene	B	3 2	19.2	µg/L	4/46	19.2	Max
	2-Butanone	A	2.4	2.4	µg/L	1/42	2.4	Max
	2-Methylnapthalene	B	17.8	33	µg/L	2/34	33	Max
	4-Isopropyltoluene	B	2.8	9	µg/L	3/21	9	Max
	Acenaphthene	A	0.168	0.168	µg/L	1/33	0.168	Max
	Acetone	B	3.1	1,700	µg/L	6/41	1,700	Max
	alpha-BHC	R	0.8	0.8	µg/L	1/41	0.8	Max[3]
	Antimony	B	1.1	2.9	µg/L	7/41	2 9	Max
	Arsenic	B	3.2	228	µg/L	9/41	228	Max
	Barium	B	62.4	695	µg/L	7/7	695	Max
	Beryllium	B	0 7	8.4	µg/L	4/41	8 4	Max
	bis-(2-ethylhexyl)phthalate	B	4.4	25.6	µg/L	2/34	25.6	Max
	Cadmium	B	1.5	26 7	µg/L	3/41	26 7	Max
	Chloroform	B	2	2	µg/L	1/47	2	Max
	Chromium	R	9.5	1,220	µg/L	12/41	1,220	Max[3]
	cis-1,2-Dichloroethene	B	5.8	9 5	µg/L	3/47	9.5	Max
	Copper	B	3 6	875	µg/L	11/41	875	Max
	DRO	B	100	3,400	µg/L	25/46	3,400	Max
	Ethylbenzene	A	0.9	6	µg/L	5/46	6	Max
	Fluorene	A	0.202	0.202	µg/L	1/33	0 202	Max
	GRO	B	20.5	417	µg/L	15/35	417	Max
	Isopropylbenzene	A	5	6	µg/L	2/8	6	Max
	Lead	B	3.6	169	µg/L	14/41	169	Max
	Mercury	R	0.22	0 86	µg/L	2/40	0.86	Max[3]
	Methylene Chloride	B	6 3	120	µg/L	2/47	120	Max
	n-Butylbenzene	A	5	5	µg/L	1/20	5	Max
	n-Propylbenzene	B	1	9	µg/L	3/20	9	Max
	Napthalene	B	0.066	34	µg/L	7/38	34	Max
	Nickel	B	8 8	165	µg/L	7/37	165	Max
	Selenium	R	4.6	9.7	µg/L	2/39	9 7	Max[3]
	Thallium	B	2.1	2.1	µg/L	1/40	2.1	Max
	Toluene	A	1	2	µg/L	7/47	2	Max
	Trichloroethene	B	1	5	µg/L	4/47	5	Max
	Trichlorofluoromethane	A	2	2	µg/L	1/7	2	Max
	Xylenes	A	1.4	9.7	µg/L	4/46	9.7	Max
	Zinc	B	31.1	1,560	µg/L	9/43	1,560	Max
Surface Water (Water Gallery) – Direct Contact	Beryllium	R	1.1	1 1	µg/L	1/11	1.1	Max[3]
	Copper	R	2.3	143	µg/L	6/11	143	Max[3]
	Lead	R	4.4	6 9	µg/L	2/11	6.9	Max[3]
Surface Water – Direct Contact	2-Methylnaphthalene	A	9	9.0	µg/L	1/27	9	Max
	4-Isopropyltoluene	A	0.5	0.5	µg/L	1/15	0.5	Max
	Acenaphthylene	A	0 052	0 052	µg/L	1/26	0 052	Max
	Acetone	A	51.7	137	µg/L	2/19	137	Max
	Antimony	A	5.2	10.7	µg/L	2/27	10.7	Max
	DRO	A	100	3,020	µg/L	15/28	3,020	Max
	GRO	A	25.2	92	µg/L	3/23	92	Max
	Napthalene	A	0 0717	3	µg/L	4/29	3	Max
	Phenanthrene	A	0.061	0.061	µg/L	1/26	0 061	Max
	Trichloroethene	A	2.7	2.7	µg/L	1/32	2.7	Max

mg/Kg: milligrams per Kilogram
µg/L: micrograms per Liter
95% UCL: 95% Upper Confidence Limit
ND (0.0041): Analyte not detected above the analytical detection limit (in parenthesis)
Max: Maximum Concentration
J: Estimated Value
R: COC identified in the Baseline Risk Assessment (Shannon & Wilson 2000)
A: COC identified in the Baseline Risk Assessment Addendum (USAF 2002)
B: COC identified in both the Baseline Risk Assessment and the Addendum

Notes:
1 - Concentration and Frequency of Detection data came from the Baseline RA Addendum (USAF 2002), Appendix B, Tables B-1 to B-6
2 - Exposure Point Concentrations (EPCs) and Statisical Measure are based on samples within the combined Lower Camp Exposure Area (including other IRP sites) from the Sparrevohn LRRS Baseline Risk Assessment (USAF 2002).
EPCs were taken from the Sparrevohn Baseline RA Addendum (USAF 2002), Appendix C, Tables C-1 to C-6.
3 - EPCs were taken from the Sparrevohn LRRS Baseline RA (Shannon & Wilson 2000), Appendix B, Table B-2.

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as a COC. PCBs were not retained as a COC due to low detection frequencies (Shannon and Wilson 1999; 2000a). Arsenic, cadmium and lead were retained as COPCs for risk assessment (Shannon and Wilson 1999; 2000a); however, they were considered naturally occurring and not significant to risk, and as a result were not retained as human health COCs (Shannon and Wilson 1999; 2000a).

Following evaluation of compounds detected in groundwater and comparison to the Table C Groundwater cleanup levels found in18 AAC 75.345, only two compounds, DRO and TCE, were retained as human health COCs in groundwater.

Surface Water

Surface water from the water gallery is used as a drinking water source, and as a result, water gallery samples were compared with maximum contaminant levels under 18 AAC 80 (ADEC 2009b) for screening of COPCs and COCs. Surface water downgradient of the water gallery, which is not used for drinking water, was screened against Alaska Water Quality Standards in 18 AAC 70 (ADEC 2009a).

Although fuel compounds, VOCs, metals, and PCBs were identified in the water gallery samples, no compounds exceeded the ADEC Maximum Drinking Water levels listed under 18 AAC 80 (Table 2-6) (Shannon and Wilson 2000a). Therefore, no human health COCs were identified from the water gallery area at ST005.

In other surface water samples from ST005, TAH and total aqueous hydrocarbons (TAqH) exceeded the Alaska Water Quality Standards under 18 AAC 70 (Table 2-7). In addition, benzo(a)anthracene, 4,4'-DDD, 4,4'-DDT, and lead exceeded the CCC for fresh surface water listed in the NOAA SQuiRTs (Buchman 2008) in 1996 and/or 1997, but were below screening levels in 1998; as a result, these were not retained as COCs (Table 2-7).

DRO, GRO, VOCs, SVOCs, metals, and PCBs were identified in surface water samples, but did not exceed the screening levels.

Because TAH and TAqH concentrations decreased to below 18 AAC 70 screening levels between the 1996 and 1998 sampling events, TAH and TAqH were not retained as human health COCs (Table 2-7).

Following evaluation of drinking water (water gallery) and non-drinking water surface water samples, and comparison of detected compounds against cleanup criteria listed in 18 AAC 70 and 80, no compounds were retained as human health COCs in surface water at ST005.

Sediment

In sediment, the maximum concentrations for PCBs (Aroclor 1260), 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT exceeded the PEL for freshwater listed in the NOAA SQuiRTs (Buchman 2008) (Table 2-8), and were considered as COPCs for risk assessment (Shannon and Wilson 2000a). However, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were detected in background samples upgradient of the water gallery, indicating that their presence at ST005 is likely related to use rather than release (Shannon and Wilson 1999). In addition, pesticide concentrations were well below

ADEC soil cleanup levels protective of human health via direct contact. As a result, pesticides were not retained as a human health COC.

Although several PCB samples exceeded the NOAA SQuiRT screening value for freshwater sediment, only one sample had a PCB concentration exceeding 1 mg/Kg, the human health-based soil cleanup concentration (Table 2-8). PCBs were evaluated as COPCs in the risk assessment, but were not retained as human health COCs due to low concentrations and low frequencies of detection.

Fluorene was the only SVOC or PAH detected in the Lower Camp area exceeding screening levels. Although fluorene was retained as a COPC for risk assessment in the Lower Camp exposure area, it was not detected at ST005, and therefore was not retained as a human health COC for ST005.

Maximum metal concentrations for arsenic, chromium, and nickel exceeded NOAA SQuiRTs (Buchman 2008) (Table 2-8); however, because arsenic and chromium do not bioaccumulate, they were not retained as human health COCs (Shannon and Wilson 2000a). Nickel was detected in all samples at concentration levels that were within the range of sediment background concentrations, and as a result were considered to be naturally occurring (Shannon and Wilson 2000a). As a result, nickel was not retained as a human health COC.

Following the evaluation of sediment data against the applicable NOAA SQuiRTs (Buchman 2008), no compounds were retained as human health COCs in for sediment.

2.7.1.2 Exposure Assessment

The objectives of the exposure assessment are to characterize potentially exposed human populations in the area associated with the Sparrevohn LRRS facility, to identify actual or potential exposure pathways, and to determine the extent of exposure. The exposure assessment involves several key elements, including the following: definition of local land use, definition of local water use, identification of the potential receptors/exposure scenarios, identification of exposure routes, estimation of exposure point concentrations, and estimation of daily doses.

As part of the exposure assessment, a conceptual site model (Figure 2-1) was developed separately for the ST005 site showing the potential human exposure pathways. Complete exposure pathways included ingestion of chemicals in surface and subsurface soil, and dermal contact by current site workers, recreational users, and subsistence users.

2.7.1.3 Toxicity Assessment

Human health criteria (cancer slope factors and reference doses [RfDs]) developed by the EPA were obtained preferentially from the Integrated Risk Information System database (IRIS; EPA 1999) or the 1997 Health Effects Assessment Summary Tables (HEAST; EPA 1998). In some cases, the National Center for Environmental Assessment toxicity values found in the Region III Risk-Based Concentration Table were used when neither IRIS nor HEAST had data.

The purpose of the toxicity assessment is to select toxicity values (criteria) for each chemical evaluated in the human health risk assessment. The toxicity values are used in combination with

Table 2-4 Soil Sample Results

Media	Analyte[1]	Screening Criteria 18 AAC 75 Method Two Under 40-Inch Zone	1996 RI/FS Maximum Concentration[3,4]	1996 RI/FS Frequency of Detections[4,5]	1997 RI/FS Maximum Concentration[3,4]	1997 RI/FS Frequency of Detections[4,5]	1998 RI/FS Maximum Concentration[3,4]	1998 RI/FS Frequency of Detections[4,5]
Soil (mg/Kg)	**Fuels**							
	GRO	300	**1,460**	59/164	3.9	2/3	NS	NA
	DRO	250	**13,200**	150/164	**2,910 J,T**	2/3	NS	NA
	RRO	10,000	2,680 J	85/164	1,700J	2/3	NS	NA
	VOCs							
	1,1-Dichloroethene	0.03	NR	NA	NS	NA	NS	NA
	1,2,4-Trimethylbenzene	23	**43.3**	8/101	NS	NA	NS	NA
	1,3,5-Trimethylbenzene	23	15.1	9/101	NS	NA	NS	NA
	2-Butanone	59	NR	NA	0.0069	1/3	NS	NA
	4-Isopropyltoluene	--	NR	NA	0.0045	1/3	NS	NA
	Acetone	88	0.775	1/101	0.038	2/3	NS	NA
	Benzene	0.025	**0.134**	2/101	NS	NA	NS	NA
	Carbon disulfide	12	NS	NA	0.002	1/3	NS	NA
	Chloroform	0.46	ND (0.139)	0/101	0.0031	2/3	NS	NA
	cis-1,2-Dichloroethene	0.24	ND (0.139)	0/101	NS	NA	NS	NA
	Ethylbenzene	6.9	2.66	4/101	NS	NA	NS	NA
	Isopropylbenzene	51	NR	NA	NS	NA	NS	NA
	Methylene Chloride	0.016	NS	NA	0.0078	1/3	NS	NA
	n-Butylbenzene	15	NR	NA	0.0015	1/3	NS	NA
	n-Propylbenzene	15	NR	NA	NS	NA	NS	NA
	Napthalene	20	NR	NA	NS	NA	NS	NA
	sec-Butylbenzene	12	NR	NA	NS	NA	NS	NA
	Tetrachloroethene	0.024	**0.852**	15/101	0.0014	1/3	NS	NA
	Toluene	6.5	0.445	11/101	0.032	2/3	NS	NA
	Total Xylenes	63	20.3	11/101	NS	NA	NS	NA
	Trichloroethene	0.020	ND (0.588)	0/101	0.0033	2/3	NS	NA
	Trichlorofluoromethane	86	NR	NA	NS	NA	NS	NA
	Vinyl Chloride	0.0085	NR	NA	NS	NA	NS	NA
	SVOCs							
	2-Methylnapthalene	6.1	**74.1 J**	10/99	NS	NA	NS	NA
	4-Methylphenol (p-cresol)	1.5	NS	NA	**1.5**	1/3	NS	NA
	Acenaphthene	180	ND (12)	0/99	NS	NA	NS	NA
	Acenaphthylene	180	ND (12)	0/99	NS	NA	NS	NA
	Anthracene	3,000	ND (12)	0/99	NS	NA	NS	NA
	Benzo(a)Anthracene	3.6	ND (12)	0/99	NS	NA	NS	NA
	Benzo(a)pyrene	0.49	ND (12)	0/99	NS	NA	NS	NA
	Benzo(b)Fluoranthene	4.9	ND (12)	0/99	NS	NA	NS	NA
	Benzo(g,h,i)perylene	1,400	ND (12)	0/99	NS	NA	NS	NA
	Benzo(k)fluoranthene	49	ND (12)	0/99	NS	NA	NS	NA
	bis(2-ethylhexyl)phthlate	13	6.72 J	15/99	1.4	1/3	NS	NA
	Chrysene	360	ND (12)	0/99	NS	NA	NS	NA
	Dibenzo(a,h)anthracene	0.49	ND (12)	0/99	NS	NA	NS	NA
	Di-n-octyl phthalate	3,100	NS	NA	0.35	1/3	NS	NA
	Fluoranthene	1,400	ND (12)	0/99	NS	NA	NS	NA
	Fluorene	220	1.32 J	5/99	NS	NA	NS	NA
	Indeno(1,2,3)pyrene	4.9	ND (12)	0/99	NS	NA	NS	NA
	Naphthalene	20	**41.4 J**	9/99	NS	NA	NS	NA
	Phenanthrene	3,000	0.4	3/99	NS	NA	NS	NA
	Phenol	68	NS	NA	0.35	1/3	NS	NA
	Pyrene	1,000	ND (12)	0/99	NS	NA	NS	NA
	Metals							
	Antimony	3.6	**10.6**	6/69	0.41	1/3	NS	NA
	Arsenic	3.9	**15.0**	66/69	**9.74**	3/3	NS	NA
	Beryllium	42	1.2	64/69	0.56	3/3	NS	NA
	Cadmium	5.0	0.616	69/69	0.61	3/3	NS	NA
	Chromium	25	**168**	69/69	**79.9**	3/3	NS	NA
	Copper	460	74.6	69/69	95.5	3/3	NS	NA
	Lead	400	76.6	69/69	17.9	3/3	NS	NA
	Mercury	1.4	0.216	29/69	1.21	1/3	NS	NA
	Nickel	86	82	69/69	NS	NA	NS	NA
	Selenium	3.4	0.366	1/69	NS	NA	NS	NA
	Silver	11.2	0.511	68/69	3.5	1/3	NS	NA
	Thallium	1.9	ND (0.679)	0/69	0.83	2/3	NS	NA

