UNITED STATES AIR FORCE
611TH AIR SUPPORT GROUP
611TH CIVIL ENGINEER SQUADRON

JOINT BASE ELMENDORF-RICHARDSON, ALASKA

INDIAN MOUNTAIN LONG-RANGE RADAR SITE

FEASIBILITY STUDY FOR SITE OT008

INDIAN MOUNTAIN, ALASKA

FINAL
JUNE 2012

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ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
BMP	best management practices
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COPC	contaminant of potential concern
cy	cubic yards
EPA	U.S. Environmental Protection Agency
FS	feasibility study
ft	feet
HHE	human health and the environment
Jacobs	Jacobs Engineering Group Inc.
LRRS	Long-Range Radar Site
mg/kg	milligrams per kilogram
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOV	notice of violation
PCB	polychlorinated biphenyls
POL	petroleum, oil and lubricants
PPE	personal protective equipment
RAO	remedial action objective
RI	remedial investigation
S/S	solidification/stabilization
TSCA	Toxic Substances Control Act
TSDF	treatment, storage, and disposal facility
USAF	U.S. Air Force
WACS	White Alice Communications System
°C	degrees Celsius

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EXECUTIVE SUMMARY

This Feasibility Study (FS) evaluates potential remedial technologies to address polychlorinated biphenyl (PCB) and petroleum, oil, and lubricant (POL) contamination in soil at the OT008 Site located at Indian Mountain Long-Range Radar Site (LRRS). The alternatives presented in this FS were screened based on site-specific effectiveness, implementability, and cost.

The following alternatives were developed for addressing the PCB soil contamination:

- PCB Alternative 1: No Action
- PCB Alternative 2: Offsite Disposal of PCB-Contaminated Soil Greater Than 1 milligrams per kilogram (mg/kg)
- PCB Alternative 3: Grain-Size Separation and Offsite Disposal of PCB-Contaminated Soil Greater Than 1 mg/kg
- PCB Alternative 4: Grain-Size Separation, Offsite Disposal of PCB-Contaminated Soil Greater Than 25 mg/kg, and Solidification and Capping of PCB-Contaminated Soil Between 1 mg/kg and 24.9 mg/kg

The following alternatives were developed for addressing the POL soil contamination:

- POL Alternative 1: No Action
- POL Alternative 2: Grain-Size Separation and Onsite Landfarming of POL-Contaminated Soils Above the Direct Contact Criteria
- POL Alternative 3: Grain-Size Separation and Offsite Disposal of POL-Contaminated Soils Above the Direct Contact Criteria

As required by the Code of Federal Regulations, Title 40, Part 300.430(e)(6), the No-Action alternative was retained for both types of contamination to be used as a baseline for which the other alternatives can be compared. Each alternative was subjected to detailed analysis, based on the threshold and primary balancing criteria established under the Comprehensive Environmental Response, Compensation, and Liability Act (Code of Federal Regulations, Title 40, Chapter 300).

The threshold criteria are:

- Overall protection of human health and the environment
- Compliance with applicable or relevant and appropriate requirements

The primary balancing criteria are:

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

Other remediation technologies were considered but failed to meet the threshold or balancing criteria; therefore, only the four alternatives described above were retained for detailed analysis. Table ES-1 summarizes the proposed alternatives and presents an estimated cost for comparison purposes. Each alternative is discussed in detail in Section 4.0.

Following final approval of this FS, the U.S. Air Force will issue a proposed plan for the OT008 Site at Indian Mountain LRRS, including alternatives based on the evaluations performed in this FS. Comments on the proposed plan will be solicited from the community and state. Following receipt of comments, the alternatives will be further evaluated based on the modifying criteria (state acceptance and community acceptance), and then a remedy will be selected for the site. The selected remedy will be recorded in the Record of Decision for the site.

Table ES-1
OT008 Site at Indian Mountain PCB and POL Alternatives Summary

Alternative	Description	Cost Estimate
PCB Alternatives		
PCB Alternative 1	No Action	$0
PCB Alternative 2	Offsite disposal of all PCBs above 1 mg/kg	$11,690,169
PCB Alternative 3	Grain-size separation and offsite disposal of all PCBs above 1 mg/kg	$9,010,597
PCB Alternative 4	Grain-size separation, offsite disposal of all PCBs above 25 mg/kg, and onsite solidification and capping of all PCBs between 1 and 25 mg/kg	$4,414,467
POL Alternatives		
POL Alternative 1	No Action	$0
POL Alternative 2	Grain-size separation and onsite landfarming of all POL soils above direct contact	$1,633,699
POL Alternative 3	Grain-size separation and offsite disposal of all POL soils above direct contact	$2,431,482

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1.0 INTRODUCTION

This Feasibility Study (FS) presents and evaluates remedial alternatives for the OT008 Site at Indian Mountain Long-Range Radar Site (LRRS). This study is part of continuing efforts by the U.S. Air Force (USAF) 611th Civil Engineer Squadron (611 CES) to address contamination at the facility. The 611 CES' overall goal for the OT008 Site at Indian Mountain LRRS is to obtain regulatory site closure. Jacobs Engineering Group Inc. (Jacobs) prepared this FS on behalf of the 611th CES under AFCEE Contract No. FA8903-08-D-8773, Task Order No. 120.

Sampling activities during the 2011 follow-on remedial investigation (RI) focused on collecting soil, sediment, and surface water samples at three sites associated with Site OT008: the former White Alice Communications System (WACS), the Stained Soil Area, and the former Pump House (USAF 2012). Results of the RI concluded that polychlorinated biphenyls (PCB) and petroleum, oil, and lubricants (POL) are present in the soil at the OT008 site at concentrations above cleanup limits.

As outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (Code of Federal Regulations [CFR], Title 40, Part 300.430[e]), the objective of this FS is to develop and evaluate remedial alternatives for contamination at the OT008 Site at Indian Mountain LRRS. The specific goals of this document are to:

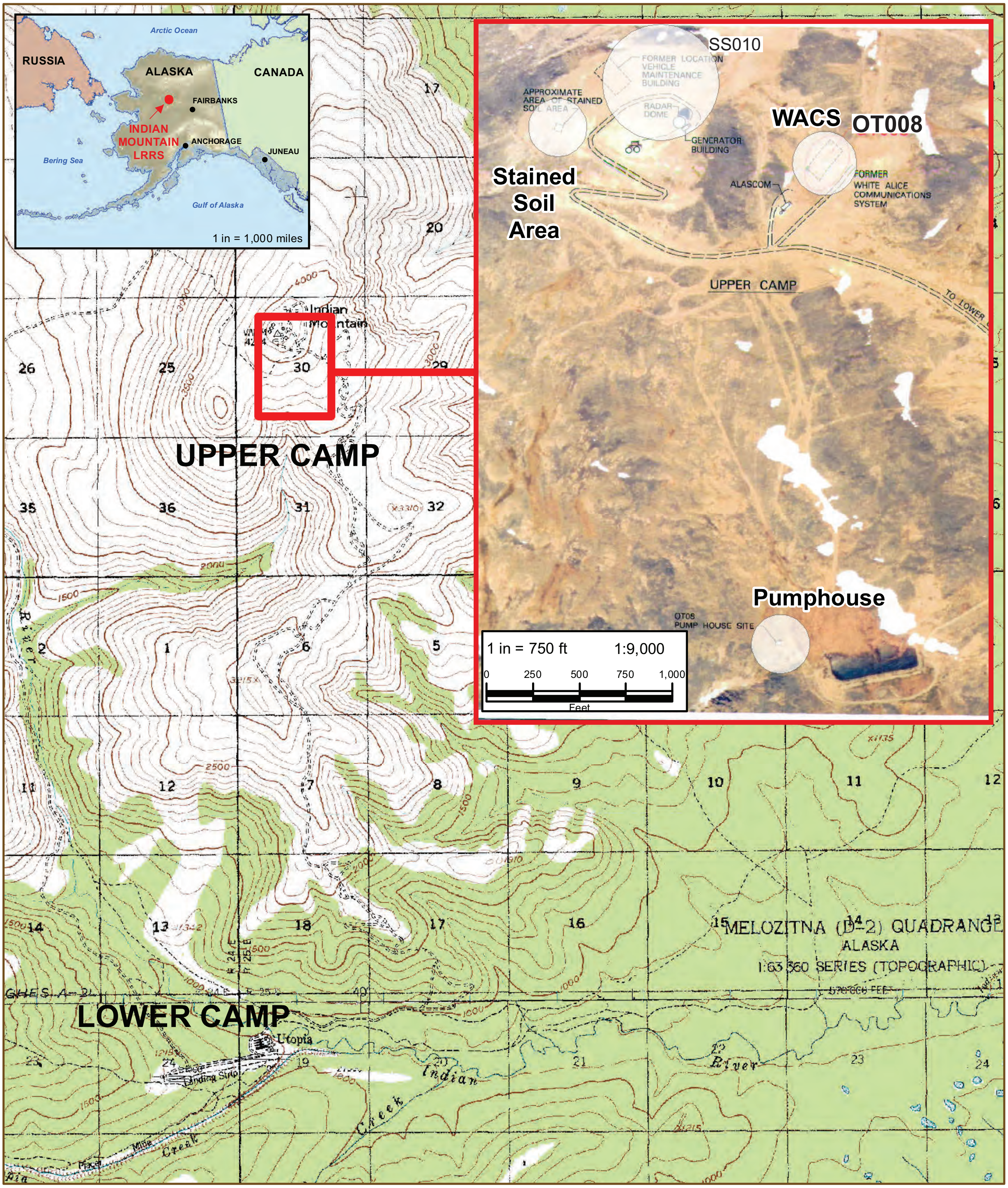
- Formulate site-specific remedial action objectives (RAO)
- Identify applicable remedial technologies based on the contaminants, their distribution, their concentration, and local site conditions
- Screen the identified technologies based on effectiveness, implementability, and cost
- Use technologies that pass the screening process to develop alternatives that eliminate, control, and/or reduce risk to human health and the environment (HHE) at the site

- Evaluate each alternative that passes screening against the following seven NCP criteria:
  - Protection of HHE
  - Compliance with applicable or relevant and appropriate requirements (ARAR)
  - Long-term effectiveness and permanence
  - Reduction of toxicity, mobility, or volume through treatment
  - Short-term effectiveness
  - Implementability
  - Cost
- Present a comparative analysis to determine the relative performance of the alternatives

1.1 SITE DESCRIPTION AND HISTORY

The Indian Mountain LRRS is located in the Kuskokwim Mountains, approximately 170 miles northwest of Fairbanks, Alaska and 35 miles south of the Arctic Circle. The closest city is Hughes, which is approximately 16 miles to the west-southwest. The Indian Mountain LRRS was constructed as an Aircraft Control and Warning facility in 1951 and became operational in 1953. The facility consisted of two separate camps, Upper Camp and Lower Camp, which were connected by a 10-mile long road (Figure 1-1). The radar facilities, including the WACS, were constructed at Upper Camp on the summit of Indian Mountain; personnel quarters and maintenance and support facilities were constructed at Lower Camp. The installation has been downscaled since the early 1970s, and is currently operated and maintained year-round by contractor personnel as an LRRS. Between 1984 and 2009, a number of environmental investigations and cleanup projects were conducted at the OT008 Site at Indian Mountain LRRS. A full description of previous environmental work conducted at this site can be found in the *Follow-on Remedial Investigation Report* (USAF 2012).

OT008 is located at Upper Camp and is the site of the former WACS. No other structures were present at this site. The WACS was activated in 1958, deactivated in 1979, and demolished in 1986. The Stained Soil Area is located approximately 1,500 feet west of the former WACS. The former Pump House is located approximately 2,750 feet south and downgradient from the former WACS. The contaminants of potential concern (COPC) for all of the sites at OT008 are primarily PCBs and fuels such as gasoline-range organics, diesel-range organics, residual-range organics, and related constituents.



0 0.25 0.5 0.75 1

Miles

Coordinate System: AK State Plane Zone 5
Projection: Transverse Mercator
Datum: North American 1983
Units: Foot US
1 inch = 1 miles

N

LOCATION, VICINITY & SITE MAP FOR SITE OT008 INDIAN MOUNTAIN LONG RANGE RADAR SITE INDIAN MOUNTAIN, ALASKA			
JACOBS	DATE: 17 JUNE 2011	PROJECT MANAGER: J. WEHRMANN	FIGURE NO.: 1-1

Path: P:\IndianMountain\MXD\RI\Fig1-1_SiteLoc8x11P.mxd

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1.2 SUMMARY OF ENVIRONMENTAL CONTAMINATION

Site-specific contaminant data can be found in the *Follow-on Remedial Investigation Report for Sites OT008 and SS010* (USAF 2012).

The primary COPCs at the OT008 Site at Indian Mountain LRRS are PCBs and POLs. Tables 1-1 and 1-2 present estimated soil bank volumes based on in situ or undisturbed volumes of the soil without compensation for swell upon excavation, and weights used to develop cost estimates for potential remedial alternatives. These estimates were developed by multiplying the area of contaminated soil by its depth; however, in some locations the PCB- and POL-contaminated soils were comingled, so the total volume of contaminated soil is less than the sum of each individually. Table 1-3 presents a summary of all contamination located at the site.

Table 1-1
Estimated Bank Volume of Polychlorinated Biphenyl-Contaminated Soil at the OT008 Site at Indian Mountain

Site	PCB Soil Between 1 and 25 mg/kg (cy)[1]	Depth of Contamination (ft bgs)	PCB Soil Between 25.1 and 50 mg/kg (cy)	Depth of Contamination (ft bgs)	PCB Soil Greater Than 50 mg/kg (cy)	Depth of Contamination (ft bgs)
WACS	2,170	4	80	3	34	2
Stained Soil Area	6	4	0.6	2	2	2
Pump House	12	4	1	3	1	2

Notes:
[1] A total of 2,037 cy of soil is contaminated with PCBs between 1 and 10 mg/kg.
All volume estimates are in bank cubic yards.
For definitions, see the Acronyms and Abbreviations section.

Table 1-2
Estimated Bank Volume of Petroleum, Oil, and Lubricant-Contaminated Soil at the OT008 Site at Indian Mountain

Site	POL Soil Between 250 and 10,249.9 mg/kg (cy)	Depth of Contamination (ft bgs)	POL Soil Above the Direct Contact Criteria (cy)	Depth of Contamination (ft bgs)
WACS	1,502	8	419	6
Stained Soil Area	1	2	0	0
Pump House	9	3	0	0

Notes:
All volume estimates are in bank cubic yards.
For definitions, see the Acronyms and Abbreviations section.

Table 1-3
Summary of Contaminants by Location

Contaminant Type	Total Estimated Area (sq ft) DRO >250 mg/kg	Total Estimated Volume (cy) DRO >250 mg/kg	Total Estimated Area (sq ft) DRO >10,250 mg/kg	Total Estimated Volume (cy) DRO >10,250 mg/kg
WACS				
PCB/POL comingled	14,041	2,070	10,025	1,485
POL Only	7,242	1,502	2,659	419
Total	21,283	3,572	12,684	1,904
Stained Soil Area				
PCB/POL comingled	143	11	143	11
DRO Only	10	1	0	0
Total	153	12	153	11
Pump House				
PCB/POL comingled	22	2	22	2
DRO Only	82	9	0	0
Total	104	12	22	2
OT008 Total	**21,540**	**3,596**	**12,859**	**1,917**

Note:
PCB/POL comingled also includes PCB-only soils.
For definitions, see the Acronyms and Abbreviations section.

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2.0 TECHNICAL APPROACH

In order to provide a clear understanding of remedial options available for the OT008 Site at Indian Mountain LRRS, this FS followed the process outlined in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (U.S. Environmental Protection Agency [EPA] 1988). This process entails the following steps:

- Development of RAOs and general response actions
- Identification and screening of remedial technologies capable of obtaining the RAOs
- Development of remedial alternatives
- Screening of remedial alternatives
- Detailed analysis of remedial alternatives

Each step is discussed in detail in this section, and the implementation of each step is discussed in Sections 3.0 through 6.0 of this document.

2.1 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES AND GENERAL RESPONSE ACTIONS

RAOs were developed (as further detailed in Section 3.1) based on contaminant concentration standards established under various chemical-specific ARARs. RAOs for soil contamination were set at the concentrations established under Method Two in the Alaska Administrative Code, Title 18, Chapter 75 (Alaska Department of Environmental Conservation [ADEC] 2008). General response actions are broad categories of action that can be undertaken to satisfy RAOs (Section 3.2).

2.2 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES

Section 4.0 presents the technology identification and screening process. Remedial technologies were selected in accordance with *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988). These technologies were screened based on effectiveness, implementability, and cost.

For the technologies evaluated, the Treatment Technologies Screening Matrix (Federal Remediation Technologies Roundtable 2008) was used to obtain information on the effectiveness, implementability, and costs of process options implemented in similar projects in remote Alaska.

2.2.1 Effectiveness

To evaluate effectiveness, each technology was screened against:

- Proven ability to achieve cleanup goals
- Potential impacts on HHE
- Reliability with respect to site contaminants

2.2.2 Implementability

This criterion evaluates the technical and administrative feasibility of implementing the technology considering the site-specific conditions. This criterion accounts especially for the logistics of performing the technology relative to the remoteness and seasonal weather conditions of the site location.

2.2.3 Cost

This criterion qualitatively evaluates if the capital and operating costs of implementing the technology are low, moderate, or high. The cost also includes the additional requirements of working at a remote Alaska site.