	Zinc	4,100	196	69/69	137	3/3	NS	NA
	PCBs and Pesticides							
	Aroclor-1016[6]	1	NS	NA	NS	NA	2.4 J	1/24
	Aroclor-1254[6]	1	0.167	2/143	NS	NA	**57.5**	21/24
	Aroclor-1260[6]	1	**7.04**	52/143	NS	NA	NS	NA
	4,4'DDD	7.2	**7.41 J**	60/143	0.0361 J,T	3/3	NS	NA
	4,4'DDE	5.1	0.35	45/143	0.027 J	1/3	NS	NA
	4,4'DDT	7.3	5.11 J	75/143	0.054 J	2/3	NS	NA
	Aldrin	0.070	0.0181 J	1/143	NS	NA	NS	NA
	alpha-BHC	0.0064	ND (0.982)	0/143	NS	NA	NS	NA
	beta-BHC	0.022	0.000474 J	1/143	NS	NA	NS	NA
	Endosulfan sulfate	64	0.00075 J	2/143	NS	NA	NS	NA

Notes

1 - Only methods and compounds with detections are shown.
2 - Lowest value of Direct Contact, Inhalation, or Migration to Groundwater shown from 18 AAC 75, Tables B1 and B2, referred to as "Method Two Cleanup Levels" for the Under 40-Inch Zone (ADEC October 9, 2008).
3 - Highest detected values shown. Maximum concentration is the maximum detection or highest PQL if all samples were nondetect.
4 - 1996, 1997 and 1998 data were taken from *Sparrevohn LRRS, Alaska Final Remedial Investigation Report*, September 1999 (Shannon and Wilson 1999).
5 - The frequency of detections is the number of times the analyte was detected in the samples collected at the site. Frequencies do not include duplicate samples collected.
6 - Screening level is for Total Polychlorinated Biphenyls.

Abbreviations

"--"	Screening criteria does not exist for this compound	NS	Not Sampled
F	Estimated quantity below the PQL	NA	Not Applicable
T	Due to laboratory problems in 1997 the sample was recollected for this analysis in 1998, and thus may show temporal or spatial variation from other parameters for this sample.	ND	The analyte was analyzed for, but not detected. The PQL is in adjacent parentheses.
		NR	Not reported
		J	Estimated value
		*	Indicates concentration by 8270B SIM

Acronyms

AAC	Alaska Administrative Code	GRO	Gasoline Range Organics
NOAA	National Oceanic and Atmospheric Administration	DRO	Diesel Range Organics
SQuiRT	Screening Quick Reference Table	RRO	Residual Range Organics
mg/Kg	milligrams per kilogram	PCB	Polychlorinated Biphenyl
USAF	United States Air Force	RCRA	Resource Conservation and Recovery Act
LRRS	Long Range Radar Station	VOC	Volatile Organic Compound
RI/FS	Remedial Investigation/Feasibility Study	SVOC	Semivolatile Organic Compound
PQL	Practical Quantitation Limit		

Bold and shaded result indicates an exceedance of the screening criteria for soil.
Shaded result indicates an exceedance of one-tenth the most stringent of inhalation or direct contact 18 AAC 75 Method Two Cleanup Levels for soils. Per 18 AAC 75.340(k), a chemical ≥ this value must be included in cumulative risk calculations. This requirement is not applicable to GRO, DRO, RRO, or lead.

Table 2-5 Groundwater Sample Results

Media	Analyte[1]	Screening Criteria: 18 AAC 75 Table C for Groundwater[2]	1996 RI/FS Maximum Concentration[3,4]	1996 RI/FS Frequency of Detections[4,5]	1997 RI/FS Maximum Concentration[3,4]	1997 RI/FS Frequency of Detections[4,5]	1998 RI/FS Maximum Concentration[3,4]	1998 RI/FS Frequency of Detections[4,5]
Groundwater (µg/L)	**Fuels**							
	GRO	2,200	1,020	11/25	326	6/9	280	3/5
	DRO	1,500	**604,000**	16/25	**2,700**	8/12	**1,600**	4/5
	RRO	1,100	**1,690**	1/25	ND (1,550)	0/11	NS	NA
	VOCs							
	1,1,2,2-Tetrachloroethane	4.3	ND (2)	0/22	1.2	1/11	ND (1)	0/5
	1,2,4-Trimethylbenzene	1,800	37	5/25	57.3	2/11	28	1/5
	1,3,5-Trimethylbenzene	1,800	24	3/25	19.2	2/11	7	1/5
	4-Isopropyltoluene	--	9	3/4	2.8	1/3	3	1/5
	Benzene	5	NR	NA	NR	NA	NR	NA
	Acetone	33,000	39.3	3/23	ND (10)	0/11	NR	NA
	Carbon Tetrachloride	5	NR	NA	NR	NA	NR	NA
	Chloromethane	66	NR	NA	NR	NA	NR	NA
	Chloroform	140	ND (2)	0/21	ND (5)	0/10	2	1/5
	cis-1,2-Dichloroethene	70	9.5	1/24	5.8	1/11	8	1/5
	Ethylbenzene	700	6	5/25	6	2/11	3	1/5
	Methylene Chloride	5	NR	NA	NR	NA	NR	NA
	Isopropylbenzene	3,700	6	1/3	ND (2)	0/1	5	1/5
	m,p-Xylene	--	4.1	1/2	ND (5)	0/2	NR	NA
	n-Butylbenzene	370	5	1/4	ND (5)	0/3	NR	NA
	n-Propylbenzene	370	9	3/4	ND (5)	0/3	9	2/5
	sec-Butylbenzene	370	6.5	3/4	2.7	2/3	3	3/5
	Toluene	1,000	2	6/25	ND (5)	0/11	ND (1)	0/5
	Trichloroethene	5	2.9	2/25	2.1	1/11	**5**	1/5
	Trichlorofluoromethane	11,000	ND (2)	0/2	ND (0.5)	0/1	2	1/5
	Xylenes	10,000	9.7	4/25	7.5	2/11	2	1/5
	SVOCs							
	2-Methylnaphthalene	150	**445**	3/22	17.8	1/9	NS	NA
	Acenaphthene	2,200	0.168	1/22	ND (5.2)	0/8	NS	NA
	Napthalene	730	34	5/23	15.4	2/7	24	2/5
	bis-(2-ethylhexyl) phthalate	6	**25.6**	2/22	ND (5.2)	0/9	NS	NA
	Di-n-octyl phthalate	1,500	68.6	1/18	ND (21)	0/9	NS	NA
	Fluorene	1,500	0.202	1/25	ND (5.2)	0/7	NS	NA
	PCBs and Pesticides							
	PCBs	0.5	**0.86**	2/24	ND (1.1) J	0/11	NS	NA
	4,4'DDD	3.5	0.0306	1/22	ND (0.11) J	0/11	NS	NA
	4,4'DDT	2.5	0.164	2/22	ND (0.11) J	0/11	NS	NA
	alpha-BHC	0.14	**0.8**	1/22	ND (0.102)	0/11	NS	NA
	RCRA Metals							
	Antimony	6	ND (110)	0/24	1.2	1/11	NS	NA
	Arsenic	10	**17**	2/24	7.1	2/11	NS	NA
	Barium	2,000	NR	NA	329	2/2	NS	NA
	Beryllium	4	0.9	1/24	ND (5)	0/11	NS	NA
	Cadmium	5	1.5	2/24	**26.7**	1/11	NS	NA
	Chromium	100	20	3/24	48.7	2/11	NS	NA
	Copper	1,000	46	1/24	87.3	2/11	NS	NA
	Lead	15	**29**	5/24	14.3	2/11	NS	NA
	Nickel	100	ND (110)	0/24	45.8	2/11	NS	NA
	Zinc	5,000	76.3	3/24	33.5	1/11	NS	NA
	Other							
	Methane/Ethane/Ethene	--	695	1/22	ND	0/9	ND	0/2
	Nitrogen, Nitrate	10,000[6]	960	16/22	480	6/9	99	3/5

Notes

1 - Only methods and compounds with detections are shown.

2 - 18 AAC 75 Table C Groundwater Cleanup Levels (ADEC October 9, 2008).

3 - Highest detected values shown. Maximum concentration is the maximum detection or highest PQL if all samples were nondetect.

4 - 1996, 1997, and 1998 data taken from the *Sparrevohn LRRS, Alaska, Final Remedial Investigation Report*, September 1999 (Shannon and Wilson 1999).

5 - The frequency of detections is the number of times the analyte was detected in the samples collected at the site. Frequencies do not include duplicate samples collected.

6 – This value equals the MCL for nitrate listed in 40 CFR 141.62(b), adopted by reference in 18 AAC 80.010(a).

Abbreviations

"--"	Screening criteria does not exist for this compound	NS	Not Sampled
F	Estimated quantity below the PQL	NA	Not Applicable
J	Estimated value	NR	Not Reported
B	The compound was detected in a blank associated with the sample.	ND	The analyte was analyzed for, but not detected. The PQL is in adjacent parentheses.

Acronyms

AAC	Alaska Administrative Code	GRO	Gasoline Range Organics
µg/L	Micrograms per Liter	DRO	Diesel Range Organics
LRRS	Long Range Radar Station	VOC	Volatile Organic Compound
RI/FS	Remedial Investigation/Feasibility Study	SVOC	Semivolatile Organic Compound
PQL	Practical Quantitation Limit	PCB	Polychlorinated Biphenyl
		RCRA	Resource Conservation and Recovery Act

Bold and shaded result indicates an exceedance of the 18 AAC 75 Table C Groundwater Cleanup Level.
Shaded result indicates an exceedance of 1/10th the 18 AAC 75 criteria.

Table 2-6 Surface Water (Water Gallery) Sample Results

Media	Analyte	Screening Criteria: 18 AAC 80 MCL for Drinking Water[1]	Screening Criteria: NOAA SQuiRT for Fresh Surface Water[2]	1996 RI/FS Maximum Concentration[3,4]	1996 RI/FS Frequency of Detections[4,5]	1997 RI/FS Maximum Concentration[3,4]	1997 RI/FS Frequency of Detections[4,5]	1998 RI/FS Maximum Concentration[3,4]	1998 RI/FS Frequency of Detections[4,5]
Surface Water (µg/L)	**Fuels**								
	GRO	2,200	--	ND (20)	0/4	ND (20)	0/2	ND(100)	0/2
	DRO	1,500	--	ND (110)	0/4	120	1/7	ND(260)	0/2
	VOCs								
	Chloroform	140	1.8	7	2/4	5.2	2/7	ND(1)	0/2
	SVOCs								
	Anthracene	11,000	0.73	ND (5.5)	0/4	0.0993	1/5	NS	NA
	Benzo(a)anthracene	1.2	0.027	ND (5.5)	0/4	0.056	1/5	NS	NA
	Chrysene	120	--	ND (5.5)	0/4	0.053	1/5	NS	NA
	PCBs and Pesticides								
	PCBs	0.5	0.014	NS	NA	NS	NA	NS	NA
	4,4'DDT	2.5	0.0005	ND (0.0112)	0/4	0.16 J	2/7	NS	NA
	beta-BHC	0.47	--	ND (0.0112)	0/4	0.44 J	2/7	NS	NA
	Heptachlor	0.4	0.0019	ND (0.0112)	0/4	0.031 J	1/7	NS	NA
	RCRA Metals								
	Barium	2,000	3.9	NS	NA	32.5	3/3	NS	NA
	Beryllium	4	0.66	ND (2)	0/4	1.1	1/7	NS	NA
	Copper	1,000	9.0	140	2/4	143	4/7	NS	NA
	Lead	15	2.5	ND (10)	0/4	6.9	2/7	NS	NA
	Nickel	100	52	ND (100)	0/4	3.2	2/5	NS	NA
	Selenium	50	5	NR	NA	NR	NA	NR	NA
	Zinc	5,000	120	103	2/4	116	5/7	NS	NA
	Other								
	Methane/Ethane/Ethene[6]		--	ND	0/4	ND	0/5	NS	NA
	Nitrogen, Nitrate	10,000	--	280	4/4	350	4/4	NS	NA

Notes

1 - 18 AAC 70 Maximum Contaminant Level (ADEC 2009b) as referenced in 18 AAC 80 (ADEC 2009c).

2 - NOAA SQuiRT values shown for fresh water criteria continuous concentration (CCC) unless otherwise indicated (Buchman 2008).

Criteria maximum concentration (CMC) shown if no CCC available. These criteria are not directly applicable.

3 - Highest detected values shown. Maximum concentration is the maximum detection or highest PQL if all samples were nondetect.

4 - 1996, 1997, and 1998 data were taken from *Sparrevohn LRRS, Alaska Final Remedial Investigation Report, September 1999* (Shannon and Wilson 1999).

5 - The frequency of detections is the number of times the analyte was detected in the samples collected at the site. Frequencies do not include duplicate samples collected.

6 - If ND is noted, the compound was known to be nondetect, but the PQL is not provided.

Abbreviations

"--"	Screening criteria does not exist for this compound	NS	Not Sampled
ND	The analyte was analyzed for, but not detected. The PQL is in adjacent parentheses.	NA	Not Applicable
NR	Not Reported	J	Estimated value

Acronyms

AAC	Alaska Administrative Code	GRO	Gasoline Range Organics
NOAA	National Oceanic and Atmospheric Administration	DRO	Diesel Range Organics
SQuiRT	Screening Quick Reference Table	PAH	Polynuclear aromatic hydrocarbons
µg/L	Micrograms per Liter	PCB	Polychlorinated Biphenyl
RI/FS	Remedial Investigation/Feasibility Study	VOC	Volatile Organic Compound
USAF	United States Air Force	SVOC	Semivolatile Organic Compound
LRRS	Long Range Radar Station	PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act	MCL	Maximum Contaminant Level

Bold and Shaded result indicates an exceedance of 18 AAC 70 criteria.
Shaded result indicates an exceedance of NOAA SQuiRT criteria.

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Table 2-7 Surface Water Sample Results

Media	Analyte[1]	Screening Criteria: 18 AAC 70 Alaska Water Quality Standards[2]	Screening Criteria: NOAA SQuiRT for Fresh Surface Water[3]	1996 RI/FS Maximum Concentration[4,5]	1996 RI/FS Frequency of Detections[5,6]	1997 RI/FS Maximum Concentration[4,5]	1997 RI/FS Frequency of Detections[5,6]	1998 RI/FS Maximum Concentration[4,5]	1998 RI/FS Frequency of Detections[5,6]
	Fuels								
	GRO	--	--	318	6/26	238	4/11	160	2/7
	DRO	--	--	7,700	18/26	3,020	8/9	1,000	3/9
	VOCs								
	1,2,4 Trimethylbenzene	--	2,400	29.8	3/26	30.4	2/15	5	1/7
	1,3,5-Trimethylbenzene	--	--	18.3	3/26	15.2	3/15	2	1/7
	4-Isopropyltoluene	--	--	8.7	3/5	0.5 J	1/8	NR	NA
	Acetone	--	1,500	11,600	5/22	137	2/15	ND (10)	0/1
	Benzene	5	46	2.3	3/26	2.2	1/15	ND (1)	0/7
	Carbon disulfide	--	--	ND (200)	0/18	2.8 R	3/14	ND (1)	0/1
	Ethylbenzene	700	7.3	6.6	3/26	6.9	1/15	2	1/7
	Isopropylbenzene	--	--	NR	NA	NR	NA	3	1/6
	m,p-Xylene	--	--	5.4	1/4	ND (5)	0/7	ND (1)	0/1
	n-Propylbenzene	--	--	11	1/6	ND (5)	0/8	4	1/6
	Napthalene	--	620	NR	NA	3	1/8	12 B	1/6
	p-Isopropyltoluene	--	--	NR	NA	NR	NA	3	2/6
	sec-Butylbenzene	--	--	11	3/6	0.5 J	1/8	7	2/6
	Toluene	1,000	10	0.9 J	2/26	ND (5)	0/15	ND (1)	0/7
	Trichloroethene	--	21	9	2/26	ND (5)	0/15	ND (1)	0/7
	tert-Butylbenzene	--	--	1	1/6	ND (5)	0/7	NR	NA
Surface Water (µg/L)	Xylenes	10,000	13	7.8	3/26	7.6	1/15	2	1/7
	TAH	10	--	17.6 J	NA	16.7	NA	4	NA
	SVOCs								
	1-Methylnaphthalene	--	--	NR	NA	NR	NA	NR	NA
	2-Methylnaphthalene	--	--	31.8	2/22	36.1	2/9	ND (11) T	0/2
	Acenaphthene	1,200	520	0.863	5/22	0.637	3/10	ND (11) T	0/2
	Acenaphthylene	--	4,840	0.0588 J	1/22	0.309	2/10	ND (11) T	0/2
	Benzo(a)anthracene	--	0.027	ND (0.057)	0/22	0.0701	2/10	ND (11) T	0/2
	Chrysene	--	--	0.01 J	1/21	ND (10)	0/10	ND (11) T	0/2
	Dibenzofuran	--	3.7	ND (11)	0/18	0.106	1/9	ND (11) T	0/2
	Fluorene	1,300	3.9	1.65	5/21	1.23	3/10	ND (11) T	0/2
	Napthalene	--	620	12.3 B	0	23	0	ND (11) T	0/2
	Phenanthrene	--	6.3	0.178	3/21	0.196	2/10	ND (11) T	0/2
	Total PAH	--	--	34.6	NA	38.6	NA	ND (11) T	NA
	TAqH = PAH + TAH	15	--	52.2 J	NA	55.3	NA	4	NA
	PCBs and Pesticides								
	PCBs[7]	0.5	0.014	ND	ND	ND	ND	ND	ND
	4,4'DDD	--	0.011	0.0423	1/22	ND (0.11) J	0/11	ND (0.01)	0/1
	4,4'DDT	--	0.0005	0.0354	1/22	ND (0.11) J	0/11	ND (0.01)	0/1
	RCRA Metals								
	Copper	--	9.0	4 J	1/26	2.5	2/11	ND (11.4)	0/1
	Lead	--	2.5	ND (10)	0/26	7.2	3/11	ND (5.7)	0/1
	Zinc	--	120	18	3/26	12.6	1/11	ND (22.7)	0/1

Notes

1 - Only methods and compounds with detections are shown.

2 - 18 AAC 70 Maximum Contaminant Level (ADEC 2009b).

3 - NOAA SQuiRT values shown for fresh water criteria continuous concentration (CCC) unless otherwise indicated (Buchman 2008). Criteria maximum concentration (CMC) shown if no CCC available.

4 - Highest detected values shown. Maximum concentration is the maximum detection or highest PQL if all samples were nondetect.

5 - 1996, 1997, and 1998 data taken from *Sparrevohn LRRS, Alaska Final Remedial Investigation Report, September 1999* (Shannon and Wilson 1999).

6 - The frequency of detections is the number of times the analyte was detected in the samples collected at the site. Frequencies do not include duplicate samples collected.

7 – The RI indicates that PCBs in surface water were nondetect; however, surface water PCB results and detection limits could not be located.

Abbreviations

"--"	Screening criteria does not exist for this compound	J	Estimated value
F	Estimated quantity below the PQL	NS	Not Sampled
B	Compound detected in a blank associated with the sample.	NA	Not Analyzed
R	The data was rejected.	NR	Not Reported
T	Due to laboratory problems in 1997 the sample was recollected for this analysis in 1998, and thus may show temporal or spatial variation from other parameters for this sample.	ND	The analyte was analyzed for, but not detected. The PQL is in adjacent parentheses.

Acronyms

AAC	Alaska Administrative Code	GRO	Gasoline Range Organics
NOAA	National Oceanic and Atmospheric Administration	DRO	Diesel Range Organics
SQuiRT	Screening Quick Reference Table	PAH	Polynuclear aromatic hydrocarbons
µg/L	micrograms per liter	PCB	Polychlorinated Biphenyl
USAF	United States Air Force	VOC	Volatile Organic Compound
LRRS	Long Range Radar Station	SVOC	Semi-Volatile Organic Compound
RI/FS	Remedial Investigation/Feasibility Study	RCRA	Resource Conservation and Recovery Act
PQL	Practical Quantitation Limit	TAH	Total Aromatic Hydrocarbons
MCL	Maximum Contaminant Level	TAqH	Total Aqueous Hydrocarbons, TAH + PAH

Bold and shaded result indicates an exceedance of 18 AAC 70 criteria.
Shaded result indicates an exceedance of NOAA SQuiRT criteria.

Table 2-8 Sediment Sampling Results

Media	Analyte[1]	Screening Criteria: NOAA SQuiRT for Freshwater Sediment[2]	1996 RI/FS Maximum Concentration[3,4]	1996 RI/FS Frequency of Detections[4,5]	1997 RI/FS Maximum Concentration[3,4]	1997 RI/FS Frequency of Detections[4,5]	1998 RI/FS Maximum Concentration[3,4]	1998 RI/FS Frequency of Detections[4,5]
	Fuels							
	GRO	–	178 J	3/17	4.3	1/4	ND (2.91)	0/4
	DRO	–	4,070 J	17/17	25,000 J	4/4	138 J	4/4
	RRO	–	412	9/17	3,900 J	3/4	626 J	4/4
	VOCs							
	1,2,4-Trimethylbenzene	–	0.481	1/17	ND (0.028)	0/3	ND (0.027)	0/4
	1,3,5-Trimethylbenzene	–	0.45	1/17	ND (0.028)	0/3	ND (0.027)	0/4
	Acetone	–	ND (1.26)	0/17	ND (0.055)	0/3	ND (0.52)	0/4
	Benzene	0.005	ND (0.126)	0/17	ND (0.028)	0/3	ND (0.027)	0/4
	Chloroform	0.020	ND (0.126)	0/17	0.0057	1/3	ND (0.027)	0/4
	cis-1,2-Dichloroethene	0.200	ND (0.126)	0/17	ND (0.028)	0/3	ND (0.027)	0/4
	Ethylbenzene	0.030	ND (0.126)	0/17	ND (0.028)	0/3	ND (0.027)	0/4
	Tetrachloroethene	0.002	ND (0.126)	0/17	0.0044	1/3	ND (0.027)	0/4
	Toluene	0.010	ND (0.126)	0/17	ND (0.028)	0/3	ND (0.027)	0/4
	Total Xylenes	0.130	ND (0.126)	0/17	ND (0.028)	0/3	ND (0.027)	0/4
	Trichloroethene	0.0078	ND (0.126)	0/17	0.008	1/3	ND (0.027)	0/4
	SVOCs							
	2-Methylnapthalene	–	3.44	3/17	ND (3.1) J	0/4	ND (1.3)	0/4
	Acenaphthene	0.0889	0.00275*	2/17	ND (0.77)	0/8	ND (0.0066)*	0/4
	Acenaphthylene	0.128	ND (0.42)	0/17	ND (0.77)	0/8	ND (0.0066)*	0/4
	Anthracene	0.245	0.00221*	1/17	ND (0.77)	0/8	ND (0.0066)*	0/4
	Benzo(a)Anthracene	0.385	0.0081*	2/17	0.0049*	1/8	ND (0.0066)*	0/4
	Benzo(a)pyrene	0.782	0.0084*	2/17	0.00159*	1/8	0.0613*	1/4
	Benzo(b)Fluoranthene	–	0.0139*	1/17	0.0085*	2/8	0.00818*	1/4
	Benzo(g,h,i)perylene	0.025	0.00964*	3/17	0.0074*	3/8	0.0047*	1/4
	Benzo(k)fluoranthene	0.380	0.00398*	1/17	0.0056*	1/8	ND (0.0066)*	0/4
	bis(2-ethylhexyl)phthalate	<.1	ND (0.42)	0/17	0.88 J	1/4	ND (1.3)	0/4
	Chrysene	0.862	0.00846*	2/17	ND (0.028)	0/8	ND (0.0066)*	0/4
	Dibenzo(a,h)anthracene	0.135	NR	NA	0.006*	1/8	ND (0.0066)*	0/4
Sediment (mg/Kg)	Fluoranthene	2.355	0.00406*	2/17	0.0038* J	2/8	ND (0.0066)*	0/4
	Fluorene	0.144	**0.286**	4/17	ND (0.77)	0/8	ND (0.0066)*	0/4
	Indeno(1,2,3)pyrene	0.031	0.0089	2/17	0.0059*	2/8	ND (0.0066)*	0/4
	Naphthalene	0.391	0.0829*	6/17	0.015 J*	2/8	ND (0.0066)*	0/4
	Phenanthrene	0.515	0.0118*	2/17	0.026 J*	4/8	ND (0.0066)*	0/4
	Pyrene	0.875	0.00883*	2/17	0.014 J*	3/8	ND (0.0066)*	0/4
	RCRA Metals							
	Antimony	–	10	3/17	0.26	1/4	0.379	3/4
	Arsenic	17	15	17/17	**31.5**	4/4	11.4	4/4
	Beryllium	–	0.873	16/17	0.835	4/4	1	3/4
	Cadmium	3.53	0.524	17/17	0.44	3/4	0.9	5/8
	Chromium	90.0	**96.4**	17/17	83.7	4/4	74.7	4/4
	Copper	197	71.6	16/17	71.3	4/4	46.8	8/8
	Lead	91.3	69.8	17/17	19.6	4/4	11.4	8/8
	Mercury	0.486	0.132 J	4/17	ND (0.43)	0/4	0.123	5/8
	Nickel	36.0	**73.3**	17/17	**56.1**	1/1	**61.3**	8/8
	Selenium	–	ND (6.13)	0/17	2.2	1/4	ND (0.379)	0/4
	Silver	–	1	11/17	1.8	1/4	0.149	4/4
	Thallium	–	ND (0.613)	0/17	12.4	3/4	ND (2.27)	0/4
	Zinc	315	188	17/17	229	4/4	134	6/6
	TOC							
	TOC	–	51,500	17/17	NS	NA	NS	NA
	PCBs and Pesticides							
	Aroclor-1254	0.340	ND (2.32)	0/17	ND (0.0615) T**	0/1	ND (0.0958)	0/7
	Aroclor-1260[7]	0.277	**2.34 J**	5/17	**0.341 T****	1/1	**0.831**	3/7
	4,4'DDD	0.00851	**1.51 J**	6/17	ND (0.0123) T**	0/1	**0.069 J**	5/7
	4,4'DDE	0.00675	**0.007**	2/17	ND (0.0123) T**	0/1	**0.0441 J**	4/7
	4,4'DDT	0.00477	**1.53 J**	8/17	ND (0.0123) T**	0/1	**0.186 J**	7/7
	Aldrin	0.00006	ND (0.232)	0/17	ND (0.0123) T**	0/1	ND (0.0096)	0/7
	alpha-BHC	-0.003	ND (0.232)	0/17	ND (0.0123) T**	0/1	ND (0.0096)	0/7
	delta-BHC	<0.010	ND (0.232)	0/17	ND (0.0123) T**	0/1	ND (0.0096)	0/7
	Endosulfan sulfate	–	ND (0.232)	0/17	ND (0.0123) T**	0/1	0.0008T	1/7

Notes

1 - Only methods and compounds with detections are shown.

2 - Lowest value of Direct Contact, Inhalation, or Migration to Groundwater shown from 18 AAC 75, Tables B1 and B2,
referred to as "Method Two Cleanup Levels" for the Under 40-Inch Zone (ADEC October 9, 2008).

3 - NOAA SQuiRT DUTCH Target level unless otherwise noted or probable effects level (PEL) for freshwater sediment(Buchman 2008).

4 - Highest detected values shown. Maximum concentration is the maximum detection or highest PQL if all samples were nondetect.

5 - 1996, 1997 and 1998 data were taken from *Sparrevohn LRRS, Alaska Final Remedial Investigation Report, September 1999* (Shannon and Wilson 1999).

6 - The frequency of detections is the number of times the analyte was detected in the samples collected at the site.
Frequencies do not include duplicate samples collected.

7 - Screening level is for Total Polychlorinated Biphenyls.