2.3 DEVELOPMENT OF REMEDIAL ALTERNATIVES

Remedial alternatives were developed based on the results of the technology screening. In accordance with CERCLA guidance, a range of alternatives was developed to include the No Action alternatives, alternatives that focus on reducing risk by preventing exposure, and (to the extent practicable) alternatives that focus on treatment of contaminated media. Alternatives considered were generally limited by the feasibility due to the remote site location.

2.4 SCREENING OF REMEDIAL ALTERNATIVES

The alternatives were screened based on their effectiveness, implementability, and cost.

Effectiveness is the ability of the alternative to protect HHE. It includes both short-term effectiveness, such as protection of workers during remedial actions, and long-term effectiveness, such as the magnitude of residual risk. Effectiveness also includes the ability of the alternative to reduce the toxicity, mobility, and volume of contamination and the ability to meet RAOs and related ARARs.

Implementability is the technical and administrative feasibility of the alternative as well as the availability of the various resources that would be required. Technical feasibility generally refers to the ability to construct and reliably operate the process until the remedial goal is achieved. Administrative feasibility includes the ability to obtain agency and public approval and the availability of required facilities, specialists, and equipment.

Relative, rough order-of-magnitude costs for each alternative were provided for comparative purposes during screening. Alternatives were not eliminated from further consideration purely on the basis of cost factors because these are only rough estimates at this stage of the FS process.

2.5 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

The NCP (40 CFR 300) presents nine criteria for evaluating the acceptability of a given alternative; these nine criteria are categorized as threshold criteria, primary balancing criteria, and modifying criteria. A rating system based on the definitions provided in 40 CFR 300.430(e)(9)(iii) was developed for this document to evaluate and summarize the ability of the alternatives to meet the criteria (Table 2-1). A pass or fail determination was used for each threshold criterion; failure to pass both threshold criteria eliminated the alternative from further evaluation. Except for cost, a number between 0 and 5 was assigned to each of the primary balancing criterion, as follows:

- Criterion was fully met (5).

- Criterion was partially met (1 through 4, depending on the degree to which the criterion is satisfied).
- Criterion was not met (0).

Numerical values were assigned subjectively, according to professional judgment, and used only as a means of weighing the trade-offs involved. The highest total numerical score does not indicate that an alternative was preferred. Consideration of modifying criteria (Section 2.5.3) is not within the scope of this document and can only be evaluated after state and community review of the alternatives to provide information about acceptance for further evaluation in the Record of Decision.

Table 2-1
Remedial Alternative Evaluation System

Category	Evaluation Criteria	Standard	Value
Threshold Criteria	Overall Protection of Human Health and the Environment	Protective; provides adequate risk reduction.	Pass or Fail
	Compliance with ARARs	Complies with ARARs.	Pass or Fail
Primary Balancing Criteria	Long-Term Effectiveness and Permanence	Contaminants are destroyed or removed; no recurrence is possible.	5
		Some contaminants destroyed, removed, or contained.	1 to 4
		Contaminants not removed or contained.	0
	Reduction of Toxicity, Mobility, or Volume through Treatment	Significantly reduces toxicity, mobility, or volume through treatment; no residuals remaining after treatment.	5
		Somewhat reduces toxicity, mobility, or volume through treatment; some residuals remaining after treatment.	1 to 4
		Does not reduce toxicity, mobility, or volume through treatment; significant residuals remaining after treatment.	0
	Short-Term Effectiveness	Protective of community and workers during remediation; no environmental impacts; rapidly meets RAOs.	5
		Somewhat protective of community and workers during remediation; limited environmental impacts; meets RAOs over a period of years to decades.	1 to 4
		Not protective of community and workers during remediation; significant environmental impacts; will not meet RAOs in the near future.	0

Table 2-1
Remedial Alternative Evaluation System (Continued)

Category	Evaluation Criteria	Standard	Value
Primary Balancing Criteria (continued)	Implementability	Proven, reliable technologies; little or no difficulty in obtaining needed approval, equipment, personnel, and materials. Technical difficulties are expected to be minimal.	5
		Somewhat unproven technologies; potentially more difficulty in obtaining needed approval, equipment, personnel, and materials. Technical difficulties may be significant.	1 to 4
		Unproven technologies; obtaining needed approval, equipment, personnel, and materials could be very difficult. Technical difficulties could prevent implementation.	0
	Cost	Estimated present worth cost is listed for each alternative.	Estimate
Modifying Criteria[1]	State Acceptance	To be determined.	not applicable
	Community Acceptance	To be determined.	not applicable

Notes:
[1] State and community acceptance will be evaluated following public comment on the proposed plan and addressed when the Record of Decision is prepared.
For definitions, see the Acronyms and Abbreviations section.

2.5.1 Threshold Criteria

Threshold criteria represent the minimum requirements that each alternative must meet to be eligible for selection. Failure to achieve each threshold criterion will eliminate the alternative from further consideration. The two threshold criteria are

- Overall protection of HHE
- Compliance with ARARs.

Overall Protection of Human Health and the Environment

This criterion assesses the overall effectiveness of an alternative and focuses on whether that alternative achieves adequate protection and risk reduction, elimination, or control. This criterion overlaps with considerations under compliance with ARARs as well as with some primary balancing criteria, such as long-term and short-term effectiveness.

Compliance with ARARs

Each alternative is assessed to determine whether it complies with ARARs. Appendix A presents ARARs for the OT008 Site at Indian Mountain LRRS.

This criterion assesses whether an alternative complies with all federal and state ARARs or whether a waiver would be required and would be justified under CERCLA and the NCP [42 United States Code 9621(d)(4) and 40 CFR 300.430(f)(1)(ii)(C)], such as for technical impracticability. ARARs include chemical-specific, such as risk-based levels established for safe drinking water (e.g., maximum contaminant levels), location-specific, such as protection of wetlands, and action-specific, such as post-closure requirements. Other potential requirements that are not necessarily laws or promulgated regulations, such as EPA Regional Screening Levels, are To Be Considered that can be treated as ARARs, particularly when no other specific laws or regulations are available as ARARs.

2.5.2 Primary Balancing Criteria

Primary balancing criteria form the basis for comparing alternatives in light of site-specific conditions. The five primary balancing criteria are:

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

Long-Term Effectiveness and Permanence

This criterion assesses the destruction or removal of contaminants, the magnitude of residual risks remaining at the conclusion of remedial activities, and the adequacy and reliability of controls to be used to manage residual risk.

This criterion addresses the results of a remedial action in terms of risk remaining at the site after RAOs have been met. The primary focus of this evaluation is the extent and effectiveness of the controls that may be required to manage the risk posed by untreated residual contamination. The following factors of the criterion are addressed for each alternative:

- **Magnitude of residual risk**. This factor assesses the risk from residual COPCs at the conclusion of the proposed activities. The characteristics of the residual COPCs will be considered to the degree that they remain hazardous. They will account for volume, toxicity, mobility, and propensity to bioaccumulate.
- **Adequacy and reliability of controls**. This factor assesses the adequacy and suitability of controls, if any, that are used to manage COPCs that remain at the site. It also assesses the long-term reliability of management controls for providing continued protection from residual COPCs and includes an assessment of potential needs for replacement of technical and engineered components of the alternative.

Reduction of Toxicity, Mobility, or Volume through Treatment

Section 9621 of CERCLA (Cleanup Standards) states: "Remedial actions in which treatment permanently and significantly reduces the volume, toxicity, or mobility of the hazardous substances, pollutants, and contaminants is a principle element, are to be preferred over remedial actions not involving such treatment." This criterion addresses the capacity of the alternative to reduce principle risks through destruction of contaminants, reduction in the total mass of contaminants, irreversible reduction in contaminant mobility, or reduction in the total volume of contaminated media. This evaluation focuses on these specific factors:

- Treatment processes employed and the materials and COPCs treated.
- Amount of hazardous materials destroyed or treated, including how the principle threats will be addressed.

- Degree of expected reduction in toxicity, mobility, or volume through treatment as measured as a percentage of reduction.
- Degree to which the treatment will be irreversible.
- Type and quantity of treatment residuals remaining after treatment.
- Whether the alternative will satisfy the statutory preference for treatment as a principle element.

Short-Term Effectiveness

This criterion addresses the effects of the alternative during construction and operation until RAOs are met. Each alternative is evaluated with respect to its potentially negative effects on community health, worker safety, and environmental quality during the course of remedial actions. This criterion also addresses the time required by each alternative until RAOs are achieved.

Implementability

The implementability criterion is used to assess the technical and administrative feasibility of implementing an alternative. Technical issues include the reliability of the technology under consideration, potential construction difficulties, and the availability of required services, materials, and equipment, preferably from multiple sources. Administrative issues include permitting and access for construction and monitoring. Factors addressed include:

- Whether the technology is proven under the site-specific conditions.
- The administrative requirements and relative difficulties associated, such as requirements for permits.
- Whether skilled workers are required and are available locally.
- Whether materials are locally available or would require transportation. Consequent evaluation factors for transportation of materials may include risk from transport of the materials while other factors, such as cost of transport, would be addressed under the cost evaluation.

Cost

A detailed cost analysis of each alternative involves estimating the cost required to complete each measure through the entire life-cycle until the remedy is complete, which includes capital costs and annual operation and maintenance costs. A present worth based on the total costs is used to estimate a cost for comparative analysis. Cost estimates for each alternative are based on site-specific conceptual designs as described in Sections 5.1 and 6.1 and are expressed in 2013 dollars. Cost estimates include equipment, materials, construction-related labor, and site development. Cost estimates are prepared using data available from the 2011 RI (USAF 2012) and are intended to provide an accuracy of between +50 and –30 percent. The cost estimates provided (Appendix B) are preliminary and were developed in accordance with *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA 2000). More detailed and accurate cost estimates will be developed as the CERCLA process progresses. Cost estimates included in this document are intended for comparative purposes only. They intentionally emphasize comparability (a key factor in the decision-making process) versus accuracy. Costs for each alternative provided in this FS assume the following:

- All remediation fieldwork will be performed in 2013
- The inflation rate will be 3.8 percent per year to calculate costs beyond 2013
- A discount rate of 7 percent will be used to calculate present value for work completed beyond 2013
- The mark-up on labor costs will be added to overhead for the project
- A contingency rate of 10 percent will be used

The cost estimates include consistent assumptions and methodologies such that potential unit cost, quantity, or other biases will equally impact each cost estimate. Consequently, the cost estimates should be proportionally impacted and the relative difference for comparative analysis maintain the ranking of relative cost. The cost estimate, however, is not adequate for budgetary planning purposes. Budgetary cost estimates may subsequently refine these comparative analysis cost estimates as more information is developed.

2.5.3 Modifying Criteria

The two modifying criteria are state acceptance and community acceptance. State acceptance evaluates the technical and administrative issues and concerns of ADEC. Community acceptance evaluates the issues and concerns that the public may have regarding each of the alternatives. In accordance with EPA guidance (EPA 1988), modifying criteria will be evaluated following regulatory comment and public response to the proposed plan. State and community acceptance will be addressed when final decisions are made and decision documents prepared. Alternatives are not evaluated against modifying criteria in this document.

3.0 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES AND GENERAL RESPONSE ACTIONS

This section describes the development of RAOs and general response actions for the OT008 Site at Indian Mountain LRRS.

3.1 REMEDIAL ACTION OBJECTIVES

RAOs consist of site-specific goals for protecting HHE. In accordance with EPA guidance, the objectives are as specific as possible but not so specific that the range of alternatives that can be developed is unduly limited (EPA 1988). RAOs specify the following:

- COPCs
- Media (e.g., soil or groundwater)
- Exposure routes and receptors
- Acceptable contaminant concentrations, commonly referred to as preliminary remediation goals

The following RAOs were identified for OT008:

- Minimize or eliminate direct worker exposure to COPCs
- Prevent direct contact of humans to soil containing PCBs in excess of 1 milligram per kilogram (mg/kg)
- Prevent direct contact of humans to soil containing POLs in excess of direct contact or ingestion criteria
- Minimize or eliminate direct ecological exposure to COPCs
- Reduce the potential for COPCs to migrate from site soil to any groundwater, surface waters, and/or sediments where human receptors could be exposed
- Reduce the potential for COPCs to migrate in surface water from the site

The cleanup levels selected for this site are chemical-specific ARARs, for the following COPCs:

- ADEC Method Two soil cleanup level for PCBs (1 mg/kg for direct contact)
- ADEC Method Two soil cleanup levels for POL (particularly DRO 10,250 mg/kg for ingestion)

Achievement of these criteria as RAOs will be necessary to be protective of HHE allowing continued use of the site for the USAF mission at Indian Mountain LRRS. These cleanup levels will also be protective of ecological receptors.

3.2 GENERAL RESPONSE ACTIONS

General response actions are broad categories of actions that can be undertaken to satisfy RAOs. An evaluation of general actions that may be effective in meeting RAOs has led to the selection of the following potential general response actions:

- No action
- In situ treatment
- Ex situ treatment
- Disposal
- Containment
- Land use controls

These general response actions (Sections 3.2.1 to 3.2.6) can be combined to form an effective remedy. Tables 3-1 and 3-2 summarize the general response actions and potentially applicable technologies for PCB and POL contamination, respectively.

Table 3-1
OT008 Site at Indian Mountain General Response Actions and Potentially Applicable Technologies for PCB-Contaminated Soil

General Response Actions	Technology Category	Potentially Applicable Technologies
No Action	None	None
In Situ Treatment	Physical/Chemical Treatment	Reductive Dechlorination by Nanoscale Zero-Valent Iron
		Solidification/Stabilization
		Vitrification
	Biological Treatment	Anaerobic Reductive Dechlorination
		Aerobic Biodegradation
		Phytotechnology
	Thermal Treatment	Thermal Desorption
Ex Situ Treatment	Physical/Chemical Treatment	Solvent Extraction
		Base-Catalyzed Decomposition Dehalogenation
		Glycolate Dehalogenation Process
		Solidification/Stabilization
		Onsite/Offsite Vitrification
		Grain-size separation
	Thermal Treatment	Onsite Thermal Desorption
		Onsite/Offsite Incineration
		Offsite Low-Temperature Thermal Desorption
Disposal	Physical	Offsite Disposal
Containment and Land Use Controls	Physical or regulatory	Permeable Cap
		Impermeable Cap
		Land Use Controls

Table 3-2
OT008 Site at Indian Mountain General Response Actions and Potentially Applicable Technologies for Petroleum-Contaminated Soil

General Response Actions	Technology Category	Potentially Applicable Technologies
No Action	None	No Action
In Situ Treatment	Physical/Chemical Treatment	Chemical Oxidation
		Solidification/Stabilization
		Phytotechnology
		Bioventing
		Aerobic Bioremediation
	Thermal Treatment	Thermal Desorption
Ex Situ Treatment	Physical/Chemical Treatment	Solvent Extraction
		Grain-Size Separation
		Solidification/Stabilization
		Landspreading
	Thermal Treatment	Onsite/Offsite Thermal Desorption
		Onsite/Offsite Incineration
Disposal	Physical	Offsite Disposal
Containment and Land Use Controls	Physical or regulatory	Permeable Cap
		Impermeable Cap
		Land Use Controls

3.2.1 No Action

The No Action general response action serves as a baseline for comparison with other general response actions.

3.2.2 In Situ Treatment

In situ treatment reduces long-term risks to HHE by destroying or immobilizing contaminants in place through a variety of physical, chemical, biological, or thermal processes. Generally contaminants are not brought above the ground surface, minimizing short-term risks; however, several in situ technologies for remediating PCBs, including thermal desorption, require the treatment of off-gas contamination. In addition, limited access to the contaminated media can reduce the effectiveness of in situ treatment options. Thermal treatment technology for PCB-contaminated soils is not available in Alaska.

3.2.3 Ex Situ Treatment

This general response action entails the removal and treatment of contaminated media. Treatment mechanisms may be physical, chemical, biological, or thermal processes. Removal of contaminated media can reduce long-term risks to HHE but requires extra care to minimize short-term risks associated with handling the contaminated media.

3.2.4 Disposal

Contaminated media can be removed and disposed of offsite at a location in compliance with the Resource Conservation and Recovery Act and Toxic Substances Control Act (TSCA), such as an approved hazardous waste landfill or an industrial waste landfill for PCBs. POL-contaminated soils can be characterized and disposed of in landfills in accordance with regulations.

3.2.5 Containment

Containment actions reduce risks to human health and environmental receptors by limiting possible exposure to contaminants. Containment can prevent either direct exposure (ingestion or inhalation) or indirect exposure (migration to groundwater). Containment technologies do not reduce the toxicity or volume of contaminants but may reduce contaminant mobility. For example, placing an impermeable cap over a landfill may be used to protect the underlying groundwater.

3.2.6 Land Use Controls

Land use controls include institutional controls and site controls. Institutional controls are legal or administrative measures taken to limit human exposure to contaminants by restricting access to and use of an area. Site controls include actions such as fencing and physically blocking access to the site. Institutional controls and site controls are commonly used as temporary measures to ensure the protection of human health until remedial actions are complete.

4.0 REMEDIAL TECHNOLOGIES IDENTIFICATION AND SCREENING

This section describes the identification and screening of remedial technologies to address PCB and POL contamination at the OT008 Site at Indian Mountain LRRS.