8 - If ND is noted, the compound was known to be nondetect, but the PQL is not provided.

Abbreviations

"–"	Screening criteria does not exist for this compound	NS	Not Sampled
F	Estimated quantity below the PQL	NA	Not Analyzed
T	Due to laboratory problems in 1997 the sample was recollected for this analysis in 1998, and thus may show temporal or spatial variation from other parameters for this sample.	ND	The analyte was analyzed for, but not detected. The PQL is in adjacent parentheses.
		NR	Not Reported
		J	Estimated value
		*	Indicates concentration by 8270B SIM

Acronyms

AAC	Alaska Administrative Code	GRO	Gasoline Range Organics
NOAA	National Oceanic and Atmospheric Administration	DRO	Diesel Range Organics
SQuiRT	Screening Quick Reference Tables	RRO	Residual Range Organics
mg/Kg	milligrams per kilogram	PCB	Polychlorinated Biphenyl
USAF	United States Air Force	RCRA	Resource Conservation Recovery Act
LRRS	Long Range Radar Station	VOC	Volatile Organic Compound
RI/FS	Remedial Investigation/Feasibility Study	SVOC	Semi-Volatile Organic Compound
PQL	Practical Quantitation Limit		

Shaded result indicates an exceedance of NOAA SQuiRT criteria for sediments.
Per 18 AAC 75.340(k), a chemical ≥ this value must be included in cumulative risk calculations (ADEC 2008c). This requirement is not applicable to GRO, DRO, RRO, or lead.

the estimated doses to which a human could be exposed to evaluate the potential human health risks associated with each chemical.

For each COPC, carcinogenic and noncarcinogenic effects (where applicable) were considered for the inhalation, dermal contact and ingestion exposure routes. Risk characterization methodology and results are discussed below.

For the risk assessment, only chronic exposure to the COPCs was evaluated. This exposure scenario would simulate multiple exposures occurring over an extended period of time for carcinogenic COPCs, or exposure duration of seven years or longer for noncarcinogens.

2.7.1.1 Risk Characterization

The site specific human health risk assessment was conducted in 2000. Cumulative risk calculations were performed using RI soil data following the ADEC *Risk Assessment Procedure Manual* (ADEC 1998) and ADEC Cumulative Risk Guidance (ADEC 2008c). Cumulative risks for all relevant pathways and populations are also described. These risk estimates are summarized in Tables 2-9 through 2-16. The results of the human health risk assessment are interpreted within the context of the CERCLA acceptable risk range and ADEC risk management standards, in accordance with 18 AAC 75.325(g).

When applying ADEC Method Two cleanup levels to a site, 18 AAC 75.325(g) states that the risks from hazardous substances cannot exceed a cumulative carcinogenic risk of 1 in 100,000 (or $1x10^{-5}$) and a cumulative noncarcinogenic hazard index (HI) of 1.0. As specified in 18 AAC 75.340(k), chemicals that are detected at greater than or equal to one-tenth of the ADEC Method Two direct contact or inhalation cleanup levels must be included when calculating cumulative risk. Therefore, as part of the screening process, contaminants exceeding one-tenth the ADEC Method Two cleanup levels were identified, and their maximum concentrations were used to calculate the cumulative human health risk in accordance with ADEC guidelines (ADEC 2002).

The major uncertainties affecting the risk assessment are also presented in this section, including uncertainties related to sampling and analysis, environmental fate and transport modeling, the use of default exposure assumptions, and those associated with the toxicity criteria.

<u>Carcinogenic Risk Approach</u>

For carcinogens, risks are generally expressed as the incremental probability of an individual's likelihood of developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

Risk = CDI x SF

Where:

> Risk = a unitless probability (e.g., 2×10^{-5}) of an individual's likelihood of developing cancer
>
> CDI = chronic daily intake averaged over 70 years (mg/kg-day)
>
> SF = slope factor, expressed as $(mg/kg\text{-}day)^{-1}$.

These risks are probabilities that usually are expressed in scientific notation (e.g., $1x10^{-6}$). An excess lifetime cancer risk of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all other causes has been estimated to be as high as one in three. The EPA's generally acceptable risk range for site-related exposure is 10^{-4} to 10^{-6}.

Carcinogenic Risk Results

The BLRA calculated the carcinogenic risk for a subsistence hunter as 7.07×10^{-7} (Table 2-9) (Shannon and Wilson 2000a). This risk calculation used area-specific home range exposure factors for wild game. The risk calculated for a recreational receptor was 1.65×10^{-7} for carcinogenic compounds (Table 2-10), based on exposure to onsite game meat. The baseline risk assessment concluded that the overall excess carcinogenic risk (i.e., increased risk of cancer due to exposure to contamination) to a resident at Lower Camp was 4.78×10^{-6} (Table 2-9), which is below the 18 AAC 75.325(g) ADEC risk management standard of 1×10^{-5}. This scenario was evaluated with the assumption that the resident could be exposed to contaminants in the drinking water gallery as well as to contaminated soil and sediment by direct contact.

These risk values are all considered overestimates because they include more compounds and a larger exposure area than is associated with ST005. The baseline risk assessment also provided risk estimates on a well-by-well basis for future Lower Camp residents that use groundwater from the onsite monitoring wells for drinking water. Based on the chemical concentrations in each well, future cumulative carcinogenic risk values were calculated. Risk values exceeded the ADEC risk management standards in the vicinity of monitoring wells MW5, MW9, MW11, MW22, MW33, MW34, MW35, and MW36, with the highest cumulative cancer risk of 1.6×10^{-3} occurring in the vicinity of MW36 (Shannon and Wilson 2000a). Only the residential risk calculated under these scenarios exceeds the ADEC risk management standard of 1×10^{-5}.

Each of the risk scenarios were modified and reevaluated in the risk assessment addendum to include the sediment-to-fish contaminant pathway for bio-accumulative chemicals, and six additional residential exposure scenarios were included for the Lower Camp. Soil exposure was limited to surface soil (less than 15 feet deep), but included inhalation of indoor air transported from surface and subsurface soil via vapor intrusion. Groundwater exposure was modified to include ingestion and inhalation of volatiles released during household use of groundwater, and inhalation of air impacted by contaminants in groundwater via vapor intrusion. Based on these modified scenarios, the residential risk was calculated to be 6×10^{-3}. For a recreational user, the risk was calculated to be 2×10^{-6}, and for a subsistence hunter, the risk was calculated to be 2.7×10^{-7}. Only the residential risk calculated under these scenarios exceeds the ADEC risk management standard of 1×10^{-5}.

The only cumulative risk calculation that exceeded ADEC risk management standards in the baseline risk assessment was for a future resident scenario in which the resident was exposed to contaminated groundwater (Table 2-12). Without exposure to groundwater, which is unlikely due to groundwater restrictions that will be in place as part of the remedy, all human health risk scenarios result in cumulative risk values below ADEC risk management standards.

Based on the baseline risk assessment and risk assessment addendum, the COPCs which contribute most to the carcinogenic risk, in order of contribution, are PCBs (Aroclor 1260), arsenic, GRO, DRO, chloroform, cis-1,2 dichloroethene, and tetrachloroethene in soil, and arsenic, acetone, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, 2-methylnapthalene, cadmium, chloroform, methylene chloride, and DRO in groundwater.

Table 2-9 Current Risk Characterization Summary – Carcinogens (Subsistence Hunter)

Scenario Timeframe: Lifetime
Receptor Population: Subsistence Hunter
Receptor Age: Adult

Media	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk			
			Ingestion	Inhalation	Dermal	Cumulative Carcinogenic Risk
Moose	Meat On Site – Direct Contact	PCBs	7.07×10^{-7}	NA	NA	7.07×10^{-7}
					Total Risk =	7.07×10^{-7}

Key:
PCBs – Polychlorinated Biphenyls
NA – Not Applicable
Source: Shannon and Wilson (2000a) Table 7-7

Table 2-10 Current Risk Characterization Summary – Carcinogens (Recreational User)

Scenario Timeframe: Lifetime
Receptor Population: Recreational User
Receptor Age: Adult

Media	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk			
			Ingestion	Inhalation	Dermal	Cumulative Carcinogenic Risk
Moose	Meat On Site – Direct Contact	PCBs	1.65×10^{-7}	NA	NA	1.65×10^{-7}
					Total Risk =	1.65x10-7

Key:
PCBs – Polychlorinated Biphenyls
NA – Not Applicable
Source: Shannon and Wilson (2000a) Table 7-5

Table 2-11 Current Risk Characterization Summary – Carcinogens (Worker Resident)

Scenario Timeframe: Lifetime
Receptor Population: Worker Resident
Receptor Age: Adult

Media	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk			
			Ingestion	Inhalation	Dermal	Cumulative Carcinogenic Risk
Soil	Soil On Site – Direct Contact	PCBs	NA	NA	1.16×10^{-6}	1.16×10^{-6}
Gallery Water	NA	NA	NA	NA	NA	NA
Sediment	Sediment On Site – Direct Contact	PCBs	NA	NA	3.62×10^{-6}	3.62×10^{-6}
					Total Risk =	**4.78×10^{-6}**

Key:
PCBs – Polychlorinated Biphenyls
NA – Not Applicable
Source: Shannon and Wilson (2000a) Table 7-3

Table 2-12 Future Risk Characterization Summary – Carcinogens (Worker Resident)

Scenario Timeframe: Lifetime
Receptor Population: Worker Resident
Receptor Age: Adult

Media	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk			
			Ingestion	Inhalation	Dermal	Cumulative Carcinogenic Risk
Soil	Soil On Site – Direct Contact	PCBs	NA	NA	1.16×10^{-6}	1.16×10^{-6}
Groundwater	Water On Site – Direct Contact	Arsenic	1.61×10^{-3}	NA	NA	1.61×10^{-3}
Gallery Water	NA	NA	NA	NA	NA	NA
Sediment	Sediment On Site – Direct Contact	PCBs	NA	NA	3.62×10^{-6}	3.62×10^{-6}
					Total Risk =	**1.61×10^{-3}**

Key:
PCBs – Polychlorinated Biphenyls
NA – Not Applicable
Source: Shannon and Wilson (2000a) Table 7-9

Noncarcinogenic Risk Approach

Noncarcinogenic health effects can range from rashes, eye irritation, and breathing difficulties to organ damage, birth defects, and death. The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., lifetime) with an RfD derived for a similar exposure period. An RfD represents an intake level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of site-related daily intake to the RfD is called a hazard quotient (HQ).

The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD

Where: CDI = chronic daily intake

RfD = reference dose

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

An HQ < 1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely.

The HI is generated by adding the HQs for all COPCs at a site that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which an individual may reasonably be exposed. An HI less than 1 indicates that adverse effects are unlikely from additive exposure to site chemicals. An HI greater than 1 indicates that site-related exposures may present a risk to human health.

Noncarcinogenic Risk Results

The HI calculated in the BLRA for a subsistence hunter was 0.0016 (Table 2-13) (Shannon and Wilson 2000a). The HI calculated for a recreational receptor was 0.0022 (Table 2-14), based on exposure to onsite game meat. These calculations used area-specific home range exposure factors for wild game. The baseline risk assessment concluded that the noncarcinogenic HI for a resident at Lower Camp was 0.25 (Table 2-15), which is below the 18 AAC 75.325(g) ADEC risk management standard of 1. This HI was calculated with the assumption that the resident would only be exposed to groundwater from the drinking water gallery, and contaminated soil and sediment by direct contact. Future noncarcinogenic risk values for the worker resident for all media are provided in Table 2-16.

These risk values are all considered overestimates because they include more compounds and a larger exposure area than are associated with ST005. The baseline risk assessment also provided risk estimates on a well-by-well basis for future Lower Camp residents that use and drink groundwater with contaminant concentrations equivalent to that of onsite monitoring wells. Based on the chemical concentrations in each well, cumulative noncarcinogenic risk values were calculated. Risk values exceeded the ADEC risk management standard in the vicinity of monitoring wells MW5, MW9, MW11, MW22, MW33, MW34, MW35, and MW36, with the highest non-carcinogenic HI of 23.9 occurring in the vicinity of MW36.

Each of the exposure scenarios were modified and reevaluated in the Addendum to include the sediment-to-fish contaminant pathway for bioaccumulative chemicals, and to include six additional residential exposure scenarios for the Lower Camp. Soil exposure was limited to surface soil, but included inhalation of indoor air transported from surface and subsurface soil via vapor intrusion. Groundwater exposure was modified to include ingestion and inhalation of volatiles released during household use of groundwater, and inhalation of air impacted by contaminants in groundwater via vapor intrusion. Based on this scenario, the noncarcinogenic residential risk increased to 25.4. For a recreational user, the HI was calculated to be 2.2. For a subsistence hunter, the HI was calculated to be 21.2 (USAF 2002a).

Based on the BLRA and Addendum, the COPCs contributing most to the noncarcinogenic HI are GRO and DRO in soil, and 2-methylnapthalene, acetone and DRO in groundwater.

Primary Uncertainties Associated with the Risk Estimates: Assumptions made during the risk assessments bias the outcome and result in risk values that are either overestimated or underestimated. The positive or negative bias and magnitude of the bias were evaluated and discussed in the BLRA and Addendum to determine the level of uncertainty.

Four primary areas of uncertainty were identified in the BLRA. These uncertainties included data and COPC selection, assumptions for the exposure assessment, assumptions for the toxicity assessment, and assumptions for the risk characterization. With regard to laboratory data and COPC selection, laboratory quality control problems and exclusion of compounds that may have been present between the reporting and detection limit may both result in underestimation of risk. For the exposure assessment, toxicity assessment, and risk characterization overestimation of site risk may have resulted from the following:

- The use of non site-specific parameters;
- Assumptions that fish and game consumption are restricted to the site only;
- The use of values that are often based on experimental studies;
- The use uncertainty factors meant to conservatively bias the results of the risk characterization; and
- The general use of overly conservative assumptions.