4.1 IDENTIFICATION OF REMEDIAL TECHNOLOGIES TO ADDRESS POLYCHLORINATED BIPHENYL-CONTAMINATED SOIL

Potentially applicable remedial technologies were identified based on Jacobs previous experience addressing PCB contamination at remote sites in Alaska, professional judgment, EPA databases (EPA 2008a), emerging technologies, technical reports, papers, and reference guides. For each general response action except No Action, remedial technologies and associated technologies considered potentially appropriate for the site were identified (Sections 4.1.1 to 4.1.5).

4.1.1 In Situ Treatment

In situ treatment technologies avoid the need to excavate soil. By treating soil in place, in situ treatment technologies minimize costs and worker exposure to contaminated soil. However, because soil is left in place, uniform treatment can be more difficult to achieve, particularly in areas with heterogeneous subsurface lithology or where the contaminant distribution is highly heterogeneous, such as at the OT008 site. In situ treatment technologies have been divided into three groups: physical/chemical, biological, and thermal treatment processes (Table 3-1).

Reductive Dechlorination by Nanoscale Zero-Valent Iron

Reductive dechlorination by nanoscale zero-valent iron is a chemical treatment that occurs as very reactive nano-sized metal particles pull electrons from the PCB molecules, allowing hydrogen to replace chloride. The result is a biphenyl product, confirming the complete dechlorination of PCB molecules. Nanoscale zero-valent iron is injected into PCB-contaminated sediments at 3 percent of the sediment mass. This technology targets aqueous-phase contamination in loose and sandy soil (Mikszewski 2004).

Solidification/Stabilization

Solidification/stabilization (S/S) is a physical/chemical treatment that refers to two closely related treatment processes that blend treatment reagents, such as cement or phosphate-induced metal stabilization, to impart physical and/or chemical changes to minimize the potential for contaminants to leach from the matrix and often to minimize the bioavailability of contaminants. Solidification, or encapsulation, is a physical and/or chemical process that changes the characteristics of the matrix to decrease the surface area exposed for leaching and/or coating the contaminated material with low-permeability material. This entraps the contaminated material within a granular or monolithic matrix. S/S is effective for treating many inorganic contaminants and some organic contaminants. This process can also be used over a range of soil moisture contents. However, the contaminants are not destroyed or removed, so long-term stewardship may be required, and there are uncertainties associated with long-term behavior of the waste form, so toxicity characteristic leaching procedure or synthetic precipitation leaching procedure or other leaching tests are necessary. In situ treatment can be performed by auger mixing (e.g., using a bucket auger and overlapping borings), shallow in-place mixing with heavy equipment, or possibly by high-pressure injection through borings.

The long-term stability of the S/S treatment is uncertain and depends on many factors, including site-specific factors. Therefore, treatability studies and/or pilot studies are performed to optimize the admixture, cement, and soil ratio.

Vitrification

In situ vitrification is a chemical/physical treatment that uses an electric current to melt soil or other earthen materials at above 1,600 degrees Celsius (°C), thereby immobilizing most inorganics into a glass-like material, and destroying organic pollutants by pyrolysis. This process is initiated through a path of conducting material (typically graphite) originating from the soil surface, extending into the boring. The conducting material allows the soil to get hot enough to reach its melting point and become conductive itself. The melting temperature of soil at Indian Mountain will vary depending on its content of alkali metal oxides. Water vapor and organic pyrolysis combustion products are captured in a vacuum-pressurized hood and drawn into an off-gas treatment system that cools and scrubs particulates and other pollutants from the gas before discharge (EPA 2005). The vitrification product is a chemically stable, leach-resistant, glass and crystalline material similar to obsidian or basalt rock. Depth of contamination in the soil requires additional logistics when using the technology in situ versus ex situ. Advantages to in situ vitrification include the following:

- There is no removal of contaminated material, which in turn reduces exposure risks
- Contaminated material remains in place, and therefore reduces the exposure risk from removing it (as with ex situ)
- It reduces waste streams.

However, in situ vitrification operates at an increased temperature than ex situ (EPA 1992) and this technology would require extensive permitting in the state of Alaska.

Anaerobic Reductive Dechlorination

In the 1980s, anaerobic reductive dechlorination was identified as a naturally occurring microbe-driven dechlorination process in PCB-contaminated sediment. Research has identified eight anaerobic microbial dechlorination processes using methanogens and sulfate-reducing bacteria. These processes replaced chlorine with hydrogen on the PCB molecule during dehalorespiration, a process in which microbes use halogenated compounds for energy synthesis. In order to remediate PCBs, a primer (a carbon source or ferrous sulfate) is added to the soil to stimulate dechlorinating bacterial populations. PCB dechlorination is inhibited because sulfate is more readily used as an electron acceptor for microbial respiration. Once the primer is consumed, sulfate-reducing bacteria attack PCB concentrations. These bacteria are naturally present in sediment and some soil (Mikszewski 2004).

Aerobic Biodegradation

Aerobic biodegradation breaks down PCBs by the catabolic “biphenyl pathway”, a four-step enzymatic process reducing PCBs into two nontoxic components. To facilitate the biodegradation process, moist, well-oxygenated soil is required, and nutrient supplements and dissolved oxygen must be added to stimulate onsite aerobic biodegradation (Mikszewski 2004).

Phytotechnology

Phytotechnology uses plants to remediate persistent organic pollutants and provides a polishing technology to address residual contamination in soil. Phytotechnology is specifically used to remediate PCBs through rhizosphere biodegradation (degradation in the soil surrounding the plant roots) and phytodegradation (metabolism of contaminants within plant tissues). Plant species that support rhizosphere biodegradation and phytodegradation of PCBs are introduced and cultivated in areas of residual contamination (ADEC 2005).

Thermal Desorption

This thermal technology includes conductive soil heating to enhance the removal of volatile subsurface contaminants. The most common in situ thermal desorption methods use steam or resistive heating to transfer heat to soil. Once high soil temperatures are reached, the organic contaminants either pyrolize or oxidize, if sufficient air is present. Following the controlled application of heat to a contaminated area, the desorbed contaminants are collected through vapor extraction and treated. Methods of vapor treatment vary but typically include condensation followed by activated carbon adsorption.

4.1.2 Ex Situ Treatment

A variety of ex situ processes are available for the treatment of excavated PCB-contaminated soil. Technologies are grouped as physical/chemical or thermal treatment processes and are discussed in the subsequent subsections.

Solvent Extraction

This technology is used for treatment of chlorinated organic contaminants. An organic chemical is used as a solvent to dissolve and extract contaminants from soil, and then the contaminated solvent is removed from the soil. This physiochemical process effectively reduces the volume of pollutant that must be treated or removed. In some solvent extraction procedures, physical separation techniques are used to screen and crush soil to enhance kinetics of the extraction process. Several extraction solvents and follow-on solvent treatment procedures are used to treat PCB-contaminated soil. Follow-on PCB solvent treatment procedures include incineration, chemical dehalogenation, gamma-ray irradiation, and sonic technology (EPA 2005).

Base-Catalyzed Decomposition Dehalogenation

This mobile technology was developed for remediating PCB-contaminated soil and can also treat other chlorinated and non-chlorinated organic contamination. Contaminated soil is screened, processed with a crusher and pug mill, and mixed with sodium bicarbonate, which promotes lower temperature desorption and partial destruction of chlorinated organics. The mixture is heated in a rotary reactor above 300 °C to decompose and volatilize the contaminants. Heat separates the halogenated compounds from the soil by evaporation. The contaminants are partially decomposed and the volatilized material is captured, condensed, and treated separately. The condensed liquid is then sent to a base-catalyzed decomposition liquid tank reactor, where reagents are added, and the solution is heated to break down contamination. Treated soil can be returned to the site (EPA 2005).

Glycolate Dehalogenation Process

This technology is used for treatment of chlorinated organic contaminants. Contaminated soil is screened, blended with an alkali metal hydroxide and polyethylene glycol reagent in a reactor, mixed, and heated. Resultant vapors are collected and condensed for treatment through activated carbon adsorbers and are one of three waste streams generated using this technology. The alkali metal hydroxide reacts with the halogen from the contaminant to form a nontoxic salt, and the glycol takes the location formerly occupied by the halogen in the PCB molecule, making it less hazardous. Both products are water-soluble and are removed along with residual reagents from the soil during the follow-up washing procedure. The soil is dewatered and tested for contaminant concentration. Any remaining contaminated soil will be reprocessed by the system (Rahuman et al. 2000).

Solidification/Stabilization

The ex situ S/S, process is the same as the in situ process discussed in Section 4.1.1. However, ex situ treatment of the soil would, in simple terms, mix the soil with aggregate, admixtures, and cement as determined in the treatability or pilot studies in the same general way that concrete is mixed. This process could require mobilizing mixing units (e.g., pugmills) and conveyance systems (e.g., screw conveyors) to the site to mix, hydrate, and process the treated soil. An advantage to ex situ treatment is control of the process. Additionally, pre-treatment, including removal of debris and addition of any admixture prior to introduction of the cement, can be performed more effectively than in situ processing.

The long-term stability of the S/S treatment is uncertain and depends on many factors, including site-specific factors. Therefore, treatability studies and/or pilot studies are performed to optimize the admixture, cement, and soil ratio.

Vitrification

Ex situ vitrification uses the same process as the in situ process described in Section 4.1.1. Advantages of ex situ vitrification include the following (EPA 1992):

- It is not limited to the area of electrode coverage, as with in situ
- There is increased control of combustion and the final product
- It is conducted at a lower temperature, which is more easily obtained and maintained than the higher temperature required for in situ treatment

Grain-Size Separation

Contaminated soil is screened based on grain size. Larger material is left onsite, and smaller sand and silt material is containerized for offsite disposal. Large rocks contain a disproportionately small amount of total contamination in soil because the contamination is only potentially present on the exposed surface, which is small compared to the entire volume of the rock. Therefore, disposing of sand and silt eliminates the majority of contamination. Omitting larger material from the process reduces the soil volume to be treated and removed.

Soil would either be screened through a physical separation method by employing simple stationary grizzlies and/or vibrating screens, or through a liquid separation process using an agitating wash (e.g., pugmill).

Onsite Thermal Desorption

Contaminated soil is excavated to meet cleanup levels, screened to remove rocks greater than 2 inches in particle size, and fed into a mobile indirect fire rotary treatment unit. The reactor is typically a horizontal cylinder that rotates around its axis. PCB-contaminated soil is partially vaporized under low vacuum conditions at temperatures from 450 to 800 °C. Vapors are incinerated and scrubbed following thermal desorption (ADEC 2005).

Offsite Low-Temperature Thermal Desorption

Contaminated soil is excavated to meet cleanup levels, screened to remove material greater than 2 inches in particle size, and fed into a heated drying unit with off-gas treatment subsystems to remove particulates and contaminants from the off-gas stream. Operating temperature is typically 90 to 320 °C. Contaminants are separated into the off-gas stream, condensed, and treated by carbon adsorption or secondary combustion. Decontaminated soil retains its physical properties when not heated to the higher end of the temperature range. Either hot-air vapor extraction or rotary unit treatment methods are used with this form of remediation.

Onsite Incineration

Onsite incineration is a widely used remediation technology to address PCB-contaminated soil. Contaminated soil is excavated, fed into an incinerator, and heated to a temperature above 1,400 °C. Under high temperature and in the presence of oxygen, contaminants volatilize and combust into innocuous substances (Rahuman 2000).

Offsite Incineration

This process is identical to onsite incineration. Contaminated soil is excavated, containerized, shipped offsite, fed into an incinerator, and heated to a temperature above 1,400 °C. Under high temperature and in the presence of oxygen, contaminants volatilize and combust into innocuous substances (Rahuman 2000).

4.1.3 Offsite Disposal

This technology requires excavation and offsite shipment of contaminated soil to a treatment, storage, and disposal facility (TSDF) for treatment or disposal. To accept PCB-contaminated soils at concentrations above 50 mg/kg, the TSDF must be permitted under TSCA.

4.1.4 Containment

Capping is a method of containment that minimizes the potential for exposure to contaminants by physically isolating and securing contaminated soil in place using barrier materials. Caps may be permeable or impermeable. Caps do not result in the destruction or removal of contaminants and are widely used to contain low levels of PCB contamination. The ideal area for an in situ capping is a stable, sheltered area not exposed to high erosive forces or upwelling from groundwater. Caps may be temporary or permanent and can be installed before permanent site closure to minimize contaminant migration until a better remedy is selected.

Permeable Cap

A permeable cap, which could be constructed using native soil suitable for re-vegetation, effectively prevents contaminant exposure due to direct contact; however, a permeable cap will not prevent exposure due to migration of contaminants to groundwater. Low or high permeability soil can be used to control the amount of water passing through the cap to the contained contamination. Disadvantages to a permeable cap include the following factors:

- Limited soil is available at the site, and harvesting may cause damage to nearby areas

- The cap could easily be damaged by burrowing animals, which could also be exposed to, and spread any remaining contamination
- Fill material would need to be tested to ensure that no additional contamination is introduced to the site
- Contamination would remain onsite, and potentially be re-exposed due to natural weathering and erosion
- The cap would require long-term maintenance.

Impermeable Cap

Impermeable caps can minimize direct contact with contaminants, and migration of soluble soil contaminants to groundwater. An impermeable cap can be constructed using bentonite, asphalt, concrete, or a synthetic liner. These cap materials drain water and prevent its passage to the containerized waste. Disadvantages to using an impermeable cap include the following:

- An adequate site-specific design would be required
- Long-term inspections, upkeep, and maintenance would be required

4.1.5 Land Use Controls

The two types of land use controls considered are institutional controls and site controls. Consideration of limited actions to address site contaminants applies to soil.

Institutional Controls

- Institutional controls are legal or administrative measures designed to prevent or reduce human or environmental exposure to contamination and to prevent activities that may result in increased exposure to, or the spread of, contamination. ADEC has provided guidance describing varying levels of institutional controls that are likely to be required based on the cleanup standard used at any given site. Table 4-1 presents Institutional Controls Quick Reference Guide–Soil, from the ADEC *Site Closure Policy and Procedures* (ADEC 2011).

Table 4-1
Institutional Controls Quick Reference Guide - Soil

Description	**Residual Contaminant Concentrations**		
	Representative contaminant levels greater than human health levels (Table B direct contact or inhalation) or site-specific ecological risk levels	Representative contaminant levels between the most conservative default cleanup levels and human health levels (Table B direct contact or inhalation); ecological risk mitigated or controlled.	Representative contaminant concentrations below the most stringent level for the applicable precipitation zone.
Implementation Mechanism or Instrument	**Generally enforceable:** Equitable servitude Restrictive covenant Management right assignment Compliance order by consent On-line availability of cleanup complete determination Other decision documents and land and activity use control details Default “reopener” and soil disposal notification conditions articulated in cleanup complete determination	**Generally informational:** In some cases informational controls such as a deed notice or other informational mechanism may be used if concerned about relocation of contaminated soil to a sensitive area. On-line availability of cleanup complete determination and any condition details Default “reopener” and soil disposal notification conditions articulated in cleanup complete determination	**Generally no institutional controls:** On-line availability of cleanup complete determination Default “reopener” and soil disposal notification conditions articulated in cleanup complete determination.
Monitoring and Reporting	Annual scheduled monitoring and reporting periods tracked on the ADEC database, possibly combined with ADEC inspections.	Variable monitoring and reporting requirements, based on individual site circumstances, tracked on the ADEC database; ADEC inspections infrequent or unnecessary.	Generally none.
Enforcement	Formal enforcement action discretionary for non-compliance depending onsite-specific factors.	Formal enforcement action usually unnecessary but other measures, such as a site inspection or responsible party meeting, may be appropriate for non-compliance.	Generally none.

Site Controls

Site controls are physical measures taken to prevent access to sites that may pose an unacceptable risk to human health. Site controls can also be used to prevent actions that could cause the spread of contaminants or to prevent vehicular access. Typical site controls include fences and barricades.

4.2 IDENTIFICATION OF REMEDIAL TECHNOLOGIES TO ADDRESS PETROLEUM, OIL, AND LUBRICANT-CONTAMINATED SOIL

Potentially applicable remedial technologies were identified based on previous experience addressing petroleum contamination at remote sites in Alaska, professional judgment, EPA databases (EPA 2008a), emerging technologies, technical reports, papers, and reference guides. For each general response action with the exception of No Action, remedial technologies and associated technologies considered potentially appropriate for the site were identified (Sections 4.2.1 to 4.2.5).

4.2.1 In Situ Treatment

In situ treatment technologies avoid the need to excavate soil. By treating soil in place, in situ treatment technologies minimize costs and worker exposure to contaminated soil. However, because soil is left in place, uniform treatment can be more difficult to achieve, particularly in areas with heterogeneous subsurface lithology or where the contaminant distribution is highly heterogeneous, such as the OT008 Site. In situ treatment technologies have been separated into three groups: physical/chemical, biological, or thermal treatment processes.

Chemical Oxidization

Chemical oxidation converts contaminants to nonhazardous or less toxic compounds that are more stable, less mobile, and/or inert. The oxidizing agents most commonly used are ozone, hydrogen peroxide, hypochlorites, chlorine, and chlorine dioxide. The method of applying the oxidizing agent depends on the agent but is designed to have as much surface contact with the soil, and hence the contaminant, as possible.

Solidification/Stabilization

S/S, as described in Section 4.1.1 can be performed by auger mixing (e.g., using a bucket auger and overlapping borings), shallow in-place mixing with heavy equipment, or possibly by high-pressure injection through borings.

The long-term stability of the S/S treatment is uncertain and depends on many factors, including site-specific factors. Therefore, treatability studies and/or pilot studies are performed to optimize the admixture, cement, and soil ratio.