Table 2-13 Current Risk Characterization Summary – Noncarcinogens (Subsistence Hunter)

Scenario Timeframe: Lifetime
Receptor Population: Worker Resident
Receptor Age: Adult

Media	Exposure Point	Chemical of Potential Concern	Primary Target Organ	Non-carcinogenic Hazard Quotient			
				Ingestion	Inhalation	Dermal	Cumulative Carcinogenic Risk
Moose	Meat On Site – Direct Contact	PCBs	Ocular, Immune	0.0016	NA	NA	0.0016
						Receptor Hazard Index Total =	0.0016

Key:
PCBs – Polychlorinated Biphenyls
NA – Not Applicable
Source: Shannon and Wilson (2000a) Table 7-7

Table 2-14 Current Risk Characterization Summary – Noncarcinogens (Recreational User)

Scenario Timeframe: Lifetime Receptor Population: Worker Resident Receptor Age: Adult							
Media	Exposure Point	Chemical of Potential Concern	Primary Target Organ	Non-carcinogenic Hazard Quotient			
				Ingestion	Inhalation	Dermal	Cumulative Carcinogenic Risk
Moose	Meat On Site – Direct Contact	PCBs	Ocular, Immune	0.0022	NA	NA	0.0022
						Receptor Hazard Index Total =	0.0022

Key:
PCBs – Polychlorinated Biphenyls
NA – Not Applicable
Source: Shannon and Wilson (2000a) Table 7-5

Table 2-15 Current Risk Characterization Summary – Noncarcinogens (Worker Resident)

Scenario Timeframe: Lifetime Receptor Population: Worker Resident Receptor Age: Adult							
Media	Exposure Point	Chemical of Potential Concern	Primary Target Organ	Non-carcinogenic Hazard Quotient			
				Ingestion	Inhalation	Dermal	Cumulative Carcinogenic Risk
Soil	Soil on Site – Direct Contact	PCBs	Ocular, Immune	NA	NA	0.02	0.02
Gallery Water	Water – Direct Contact	Copper	Liver	0.12	NA	NA	0.12
Sediment	Sediment On Site – Direct Contact	PCBs	Ocular, Immune	NA	NA	0.11	0.11
						Receptor Hazard Index Total =	0.25

Key:
PCBs – Polychlorinated Biphenyls
NA – Not Applicable
Source: Shannon and Wilson (2000a) Table 7-3

Table 2-16 Future Risk Characterization Summary – Noncarcinogens (Worker Resident)

Scenario Timeframe: Lifetime
Receptor Population: Worker Resident
Receptor Age: Adult

Media	Exposure Point	Chemical of Potential Concern	Primary Target Organ	Non-carcinogenic Hazard Quotient			
				Ingestion	Inhalation	Dermal	Cumulative Carcinogenic Risk
Soil	Soil on Site – Direct Contact	PCBs	Ocular, Immune	NA	NA	0.14	0.14
Groundwater	Water On Site – Direct Contact	Arsenic	Skin, Vascular	23.7	NA	NA	23.7
Gallery Water	Water – Direct Contact	Copper	Liver	NA	NA	NA	NA
Sediment	Sediment On Site – Direct Contact	PCBs	Ocular, Immune	NA	NA	0.11	0.11
						Receptor Hazard Index Total =	23.95

Key:
PCBs – Polychlorinated Biphenyls
NA – Not Applicable
Source: Shannon and Wilson (2000a) Table 7-9

2.7.2 Summary of Ecological Risk Assessment

This section summarizes the approaches and findings of the ERA that has been performed at the Sparrevohn Lower Camp areas, which contain ERP site ST005. Based on the concentrations of PCBs, pesticides (4,4'-DDD and 4,4'-DDT), fuel components (DRO, RRO, and xylenes) and metals (arsenic, chromium, lead and thallium) in the Lower Camp, initial estimates indicated that significant ecological risk may be present within ST005 to several ecological communities.

However, after taking all of the risk estimates, receptors, media, and overestimation factors into consideration, risk assessment results suggest that the only ecologically significant risks at the Lower Camp (on-site) exposure area are likely to be posed to benthic species and masked shrews due primarily to PCBs and petroleum compounds. The ecological impacts of PCBs and petroleum compounds to regional populations of masked shrews are likely minimal, however, given the small areas of contamination relative to the available shrew habitat in the region that has not been affected by PCB or petroleum compounds.

2.7.2.1 Identification of Chemicals of Concern

This section identifies those chemicals associated with unacceptable ecological risk at the site and that are the basis for the proposed remedial action. Although other chemicals were detected at the site, these COPCs are the primary risk-driving chemicals.

Final COPCs were only identified for soil, surface water, and sediment because ecological receptors are not exposed to groundwater or gallery water.

The majority of risk predicted for plants and soil invertebrates was due to chromium, which was detected in 64 of 64 samples with an exposure point concentration of 59 mg/Kg in soil. The calculated background concentration for chromium in soil was 70 mg/Kg. Therefore, potential risks attributed to the presence of chromium are being predicted at a concentration that is below the background concentration. As such, chromium was not retained as a soil COC.

The majority of risk predicted for aquatic species was due to 4,4'-DDT and DRO-aromatic. 4,4'-DDT is known to be very toxic to aquatic species and upper trophic level species. However, it was only detected in 1 of 16 water samples collected from Sparrevohn Creek and its tributaries within Lower Camp, and multiple samples at downstream locations were non-detect. As a result, 4,4'-DDT was not retained as a surface water COC.

Accurate prediction of the risks due to DRO in water (surface water or groundwater) is difficult due to the complex make-up of DRO and the weathering that likely has occurred since the fuel was released. At Sparrevohn, surface water risk is mitigated to some degree because streams within Lower Camp are ephemeral, and as a result, exposure potential is limited. Based on the presumed reduced toxicity of weathered DRO and limited exposure, DRO was not retained as a surface water COC.

The most significant risks predicted for benthic species were due to 4,4'-DDD, 4,4'-DDT, PCBs, and xylenes in sediment. The exposure point concentrations for 4,4'-DDD and 4,4'-DDT were based on the maximum concentration detected in 8 of 13 samples. The maximum detected concentration of 4,4'-DDD was orders of magnitude larger than the other seven detections. Similarly, the maximum concentration for 4,4'-DDT was up to 450 times larger than the other seven detected concentrations. Therefore, the actual exposure of benthic invertebrates is likely lower than predicted. PCBs (Aroclor 1260) were detected in 8 of 16 samples. As with 4,4'-DDD and 4,4'-DDT, the maximum detected concentration of PCBs was used as the exposure point concentration for benthic species, and this concentration was up to 1,900 times greater than the other detections. This also suggests that the exposure of benthic species to PCBs was significantly overestimated. Xylenes were only detected in 1 of 15 samples, and as a result, the overall risk predicted for xylenes was likely overestimated for the entire exposure area. Therefore, 4,4'-DDD, 4,4'-DDT, PCBs, and xylenes were not retained as COCs for sediment.

Upper trophic level species most likely at risk include rock ptarmigan, masked shrew, Lapland longspur, and mink. The COPCs associated with these risks are arsenic, chromium, DRO-aliphatic, lead, PCBs, RRO-aliphatic, RRO-aromatic, thallium, and zinc in soil. Metals present the majority of the potential risk for rock ptarmigan, Lapland longspur, and mink. However, as previously noted, metal concentrations generally fall in the range of calculated background concentrations. Specifically, the exposure point concentrations for arsenic, chromium, thallium, and zinc are below background concentrations, and lead is only 1 mg/Kg greater than the calculated background concentration. As a result, no metals were retained as COCs in soil.

Risks to the masked shrew are predominantly attributable to metals, petroleum, and PCBs. As discussed previously, metals are in the range of background concentrations and likely do not pose a risk. DRO-aliphatic, RRO-aliphatic, and RRO-aromatic contribute the most to the predicted risks due to petroleum compounds, but are assessed using a surrogate approach. This approach is very conservative because it assumes the petroleum product at the site is fresh. As a result, the toxicity of DRO and RRO for the masked shrew is overestimated in the BLRA. In addition, the fact that only one petroleum indicator chemical (xylene) had an HQ greater than 10 for any species, at any of the exposure areas, confirms that the surrogate approach likely overestimated the ecological risk for fuel at the site. As a result, DRO and RRO were not retained as COCs in soil based on ecological risk. However, DRO is retained as a COC in soil based on concentrations exceeding ADEC Method Two soil cleanup levels under 18 AAC 75.341(b).

PCBs were detected in samples collected throughout the Lower Camp (on-site) exposure area, but the most elevated concentrations were only found in the vicinity of the former powerhouse in the northern part of Lower Camp and at two test pits in the central part of Lower Camp (TP-45 and TP-54). This limited area of higher exposure indicates the exposure point concentration for PCBs and associated exposure and ecological risks were somewhat overestimated. Given these arguments, it is still possible that PCBs pose a significant potential ecological risk to masked shrews. PCBs were retained as a COC in soil based on concentrations exceeding ADEC Method Two soil cleanup levels under 18 AAC 75.341(b).

2.7.2.2 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.

The Lower Camp consists of forested lowlands with soils ranging from moderately-drained to wet. Ground cover is nearly continuous in this area. Ephemeral streams are present in several small drainages. This setting provides habitat for a variety of aquatic and terrestrial organisms. Based on the evaluation of complete exposure pathways, populations in ST005 that could be exposed to significant concentrations of contaminants include plants, soil invertebrates, aquatic species, benthic invertebrates, mammals and avian species (Shannon and Wilson 2000a).

2.7.2.3 Ecological Effects Assessment

An ecological toxicity assessment provides species-specific estimates of the dose of each COPC above which significant effects would be expected for the indicator species. These toxicity estimates are termed ecological reference doses (ERfDs).

No ecological effects assessment was conducted as part of the BLRA or Addendum. The measurement endpoints used to evaluate the ecological response to contamination consist of measured concentrations of COPCs in soil, surface water, and sediment and the toxicity data from available literature. These toxicity data determine the link between an estimated daily intake of a COPC for a particular indicator species, and the potential effects that may occur as a result of that dose. This link is crucial to the determination of whether there is a potential for ecological risks at a given site.

Ideally, ERfDs would be based on site-specific toxicity data. However, since such toxicity data were not obtained as part of the baseline ERA, toxicity benchmark doses were selected from the literature and converted, using uncertainty factors, to receptor-specific ERfDs.

The sources of toxicity values and the receptors for which the values apply included:

- Oak Ridge National Laboratory (Sample et al., 1996) [soil, surface water, mammals, birds];
- Agency for Toxic Substances and Disease Registry (ATSDR 1993) toxicity profiles [soil, sediment, surface water, aquatic species, fish, mammals];
- United States Fish and Wildlife Service synoptic reviews of hazards to fish, wildlife, and invertebrates [surface water, aquatic species, benthic invertebrates, mammals, birds];
- EPA's IRIS database (EPA 1999) [soil, sediment, surface water, mammals, birds];
- Registry of Toxic Effects of Chemical Substances, a National Institute of Occupational Safety and Health on-line database (NIOSH 1997) [soil, mammals, birds];
- Health and Safety Databank, a National Library of Medicine on-line database [sediment, surface water, mammals, birds];
- Oil and Hazardous Materials/Technical Assistance Data System, EPA on-line database (EPA 1997) [soil, mammals, birds];
- The Michigan Department of Natural Resources Chemical Evaluation Search and Retrieval system (Michigan Department of Environmental Quality 1999) [plants, aquatic species, mammals]; and
- Technical literature, as cited [soil, sediment, mammals, birds].

2.7.2.4 Ecological Risk Characterization

This section summarizes the approach and findings of the BLRA (Shannon and Wilson 2000a) and Addendum (USAF 2002a) that were performed at Sparrevohn LRRS and included ST005.

The ERAs included a risk estimation and risk description. The risk estimation reported significant HQs for each combination of chemicals and indicator species (flora and fauna species representative of the site) for the exposure area. The HQs were considered indicative of a chemical's potential to pose ecological risk to the indicator species within the exposure area. The risk description predicted the ecological significance of the risk estimates based on the uncertainties in the assessment and a weight-of-evidence evaluation. The ERA identified potential unacceptable risk associated with PCBs, metals, fuels, and pesticides occurring in the Lower Camp exposure area (Shannon and Wilson 2000a; USAF 2002a).

The HQs for the indicator species and exposure media were summed across all media-specific chemicals to obtain HIs for the indicator species. The HI's were then summed across all exposure media to obtain the total risk to the indicator species for the exposure area. A total risk, HI, or HQ of 1 was considered the threshold level at which adverse effects may occur for a particular community or species. A total risk, HI, or HQ between 1 and 10 was considered to present a small potential for adverse ecological effects, and values between 10 and 100 were considered to present a significant potential for adverse ecological effects (Shannon and Wilson 2000a).

Potentially significant ecological risks were initially predicted for each of the indicator communities and for lapland longspur, snowshoe hares, rock ptarmigan, mink, and masked shrews within the Lower Camp exposure areas. Metals, pesticides (primarily 4,4'-DDD and 4,4'-DDT), PCBs, and/or petroleum compounds are the COPCs primarily responsible for the potential risks. These potential risks were examined with respect to the aerial extent of contamination, prescribed risk assessment procedures (particularly in relation to background screening for metals), and the uncertainties involved in the BLRA.

Results of the risk assessment indicated that the species most likely to be subjected to ecologically significant risks due to the presence of PCBs are benthic species for sediment and masked shrews for soil. The risk due to PCBs in soil, however, was likely overestimated, as the highest PCB concentration was used to calculate risk and the areas with elevated PCB levels (the former Power House and two test pits in the central part of Lower Camp area) represent only a small portion of the ST005 site. However, even with the omission of these PCB "hot spots," there is still a potential for significant risks to masked shrews at the Lower Camp (on-site) from PCBs in other soils. Regardless, the ecological impacts to regional populations of masked shrews are likely minimal given the small areas of contamination relative to the available "clean" shrew habitat in the region. No upper trophic level indicator carnivores/piscivores were found to be potentially at risk from the bioaccumulation/biomagnification of PCBs in the aquatic food chain (Shannon and Wilson 2000a).

Risks were also predicted for the lapland longspur and masked shrew due to chromium in soil (lapland longspur), and arsenic, chromium, DRO, RRO, thallium, and lead in soil (masked shrew) (Shannon and Wilson 2000a). For both species, risks predicted from metals (arsenic, chromium, lead and thallium) were considered overestimated since the exposure point concentrations used in the risk assessment for these two metals were within the range of background concentrations for Sparrevohn LRRS (Shannon and Wilson 2000a). Therefore, no ecologically significant risks are predicted for any indicator communities or species due to the presence of metals.

Very limited distribution of pesticide contamination in all media, except sediment at the Lower Camp (on-site), limits the potential exposure of all receptors, except benthic species within the Lower Camp. The benthic species inhabiting the ephemeral streams of the Lower Camp may be realizing significant effects due to the presence of 4,4'-DDD and 4,4'-DDT. No upper trophic level indicator carnivores/piscivores were found to be potentially at risk from the bioaccumulation/biomagnification of these persistent pesticides.