Phytotechnology

Phytotechnology uses plants to remediate persistent organic pollutants and to address residual contamination in soil. Phytotechnology is specifically used to remediate POLs through rhizosphere biodegradation (degradation in the soil surrounding the plant roots) and phytodegradation (metabolism of contaminants within plant tissues). Plant species that support rhizosphere biodegradation and phytodegradation of POLs are introduced and cultivated in areas of residual contamination (ADEC 2005).

Bioventing

Bioventing stimulates the natural in situ biodegradation of any aerobically degradable compound in soil by providing oxygen to existing soil microorganisms. Bioventing is essentially an augmented in situ bioremediation process that uses low air flow rates to provide enough oxygen to sustain microbial activity. Bioventing can either inject or extract air.

Soil vapor vacuum extraction uses the differential vapor pressure of volatile organic compounds and some semivolatile organic compounds to strip the contaminants from the soil and then treat the off-gas to concentrate the contaminants for other treatment/disposal.

The effectiveness of both soil vapor vacuum extraction and bioventing are dependent on the radius of influence and can be affected by short-circuiting of subsurface airflow. Also, bioventing (both injection and extraction) can dry out the soil, causing a decrease in biological activity.

<u>Enhanced Aerobic Bioremediation</u>

Enhanced aerobic bioremediation increases the rate of natural attenuation processes occurring at the site by adding additional oxygen to the system. Petroleum hydrocarbons are degraded with no significant wastes (off-gasses or fluid discharges). Site-specific conditions such as soil permeability, available oxygen, and the biodegradability of the contaminants will affect the success rate of the bioremediation process.

<u>In Situ Thermal Desorption</u>

This technology includes conductive heating to enhance the removal of volatile subsurface contaminants. The most common in situ thermal desorption methods use steam or resistive heating to transfer heat to soil. Once high soil temperatures are reached, the organic contaminants either pyrolize or oxidize, if sufficient air is present. Following the controlled application of heat to a contaminated area, the desorbed contaminants are collected through vapor extraction and treated. Methods of vapor treatment vary but typically include condensation followed by activated carbon adsorption.

4.2.2 Ex Situ Treatment

A variety of ex situ processes are available for the treatment of excavated POL-contaminated soils. Technologies are grouped as physical/chemical, biological, or thermal treatment processes and are discussed below.

<u>Solvent Extraction</u>

Solvent extraction is a physiochemical process that effectively reduces the volume of pollutant that must be treated or disposed of by extracting the hydrocarbon contamination from the soil. In some solvent extraction procedures, physical separation techniques are used to screen and crush soil to enhance kinetics of the extraction process. The process uses heat (175 °C) and a solvent, such as methylene chloride/acetone (1:1).

Grain-Size Separation

Contaminated soil is screened based on grain size. Larger material is left onsite, and smaller sand and silt material is consolidated for offsite disposal. Large rocks contain a disproportionately small amount of total contamination in soil because the contamination is only potentially present on the exposed surface, which is small compared to the entire volume of the rock. Therefore, disposing of sand and silt eliminates the majority of contamination without removing the entire soil volume.

Solidification/Stabilization

S/S as discussed in Sections 4.1.1 and 4.1.2 works in the same manner for POL contamination.

Landspreading

Landspreading of contaminated soils allows for expedited occurrence of natural attenuation and biological degradation of organic contaminants. Landspreading consists of a one-time spread, compared to landfarming which requires continual upkeep and maintenance. The topography and hydrology should be evaluated for the site chosen for landspreading to minimize the potential for runoff from the contaminated soil.

Onsite Thermal Desorption

Contaminated soil is excavated to meet cleanup levels, screened to remove rocks greater than 2 inches in particle size, and fed into a mobile indirect fire rotary treatment unit. The reactor is typically a horizontal cylinder that rotates around its axis. POL-contaminated soil is partially vaporized under low vacuum conditions at temperatures between 450 and 800 °C. Vapors are incinerated and scrubbed following thermal desorption (ADEC 2005). However, at this site, POL only needs to be reduced below the direct contact or ingestion criteria (10,250 mg/kg for

DRO) so thermal desorption could be operated with lower temperatures and shorter residence times to minimize killing beneficial organisms in the soils necessary for re-vegetation.

Onsite Incineration

Onsite incineration is a widely used remediation technology to address POL-contaminated soil. Contaminated soil is excavated, fed into an incinerator, and heated to a temperature above 1,400 °C. Under high temperature and in the presence of oxygen, contaminants volatilize and combust into innocuous substances (Rahuman 2000). However at this site, POL only needs to be reduced below the direct contact or ingestion criteria (10,250 mg/kg for DRO), so thermal desorption could be operated with lower temperatures and shorter residence times to minimize killing beneficial organisms in the soils necessary for re-vegetation.

Offsite Incineration

This process is identical to onsite incineration. Contaminated soil is excavated, containerized, shipped offsite, fed into an incinerator, and heated to a temperature above 1,400 °C. Under high temperature and in the presence of oxygen, contaminants volatilize and combust into innocuous substances (Rahuman 2000).

Offsite Low-Temperature Thermal Desorption

Contaminated soil is excavated to meet cleanup levels, screened to remove material greater than 2 inches in particle size, and fed into a heated drying unit with off-gas treatment subsystems to remove particulates and contaminants from the off-gas stream. Operating temperature is typically 90 to 320 °C. Contaminants are separated into the off-gas stream, condensed, and treated by carbon adsorption or secondary combustion. Decontaminated soil retains its physical properties when not heated to the higher end of the temperature range. Either hot-air vapor extraction or rotary unit treatment methods are used with this form of remediation.

4.2.3 Offsite Disposal

This technology requires excavation, containerization, and offsite shipment of contaminated soil to an appropriately permitted landfill for disposal or to a permitted TSDF for treatment or disposal as necessary. The facility would be provided with waste characterization sample results to identify the nature of contamination to ensure that the waste meets the waste acceptance criteria of the facility.

4.2.4 Containment

Capping is a method of containment that minimizes the potential for exposure to contaminants by physically isolating and securing contaminated soil in place using barrier materials. Caps generally fall into one of two categories: permeable or impermeable. Caps do not result in the destruction or removal of contaminants. The ideal area for an in situ capping is a stable, sheltered area not exposed to high erosive forces or upwelling from groundwater. Caps may be temporary or permanent and can be installed before permanent site closure to minimize contaminant migration until a better remedy is selected.

Permeable Cap

A permeable cap, which could be constructed using native soil suitable for re-vegetation, effectively prevents contaminant exposure due to direct contact; however, a permeable cap will not prevent exposure due to migration of contaminants to groundwater. Low or high permeability soil can be used to restrict the amount of water passing through the cap to the contained contamination. Fill material would need to be tested to ensure that no contamination is introduced to the site.

Impermeable Cap

Impermeable caps can minimize direct contact to contaminants and migration of soluble soil contaminants to groundwater. An impermeable cap can be constructed using bentonite, asphalt, concrete, or a synthetic liner. These cap materials drain water and prevent its passage to the containerized waste.

4.2.5 Land Use Controls

The two types of land use controls considered are institutional controls and site controls. Consideration of limited actions to address site contaminants applies to soil.

Institutional Controls

Institutional controls are legal or administrative measures designed to prevent or reduce human or environmental exposure to contamination and to prevent activities that may result in increased exposure to, or the spread of, contamination. ADEC has provided guidance describing varying levels of institutional controls that are likely to be required based on the cleanup standard used at any given site. Table 4-1 presents the Institutional Controls Quick Reference Guide–Soil, from ADEC's *Site Closure Policy and Procedures* (ADEC 2011).

Site Controls

Site controls are physical measures taken to prevent access to sites that may pose an unacceptable risk to human health. Site controls can also be used to prevent actions that could cause the spread of contaminants or to prevent vehicular access. Typical site controls include fences and barricades.

4.3 SCREENING OF REMEDIAL TECHNOLOGIES

Following identification of the remedial and containment technologies appropriate for the OT008 Site at Indian Mountain LRRS, these technologies were screened based on their effectiveness, implementability, and cost. Technology screening is presented in Figures 4-1 and 4-2 and summarized in Tables 4-2 and 4-3.

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	TECHNOLOGY CATEGORY	REMEDIAL TECHNOLOGY	EFFECTIVENESS	IMPLEMENTABILITY	COST
In Situ Treatment	Physical/Chemical Treatment	Reductive Dechlorination by Nanoscale Zero-Valent Iron	Effective in laboratory scale studies and pilot studies; not a proven technology	Not readily implementable; PCB must be aqueous	High capital costs
		Vitrification	Effective at containing and treating contaminated soil	Not readily implementable; substantial site set-up and safety issues	High mob and electrical costs
		Solidification	Effective at containing contaminated soil	Not readily implementable; poorly graded soils reduce binding	Moderate costs
	Biological Treatment	Reductive Dechlorination by Nanoscale Zero-Valent Iron	Not effective as a stand-alone technology	Not readily implementable in dry soils	Moderate costs
		Aerobic Biodegradation	Not effective on PCB in pilot studies	Not readily implementable in dry soils	Moderate costs, including LTM and O&M
		Phytotechnology	Effective only for lower concentration/residual PCB	Not readily implementable; inappropriate climate	Low costs, but requires LTM and O&M
	Thermal Treatment	Thermal Desorption	Effective at reducing PCB concentration; requires post-treatment of offgas	Not readily implementable; substantial site set-up and safety issues	High mob and energy costs
Ex Situ Treatment	Chemical/Physical Treatment	Solvent Extraction	Moderately effective at reducing PCB concentrations	Not readily implementable; requires handling and treatment of solvents, substantial site set-up, and safety issues	High mob and treatment costs
		Base-Catalyzed Decomposition Dehalogenation	Moderately effective; requires post-treatment of offgas	Not readily implementable; substantial site set-up and safety issues	High mob and treatment costs
		Glycolate Dehalogenation Process	Moderately effective; requires post-treatment of offgas	Not readily implementable; substantial site set-up and safety issues	High mob and treatment costs
		Vitrification	Effective at containing and treating contaminated soil	Not readily implementable; substantial site set-up and safety issues	High mob and energy costs
		Grain Size Screening	Effective at reducing volume for treatment/disposal	Implementable	Moderate mob and treatment costs
		Solidification	Effective at containing contaminated soil	Implementable	Moderate mob and treatment costs
	Thermal Treatment	Onsite Thermal Desorption	Effective at reducing PCB concentration; requires post-treatment of offgas	Not readily implementable; substantial site set-up and safety issues	High mob and energy costs
		Onsite/Offsite Incineration	Effective at destroying PCB; requires post-treatment of offgas	Not readily implementable; substantial site set-up and safety issues for onsite; substantial waste transportation for offsite	High mob and energy costs
		Offsite Low Temperature Thermal Desorption	Effective at reducing PCB concentration; requires post-treatment of offgas	Implementable; substantial waste transportation from remote site	High waste transportation and treatment costs
Disposal		Offsite Disposal	Effective at removing contaminated soil from site	Implementable; substantial waste transportation from remote site	High waste transportation cost
Containment and Land Use Controls		Permeable Cap	Moderately effective at containing PCB and preventing exposure	Implementable	Moderate cost for long-term maintenance
		Impermeable Cap	Moderately effective at containing PCB, preventing exposure, and protecting groundwater	Not readily implementable; requires importing of material for cap to remote site	Moderate cost to import liner material and long-term maintenance
		Land Use Controls	Moderately effective at preventing exposure	Implementable; problematic to maintain over the long-term	Moderate cost for long-term maintenance
		Site Controls	Moderately effective at preventing exposure	Implementable; problematic to maintain over the long-term	Moderate cost for long-term maintenance

Legend

Indicates a technology option that will no longer be considered viable as a primary technology for the site

TECHNICAL SCREENING PROCESS FOR PCB CONTAMINATION
INDIAN MOUNTAIN LONG-RANGE RADAR SITE
INDIAN MOUNTAIN, ALASKA

JACOBS | DATE: 2 Apr. 2012 | PROJECT MANAGER: J. Wehrmann | FIGURE NO: 4-1

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	TECHNOLOGY CATEGORY	REMEDIAL TECHNOLOGY	EFFECTIVENESS	IMPLEMENTABILITY	COST
In Situ Treatment	Physical/Chemical Treatment	Chemical Oxidation	Effective at reducing POL concentration	Implementable; may require multiple treatments	High costs if multiple treatments are required
		Solidification	Effective at containing contaminated soil	Not readily implementable; poorly graded soils reduce binding	Moderate costs
	Biological Treatment	Aerobic Biodegradation	Effective in reducing POL concentrations	Not readily implementable in dry soils	Moderate costs, including LTM and O&M
		Phytotechnology	Effective in reducing POL concentrations	Not readily implementable; inappropriate climate	Low costs, but requires LTM and O&M
	Thermal Treatment	Thermal Desorption	Effective at destroying POL contamination; requires post-treatment of offgas	Not readily implementable; substantial site set-up and safety issues	High mob and energy costs
Ex Situ Treatment	Chemical/Physical Treatment	Solvent Extraction	Effective at reducing POL concentrations	Not readily implementable; requires handling and treatment of solvents, substantial site set-up, and safety issues	High mob and treatment costs
		Grain Size Screening	Effective at reducing volume for treatment/disposal	Implementable	Moderate mob and treatment costs
		Solidification	Effective at containing contaminated soil	Implementable	Moderate mob and treatment costs
		Landspreading	Effective at reducing POL concentrations	Implementable	Low costs
	Thermal Treatment	Onsite Thermal Desorption	Effective at destroying POL contamination; requires post-treatment of offgas	Not readily implementable; substantial site set-up and safety issues	High mob and energy costs
		Onsite/Offsite Incineration	Effective at destroying POL contamination; requires post-treatment of offgas	Not readily implementable; substantial site set-up and safety issues for onsite; substantial waste transportation for offsite	High mob and energy costs
		Offsite Low Temperature Thermal Desorption	Effective at reducing POL concentration; requires post-treatment of offgas	Implementable; substantial waste transportation from remote site	High waste transportation and treatment costs
Disposal		Offsite Disposal	Effective at removing contaminated soil from site	Implementable; substantial waste transportation from remote site	High waste transportation cost
Containment and Land Use Controls		Permeable Cap	Moderately effective at containing POL and preventing exposure	Implementable	Moderate cost for long-term maintenance
		Impermeable Cap	Moderately effective at containing POL, preventing exposure, and protecting groundwater	Not readily implementable; requires importing of material for cap to remote site	Moderate cost to import liner material and long-term maintenance
		Land Use Controls	Moderately effective at preventing exposure	Implementable; problematic to maintain over the long-term	Moderate cost for long-term maintenance
		Site Controls	Moderately effective at preventing exposure	Implementable; problematic to maintain over the long-term	Moderate cost for long-term maintenance

Legend

Indicates a technology option that will no longer be considered viable as a primary technology for the site

TECHNICAL SCREENING PROCESS FOR POL CONTAMINATION
INDIAN MOUNTAIN LONG-RANGE RADAR SITE
INDIAN MOUNTAIN, ALASKA

JACOBS | DATE: 2 Apr. 2012 | PROJECT MANAGER: J. Wehrmann | FIGURE NO: 4-2

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Table 4-2
OT008 Site at Indian Mountain Long Radio Relay Station Technology Screening for PCB-Contaminated Soils

General Response Action	Technology Process Option	Effectiveness	Implementability	Cost	Technology Screening
No Action	No Action	○	●	●	Retained[1]
In Situ Treatment	Reductive Dechlorination by Nanoscale Zero-Valent Iron	○	○	○	Eliminated
	Vitrification	●	○	○	Eliminated
	Solidification	●	○	●	Eliminated
	Anaerobic Reductive Dechlorination	○	○	●	Eliminated
	Aerobic Biodegradation	○	○	●	Eliminated
	Phytotechnology	○	●	●	Eliminated
	Thermal Desorption	●	○	○	Eliminated
Ex Situ Treatment	Solvent Extraction	○	○	○	Eliminated
	Base-Catalyzed Decomposition Dehalogenation	○	○	○	Eliminated
	Glycolate Dehalogenation Process	○	○	○	Eliminated
	Onsite/Offsite Vitrification	●	○	○	Eliminated
	Solidification	●	●	●	Retained
	Grain-Size Screening	●	●	●	Retained
	Onsite Thermal Desorption	●	○	○	Eliminated
	Onsite/Offsite Incineration	●	○	○	Eliminated
	Offsite Low-Temperature Thermal Desorption	●	●	○	Eliminated
Disposal	Offsite Disposal	●	●	○	Retained
Containment and Land Use Controls	Permeable Cap	○	●	●	Eliminated
	Impermeable Cap	○	○	○	Eliminated
	Institutional Controls	○	○	●	Eliminated
	Site Controls	○	○	●	Eliminated

Notes:
[1] This is retained to establish baseline conditions
● Effective, implementable, or low cost
○ Not effective, not implementable, or high cost

Table 4-3
OT008 Site at Indian Mountain Long Radio Relay Station Technology Screening for POL-Contaminated Soils

General Response Action	Technology Process Option	Effectiveness	Implementability	Cost	Technology Screening
No Action	No Action	○	●	●	Retained[1]
In Situ Treatment	Chemical Oxidation	●	○	○	Eliminated
	Aerobic Bioremediation	●	○	○	Eliminated
	Phytotechnology	●	○	○	Eliminated
	Thermal Desorption	●	○	○	Eliminated
	Solidification	●	○	●	Eliminated
Ex Situ Treatment	Grain-Size Screening	●	●	●	Retained
	Solidification	●	●	●	Retained
	Landspreading	●	●	●	Retained
	Solvent Extraction	●	○	○	Eliminated
	Onsite Thermal Desorption	●	○	○	Eliminated
	Offsite Thermal Desorption	●	●	○	Eliminated
	Onsite/Offsite Incineration	●	○	○	Eliminated
	Offsite Low-Temperature Thermal Desorption	●	●	○	Eliminated
Disposal	Offsite Disposal	●	●	○	Retained
Containment and Land Use Controls	Permeable Cap	○	●	●	Eliminated
	Impermeable Cap	○	○	○	Eliminated
	Institutional Controls	○	○	●	Eliminated
	Site Controls	○	○	●	Eliminated

Notes:
[1] This is retained to establish baseline conditions
● Effective, implementable, or low cost
○ Not effective, not implementable, or high cost

5.0 REMEDIAL ALTERNATIVES TO ADDRESS POLYCHLORINATED BIPHENYL-CONTAMINATED SOIL

Remedial alternatives for PCB-contaminated soil at the OT008 Site at Indian Mountain LRRS have been developed for detailed and comparative evaluation in this report. The alternatives, listed below, were developed from retained remediation technologies based on the RAOs, general response actions identified for OT008, and the screening of potential remedial technologies described in Section 4.0.

Implementation of these alternatives would include strict documented procedures that would be audited and evaluated during execution of the work to ensure that workers, individuals from the local community intermittently visiting the site, and the environment are protected from any potential risks.

5.1 DEVELOPMENT OF REMEDIAL ALTERNATIVES FOR POLYCHLORINATED BIPHENYL-CONTAMINATED SOIL

To develop a remedial strategy for PCB-contaminated soil, a conceptual understanding of how the contamination is divided among the media and site was needed. To evaluate this, estimates of contaminant mass within each medium at the site were developed with the following parameters:

- Analytical and screening data for PCBs from the 2011 investigation and previous investigations were evaluated (USAF 2012).
- Volumes of PCB-contaminated media were estimated (see Table 1-1, Section 1.0) based on the PCB cleanup values of 1 mg/kg, 25 mg/kg, and 50 mg/kg depending on the requirements for each alternative
- An estimated density of the soil of 1.5 tons per cubic yard was used to convert volume estimates to weight estimates.

Based on initial screening and site-specific conditions, the following alternatives were retained for detailed analysis for PCB-contaminated soils:

- PCB Alternative 1: No Action
- PCB Alternative 2: Offsite Disposal of PCB-Contaminated Soil Greater Than 1 mg/kg

- PCB Alternative 3: Grain-Size Separation and Offsite Disposal of PCB-Contaminated Soil Greater Than 1 mg/kg
- PCB Alternative 4: Grain-Size Separation, Offsite Disposal of PCB-Contaminated Soil Greater Than 25 mg/kg, and Solidification and Capping of PCB-Contaminated Soil Between 1 mg/kg and 25 mg/kg

Each alternative, other than the No Action Alternative, would include excavation and offsite treatment and disposal of soils with PCB concentrations greater than 50 mg/kg as PCB remediation waste in accordance with TSCA.

5.1.1 PCB Alternative 1: No Action

Under the No Action Alternative, no activities would be undertaken to treat or remove the contamination present or to prevent exposure to the contamination. No monitoring would be conducted. A No Action Alternative is required for consideration under the NCP [40 CFR 300.430(e)(6)] and serves as a baseline against which other alternatives can be compared. Figures 5-1 through 5-4 represent contamination that would remain onsite under the No Action Alternative.

5.1.2 PCB Alternative 2: Offsite Disposal of PCB-Contaminated Soil Greater Than 1 mg/kg

PCB Alternative 2 includes excavation and offsite disposal of PCB-contaminated soil greater than 1 mg/kg site at a permitted landfill (Figures 5-5 through 5-7). PCB-contaminated soil with concentrations greater than 50 mg/kg would be segregated, handled, and disposed of in accordance with TSCA [40 CFR §761.61(a)(5)(i)(B)(2)(iii)] as bulk PCB remediation waste. All excavation and soil handling activities would be monitored, controlled, and performed to minimize potential migration of PCB-contaminated soil and particulates. Appropriate personal protective equipment (PPE) would be used to protect site workers. Waste characterization samples would be collected and analyzed to ensure that the PCB-contaminated soils meet the waste acceptance criteria of the designated disposal facility. Offsite disposal of PCB-contaminated soils would entail containerizing the soil, transporting the containers to the Lower Camp, transporting the containers by air charter to Anchorage, transferring the containers into a rear-loading container, transporting the container by land by truck or rail from the airport to the barge, barging the container to the contiguous U.S., and transporting by land using truck or railways to the authorized PCB disposal facility.

Confirmation soil samples would be collected from the excavation and analyzed to provide adequate confidence that residual PCB concentrations in the remaining soils are less than the cleanup levels of 1 mg/kg. The excavation would then be backfilled with clean soil materials.

5.1.3 PCB Alternative 3: Grain-Size Separation and Offsite Disposal of PCB-Contaminated Soil Greater Than 1 mg/kg

PCB Alternative 3 would include excavation as described in PCB Alternative 2, followed by mechanical screening of all PCB-contaminated soil between 1 mg/kg and 10 mg/kg for separation of grain sizes based on the results of a pilot test (Figures 5-5 through 5-7). The pilot test would be conducted using a portion of the soils with known PCB concentrations from the site to indicate which sized materials are between 1 mg/kg and 10 mg/kg for onsite backfilling and which sized material requires offsite disposal. The pilot study would help identify the appropriate screening requirements and would also help identify the estimated volume reduction. However, waste characterization of the soils during remediation would still be performed to verify compliance with the disposal facility waste acceptance criteria or permissible use as onsite backfill.

The grain-size separation process would include performing a dry physical separation using dust control measures as appropriate to minimize migration of PCB-contaminated particulates and potential worker inhalation exposure. The physical separation process would include mechanical separation devices, such as stationary grizzly screens and powered vibratory screens, which would be mobilized to the site; soils would be handled using heavy equipment and mechanical means to minimize potential worker exposures. Larger material initially screened will be re-screened as necessary based on visual observation. Once screening is complete, oversized soil material would be left onsite as backfill while the finer-grained material would be containerized and transported for offsite disposal.

All fine soils and sands contaminated with PCBs above 1 mg/kg and less than 10 mg/kg that were segregated during the grain-size separation process, and all soil contaminated with PCBs with a concentration exceeding 25 mg/kg and below 50 mg/kg would be excavated, staged, tracked, and transported to an appropriate offsite landfill for disposal. All soil contaminated with PCBs with a concentration of equal to or greater than 50 mg/kg would be excavated, handled, manifested, transported, treated, and disposed of in accordance with TSCA requirements as bulk PCB remediation waste. Large fill material rejected through the screening process would be visually checked for the potential to hold excessive amounts of contamination and representative samples would be collected and analyzed to verify that these materials do not exceed the cleanup criterion for PCBs. Materials that may hold excessive contamination may include shales, schists, limestone, pumice, or other types of porous rocks. Soil “clumps” greater than 2 inches, including but not limited to silt/clay compounds or frozen tundra and peat material would be transported to an appropriate landfill for disposal. Large non-rock type material would be transported to an appropriate landfill for disposal. Oversize material, along with clean offsite material, would be used as backfill.

5.1.4 PCB Alternative 4: Grain-Size Separation and Offsite Disposal of PCB-Contaminated Soil Greater Than 25 mg/kg, and Solidification and Capping of PCB-Contaminated Soil Between 1 mg/kg and 24.9 mg/kg

PCB Alternative 4 would include screening all PCB-contaminated soil above 1 mg/kg for a variety of grain sizes similar to PCB Alternative 3 introduced in Section 5.1.3 (Figures 5-5 through 5-7). Once screening is complete, large material would be left onsite as backfill. All fine soils and sands contaminated with PCBs above 25 mg/kg would be excavated, staged, tracked, and transported to an appropriate landfill for disposal; soil contaminated with PCBs with a concentration exceeding 50 mg/kg would be handled, manifested, transported, treated, and disposed of in accordance with TSCA requirements as bulk PCB remediation waste. Soils contaminated with PCBs greater than 1 mg/kg but less than 25 mg/kg would be solidified and buried onsite under a clean cap. The cap covering the area of solidified PCB contamination will be suitable for re-vegetation. The cap will be constructed of a material designed to prevent exposure of humans and the environment to PCBs; and of sufficient strength and durability to withstand the use of the surface that is exposed to the environment.

Solidification of PCB-contaminated soils less than 25 mg/kg would include mixing the soil with appropriate admixtures and cementitious material, such as portland cement and/or pozzolans (e.g., fly ash), and hydrated. Mechanical mixers, such as pugmills or drum mixers mobilized to the site, would be used to batch process soils for solidification. Handling and mixing of soils, cementitious materials, and admixtures would be performed using heavy equipment, mechanical means, and appropriate dust controls to minimize potential worker exposures. Batches of solidified PCB-contaminated soil would initially be poured into trenches, and upon adequate curing, moved for use as backfill in the excavation.

As discussed in Section 5.1.3, large screened material would be visually checked for the potential to hold excessive amounts of contamination. Oversize material, along with the solidified monoliths and clean soil, would be used to backfill the excavation upon verification that confirmation soil samples provide adequate statistical confidence that the floor and sidewalls of the excavation meet the cleanup levels.

Five-year reviews per CERCLA guidance would be conducted by the landowner or landowner-representative to ensure the protectiveness of the remedy. Any damage to the cap resulting in a substantive amount of solidified material being exposed to the environment would create a need to reevaluate the selected remedy.

5.2 SCREENING OF ALTERNATIVES FOR POLYCHLORINATED BIPHENYL-CONTAMINATED SOIL

In this section, the alternatives presented in Section 5.1 are screened based on effectiveness, implementability, and cost.

5.2.1 Screening of PCB Alternative 1: No Action

The No Action Alternative is required by the NCP and serves as a baseline against which other alternatives can be compared. The No Action Alternative does not include provisions for environmental monitoring, controlling the migration of contaminants, reducing contaminant concentrations, or preventing human or ecological exposure.

This alternative would not be protective of human health or the environment. PCBs are recalcitrant and relatively immobile, and their concentrations are not expected to decrease at a rate that would allow the RAOs to be achieved in a reasonable timeframe. The potential for unacceptable human or environmental exposure to site contaminants would remain for as long as contaminant concentrations remain above cleanup levels.

No technical obstacles are involved with implementing the No Action Alternative, but administrative approval is unlikely. No costs are associated with this alternative.

This alternative will receive detailed analysis in accordance with 40 CFR 300.430(e)(6) for a baseline comparison to other alternatives.

5.2.2 Screening of PCB Alternative 2: Offsite Disposal of PCB-Contaminated Soil Greater Than 1 mg/kg

Offsite disposal is an effective remedial action for PCB-contaminated soil. This remediation alternative would require the excavation and shipment of all soil contaminated with PCBs above 1 mg/kg. If implemented, this alternative would meet the RAOs and effectively remove all PCB-contaminated soil above ADEC criteria.

The primary challenge involved with implementing this alternative would be handling and transporting the volume of soil with PCB contamination above 1 mg/kg. These soils would require containerization and transportation meeting TSCA regulations. The remoteness of the project site would require all soils to be transported offsite by air transport which adds substantial logistics and costs. Alaska does not have disposal facilities that will accept PCB-contaminated soils, therefore all soil removed would then have to be shipped to a regulated and permitted facility in the contiguous U.S. Due to the extreme climate at the site, there is a limited season when excavation of these soils can occur, adding a critical timing component to implementation. Again, due to the location of the site, excavation equipment and personnel would have to be flown to the site.

The largest proportion of cost for offsite disposal is primarily related to transportation of the soils offsite and out of Alaska.

This alternative has been retained for further consideration because of its effectiveness and implementability.

5.2.3 Screening of PCB Alternative 3: Grain-Size Separation and Offsite Disposal of PCB-Contaminated Soil Greater Than 1 mg/kg

Grain-size separation and offsite disposal is an effective remedial action for PCB-contaminated soil. This remediation option would include screening all PCB-contaminated soil above 1 mg/kg based on grain size as determined from a pilot study. If implemented, this alternative would meet the RAOs and require no additional action for PCB-contaminated soil.

Grain-size separation is an effective way of reducing soil volume while removing the soil contamination greater than the cleanup level. Compared to complete offsite disposal (PCB Alternative 2), the contaminated volume requiring offsite disposal would be decreased by an estimated 25 percent and the amount of backfill required would also be minimized. The approximate percent reduction is based on estimation of rocks greater than 2 inches as documented during the 2011 RI sampling effort (USAF 2012) and based on a similar operation at Anvil Mountain near Nome, Alaska. A pilot study, in which samples from the site would be screened and a sample from each division of grain size would be analyzed for PCBs, would also provide additional information about the percent volume reduction anticipated if this alternative is selected for consideration in the proposed plan subsequent to completion of this FS.

Although reduced, the volume of soil above 1 mg/kg for offsite disposal is still the primary challenge involved with implementing this alternative. Soil would require screening for categorization, containerization, and transportation. As with offsite disposal, scheduling of the excavation, offsite air transport, and barge services out of Alaska would complicate logistics.

The cost for offsite disposal is primarily related to transportation of the soils offsite and out of Alaska.

This alternative has been retained for further consideration because of its effectiveness and implementability.

5.2.4 Screening of PCB Alternative 4: Grain-Size Separation and Offsite Disposal of PCB-Contaminated Soil Greater Than 25 mg/kg, and Solidification and Capping of PCB-Contaminated Soil Between 1 mg/kg and 24.9 mg/kg

Grain-size separation and offsite disposal is an effective remedial action for PCB-contaminated soil as discussed in Section 5.2.3; it differs from PCB Alternative 3 in that it solidifies the PCB-contaminated soils with concentrations less than 25 mg/kg. This remediation option would include screening all PCB-contaminated soil above 1 mg/kg PCBs based on grain size as determined from a pilot study. All soils with PCB concentrations greater than 25 mg/kg would be disposed of offsite while soils less than 25 mg/kg but greater than 1 mg/kg would be solidified and used as backfill in the excavation. The treated area would be covered with a soil cap constructed to prevent exposing humans and the environment to the solidified PCBs. The cap will be of sufficient strength and durability to withstand the use of the surface that is exposed to the environment. It will also be suitable for re-vegetation. Five-year reviews per CERCLA guidance would be conducted by the landowner or landowner-representative to ensure the protectiveness of the remedy. Any damage to the cap resulting in a substantive amount of solidified material being exposed to the environment would create a need to reevaluate the selected remedy.

If implemented, this alternative would rapidly obtain the RAOs and require no additional action for PCB-contaminated soil.

As indicated for PCB Alternative 3 (Section 5.2.3), grain-size separation is an effective way of reducing soil volume while removing soil contamination greater than the cleanup value. Compared to complete offsite disposal (PCB Alternative 2), the contaminated volume requiring offsite disposal would be decreased and the amount of backfill required would also be decreased resulting in an overall decrease in the duration of construction activities and a reduction in cost. The solidification of PCB-contaminated soils with PCB concentrations less than 25 mg/kg would reduce the volume of soil requiring offsite disposal by approximately 90 percent, which would substantially reduce the cost of this alternative.

Although reduced, the remaining volume of soil above 25 mg/kg is still the primary challenge and cost involved with implementing this alternative. Soil would require screening for categorization, containerization, and transportation for offsite disposal or for solidification. Scheduling would be based on the efficiency of the soil screening process, and seasonality of barge service could impact logistics. The solidification process can have challenges, particularly in a remote location; additionally, long-term stability of the solidified monolithic structure can be uncertain, although a pilot or treatability study would be performed to optimize the process and final structure to improve confidence of implementability and long-term performance.

This alternative has been retained for further consideration because of its effectiveness and implementability.

5.2.5 Summary of Screening Results for Polychlorinated Biphenyl-Contaminated Soil

Table 5-1 compares the effectiveness, implementability, and cost of the screened alternatives.

Table 5-1
Screening of Alternatives for Polychlorinated Biphenyl-Contaminated Soil

Remedial Alternative	Effectiveness	Implementability	Cost	Retained for Detailed Analysis?
PCB 1: No Action	○	○	●	Yes
PCB 2: Offsite Disposal of PCB-Contaminated Soil above 1 mg/kg	●	◐	○	Yes
PCB 3: Grain-sized screening and offsite disposal for all PCB-Contaminated Soil above 1 mg/kg	●	◐	◐	Yes
PCB 4: Grain-sized screening and offsite disposal for all PCB-Contaminated Soil above 25 mg/kg, and onsite solidification of PCB-soils greater than 1 mg/kg but less than 25 mg/kg	●	◐	○	Yes

Notes:
● Highly effective, easy to implement, or low cost
◐ Somewhat effective, difficult to implement, or moderate cost
○ Not effective, very difficult to implement, or high cost

5.3 DETAILED ANALYSIS OF ALTERNATIVES FOR POLYCHLORINATED BIPHENYL-CONTAMINATED SOIL

This section evaluates remedial alternatives to address PCB-contaminated soil. Based on the screening presented in Section 5.2, the following alternatives were selected for detailed analysis:

- PCB Alternative 1: No Action
- PCB Alternative 2: Offsite Disposal of PCB-Contaminated Soil Greater Than 1 mg/kg
- PCB Alternative 3: Grain-Size Separation and Offsite Disposal of PCB-Contaminated Soil Greater Than 1 mg/kg
- PCB Alternative 4: Grain-Size Separation, Offsite Disposal of PCB-Contaminated Soil Greater Than 25 mg/kg, and Solidification and Capping of PCB-Contaminated Soil Between 1 mg/kg and 25 mg/kg

Sections 5.3.1 through 5.3.4 present the detailed analysis for each selected alternative. Section 5.3.5 presents comparison of the alternatives and their ability to achieve NCP criteria.