Petroleum contamination is widespread at the Sparrevohn LRRS. The potential for ecological risks from petroleum compounds is likely to have been decreased due to reductions in toxicity as a result of weathering and biodegradation in all the exposure areas. However, the uncertainties in assessing ecological risks from petroleum compounds do not allow risks to be precisely quantified, and the magnitude of their overestimation in the baseline ERA cannot be readily defined. Therefore, even though risks predicted for the masked shrew from DRO-aliphatic, RRO-aliphatic, and RRO-aromatic at Lower Camp (on-site) are likely overestimated due to the use of the surrogate approach, they are considered potentially ecologically significant. However, similar to PCBs, the ecological impacts of petroleum compounds to regional populations of masked shrews are likely minimal given the small areas of contamination relative to the available "clean" shrew habitat in the region (Shannon and Wilson 2000a). As a result, mitigation of DRO and RRO in the Lower Camp should have no significant impact on regional populations of masked shrews.

2.7.3 Basis for Action

The concentrations of PCBs and DRO exceeded the ADEC Method Two soil cleanup levels, and TCE (and potential chlorinated daughter products) exceeded ADEC Method Two groundwater cleanup level at ST005. Therefore, 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.

2.8 Remedial Action Objectives

Remedial action objectives (RAOs) define what the remedial actions should accomplish to protect potential receptors. Consistent with EPA guidance and the NCP [40 CFR §300.430(e)(2)(i)], these objectives consider COPCs, exposure routes and receptors, and cleanup goals.

The overall objectives of the Sparrevohn LRRS environmental site restoration are to ensure that conditions at each site are protective of human health and the environment, and to comply with state and federal regulations. RAOs are the specific goals that the remedial action is designed to achieve. ST005 RAOs have been developed which meet the requirements of both CERCLA and State of Alaska Contaminated Site Regulations.

The RAOs for ST005 are:

- To prevent human exposure to PCB and DRO in soil, and TCE (and daughter products) and DRO in groundwater exceeding concentrations in 18 AAC 75.341(c) Tables B1 and B2, and 18 AAC 75.345(b) Table C, respectively;
- To prevent migration of contaminants to sensitive area such as wetlands and surface water;
- Protect human health and the environment; and
- Comply with applicable Federal, State, and local laws and regulations.

2.9 Description of Alternatives

The remedial alternatives considered for ST005 were presented in the Final Feasibility Study Report, Remedial Investigation/Feasibility Study (USAF 2002a), and are summarized in Table 2-17.

Table 2-17 Summary of Remedial Alternatives Evaluated for ST005

Alternative Designation	Alternative Description
1	No Action
2	Institutional Controls (Soil, Groundwater)
3	Capping (Soil)
4	Excavation and Offsite Disposal (Soil)
5	Monitored Natural Attenuation (Groundwater)

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

2.9.1 Description of Remedy Components

A total of five alternatives were developed to address remediation at ST005. This section provides a summary overview of the components of those alternatives.

Alternative 1: No Action

- No response action

Alternative 2: Institutional Controls

- Place administrative restrictions on construction of residential structures at the Lower Camp in areas where chemical concentrations in soil exceed cleanup levels, based on the future-use residential scenario;
- Place administrative restrictions on the excavation of soil within contaminated areas at Lower Camp, where exposure to those soils could result in an increased risk to human health;
- Place administrative restrictions on groundwater use at Lower Camp in areas where chemical concentrations exceed cleanup levels based on the future residential exposure scenario;
- Install warning signs to delineate areas where contamination is present and at key points of the installation (i.e., runway apron) to alert personnel regarding soil in exceedance of cleanup levels. Areas that would be delineated include PCB-contaminated soil at the former Lower Camp Power House, DRO-contaminated soil at the Lower Camp, and VOC-contaminated groundwater at Lower Camp; and
- Install warning signs as a precautionary measure to alert site visitors to areas where chemical contamination is present in exceedance of ADEC cleanup levels, regardless of whether or not risk associated with these chemicals exceeded risk management standards.

Alternative 3: Capping

- Construct a 1-foot thick gravel cap at the former power plant site and over other areas of the Lower Camp where PCB contamination exceeds the ADEC Method Two soil cleanup standard of 1 mg/Kg.

Alternative 4: Excavation and Offsite Disposal

- Excavate contaminated soil with PCB concentrations greater than 1 mg/Kg; and
- Transport and dispose of excavated soil with PCB concentrations greater than 1 mg/Kg consistent with the Off-Site Rule (40 CFR 300.440). The soil would be shipped offsite to a landfill in the lower 48 states permitted to accept waste.

Alternative 5: Monitored Natural Attenuation

- Implement a long-term water sampling program to monitor naturally occurring degradation of TCE in groundwater at the Lower Camp to evaluate water quality changes with time, and address data gaps to assist in the determination of hydrocarbon degradation rates. The primary components of monitoring include:

- Development of a long-term monitoring plan;
- Groundwater, surface water, and sediment sampling events no less than once every five years; and
- Evaluations of water quality data no less than once every five years.

2.9.2 Common Elements and Distinguishing Features of Each Alternative

Table 2-18 provides a summary of the elements common to each alternative and features that distinguish one alternative from another.

2.10 Summary of Comparative Analysis of Alternatives

In accordance with the NCP, the alternatives for ST005 were evaluated using the nine criteria described in Section 121(b) of CERCLA and the 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 Applicable or Relevant and Appropriate Requirements (ARARs)

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 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.

2.10.1 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.

The "No Action" alternative is not protective of human health and the environment because it does not reduce the toxicity, mobility, or volume of the COPCs on site to ADEC Method Two soil cleanup levels, nor prevent exposure under all exposure scenarios. PCBs are known to persist in the environment and are unlikely to degrade over time. Under the "No Action" alternative, no monitoring would be performed at the facility to assess site conditions over time.

Alternative 2 is protective of human health and the environment by preventing exposure. Signage identifying PCB- and DRO-contaminated soil and TCE in groundwater will be adequately effective at preventing incidental exposure given the isolated occurrence of PCBs (i.e., in the vicinity of the Power Plant). Maintenance of the signs to ensure they are in good condition will be required as long as contaminant concentrations in the soil and/or groundwater at the site exceed the applicable ADEC Method Two soil and groundwater cleanup levels. Alternative 2 also requires land use restrictions, which are designed to limit residential use and excavations in areas where PCBs in soil exceed 1 mg/Kg.

Alternative 3 is protective of human health and the environment because it reduces the mobility of the PCBs and eliminates exposure at the ST005 site. Capping of PCB-contaminated soil will provide a protective barrier and prevent incidental exposure to workers and site visitors. However, there would be some temporary risk of adverse air emissions (dust) during construction. Long-term maintenance is necessary to ensure integrity of the cap over time.

Alternative 4 is protective of human health and the environment by removing PCB-contaminated soil from the site and, therefore, preventing exposure. There would be temporary risk to workers (dust inhalation) during implementation of the remedy when soil is excavated and packaged for shipment.

Alternative 5 would provide protection by restricting use and monitoring the groundwater quality over time. If water concentrations decrease to below applicable cleanup levels, restrictions would no longer be required. Natural attenuation alone does not limit exposure or site access by itself.

2.10.2 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.

Alternatives 3 and 4 meet all State and Federal ARARs, assuming land use restrictions are part of Alternative 3 (capping). Alternative 2 would meet ARARs with appropriate maintenance, land use restrictions, and CERCLA Five-Year Reviews. Alternative 1 does not meet State or Federal ARARs because PCB and DRO concentrations at the ST005 site exceed the ADEC Method Two soil cleanup levels. Alternative 5 applies to groundwater contamination and requires CERCLA Five-Year Reviews, as well as additional restrictions placed on groundwater use at the site.

2.10.3 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.

Alternative 1 provides no long-term effectiveness because PCB- and DRO-contaminated soil and TCE-contaminated groundwater would remain in place and undocumented, with a potential for exposure to receptors. Alternative 2 reduces the risk to humans by identifying areas of contaminated soil and groundwater; long-term maintenance will be required for Alternative 2 to remain effective in the future. Alternative 5 provides similar effectiveness as Alternative 2, but also provides a method to monitor contaminant concentrations. Alternative 4 provides a permanent solution by removing soil with PCB concentrations exceeding 1 mg/Kg and eliminating future risk, but does not address the contaminated groundwater. Alternative 3 reduces the risk to humans and the environment by isolating PCB-contaminated soil; long term maintenance will be required to ensure cap integrity, and institutional controls will be necessary to ensure that site activities that may damage the cap (i.e., excavation or construction) do not occur.

2.10.4 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.

None of the alternatives include treatment as a component of the remedy. Therefore, these alternatives would not reduce the toxicity, mobility, or volume of contamination at the site through treatment. Alternative 3 reduces mobility of contaminants in the soil, but requires long-term maintenance to continue. Alternative 4 does result in a permanent reduction in toxicity, mobility, and volume of contamination by removing the PCB-contaminated soil from ST005.

2.10.5 Short-Term Effectiveness

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

Alternative 1 would not provide any short-term risk to workers because no action is being implemented; risk of exposure to contaminated soil remains. Signage associated with Alternative 2 would immediately warn site workers and visitors of soil and groundwater contamination at the site, resulting in the reduction of potential incidental exposure. Alternative 3 could be completed in one construction season and would immediately confine PCB-containing soils, protecting site workers. There would be a small temporary increase in risk to site workers due to disturbing PCB-containing soil while constructing the cap. Alternative 4 could be completed in one construction season, and therefore reduce the overall risk quickly. However, Alternative 4 requires construction and the use of heavy equipment, potentially resulting in a temporary increase in exposure to PCB-contaminated soil via fugitive dust. Alternative 4 also has a risk of release of PCB contamination due to the potential for soil to be spilled during transport and shipment from the site. Alternative 5 would not result in a short-term decrease of contamination. As part of Alternative 5, field personnel would potentially be exposed to site contaminants during long-term monitoring activities.

2.10.6 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.

Alternative 1, which requires no action, is technically simple to implement. Alternative 2 is simple to implement, but long-term maintenance of the signs will be required. Alternative 3 is easily constructed using easily obtainable materials. Alternative 4 requires relatively common removal and disposal practices. Alternatives 3 and 4 require equipment and facilities that may not be readily available at Sparrevohn LRRS and would be required to be shipped to the site. Alternative 5 is readily implementable.

2.10.7 Relative Cost

There is no cost to implement Alternative 1 (No Action). The cost to implement Alternative 2, \$48,638, includes producing and installing signs, updating the base general plan and maintenance for 30 years. Alternative 4 requires the greatest labor and equipment, and is the most costly of the three soil alternatives at \$306,440. Alternative 3 is more expensive than Alternative 2, at \$296,080; however, PCB-contaminated soils would remain at the site. Alternative 5, which costs \$595,450, has no comparable alternative because it pertains to groundwater only.

Table 2-18 Common Elements and Distinguishing Features of Alternatives

Elements/Features	ALTERNATIVES				
	Alternative 1: No Action	Alternative 2: Institutional Controls	Alternative 3: Capping	Alternative 4: Source Removal and Offsite Disposal	Alternative 5: Monitored Natural Attenuation
Key Appropriate, Relevant, or Applicable Requirements (ARARs) associated with each remedy.	Oil and Hazardous Substances Pollution Control Regulations (18 AAC 75 300 – 18 AAC 75 396)	Oil and Hazardous Substances Pollution Control Regulations (18 AAC 75.300 – 18 AAC 75.396)	Oil and Hazardous Substances Pollution Control Regulations (18 AAC 75.300 – 18 AAC 75 396), TSCA PCB Regulations (40 CFR 761), RCRA Corrective Action Management Unit designation (40 CFR 264, Subparts F and G)	Identification and Listing of Hazardous Wastes (40 CFR Part 261), 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)
Long term reliability of remedy	No long term reliability - PCBs are present in the soil PCBs are stable and do not readily degrade	Long-term, but not permanent reliability. PCBs are present in the soil. Access would be limited PCBs are stable and do not readily degrade Installed signage would likely last the projected timeframe of the remedy and would be maintained as part of standard installation routine.	Long term, but not permanently reliable due to climate stresses and site activities that may cause damage to the cap Periodic maintenance is required to ensure the long-term integrity of the cap	Permanent long-term reliability - Permanent removal of PCB-contaminated soil from Sparrevohn LRRS	Provides long-term effectiveness for organic compounds (DRO and VOCs) present at the site – organic compounds will naturaly attenuate over time This remedy has no effectiveness regarding PCBs present at ST005
Quantity of untreated waste and treatment residuals to be disposed of off site or managed on site in a containment system and the degree of hazard remaining in such material	No management Approximately 100yd^3 of PCB-contaminated soil would remain at the site Site risk exceeds the ADEC risk management standard of 1 x 10^{-5} for carcinogenic risk and 1 0 for the non-cancer hazard index. No onsite treatment is planned as part of this alternative, and therefore, no treatment residuals	Approximately 100yd^3 of PCB-contaminated soil would remain at the site Site risk exceeds the ADEC risk management standard of 1 x 10^{-5} for carcinogenic risk and 1.0 for the non-cancer hazard index. No onsite treatment is planned as part of this alternative, and therefore, no treatment residuals	Approximately 100yd^3 of PCB-contaminated soil would remain at the site Site risk exceeds the ADEC risk management standard of 1 x 10^{-5} for carcinogenic risk and 1 0 for the non-cancer hazard index. No onsite treatment is planned as part of this alternative, and therefore, no treatment residuals.	Approximately 100 yd^3 of contaminated soil would be disposed of offsite Site risk exceeds the ADEC risk management standard of 1 x 10^{-5} for carcinogenic risk and 1 0 for the non-cancer hazard index under a residential scenario. Remaining site soils will be below the ADEC Method Two soil cleanup level of 1 mg/Kg for PCBs. No onsite treatment is planned as part of this alternative, and therefore, no treatment residuals	Contaminated groundwater would remain on site AWQS would be exceeded until natural attenuation of petroleum contaminants (DRO and VOCs) is complete. This remedy has no effectiveness regarding PCBs present at ST005. No onsite treatment is planned as part of this alternative, and therefore, no treatment residuals.
Estimated time for design and construction	N/A	Achievable within one construction season	Achievable within one construction season	Achievable within one construction season	N/A
Estimated time to reach remediation goals	Indefinite PCB-contaminated soil is not likely to degrade in place.	Indefinite PCB-contaminated soil is not likely to degrade in place.	Indefinite. PCB-contaminated soil is not likely to degrade in place.	Removal of contaminated soil above ADEC Method Two soil cleanup levels for the Under 40-Inch Zone would be achievable in one construction season.	>30 years
Estimated capital cost	Total Cost $0	Installation of Institutional Controls. $14,140	Total cost for Capping $122,080	Total Cost for Source Removal and Offsite Disposal $306,440	$7,500
Estimated annual Operations and Maintenance cost	Total Cost $0	Maintenance Cost $1,150	$5,800	$0	Total Cost for Monitored Natural Attenuation $19,598
Estimated total present worth	$0	$48,639	$296,080	$306,440	$595,450
Discount rate	N/A	N/A	N/A	N/A	N/A
Number of years over which the cost is projected	N/A	30 Years	30 Years	< 1 year	30 Years
Use of presumptive remedies and/or innovative technologies.	N/A	N/A	N/A	N/A	N/A

2.10.8 State Support/Agency Acceptance

The State of Alaska concurs that with proper implementation, Alternatives 2 and 5 will be protective of human health and the environment. The State does not support Alternative 1 because it is not protective of human health or the environment. The State of Alaska supports Alternative 2 over Alternatives 3 and 4, because ST005 is an isolated site on an active USAF facility, the highest PCB concentrations are limited to an area near the Powerhouse and four isolated occurrences, and signage reduces the risk of incidental exposure to both PCBs and DRO. Therefore, Institutional Controls for soil at this site will be protective and cost-effective.