5.3.1 PCB Alternative 1: No Action

Under the No Action Alternative, no activities would be undertaken to remove or treat the contamination present or to otherwise prevent or minimize the potential for exposure to the contamination. No monitoring would be conducted. Table 5-2 summarizes the ability of this alternative to meet the NCP criteria; values are based on the rating system described in Section 2.5.

Table 5-2
Evaluation of PCB Alternative 1

Evaluation Criteria	Value
Overall Protection of Human Health and the Environment	Fail
Compliance with ARARs	Fail
Long-Term Effectiveness and Permanence	0
Reduction in Toxicity, Mobility, and Volume through Treatment	0
Short-Term Effectiveness	1
Implementability	5
Cost	$0

Note:
Ratings were developed according to 40 CFR 300.430(e)(9)(iii). Refer to Section 2.5 for an explanation of the ratings.
For definitions, see the Acronyms and Abbreviations section.

PCB Alternative 1 – Overall Protection of Human Health and the Environment

This alternative would not be protective of human health or the environment over the short or long term. The potential for unacceptable human or environmental exposure to site contaminants would remain for as long as contaminants concentrations remain above risk-based cleanup levels, This alternative does not remove or remediate PCB contamination, and does not include institutional or site controls to prevent or minimize the potential for human contact with the contamination.

Therefore, the No Action Alternative would not meet this threshold criterion and would not be an acceptable alternative.

PCB Alternative 1 – Compliance with ARARs

There is a high risk of human contact with site contaminants at concentrations above cleanup levels because no action of any kind would be taken to mitigate the risks identified at this site. Thus, this alternative fails to comply with chemical-specific ARARs (Appendix A).

PCB Alternative 1 – Long-Term Effectiveness and Permanence

PCBs are recalcitrant and relatively immobile, and their concentrations are not expected to decrease significantly over a reasonable time without some type of remedial action. This alternative would not be effective as a treatment for PCB-contaminated soil.

PCB Alternative 1 – Reduction of Toxicity, Mobility, or Volume through Treatment

This alternative would not treat, remove, or immobilize contamination.

PCB Alternative 1 – Short-Term Effectiveness

Implementation of this alternative would not involve intrusive activities or other actions that would subject workers or members of the community to short-term risks. Implementation would have no negative impacts on community or worker health and safety or environmental quality. However, natural processes would not reduce contaminants to concentrations below those presented in the RAOs within a reasonable timeframe.

PCB Alternative 1 – Implementability

No technical obstacles would be involved with implementing the No Action Alternative.

PCB Alternative 1 – Costs

No costs are associated with this alternative.

5.3.2 PCB Alternative 2: Offsite Disposal of Polychlorinated Biphenyl-Contaminated Soil Above 1 mg/kg

Table 5-3 summarizes the ability of PCB Alternative 2 to satisfy the objectives established by the NCP. The rationale for the values in Table 5-3 is presented below.

Table 5-3
Evaluation of PCB Alternative 2

Evaluation Criteria	Value
Overall Protection of Human Health and the Environment	Pass
Compliance with ARARs	Pass
Long-Term Effectiveness and Permanence	5
Reduction in Toxicity, Mobility, and Volume through Treatment	2
Short-Term Effectiveness	4
Implementability	3
Cost (in millions)	$11.6

Note:
Ratings were developed according to 40 CFR 300.430(e)(9)(iii). Refer to Section 2.5 for an explanation of the ratings.
For definitions, see the Acronyms and Abbreviations section.

PCB Alternative 2 – Overall Protection of Human Health and the Environment

If properly implemented, this alternative would effectively protect HHE by removing the source of the contamination entirely from the site and appropriately disposing of the material at a permitted landfill where the PCB-contaminated soils would be isolated to protect HHE. Soil containing PCB-contamination exceeding 1 mg/kg would be removed and shipped offsite for disposal leaving no PCB contamination onsite above risk-based cleanup levels, allowing the RAOs to be obtained at project completion. Consequently, PCB Alternative 2 would meet this threshold criterion and would be an acceptable possible alternative.

Excavation of the soils containing PCB contamination at levels above risk-based cleanup levels would remove the source of the risk at the site. Statistically-based confirmation soil sampling representative of the remaining soil would be performed upon completion of the excavation to ensure that an adequate level of confidence was attained that any residual site risk was within an acceptable range. No administrative controls would be necessary because all residual soil would be shown to be less than the risk-based criteria. These actions and limitations would ensure long-term overall protection of HHE at the site.

The excavated soil would be transported and disposed of directly (i.e., without treatment) at a permitted landfill that has a liner, a leachate collection and control system, and is subject to long-term monitoring of the groundwater. Disposal of these PCB-contaminated soils in a lined and permitted landfill with leachate collection and subject to LTM would be protective of HHE near the landfill.

Short-term overall protection of HHE at the site would be controlled through strict procedures documented in work plans for any implementation of this alternative. For instance, dust suppression and control measures would be implemented during excavation of the PCB-contaminated soils to mitigate potential airborne dispersion of contaminated particulates. Additionally, appropriate PPE for workers would be required and site controls would be implemented to protect HHE in the short term. Risks from transportation of the waste would be controlled.

PCB Alternative 2 – Compliance with ARARs

This alternative would obtain chemical-specific ARARs (Appendix A) throughout the site. Environmental impacts associated with offsite disposal would be relatively minor since little vegetation exists at Site OT008. This alternative would therefore achieve chemical-specific ARARs for the PCB-contaminated soils at the site by removing any soils with concentrations greater than the risk-based cleanup levels. This alternative would be implemented with appropriate controls to comply with any location-specific and/or action-specific ARARs. Therefore, the offsite disposal alternative would meet this threshold criterion and would be an acceptable possible alternative.

The chemical-specific ARARs would include the direct contact exposure pathway for soils based on the present worker scenario. Disposal of the excavated PCB-contaminated soil in an independently operated offsite permitted landfill would presumably comply with all potential

ARARs because the waste soil would only be disposed of in the landfill provided that the waste characterization data comply with the facility waste acceptance criteria. Offsite disposal would ensure that any proposed landfill is presently operating in compliance with its permit, that the facility has no active or unresolved notice of violation (NOV), and that the waste meets the waste acceptance criteria. Note that soils with PCB concentrations in excess of 50 mg/kg would be handled, manifested, transported, treated, and disposed of as bulk PCB remediation waste in accordance with TSCA requirements.

PCB Alternative 2 – Long-Term Effectiveness and Permanence

The long-term effectiveness and performance goals would be completely met under this alternative because the source of the risk to HHE above the cleanup levels for PCB in soil would be removed from the site. This would provide a permanent remedy ensuring long-term protection of HHE.

Disposal of the soils at an offsite landfill would be effective in the long term because a landfill appropriately permitted for PCB-contaminated soil, including for bulk PCB remediation waste greater than 50 mg/kg, is designed for long-term protection of HHE at and near the landfill. The required landfill liner, leachate collection system, daily cover requirements, restrictions on acceptable waste characteristics (e.g., chemical and physical constraints), and other operational requirements in the permit provide assurance that long-term protectiveness of HHE will be maintained.

PCB Alternative 2 – Reduction of Toxicity, Mobility, or Volume through Treatment

Toxicity, mobility, and volume of PCB contamination would not be reduced through treatment under this alternative. Instead, the volume of PCB-contaminated soil would be reduced at the site and the mobility of the PCB in the soil at the site would be reduced by removing the soil from the OT008 site for disposal in an appropriate offsite landfill. The mobility of the PCB-contaminated soil within the landfill would be reduced through isolation in the lined waste cell of the offsite landfill, which would also include use of leachate collection/treatment systems, the landfill cap, monitoring, site controls, etc.

PCB Alternative 2 – Short-Term Effectiveness

A possibility exists of short-term exposure risk for workers associated with excavation of PCB-contaminated soil and associated with transportation of the soil to an offsite disposal facility. However, with careful implementation this alternative would be protective in the short term (during the remedial action).

Implementation of this alternative would include strict documented procedures that would be audited and evaluated during execution of the work to ensure that workers, individuals from the local community intermittently visiting the site, and the environment are protected from any potential risks. The time required until the remedy is in place (i.e., all PCB-contaminated soil is excavated and disposed of offsite) would be within a single working season of less than four months from mobilization to demobilization. The excavation of the soil and the subsequent stockpiling, handling, and loading of soil containers into haul trucks, transport of the containers to the Lower Camp, transport by air from the site, loading of the waste containers into rear-loading containers at the airport and overland transport to the barge dock, transport by barge to the contiguous U.S., overland transport from the barge to the disposal facility, and unloading of the waste containers from the rear-loading containers into the landfill each present risks to workers as well as potential for migration to offsite locations and risks to the community. Activities at each transfer station (e.g., the airport, the dock, the landfill, etc.) including the offloading of the waste containers and subsequent distribution and compaction of the soil within the waste cell, also present risks to workers. Experienced, appropriately licensed, and trained workers using well maintained, appropriately licensed, and inspected equipment and transportation vehicles would minimize transportation risks.

Excavation and soil handling would use best management practices (BMP) for typical soil excavation activities but would also include procedures to protect workers from direct contact with the PCB-contaminated soils, including use of PPE. Particulate matter generated during excavation and handling of the soils would be controlled using standard dust suppression measures, such as using a light water mist and applying water to surfaces where heavy equipment and trucks travel. Transportation of the soil to the offsite landfill would require sealing the waste container to prevent spills of material to minimize airborne dispersion of particulates during transit.

Therefore, the short-term risk associated with the implementation of PCB Alternative 2 would be controlled through engineering and administrative controls.

PCB Alternative 2 – Implementability

The remote nature of this project presents logistical concerns with the implementability of this alternative. There would be a large volume of soil that would have to be transported offsite and then properly disposed of outside of Alaska.

Excavation of the PCB-contaminated soil would use standard commonly available heavy equipment, such as tracked-excavators, rubber-tired articulated front-end loaders, bulldozers, and/or skid-steers. Haul trucks would be used to transport the waste containers from Upper Camp to Lower Camp and other equipment, such as an extending boom forklift, would be used to load the waste containers onto the transport aircraft. However, these types of equipment are not available onsite or from the local community in Hughes, Alaska, so all necessary equipment would require mobilization to the site by air transport from Fairbanks or Anchorage. These types of heavy equipment can be operated by general construction workers who would be mobilized to the site and would be housed at the Lower Camp facilities.

This alternative would require coordination with a permitted landfill for disposal of the waste soils as well as planning and coordination for several stages of transportation to ensure that waste is staged at the Lower Camp and equipment is available to load the plane upon arrival. Waste staging areas near the landing strip would be coordinated with the Indian Mountain LRRS operators/caretakers to allow adequate space for staging without interfering with other operations at the Lower Camp. Planning and coordination would also be required to offload the waste containers from the aircraft upon arrival in Anchorage and to transfer the load to trucks to move to the dock for storage and subsequent barge transportation to Seattle. A scheduled barge would transport the waste to the contiguous U.S. for disposal; most PCB-contaminated soil could be disposed of locally near the barge landing dock in Seattle at an appropriate landfill permitted to receive the waste, but the bulk PCB remediation waste (i.e., PCB concentrations greater than 50 mg/kg) would be further transported to an appropriately permitted TSCA TSDF, which would likely be the Grassy Mountain facility near Clive, Utah, by haul trucks or by rail. All transportation would be coordinated to ensure that the waste containers can be securely and appropriately staged until being loaded for the next transportation phase.

Waste characterization samples would be collected and analyzed prior to disposal of the soils demonstrating compliance with the waste acceptance criteria for the designated landfill. Coordination with the landfill and all of the transportation companies would be required to ensure initial disposal and continued transportation and disposal flow of waste soil to prevent excessive stockpiling of waste containers anywhere pending approval for disposal.

Consequently, the offsite disposal alternative can be both technically and administratively implemented, but significant planning and coordination is required to ensure timely excavation, waste containerization, waste transport, and waste disposal without delays or allowing unreasonable staging of waste at Indian Mountain or at any point in the transportation chain.

PCB Alternative 2 – Costs

This alternative would cost approximately $11,547,835 to implement (Appendix B), based on shipping approximately 2,305 cubic yards of PCB-contaminated soil offsite. Costs would include excavation, removal from site, and out-of-state disposal.

The estimated capital, including overhead and institutional control costs for the offsite disposal alternative, would be approximately $11,547,835, in 2013 dollars. These costs include factors as detailed in Appendix B and briefly summarized in Section 2.5.2 to achieve accuracy within +50 percent and -30 percent (EPA 1988). This alternative would require an estimated four months for completion for remedy-in-place. The costs for this alternative assumes transportation and offsite disposal of an estimated 2,305 cubic yards of PCB-contaminated soil. Much of the costs are associated with transportation of the waste containers from the site to the disposal facility in the contiguous U.S. using air transport, water transport, and land transport. Consequently, a qualitative sensitivity analysis indicates that any changes to fuel costs will impact all parts of the transportation chain and can substantially change the cost estimate.

5.3.3 PCB Alternative 3: Grain-size Separation and Offsite Disposal of PCB-Contaminated Soil Above 1 mg/kg

Table 5-4 summarizes the ability of PCB Alternative 3 to satisfy the objectives established by the NCP. The rationale for the values in Table 5-4 is presented in the text below.

Table 5-4
Evaluation of PCB Alternative 3

Evaluation Criteria	Value
Overall Protection of Human Health and the Environment	Pass
Compliance with ARARs	Pass
Long-Term Effectiveness and Permanence	5
Reduction in Toxicity, Mobility, and Volume through Treatment	4
Short-Term Effectiveness	4
Implementability	3
Cost (in millions)	$9.0

Note:
Ratings were developed according to 40 CFR 300.430(e)(9)(iii). Refer to Section 2.5 for an explanation of the ratings.
For definitions, see the Acronyms and Abbreviations section.

PCB Alternative 3 – Overall Protection of Human Health and the Environment

Appropriate implementation of this alternative would effectively protect HHE in much the same way as PCB Alternative 2 (Section 5.3.2) except that the waste volume for transportation and offsite disposal would be minimized through grain-size separation. Soil containing PCB contamination exceeding 1 mg/kg would be removed and shipped offsite for disposal leaving no PCB contamination in soil onsite above risk-based cleanup levels effectively protecting HHE. The RAOs would be met at project completion. Consequently, PCB Alternative 3 would meet this threshold criterion and would be an acceptable possible alternative.

As indicated in Section 5.3.2, excavation of the soils containing the PCB-contaminated soil above risk-based cleanup levels would remove the source of the risk at the site. Statistically-based confirmation soil sampling representative of the remaining soil would be performed upon completion of the excavation to ensure that an adequate level of confidence was attained that any residual site risk was within an acceptable range. No administrative controls would be necessary because all residual soil would be shown to be less than the risk-based criteria. These actions and limitations would ensure long-term overall protection of HHE at the site.

The excavated soil would be mechanically screened to remove rocks greater than approximately 2 inches, which have less surface area per unit of volume than finer-grained material and consequently less potential PCB concentration per unit of mass. These larger rocks screened from the excavated soils at the site would be sampled to ensure that total PCB concentrations are less than 1 mg/kg. These screened materials would be used to backfill the excavation upon verification of confirmation soil sample results collected within the excavation.

The remaining screened material less than approximately 2 inches would be transported and disposed of directly (i.e., without treatment) as indicated for PCB Alternative 2 (Section 5.3.2) at a permitted landfill that has a liner, a leachate collection and control system, and is subject to LTM of the groundwater. Disposal of these PCB-contaminated soils in a lined and permitted landfill with leachate collection and subject to LTM would be protective of HHE near the landfill.

Short-term overall protection of HHE at the site would be controlled through strict procedures documented in work plans for any implementation of this alternative. For instance, dust suppression and control measures would be implemented during excavation and screening of the PCB-contaminated soils to mitigate potential airborne dispersion of contaminated particulates. Additionally, appropriate PPE for workers would be required and site controls would be implemented to protect HHE in the short term. Risk from transportation of the waste would be controlled.

PCB Alternative 3 – Compliance with ARARs

This alternative would comply with all chemical-, location-, and action-specific ARARs (Appendix A). It would achieve chemical-specific ARARs for the PCB-contaminated soils at the site by removing any soils with concentrations greater than the risk-based cleanup levels; representative samples of the material screened from the soil greater than approximately 2 inch-diameters would be analyzed to ensure compliance with the chemical-specific ARARs before being used as backfill at the site. This alternative would be implemented with appropriate controls to comply with any location-specific and/or action-specific ARARs. Therefore, the offsite disposal alternative would meet this threshold criterion and would be an acceptable possible alternative.

The chemical-specific ARARs would include the direct contact exposure pathway for soils based on workers equipped with the proper PPE. Disposal of the excavated PCB-contaminated soil in an independently operated offsite permitted landfill would presumably comply with all potential ARARs because the waste soil would only be disposed of in the landfill provided that the waste characterization data comply with the facility waste acceptance criteria. Offsite disposal would ensure that any proposed landfill is presently operating in compliance with its permit, that the facility has no active or unresolved NOV, and that the waste meets the waste acceptance criteria.

PCB Alternative 3 – Long-Term Effectiveness and Permanence

The long-term effectiveness and permanence goals would be met under this alternative because the source of the risk to HHE above the cleanup levels for PCB in soil would be removed from the site. PCB-contaminated soil with a grain size below 2 inches would be removed from the site. The remaining material, with grain size above 2 inches and PCB concentrations verified to be less than the risk-based criterion associated with it, would remain at the site as backfill for the excavation. This would provide a permanent remedy ensuring long-term protection of HHE.

Permanent disposal of the soils at an offsite landfill would be effective in the long term because a landfill appropriately permitted for PCB-contaminated soil from this site is designed for long-term protection of HHE at and near the landfill. The required landfill liner, leachate collection system, daily cover requirements, restrictions on acceptable waste characteristics (e.g., chemical and physical constraints), and other operational requirements in the permit provide assurance that long-term protectiveness of HHE will be maintained.

PCB Alternative 3 – Reduction of Toxicity, Mobility, or Volume through Treatment

Volume of PCB-contaminated soil to be disposed of offsite would be reduced by approximately 25 percent through a mechanical screening process that would exclude rocks greater than approximately 2 inches. These larger materials have less surface area per unit volume and unit weight than finer grain material to which potential PCBs could adsorb. Consequently, the PCB concentration on the larger material would be less than the risk-based PCB criterion, which would be verified through confirmation sample results from these materials prior to use as backfill at the site. The estimated volume of waste reduction is based on soil descriptions recorded in boring logs for test pits at the site during the 2011 supplemental RI effort (USAF 2012) and based on a similar operation at Anvil Mountain near Nome, Alaska. If this alternative is selected for consideration in the proposed plan subsequent to completion of this FS, a pilot study would be performed to verify the PCB concentrations in the screened materials and to better estimate the volume reduction. To increase protectiveness, oversize material will be screened and removed from areas with PCB concentrations below 10 mg/kg unless the results of the pilot study verify that PCB cleanup levels are being consistently met in the higher concentration areas.

The mobility of the PCB-contaminated soil disposed of offsite (i.e., the soil with materials less than 2 inches) would be reduced through isolation in the lined waste cell of the offsite landfill, which would also include use of leachate collection/treatment systems, the landfill cap, monitoring, site controls, etc.

PCB Alternative 3 – Short-Term Effectiveness

The soil screening, excavation, and containerization would potentially expose site workers to the contamination as well as to hazards associated with working in and around excavations, operation of the mechanical screening equipment, and handling of the waste soils. However, with careful implementation this alternative would be protective in the short term (during the remedial action).

Implementation of this alternative would include strict documented procedures that would be audited and evaluated during execution of the work to ensure that workers, individuals from the local community intermittently visiting the site, and the environment are protected from any potential risks. The time required until the remedy is in place (i.e., all PCB-contaminated soil is excavated, screened, and disposed of offsite) would be within a single working season of less than two months from mobilization to demobilization. The excavation of the soil and the subsequent mechanical screening operations, stockpiling, handling, and loading of soil containers into haul trucks, transport of the containers to the Lower Camp, transport by air from the site, transport by barge to the contiguous U.S., and transport from the barge to the disposal facility each present risks to workers as well as potential for migration to offsite locations and risks to the community. Activities at each transfer station (e.g., the airport, the dock, the landfill, etc.) including the offloading of the waste containers and subsequent distribution and compaction of the soil within the waste cell, also present risks to workers. Experienced, appropriately licensed, and trained workers using well maintained, appropriately licensed, and inspected equipment and transportation vehicles would minimize transportation risks.

Excavation, screening, and soil handling would use BMPs for typical soil excavation and quarry (i.e., screening) activities but would also include procedures to protect workers from direct contact with the PCB-contaminated soils and inhalation of airborne particulates, including use of PPE. Particulate matter generated during excavation, screening, and handling of the soils would be controlled using standard dust suppression measures, such as using a light water mist and applying water to surfaces where heavy equipment and trucks travel. Additionally, the mechanical soil screening operations would be designed to minimize worker exposure to particulates, such as allowing use of heavy equipment and using mechanical means to transfer materials as appropriate to maximize distance and shielding from the operations generating the dust.

Therefore, the short-term risk associated with the implementation of PCB Alternative 3 would be controlled through engineering and administrative controls.

PCB Alternative 3 – Implementability

Transport and disposal of the screened material less than approximately two inches would have the same implementability issues discussed in Section 5.3.2 for PCB Alternative 2 except that the coordination and volume of waste would be reduced by approximately 25 percent. However, the mechanical screening would also require mobilization of equipment that is common to quarry operations, such as stationary screens (commonly known as grizzlies), powered mechanical vibrating screens, conveyors, and hoppers. Although there are some logistical concerns with the mobilization of appropriate equipment and supplies for the grain-size separation due to the remote nature of the site, the reduction in volume of soil under this alternative requiring offsite disposal would offset these concerns.

Screening would be the slowest step in the process, and therefore designing a simple, efficient, and maintainable screening system and planning the logistics of screening a large volume of soil is important to minimize potential delays during the process. Design of the screening system would include nearly continuous operation at a controllable rate to maximize separation efficiency while also minimizing worker involvement, such as use of screw conveyors. This more automated design and remote loading and soil handling using heavy equipment removing direct worker contact with the operations would therefore also reduce worker exposure, which was addressed under Short-Term Effectiveness above.

The use of screw conveyors to move the soil across the screens and powered vibratory screens to separate soils can, like all mechanical devices, require maintenance. Therefore, the design would balance simplicity and maintainability with the need for automation and efficiency. Care would need to be taken to avoid spreading contamination during screening, excavation, and containerization activities. Under this alternative, once complete, no additional activities would be required for PCB-contaminated soil.

Consequently, PCB Alternative 3 can be both technically and administratively implemented, but significant planning and coordination is required to implement an efficient and workable screening operation, to ensure timely delivery of equipment, to ensure timely excavation, waste containerization, waste transport, and waste disposal without delays, and without allowing unreasonable staging of waste at Indian Mountain or at any point in the transportation chain.

PCB Alternative 3 – Costs

Cost estimates for this alternative were based on the assumption that approximately 1,670 cubic yards of soil would require offsite disposal after grain-size separation. This estimate is based on the assumption that the oversize material has a diameter of 2 inches or greater allowing a volume reduction of 25 percent through grain-size separation. Actual diameter size has not yet been determined and may require a pilot study. The estimated capital including, overhead and institutional control combined with long term monitoring costs for PCB Alternative 3, would be approximately $9,010,597 in 2013 dollars. The total estimated cost is presented on Table 5-4. These costs include excavation, grain-size separation, containerization, shipment, and disposal of PCB-contaminated soil as well as factors as detailed in Appendix B and briefly summarized in Section 2.5.2 to achieve accuracy within +50 percent and -30 percent (EPA 1988). This alternative would require an estimated two months for completion for remedy-in-place and assumes a pilot study to determine the appropriate screening size and volume reduction.

5.3.4 PCB Alternative 4: Grain-Size Separation, Offsite Disposal of PCB-Contaminated Soil Above 25 mg/kg, and Solidification and Capping of PCB-Contaminated Soil Above 1 mg/kg and Less Than 25 mg/kg

Table 5-5 summarizes the ability of PCB Alternative 4 to satisfy the objectives established by the NCP. The rationale for the values in Table 5-5 is presented in the text below.

Table 5-5
Evaluation of PCB Alternative 4

Evaluation Criteria	Value
Overall Protection of Human Health and the Environment	Pass
Compliance with ARARs	Pass
Long-Term Effectiveness and Permanence	3
Reduction in Toxicity, Mobility, and Volume through Treatment	4
Short-Term Effectiveness	3
Implementability	3
Cost (in millions)	4.4

Note:
For definitions, see the Acronyms and Abbreviations section.

PCB Alternative 4 – Overall Protection of Human Health and the Environment

This alternative would effectively protect HHE in much the same way as PCB Alternative 3 except that the screened soil with PCB concentrations greater than 1 mg/kg but less than 25 mg/kg would be solidified onsite. HHE would be protected by solidifying and capping the screened soil with PCB concentrations greater than 1 mg/kg but less than 25 mg/kg to minimize contaminant mobility and bioavailability to eliminate this potential exposure pathway while removing PCB-contaminated soils greater than 25 mg/kg for offsite disposal. The RAOs would be met at project completion. Consequently, PCB Alternative 4 would meet this threshold criterion and would be an acceptable possible alternative.

As indicated in Section 5.3.2, excavation of the soils containing the PCB-contaminated soil above risk-based cleanup levels would remove the source of the risk at the site. Statistically-based confirmation soil sampling representative of the remaining soil would be performed upon completion of the excavation to ensure that an adequate level of confidence was attained and that any residual site risk was within an acceptable range. These actions and limitations would ensure long-term overall protection of HHE at the site.

Similar to PCB Alternative 3, the excavated soil would initially be mechanically screened to remove rocks greater than approximately 2 inches, which have less surface area per unit of volume than finer-grained material and consequently less total PCB concentration per unit of mass. These larger rocks separated from the excavated soils at the site would be sampled to ensure that total PCB concentrations are less than 1 mg/kg. These screened materials would be used to backfill the excavation upon verification of confirmation soil sample results collected within the excavation.

The remaining screened soil less than approximately 2 inches would be segregated to separate the soil with PCB concentrations exceeding 25 mg/kg for transportation and offsite disposal as indicated for PCB Alternative 2 (Section 5.3.2) at a permitted landfill that has a liner, a leachate collection and control system, and is subject to LTM of the groundwater. As noted previously, soil with PCB concentrations exceeding 50 mg/kg would be treated and disposed of as TSCA bulk PCB remediation waste. Disposal of the PCB-contaminated soils in a lined and permitted landfill with leachate collection and subject to LTM would be protective of HHE near the landfill.

The other screened PCB-contaminated soil with PCB concentrations greater than 1 mg/kg but less than 25 mg/kg would be solidified onsite using portland cement and necessary admixtures to ensure proper curing of the solidified monolith. PCB Alternative 4 would reduce the amount of PCB-contaminated soil to be transported offsite by approximately 90 percent. No groundwater is found at the site, but the solidification would reduce mobility of the residual PCB contamination to minimize potential leaching that could contribute to local seeps and springs. Also, the solidification would prevent the PCB-contaminated soil from being bioavailable to eliminate the potential exposure pathways for workers and ecological receptors. In addition, a cap covering the area of solidified PCB contamination will be constructed of a material designed to prevent exposure of humans and the environment to the solidified PCBs; and of sufficient strength and durability to withstand the use of the surface that is exposed to the environment. Five-year reviews per CERCLA guidance would be conducted by the landowner or landowner-representative, to ensure the protectiveness of the remedy. Any damage to the cap resulting in a substantive amount of solidified material being exposed to the environment would create a need to reevaluate the selected remedy.

Short-term overall protection of HHE at the site would be controlled through strict procedures documented in work plans for any implementation of this alternative. For instance, dust suppression and control measures would be implemented during excavation, screening, and mixing for solidification of the PCB-contaminated soils to mitigate potential airborne dispersion of contaminated particulates. Additionally, appropriate PPE for workers would be required and site controls would be implemented to protect HHE in the short term. Risks from transportation of the waste would be controlled.

PCB Alternative 4 – Compliance with ARARs

This alternative would comply with all chemical-, location-, and action-specific ARARs (Appendix A). It would achieve chemical-specific ARARs for the PCB-contaminated soils at the site by removing any soils with concentrations greater than the risk-based cleanup levels; representative samples of the material screened from the soil greater than approximately 2 inches would be analyzed to ensure compliance with the chemical-specific ARARs before being used as backfill at the site. Additionally, representative samples of the solidified PCB-contaminated soil would be tested to verify its leachability characteristics and strength. This alternative would be implemented with appropriate controls to comply with any location-specific and/or action-specific ARARs. Therefore, the offsite disposal alternative would meet this threshold criterion and would be an acceptable possible alternative.

The chemical-specific ARARs would include the direct contact exposure pathway for soils based on the present worker scenario. Disposal of the excavated PCB-contaminated soil in an independently operated offsite permitted landfill would presumably comply with all potential ARARs because the waste soil would only be disposed of in the landfill provided that the waste characterization data comply with the facility waste acceptance criteria. Offsite disposal would ensure that any proposed landfill is presently operating in compliance with its permit, that the facility has no active or unresolved NOV, and that the waste meets the waste acceptance criteria

PCB Alternative 4 – Long-Term Effectiveness and Permanence

This alternative has the potential to be effective for addressing the long-term effectiveness of the remediation at the site. PCB-contaminated soil with a grain size below 2 inches would be removed from the site or solidified based on concentration. The remaining material, with grain size above 2 inches and PCB contamination less than risk-based criteria associated with it, would remain at the site.

The long-term effectiveness and performance goals would be met under this alternative because soils contaminated with PCBs above 25 mg/kg would be removed from the site while the soil with PCB concentrations greater than 1 mg/kg but less than 25 mg/kg would be solidified, disposed of onsite, and covered. The PCB-contaminated soil with a grain size greater than 2 inches and PCB concentrations verified to be less than the risk-based criterion associated with it would remain at the site as backfill for the excavation. This would provide a permanent remedy ensuring long-term protection of HHE.

However, solidification does not significantly destroy PCB contamination but rather fixes the contamination within a solid matrix to minimize the potential for leaching and to prevent the contaminants from being bioavailable by eliminating the potential exposure pathway. The remaining monolithic structure would be a permanent subsurface feature limiting future potential use of the site. Removing the monolithic structures from the site, which would be poured in batches, would be possible but difficult to perform. Consequently, the remedy is potentially reversible in this regard.

High PCB concentrations in the soil may interfere with the hydration and curing process of solidification and consequently diminish the leachability characteristics and compressive strength of the monolith impacting the long-term stability. Also, organic contaminants can become more soluble as the cement increases the pH, allowing dissolved organic compounds (e.g., PCB and POL) to fill pores within the matrix. However, the maximum concentration of PCB in the soil to be solidified is 25 mg/kg, which is not anticipated to be high enough to interfere significantly with the hydration process or the curing of the monolith. These potential concerns would be addressed through the use of admixtures, which would be determined and the amount required optimized during a treatability study performed if this alternative is selected for consideration in the proposed plan subsequent to completion of this FS. Additionally, testing of representative samples of the cured solidified material would be performed to assess leachability, compressive strength, and possibly hydraulic conductivity, but uncertainties would still be associated with the long-term performance of the solidified monolith.

PCB Alternative 4 – Reduction of Toxicity, Mobility, or Volume through Treatment

The volume of PCB-contaminated soil to be solidified or disposed of offsite would be reduced by approximately 25 percent through a mechanical screening process that would exclude rocks greater than approximately 2 inches. As indicated for PCB Alternative 3 (Section 5.3.3), these larger materials have less surface area per unit volume and unit weight than finer grain material to which potential PCB could adsorb. Consequently, the PCB concentration on the larger material would be less than the risk-based PCB criterion, which would be verified through confirmation sample results from these materials prior to use as backfill at the site. The volume of waste reduction used, which also is used for costing purposes (see below), is based on soil descriptions recorded on boring logs for test pits at the site during the 2011 supplemental RI effort (USAF 2012) and based on a similar operation at Anvil Mountain near Nome, Alaska. If this alternative is selected for consideration in the proposed plan subsequent to completion of this FS, a pilot study would be performed to verify the PCB concentrations in the screened materials and to better estimate the volume reduction.

This alternative would also reduce the volume of soil requiring offsite disposal by solidifying the PCB-contaminated soil that have concentrations less than 25 mg/kg. The solidified material would reduce the mobility of the PCB contamination within the matrix of the monolith. The leachability of PCB contamination would be reduced to minimize the potential of mobilizing PCB contamination into infiltrating precipitation that may migrate and become surface water at the site at seeps or springs. Also, solidification would reduce mobility of the contamination and minimize its bioavailability to minimize the potential human and ecological exposure pathways.

The mobility of the PCB-contaminated soil disposed of offsite (i.e., the soil with materials less than two inches) would be reduced through isolation in the lined waste cell of the offsite landfill, which would also include use of leachate collection/treatment systems, the landfill cap, monitoring, site controls, etc.

PCB Alternative 4 – Short-Term Effectiveness

The soil screening, excavation, solidification, and containerization would potentially expose site workers to the contamination as well as to hazards associated with working in and around excavations, operation of the mechanical screening equipment, operation of the batch mixing plant for solidifying waste, and handling of the waste soils. However, with careful implementation this alternative would be protective in the short term (during the remedial action).

Implementation of this alternative would include strict documented procedures that would be audited and evaluated during execution of the work to ensure that workers, anyone from the local community intermittently visiting the site, and the environment are protected from any potential risks. The time required until the remedy is in place (i.e., all PCB-contaminated soil is excavated, screened, solidified and backfilled onsite, and remaining soil disposed of offsite) would be within a single working season of less than three months from mobilization to demobilization. The excavation of the soil and the subsequent mechanical screening operations, stockpiling, handling, and loading of soil containers into haul trucks, transport of the containers to the Lower Camp, transport by air from the site, transport by barge to the contiguous U.S., and transport from the barge to the disposal facility each present risks to workers as well as potential for migration to offsite locations and risks to the community as detailed for PCB Alternatives 2 and 3 (refer to Sections 5.3.2 and 5.3.3, respectively).