For groundwater, the State of Alaska supports Alternative 5, long-term monitoring, in conjunction with Institutional Controls, as the remedy at this site. Although groundwater is not used at the site, and the current risk associated with groundwater is below ADEC risk management standards, groundwater use restrictions, as specified by Alternative 2, are required to protect future workers and residents. Additionally, because current and future exposure is limited by Alternative 2, monitored natural attenuation is protective and cost effective for groundwater remediation at the site.

2.10.9 Community Acceptance

During the public comment period, there were no comments received from Lime Village, the nearest settlement to Sparrevohn LRRS, or from site workers. One set of comments were received from a citizen living in Eagle River, Alaska, approximately 200 miles east of Sparrevohn LRRS, expressing opposition to the preferred remedy at ST005 for the following reasons:

- The Proposed Plan did not provide specific remedial action objectives.
- The Proposed Plan indicates that a CERCLA Five-Year Review will be part of the remedy; however, the CERCLA Five-Year Review is required by §121 of CERCLA and should not be included as an element of the selected remedy.
- The Proposed Plan states that risk management standards are not exceeded but indicates that protection of human health is low; this is confusing and requires clarification.
- The Proposed Plan does not provide sufficient rationale to indicate that the selected remedy would provide greater protection than the No Action alternative.
- No action is necessary to comply with ARARs.
- Groundwater is not found beneath the site and therefore, there is no potential for future groundwater use.
- Because excavation provides no better protection than the selected remedy, the selected remedy would provide no better protection than no action.
- The State should fulfill its responsibilities to the public rather than rely on the public to determine regulatory compliance.

- If the USAF is intending to use the land as an industrial military installation for the foreseeable future, there should be no requirement to impose restrictions on construction of residential structures at the site because residential use is not anticipated. The selected remedy should not include action that is intended to restrict use that is not anticipated.

These comments are addressed in the Responsiveness Summary, Section 3.0 of this ROD.

2.11 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* (EPA 1991), principal threat wastes typically have a potential cancer risk of 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 at ST005. The maximum cancer risk attributed to carcinogenic COPCs in soil is $3x10^{-5}$ for PCBs (Shannon and Wilson 2000a).

2.12 Selected Remedy

The primary indicator of remedial action performance will be satisfying the RAOs for ST005 and protecting human health and the environment. Performance measures are defined herein as the RAOs (see Section 2.9 – 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 a protective and legally compliant remedy for ST005.

The selected remedies for ST005 (Alternative 2: Institutional Controls and Alternative 5: Monitored Natural Attenuation), were selected based upon best overall ability to protect human health and the environment, implementability, acceptance, long-term effectiveness, and overall cost. This section describes the selected remedy and also provides specific performance measures for the selected remedy.

Remedy selection is based on the detailed evaluation of remedial alternatives presented in the FS (USAF 2002b).

Alternative 2, Institutional Controls, is expected to be maintained as long as contaminant concentrations exceed cleanup levels in their respective media (PCBs and DRO in soil, and TCE [as well as TCE daughter products] in groundwater). If the signage and land use and groundwater use restrictions at the site are maintained, the remedy is expected to be protective of human health and the environment indefinitely. Alternative 5, Monitored Natural Attenuation, pertains to contaminated groundwater and surface water at the site. Alternative 5 will be protective of human health and the environment under current site usage until such time as the TCE (and TCE daughter products) decrease to, or below, applicable cleanup levels. Land and groundwater use controls will remain in effect for as long as site conditions pose an unacceptable risk to worker residents.

The USAF is responsible for implementing, maintaining, and monitoring the remedial action identified herein for the duration of the remedy. The USAF will exercise this responsibility in accordance with CERCLA and the NCP.

2.12.1 Summary of the Rationale for the Selected Remedy

The selected remedial alternative for ST005 is Alternative 2 – Institutional Controls. The USAF and ADEC concur that the selected remedy meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. The remedy is expected to satisfy the following statutory requirements of 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

A comparative analysis among alternatives for ST005 found Alternative 2 to be the best remedial action alternative for addressing the contaminants present at the site.

Alternative 2 is the most cost-effective and readily implementable approach to reduce the risk posed by contaminated soils, groundwater, and surface water, and therefore provides the best balance of tradeoffs with respect to balancing and modifying criteria. The other alternatives have deficiencies. The No Action Alternative (Alternative 1) was rejected because it failed to meet the threshold criteria of protection of human health and the environment. Alternatives 3 and 4 are expensive to implement, and may result in short-term exposure of site workers to PCBs in the form of fugitive dust. Alternative 3, in addition, does not reduce site risks and is subject to continued maintenance to ensure the long term integrity of the cap. Therefore, compared with Alternative 2, capping does not provide a substantial reduction in risk to justify the cost. Alternative 5 satisfies the Threshold Criteria and Balancing Criteria, with the exception of Short-Term Effectiveness, as this alternative will take approximately 30 years accomplish.

2.12.2 Description of the Selected Remedy

Remedial alternatives for ST005 were developed and evaluated through the FS (USAF 2002b).

Based on this evaluation, the USAF selected Alternative 2: Institutional Controls, and Alternative 5: Monitored Natural Attenuation for ST005.

The major components of the selected remedy in this ROD are:

Soil Specific Institutional Controls (PCB and DRO)

- Administrative restrictions on construction of structures at the Lower Camp in areas where chemical concentrations in soil exceed cleanup levels based on the future land use scenarios. Occupation of structures located within these areas could result in exposure to chemicals in excess of risk management standards via (1) incidental ingestion and dermal contact, and (2) vapor intrusion from soil to indoor air (VOCs). Areas of construction restrictions via institutional controls are shown on Figures 1-3 and 1-5.

- Administrative restrictions on excavation of soils within contaminated areas at the Lower Camp, where exposure to those soils could result in increased risk to human health. While not prohibiting such excavation, any work involving contaminated soil would be conducted in accordance with 18 AAC 75.360, Cleanup Operation Requirements. Areas of excavation restrictions via institutional controls are shown on Figures 1-3 and 1-5.

Groundwater Specific Institutional Controls (TCE and DRO)

- Administrative restrictions on groundwater use at the Lower Camp in areas where chemical concentrations exceed cleanup levels based on the future residential exposure scenario. Residential use of the Lower Camp groundwater would result in exposure to chemicals in excess of risk management standards. Therefore, changes in site use must be preceded by a review of the impacts of those changes on risks posed to human health and ecological receptors. Areas of groundwater use restrictions are shown on Figure 1-4.

Soil and Groundwater Institutional Controls

- Placement of warning signs as a precautionary measure to alert site visitors to areas where chemical contamination is present in exceedance of ADEC cleanup levels, regardless of whether or not risks associated with these chemicals exceed risk management standards. These signs could be placed at conspicuous access points to the ERP sites, or at a central location such as near the runway, intended to convey a warning regarding a general area rather than specific sample locations.

- Notations regarding residual contamination and land use restrictions will be recorded in the appropriate Sparrevohn LRRS land records, including the base general plan. As part of the update to the base general plan, the USAF will produce maps showing locations of residual contamination, and will provide these maps to ADEC.

- Institutional controls will remain in effect for as long as the contaminated media exceeds ADEC unrestricted residential use criteria. The USAF is responsible for enforcing institutional controls and the USAF will monitor the effectiveness of the institutional controls. The USAF will provide an annual report regarding institutional control monitoring to ADEC, with copies filed in the administrative record and information repository. A Five-Year Review is required under 42 U.S.C. 9621(c), since hazardous substances will remain at the site; the frequency of the annual report will be evaluated at the time of the first Five-Year Review.

- The USAF will provide prompt notification to the ADEC of institutional control deficiency/failure, along with corrective measures taken. The USAF will obtain regulatory concurrence of significant changes to use and activity restrictions. The USAF will provide prior notification to ADEC for transfer of property subject to institutional controls.

Groundwater Specific Remediation (TCE and DRO)

- Implementation of a long-term monitoring program in accordance with EPA guidance 600/R-98/128, *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents* (EPA 1998b) to evaluate naturally occurring degradation of TCE in groundwater at the Lower Camp, and evaluate water quality changes over time.

- Sampling events will occur no less that once per five years and will continue until concentrations decrease to below ADEC cleanup levels.

Existing roadways as well as the runway were addressed as part of the SD002 ROD (USAF 2009) in which the selected remedy was No Further Action. As a result, roadways running through ST005, are not included as part of the area of institutional controls for this site (Figures 1-3 through 1-5).

Changes to the remedy as described in this ROD, if they occur, will be documented using a technical memorandum in the Administrative Record, an Explanation of Significant Differences, or ROD amendment.

2.12.3 Summary of Estimated Remedy Costs

The estimated costs for accomplishing the selected remedy are provided in Tables 2-19 (Alternative 2) and 2-20 (Alternative 5). The information in this cost estimate summary table is based on the best available information from 2002 regarding the anticipated scope of the remedial alternative for the overall facility. The costs for ST005 were estimated by dividing the overall facility cost by the number of sites where the remedy was recommended in the FS.

Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the Administrative Record file, an Explanation of Significant Differences, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

2.12.4 Expected Outcomes of Selected Remedy

For soil, cleanup will be considered complete with institutional controls under CERCLA, 18 AAC 75, and ADEC Site Closure and Policy Procedures (ADEC 2008b and ADEC 2009a). Cleanup levels for the site are provided in Table 2-21. However, in accordance with 18 AAC 75.325(i), the landowner or its operator shall obtain approval from ADEC prior to disposing or transporting soil from the site. Additionally, pursuant to CERCLA §121, Five-Year Reviews will be required.

Table 2-19 Cost Estimate Summary – Capital Costs for Alternative 2

Description	Quantity	Unit	Unit Cost	Cost
Design Plans and Specifications				
Air Force Administrative Coordination	1	$1,142 each	$1,142	
ADEC Coordination	1	$714 each	$714	
Design and Acquire Signage	2	$1,214 each	$2,428	
			Design Plans and Specifications Subtotal	$4,284
Site Work				
Mob/Demob	1	$714	$714	
Acquire Signage	1	$1,142	$1,142	
Air Charter	1	$3,000	$3,000	
Reporting	1	$5,000	$5,000	
			Site Work Subtotal	$9,856
Operations and Maintenance				
Replace Signage (15 years)	1	$1,142	$1,142	
Inspect and Maintain Signage Every 5 Years	5	$500	$2,500	
Air Charter	6	$3,000	$18,000	
5-Year Review	6	$2,142	$12,857	
			Data Assessment and Reporting Subtotal	$34,499
			Total Capital Cost	$51,784

Notes

1) Costs are based on estimates from the 2002 *Final Feasibility Study Report, Remedial Investigation/Feasibility Study, Sparrevohn LRRS, Alaska* (USAF 2002b)
2) Costs calculated in the FS assumed that the remedy would be implemented at multiple sites across the entire Sparrevohn LRRS facility. The costs shown in this table were estimated using the total facility cost and dividing it by the number of sites; the resulting quotient is the estimated cost per site in 2002 dollars.

Table 2-20 Cost Estimate Summary – Capital Costs for Alternative 5

Description	Quantity	Unit	Unit Cost	Cost
Design Plans and Specifications				
Prepare Design Components of a Long-Term Monitoring Program	1	Lump Sum	$6,000	$6,000
Agency Coordination	1	Lump Sum	$1,500	$1,500
			Design Plans and Specifications Subtotal	$7,500
Site Work – Annual Monitoring				
Mob/Demob (Labor and Supplies)	15	Lump Sum	$5,000	$75,000
Well Sampling	15	Event	$8,400	$126,000
Laboratory Analysis	15	Event	$2,880	$43,200
Equipment and Supplies	15	Event	$750	$11,250
Water Quality Reporting	12	Event	$8,000	$96,000
10-Year Reporting	3	Event	$8,000	$24,000
Regulatory Coordination	15	Lump Sum	$1,500	$22,500
Project Administration	15	Lump Sum	$2,000	$30,000
R/T Personal Air Charter	15	Each	$3,000	$45,000
			Site Work Subtotal	$472,950
Operations and Maintenance				
Mobilization	2	Lump Sum	$5,000	$10,000
Well Installation	2	Event	$10,000	$20,000
Well Materials	2	Event	$3,500	$7,000
R/T Personal Air Charter	2	Each	$3,000	$6,000
R/T Air Cargo Charter	2	Each	$36,000	$72,000
			Data Assessment and Reporting Subtotal	$115,000
			Total Capital Cost	$595,450

Notes

1) Costs are based on estimates from the 2002 *Final Feasibility Study Report, Remedial Investigation/Feasibility Study, Sparrevohn*

LRRS, Alaska (USAF 2002b).

For groundwater, the selected remedy of monitored natural attenuation will be implemented . Groundwater monitoring at the site will be required until concentrations of contaminants decrease to below ADEC cleanup levels, the plume is in steady state of shrinking, concentrations of contaminants are decreasing, risk issues are resolved, and institution controls, if appropriate. Following completion of the selected remedy cleanup will be considered complete with institutional controls (if necessary) under CERCLA, 18 AAC 75, and ADEC Site Closure and Policy Procedures (ADEC 2008c and ADEC 2009a). Cleanup levels for the site are provided in Table 2-21.

Table 2-21 Cleanup Levels for Chemicals of Concern at ST005

Media: Soil On Site (Direct Contact, Incidental Ingestion); Sediment (Direct Contact, Incidental Ingestion); Groundwater (Ingestion)
Site Area: approximately 150 acres
Available Use Upon Achieving Cleanup Levels: Industrial
Controls to Ensure Restricted Use: Signage, Amendment of base general plan

Media	Chemical of Concern	Cleanup Level	Basis for Cleanup Level	Risk at Cleanup Level
Soil	Total PCBs	1 mg/Kg	18 AAC 75, Tables B1 and B2 Cleanup Levels (Under 40-Inch Zone)	See Note[1]
	DRO	250 mg/Kg		
Groundwater	Trichloroethene	5 µg/L	18 AAC 75, Table C Groundwater Cleanup Levels	
	DRO	1,500 µg/L	18 AAC 75, Table C Groundwater Cleanup Levels	

Notes
DRO – Diesel Range Organics
PCBs – Polychlorinated Biphenyls
1 - Total cumulative risk must meet ADEC risk management standards of 18 AAC 75.325(h), cumulative carcinogenic risk of less than or equal to $1x10^{-5}$ and a cumulative non-carcinogenic HI of 1.0.

2.12.4.1 Land Use

Implementation of the selected remedy assumes the current land use at the facility consists primarily of industrial use, with occasional recreational or subsistence activities by site contractors and visiting USAF personnel. Future land use is anticipated to be similar, as the USAF intends to maintain the installation indefinitely. Signs will be placed on the property alerting site workers and visitors to the presence of contaminated soil, groundwater, and surface water in excess of ADEC cleanup levels, regardless of risk. The base general plan and other land records will be updated to indicate that contaminants remain on site.

2.12.4.2 Property Transfer

The USAF will provide notice to the EPA and ADEC, consistent with CERCLA Section 120(h), at least six (6) months prior to any transfer or sale of USAF property associated with Sparrevohn LRRS, including transfers to private, state or local entities, so that the EPA and ADEC can be involved in discussions to ensure that appropriate provisions are included in the transfer terms or conveyance documents to maintain effective land use controls. If it is not possible for the USAF to notify the EPA and ADEC at least six (6) months prior to any transfer or sale, then the USAF will notify the EPA and ADEC as soon as possible but no later than sixty

(60) days prior to the transfer or sale of any property subject to land use controls.

In addition to the land transfer notice and discussion provisions above, the USAF further agrees to provide the EPA and ADEC with similar notice, within the same time frames, as for federal-to-federal transfer of property accountability and administrative control to ADEC. Review and comment opportunities afforded to the EPA and ADEC as to federal-to-federal transfers shall be in accordance with all applicable federal laws. All notice and comment provisions above shall also apply to leases, in addition to land transfers or sales.

2.13 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 (Table 2-22), is cost-effective, and uses permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment which permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes.

The sections below provide a brief, site-specific description of how the Selected Remedy satisfies the statutory requirements of CERCLA §121 (as required by NCP §300.430(f)(5)(ii)) and explains the Five-Year Review requirements.

2.13.1 Protection of Human Health and the Environment

The selected remedy for soil, Alternative 2, will protect human health and the environment by warning of site contaminants, and as a result, prevent incidental exposure to PCB- and DRO-contaminated soil at ST005. The selected remedy for groundwater, Alternative 5, will protect human health and the environment against future risk through groundwater monitoring. Implementation of Alternatives 2 and 5 will not result in short-term risks as might be the case with Alternatives 3 or 4.

2.13.2 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 2-22 summarizes the ARARs for the selected remedy at ST005 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. 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.

The selected remedy complies with the chemical-specific, location-specific, and action-specific ARARs. This is required to meet the substantive portions of these requirements and is exempt from administrative requirements such as permitting and notifications.

Table 2-22 Descriptions of ARARs

Alternative	Authority	Medium	Requirement	Status	Synopsis of Requirement	Action to be Taken to Attain Requirement
Action-Specific						
2	Federal Regulatory Requirement	Soil	Toxic Substances Control Act (40 CFR 761)	Applicable	Contains rules relating to the storage and disposal of PCB remediation waste.	The selected remedy will comply with these regulations through proper storage and disposal of TSCA-regulated wastes.
2/5	Federal Regulatory Requirement	Soil/ Surface water/ Groundwater	General Industrial Standards for Workers (29 CFR 1910 210)	Applicable	Outlines required protections for workers	The selected remedy will comply with these regulations through use of appropriate personal protective equipment and training for proper handling of hazardous materials or wastes.
2/5	Federal Regulatory Requirement	Soil/ Surface water/ Groundwater	HAZWOPER (29 CFR 1910 120 and 40 CFR 311)	Applicable	Outlines worker protection during hazardous waste cleanup.	All on-site workers will be required to have HAZWOPER certification
Chemical-Specific						
2/5	42 U S.C 9620 120(a)(4)	Soil/ Groundwater	Oil and Hazardous Substances Pollution Control Regulations (18 AAC 75 341-345)	Applicable	In general, cleanup to 1 ppm PCBs in soil is required Table C Groundwater cleanup levels are applicable.	Cleanup to 1 ppm PCBs, in order to have closure without institutional controls. Groundwater contaminants must be lower than Table C Groundwater Cleanup Levels to have closure without institutional controls
5	Federal Regulatory Requirement	Surface water/ Groundwater	Safe Drinking Water Act, 42 U.S.C §300f et seq (1974)	Applicable	Defines federal drinking water Maximum Contaminant Levels (MCLs)	Applicable to groundwater and surface water used as a potential source of drinking water
5	Federal Regulatory Requirement	Groundwater	Federal Safe Drinking Water Act (40 CFR 141; 40 CFR 143)	Applicable	Defines maximum contaminant levels and nonzero maximum contaminant level goals.	Applicable to groundwater used as a potential source of drinking water.
5	State of Alaska Regulatory Requirement	Surface water/ Groundwater	Water Quality Standards (18 AAC 70)	Applicable	Defines surface water quality standards	Applicable to surface water potentially used as a drinking water source.
5	State of Alaska Regulatory Requirement	Surface water/ Groundwater	Alaska Drinking Water Regulations (18 AAC 80, 2009)	Applicable	Defines drinking water MCLs	Applicable to surface water or groundwater that may be used as drinking water
Location-Specific						
2/5	Federal Regulatory Requirement	Soil/ Surface water/ Groundwater	Native American Grave Protection and Repatriation Act	Applicable	Provides for the protection of Native American graves and for other related areas.	No Native American grave sites have been identified at the site, however, procedures for reporting and protection of graves will be followed if encountered during implementation of the selected remedy.
2/5	Federal Regulatory Requirement	Soil/ Surface water/ Groundwater	Migratory Bird Treaty Act	Applicable	Protects any migratory bird, any part, nest, or eggs of any such bird.	The selected remedy will not impact protected species by utilizing engineering controls or avoidance measures.

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2.13.3 Cost Effectiveness

In the USAF's judgment, the selected remedy is cost-effective and represents a reasonable value for the money to be spent. The following definition was used in making this determination: "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 (i.e., 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 remedy for ST005 was demonstrated in Section 2.10 – Summary of Comparative Analysis of Alternatives, and is summarized in Table 2-23. The estimated present worth cost of the selected remedy, Alternative 2 plus Alternative 5, (in 2002 dollars) is $644,089.

2.13.4 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 the NCP §300.430(f)(1)(i)(B). Although no onsite treatment is being utilized, the selected remedy provides the most effective, long-term solution given the conditions at the site. Institutional controls are protective of human health and the environment, are readily implementable, and are cost effective in comparison to other alternatives.

The selected remedies manage the potential risks to human health and the environment by mitigating exposure of human and ecological receptors to PCB- and DRO-contaminated soils and TCE-contaminated groundwater at ST005.

2.13.5 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 remedy for ST005 does not satisfy the statutory preference for treatment as a principal element of the remedy because the costs of onsite treatment would be substantially higher without a significant reduction in risk.

2.13.6 Five-Year Review Requirements

Pursuant to CERCLA §121(c) and NCP §300.430(f)(5)(iii)(C), because the selected remedy 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 protective of human health and the environment.

In addition, the USAF will submit an Institutional Control Performance Report to the ADEC on an annual basis for the first five years. The frequency of the Institutional Control Performance Report will be evaluated with the Five-Year Review under 42 U.S.C. 9621(c).

Table 2-23 Cost and Effectiveness Summary for ST005

Alternative	Present Worth Cost[1]	Incremental Cost (if applicable)	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, and Volume Through Treatment	Short-Term Effectiveness
1 – No Action	None	N/A	No reduction in long-term risk to human health and the environment; potential for incidental exposure remains	No reduction in toxicity, mobility, or volume	No short term risk to workers; no increased risk from implementation of remedy
2 – Institutional Controls (also includes cost for Five-Year reviews)	$48,639	N/A	Reduction in long-term risk but requires long-term maintenance; potential for incidental exposure reduced	No reduction in toxicity, mobility, or volume	No short term risk to workers; no increased risk from implementation of remedy
3 – Capping	$296,080	N/A	Reduction in long-term risk but requires long-term maintenance; potential for incidental exposure reduced	Reduced mobility. No reduction in toxicity or volume	Short term risk to workers, community, and the environment while implementing remedy
4 – Source Removal and Offsite Disposal (Soil exceeding 1 mg/Kg PCBs)	$306,440	N/A	Permanent reduction in long-term risk; future risk due to bioaccumulation of PCBs is also reduced	Reduction in toxicity, mobility, and volume by removing contaminated soils from the site	Short term risk to workers, community, and the environment while implementing remedy
5 – Monitored Natural Attenuation	$595,450	N/A	Permanent reduction in long-term risk; future risk due to bioaccumulation of PCBs is also reduced.	Reduction in toxicity, mobility, and volume by through natural attenuation of contaminants in groundwater	No short term risk to workers; no increased risk from implementation of remedy

Cost Effectiveness Summary
1 – Present worth cost is assumed to equal the total cost of an alternative, which includes capital cost and operation and maintenance costs. Costs are in 2002 dollars.

2.14 Documentation of Significant Changes

The Proposed Plan for ST005 was released for public comment on October 6, 2008. The Proposed Plan identified institutional controls and long-term monitoring as the preferred alternatives for the site under Alaska laws and regulations. Although the USAF did receive written comments during the public comment period, it was determined that no significant changes to the remedy, as originally described in the Proposed Plan, were necessary.

3.0 Responsiveness Summary

This section provides a summary of the public comments regarding the Proposed Plan for remedial action at ST005, Sparrevohn LRRS. At the time of the public review period, the USAF had selected Alternative 2, Institutional Controls, to provide notice of contamination, and Alternative 5, Long Term Monitoring of groundwater (HCG 2008). Information regarding contamination will be conveyed through signage and updates to the base general plan.

During the public comment period, there were no comments received from Lime Village, the nearest settlement to Sparrevohn LRRS, or from site workers. One set of comments were received from a citizen in Eagle River, Alaska, approximately 200 miles east of Sparrevohn LRRS. The comments received are paraphrased and presented below as bullet items, along with the USAF response in italics.

- The commenter believed that the Proposed Plan did not provide specific remedial action objectives.

  The USAF noted this comment and added two additional RAOs as follows:

  1. *To prevent human exposure to PCB and DRO in soil, and TCE(and daughter products) and DRO in groundwater exceeding concentrations in 18 AAC 75.341(c) Tables B1 and B2, and 18 AAC 75.345(b) Table C, respectively.*

  2. *To prevent migration of contaminants to sensitive area such as wetlands and surface water.*

- The commenter noted that the Proposed Plan indicates that a CERCLA Five-Year Review will be part of the remedy; however, the CERCLA Five-Year Review is required by §121 of CERCLA, and should not be included as an element of the selected remedy.

  The USAF concurs with this comment. A CERCLA Five-Year Review will not be included as part of the selected remedy but will be implemented in areas where contamination exceeds the concentrations allowable for unlimited use and unrestricted exposure as per §121 of CERCLA.

- The commenter noted that the Proposed Plan states that risk management standards are not exceeded but indicates that protection of human health is low. The commenter indicated that this was confusing and required clarification.

  Although the current risk calculated for the Lower Camp Exposure Area did not exceed ADEC risk management standards, ST005 did contain PCBs in soil at concentrations that exceeded ADEC Method Two soil and groundwater cleanup levels. Table 9 presented in the Proposed Plan indicated that the No Action alternative offered the lowest (i.e., low relative to the alternatives evaluated) protection of human health and the environment. The USAF believes that *informing site workers and visitors, as well as potential future stakeholders, of the presence of contaminants that exceed ADEC cleanup levels along with long term monitoring will limit the potential for incidental exposure, and provide a higher level of protection than the No Action alternative.*

- The commenter believed that the Proposed Plan does not provide sufficient rationale to indicate that the selected remedy would provide greater protection than the No Action alternative.

  Although the current risk calculated for the Lower Camp exposure area did not exceed ADEC risk management standards, ST005 did contain contaminants in soil (DRO and PCBs) and groundwater (TCE) at concentrations that exceeded ADEC Method Two soil and groundwater cleanup levels. The USAF believes that informing site workers and visitors, as well as potential future stakeholders, of the presence of contaminants that exceed ADEC cleanup levels will limit the potential for incidental exposure, and provide a higher level of protection than the No Action alternative.

- The commenter believed that no action is necessary to comply with ARARs.

  The USAF does not agree. The No Action alternative does not comply with 18 AAC 75.341(c) because of PCB and DRO concentrations in soil, and 18 AAC 75.345(b) because of TCE concentrations in groundwater at ST005. The selected alternative does comply with state regulations by providing all current and future potential site users with information regarding PCB and DRO contamination in soil at the site, and by monitoring levels of chemicals in the groundwater until they are below ADEC cleanup criteria.

- The commenter suggested that excavation provided no better protection than the selected remedy. Therefore, the selected remedy would provide no better protection than no action.

  The USAF does not agree with this comment. All potential remedies are evaluated using the nine criteria outlined in CERCLA guidance. With regard to protectiveness, all alternatives must be compared with the No Action alternative. Institutional controls and soil removal both offer greater protection than the No Action alternative, which offers no protection from exposure to soil exceeding residential soil cleanup levels. Since both remedies are protective, other criteria, such as cost, are evaluated. If two remedies provide adequate protection, but one is less expensive than the other, then the less expensive remedy may be selected. The USAF position is that institutional controls provide greater protection than no action, and should be implemented at ST005.

- The commenter believes the State of Alaska should fulfill its responsibilities to the public rather than rely on the public to determine regulatory compliance.

The USAF notes this comment but does not believe it has any bearing on the selected remedy presented in the Proposed Plan or this ROD.

- The commenter stated that if the USAF is intending to use the land as an industrial military installation for the foreseeable future, there should be no requirement to impose restrictions on construction of residential structures at the site because residential use is not anticipated. The selected remedy should not include action that is intended to restrict use that is not anticipated.

  While the USAF intends to maintain the installation indefinitely, it is also reasonable to anticipate that the installation could become excess to the needs of the USAF at some point in the future. It is possible that future landowners could envision residential land uses, and advance knowledge of existing restrictions on residential construction would be useful to their site planning and use.

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