This alternative, however, would substantially reduce the volume of soil requiring transportation and offsite disposal because most soil would be solidified and used to backfill the excavation. It is estimated that only approximately 10 percent of the volume under PCB Alternative 2 (offsite disposal of approximately 2,305 cubic yards) would require transportation and offsite disposal. Consequently, the short-term impacts associated with transportation and disposal under this alternative would be same as PCB Alternative 2, but would be an order of magnitude less.

Excavation, screening, and soil handling would be similar to PCB Alternative 3. It would also use BMPs for typical soil excavation and quarry (i.e., screening) activities and it would include procedures to protect workers from direct contact with the PCB-contaminated soils and inhalation of airborne particulates, including use of PPE. Particulate matter generated during excavation, screening, and handling of the soils would be controlled using standard dust suppression measures, such as using a light water mist and applying water to surfaces where heavy equipment and trucks travel. Additionally, the mechanical soil screening operations would be designed to minimize worker exposure to particulates, such as allowing use of heavy equipment and using mechanical means to transfer materials as appropriate to maximize distance and shielding from the operations generating the dust. Transportation of the soil to the offsite landfill would require sealing the waste container to prevent spills of material and to minimize airborne dispersion of particulates during transit.

The short-term effectiveness would differ with PCB Alternative 3 in the additional use of solidification to treat the PCB-contaminated soil with concentrations greater than 1 mg/kg but less than 25 mg/kg. This would potentially expose workers to mechanical risks associated with the processing equipment for solidification, which are similar to the equipment used for concrete mixing. Additionally, this would potentially expose workers to inhalation of PCB-contaminated particulates generated during the mixing operations prior to introduction of water and liquid admixtures as appropriate that would limit dust generation. Similar to other site work, execution of these options would be strictly controlled through administrative controls and PPE and engineering controls, such as dust controls, would be implemented to mitigate these potential short-term risks.

Therefore, the short-term risk associated with the implementation of PCB Alternative 4 would be controlled through engineering and administrative controls.

PCB Alternative 4 – Implementability

There are some logistical concerns with the mobilization of appropriate equipment and supplies for the excavation, grain-size separation, and solidification processes due to the remote nature of the site. Implementation issues for excavation and grain-size separation are similar to those discussed in Section 5.3.3 for PCB Alternative 3. Implementation issues for transportation and offsite disposal would also be similar to those discussed for PCB Alternatives 2 and 3 (Sections 5.3.2 and 5.3.3, respectively) except that substantially less waste soil would be generated under PCB Alternative 4. PCB Alternative 4 would generate approximately 10 percent of the waste for offsite disposal generated under PCB Alternative 2 and approximately 15 percent of the waste generated under PCB Alternative 3, which would substantially reduce the logistical concerns associated with transportation and offsite disposal.

Solidification of the majority of the screened soil, which would be performed in place of offsite disposal in PCB Alternative 3, would introduce both technical and administrative implementation issues. The solidification process would require mobilization of mechanical equipment, such as pugmills and/or drum mixers, in addition to the mechanical equipment required for the screening operations discussed in PCB Alternative 3 (Section 5.3.3). The solidification process would also require mobilization of portland cement and any necessary admixtures for the organic contaminants to ensure proper curing of the monolith. The amount and types of solidification reagent, which is assumed to be portland cement, and any admixtures would be determined in a treatability study. Solidification using portland cement typically ranges between 5 percent and 25 percent cement by volume depending on moisture, soil characteristics, etc., so between approximately 80 tons and 400 tons of cement would be mobilized to the site, requiring an additional 5 to 24 flights.

Although there are some additional logistical concerns with the mobilization of appropriate equipment and supplies for the solidification due to the remote nature of the site, the reduction in volume of soil under this alternative requiring offsite disposal would substantially offset most of these concerns. Solidification would likely be the slowest step in the process. The mechanical screening step described in PCB Alternative 3 would provide adequate feed to the batch mixing plant for solidification even though some of the screened material would not be solidified and instead transported for offsite disposal. Therefore, designing a simple and maintainable yet efficient batch mixing plant and planning the logistics of screening and solidifying a large volume of soil is important to minimize potential delays during the process. Design of the batch mixing plant system and integration with the screening plant would include nearly continuous batch operation to maximize efficiency while also minimizing hands-on worker involvement, such as use of conveyors to transfer screened soil to the mixer and to add cement. This more automated design, similar to that described for the mechanical screening process in PCB Alternative 3, would therefore also reduce worker exposure, which was addressed under Short-Term Effectiveness, above. However, mechanical devices require maintenance and therefore the design would balance simplicity and maintainability with the need for automation and efficiency. Care would need to be taken to avoid spreading contamination during initial dry material mixing activities until the soil-cement slurry is formed, so dust controls such as fine water mist would be used in addition to minimization of direct worker involvement in the operation.

A potential technical implementability concern is interference in the curing process caused by high PCB concentrations in the soil. Organic contamination can interfere with the hydration process and interfere with the curing of the monolith that can diminish the leachability characteristics and compressive strength of the monolith impacting the long-term stability (see also the discussion above concerning Long-Term Effectiveness and Permanence). Additionally, organic contaminants can become more soluble as the cement increases the pH, allowing dissolved organic compounds (e.g., PCBs and POL) to fill pores within the matrix.

These potential concerns will be addressed through the use of admixtures, as determined during the treatability study. Additionally, the maximum concentration of PCB being treated is 25 mg/kg, which is not anticipated to significantly interfere with the hydration process and curing of the monolith.

A final technical issue is the increase in waste soil volume of the solidified monolith caused by the addition of the portland cement and admixtures. However, approximately 90 cubic yards of screened PCB-contaminated soil with PCB concentration greater than 25 mg/kg would be disposed of offsite, so the increase in volume for the monolith would actually provide a benefit by reducing or eliminating the volume of backfill needed. Also, the increased volume may allow the site to be contoured to better divert precipitation.

Construction of the cap covering the solidified monolith is anticipated to be constructed of local material. A portion of oversize material will be reserved for mixing into the cap to increase its durability to erosion.

Consequently, PCB Alternative 4 can be both technically and administratively implemented, but significant planning and coordination is required to implement efficient and workable screening and solidification operations, to ensure timely delivery of materials and equipment, to ensure timely excavation, waste containerization, waste transport, and waste disposal without delays, and to prevent unreasonable staging of waste at Indian Mountain or at any point in the transportation chain.

PCB Alternative 4 – Costs

Cost estimates for this alternative were based on the assumption that approximately 1,750 cubic yards of soil would result after grain-size separation and that 1,641 cubic yards would be solidified while 118 cubic yards would require offsite disposal. This estimate is based on the assumption that the oversize material has a diameter of 2 inches or greater allowing a volume reduction of 25 percent through grain-size separation. Actual diameter size has not yet been determined and may require a pilot study. The estimated capital including overhead and institutional controls combined with long-term monitoring costs for PCB Alternative 4 would be $4,268,562 and $145,905 respectively, for an approximate total project cost of $4,414,467 in 2013 dollars. The total estimated cost is presented on Table 5-5. These costs include excavation, containerization, grain-size separation, solidification, capping, shipment, and disposal of PCB-contaminated soil as well as factors detailed in Appendix B and briefly summarized in Section 2.5.2 to achieve accuracy within +50 percent and -30 percent (EPA 1988). This alternative would require an estimated four months for completion for remedy-in-place and assumes a pilot study to determine the appropriate screening size and volume reduction, and a treatability study to optimize and evaluate long-term stability of waste solidification.

5.3.5 Comparison of Remedial Alternatives for Polychlorinated Biphenyl-Contaminated Soil

Table 5-6 summarizes the four alternatives that received detailed analysis according to their ability to comply with NCP criteria.

Threshold Criteria

PCB Alternative 1, the No Action Alternative, fails to comply with the threshold criteria. Because this alternative lacks either institutional controls or contaminant removal, a possibility exists that humans could be exposed to site contaminants at concentrations above cleanup levels. The remaining alternatives are protective of HHE at project completion and would be implemented in a manner that complies with all chemical-, location-, and action-specific ARARs.

Because PCB Alternative 1 fails to attain the threshold criteria, it will not be considered further but it will be used as a baseline for comparison of the other alternatives. PCB Alternatives 2, 3, and 4 meet the threshold criteria and are compared below.

Table 5-6
Comparison of Alternatives for the Polychlorinated Biphenyl-Contaminated Soil

Evaluation Criteria	PCB Alternative 1: No Action	PCB Alternative 2: Offsite Disposal of PCB-Contaminated Soil Above 1 mg/kg	PCB Alternative 3: Grain-size separation and Offsite Disposal of PCB-Contaminated Soil above 1 mg/kg	Alternative PCB-4: Grain-size separation, Offsite Disposal of PCB-Contaminated Soil above 25 mg/kg and Solidification and Capping of PCB-Contaminated Soil above 1 mg/kg
Overall Protection of Human Health and the Environment	Fail	Pass	Pass	Pass
Compliance with ARARs	Fail	Pass	Pass	Pass
Long-Term Effectiveness and Permanence	0	5	5	3
Reduction in Toxicity, Mobility, and Volume through Treatment	0	2	4	4
Short-Term Effectiveness	1	4	4	3
Implementability	5	3	3	3
Cost (in millions)	$0	$11.6	$9.0	$4.4

Note:
For definitions, see the Acronyms and Abbreviations section.

Primary Balancing Criteria

PCB Alternatives 2, 3, and 4 include various amounts of offsite disposal for PCB-contaminated soil. PCB Alternative 2 proposes offsite disposal for all soil above 1-mg/kg, which would include transportation and offsite disposal of approximately 2,300 cubic yards of material. PCB Alternatives 3 and 4 propose grain-size separation of all PCB-contaminated material above 1 mg/kg and retaining everything above 2 inches onsite, which would be approximately 575 cubic yards of rock remaining assuming 25 percent reduction of the volume. PCB Alternative 3 proposes offsite disposal of all soils contaminated with concentrations of PCBs greater than 1 mg/kg after screening, which would be approximately 1,670 cubic yards. PCB Alternative 4 would dispose of all soils less than two inches contaminated with concentrations of PCBs greater than 25 mg/kg offsite, which would be approximately 118 cubic yards; screened soils with PCB concentration greater than 1 mg/kg but less than 25 mg/kg would be solidified, capped and left onsite, which would be approximately 1,640 cubic yards or between approximately 1,720 and 2,050 cubic yards after volume increase due to addition of solidification reagents (ranging from 5 to 25 percent increase in volume). PCB Alternative 2 would be the most protective remedial action for potential onsite receptors because it would remove all PCB-contaminated soil greater than 1 mg/kg from the site. PCB Alternative 3 would be the next most protective because all PCB-contaminated soil greater than 1 mg/kg would be removed and only larger rocks, which would not have total PCB concentrations greater than 10 mg/kg, would remain onsite. PCB Alternative 4 would further decrease the volume of soil required for offsite disposal by solidifying much of the PCB-contaminated soil, therefore decreasing the cost but retaining a high level of long-term effectiveness. All PCB alternatives would present different short-term risks of varying severity, but each alternative would be implemented to ensure short-term effectiveness. PCB Alternative 4 would require the least volume of soil to be removed from the site and therefore it would cost the least. PCB Alternative 2 would require the largest amount of soil to be removed and would therefore cost the most.

Long-Term Effectiveness and Permanence. PCB Alternatives 2, 3, and 4 are each effective in the long term while the No Action Alternative does not provide any means by which HHE would be protected in the long term. PCB Alternatives 2 and 3 are permanent remedies that remove all PCB-contaminated soils above the present risk-based cleanup level from the site, while PCB Alternative 4 would immobilize and cap PCB contamination greater than 1 mg/kg but less than 25 mg/kg using portland cement to solidify the soil. The long-term stability of the solidified monolith is uncertain, although treatability studies and testing of representative samples of the solidified material would be performed to improve confidence in the long-term performance of this remedy.

PCB Alternative 2, which includes excavation and offsite disposal, would provide the most permanent and the most effective long-term remedy of any alternative because the PCB contamination in the soil above the cleanup level is entirely removed from the site. PCB Alternative 3, which includes grain-size separation and offsite disposal of soil material less than approximately two inches, would be the next most effective for a permanent and long-term solution. PCB Alternative 3 would be almost equal in protectiveness because representative samples of the soil material greater than approximately two inches remaining onsite would be tested to ensure that total PCB concentrations are less than the cleanup level; however, these materials left onsite could still have PCB contamination adhering to the surface of the materials that could leach and be bioavailable to some degree. To increase protectiveness, oversize material will be screened and removed from areas with PCB concentrations less than 10 mg/kg. This approach may be modified to include oversize material from higher concentration areas if the pilot test confirms this material meets the PCB cleanup level.

Solidification under PCB Alternative 4 would be incrementally less effective in the long term than PCB Alternatives 2 and 3 because solidification does not necessarily destroy the PCB contamination but rather contains the contamination within the monolithic structure to minimize leaching and bioavailability. Some technical concerns with solidification make the long-term performance less certain than offsite disposal. These concerns would be addressed through a treatability study if this alternative were proposed for consideration in the proposed plan and through sampling of the solidified mass if implemented. Further, long-term use of the site may be restricted because of the buried monolith and might also require long-term stewardship of the site whereas PCB Alternatives 2 and 3 would not limit future use of the site or require long-term stewardship.

Reduction in Toxicity, Mobility, and Volume Through Treatment: Offsite disposal of PCB-contaminated soils, which is entirely relied upon for PCB Alternative 2 and is largely relied upon for PCB Alternative 3, provides no reduction in toxicity, mobility, or volume through treatment. Instead, landfilling of waste only moves the PCB-contaminated soil from uncontrolled conditions at the site to a controlled environment where mobility can be limited through the design of the landfill, i.e., using a liner system, leak detection system, leachate control, groundwater monitoring, a cap, etc. PCB Alternative 3 provides an assumed

25 percent volume reduction through treatment by mechanically screening the soil to minimize the volume requiring offsite disposal. The screened soil materials greater than approximately 2 inches would be excluded from disposal provided that representative samples of the screened material indicate that the PCB concentrations are less than the cleanup level.

PCB Alternative 4 includes the same grain-size separation of PCB Alternative 3 and adds solidification as further treatment to reduce mobility of the contaminants. This would further minimize the volume of PCB-contaminated soils requiring offsite landfilling compared with PCB Alternatives 2 and 3. Solidification under PCB Alternative 4 would increase the volume of treated soil between 5 percent and 25 percent, but the screening process would initially reduce the soil volume by an estimated 25 percent. Also, the volume generated by addition of the solidification reagents would provide a benefit in reducing the amount of backfill needed for the excavation, which would otherwise be harvested locally, further impacting the area.

Short-Term Effectiveness: Each alternative has different and varying degrees of impacts to site workers as well as offsite individuals and communities making it problematic to rank the alternatives in comparison to each other. For instance, PCB Alternative 2 transports all of the waste to an offsite disposal facility, requiring transport of the waste from the Upper to Lower Camp, loading/offloading and transporting waste containers by air to a receiving airport and then into rear-loading containers and overland to a barge, loading/offloading and transporting the rear-loading containers by barge to Seattle, loading/offloading and transporting the rear-loading containers overland to the disposal facility where the waste containers in the rear-loading containers would be unloaded into the landfill. PCB Alternative 3, on the other hand, would minimize these risks by reducing the volume to be removed by approximately 25 percent but adding more risk to the site workers by introducing mechanical separation that has physical hazards associated with the process and also has potential airborne exposure hazards, which are particularly troubling for PCB-contaminated particulates. PCB Alternative 4 would further reduce the risks to offsite individuals and communities by reducing the volume to be removed by approximately 90 percent, but this substantial volume reduction comes at the expense of not only the mechanical separation process but also the solidification process.

PCB Alternative 2 has substantial potential risk to offsite individuals and communities because of the transportation requirements, but the probability of an incident is comparatively low although the potential severity of the occurrence, if it did happen, could be very high. PCB Alternative 4 substantially reduces this, but adds more risk to the site workers by adding both mechanical screening and solidification. These mechanical processes have a higher comparative probability of either a physical injury incident or inhalation exposure than under PCB Alternative 2, although engineering and administrative controls would be implemented to minimize the probability. The comparative severity of incidents would likely be higher than for PCB Alternative 2.

Implementability: Each of the alternatives would require extensive planning and coordination between multiple transportation contractors and the landfill to ensure regular flow of waste containers from the site, which has limited area for staging. Continuous flow of waste from the site is particularly important for PCB Alternative 2 and to a lesser degree PCB Alternative 3 because of the volume of waste for offsite disposal (2,305 and 1,670 cubic yards, respectively) and the need to complete the activities within the limited weather window. Otherwise, remobilization of equipment or continued rental of the equipment would be required. PCB Alternative 4 minimizes these implementation issues because approximately 118 cubic yards of waste soil would require transportation and offsite disposal.

PCB Alternatives 3 and 4 have additional implementation constraints because of the addition of mechanical screening requirements for both alternatives and because of the addition of solidification equipment (i.e., batch mixing plant and ancillary equipment) in the case of PCB Alternative 4. Consequently, additional equipment would need to be mobilized to the site and these mechanical equipment components each have logistical operations risks, such as maintenance.

PCB Alternative 4 also presents additional potential technical implementation issues due to uncertainties associated with both the initial solidification integrity and long-term performance due to the organic contaminants being treated. Higher concentrations of PCBs could interfere with the hydration process and the curing of the monolith, although the maximum concentration of PCB in soil to be solidified is 25 mg/kg, which is not anticipated to be high enough to significantly cause these issues. A treatability study would be performed to optimize the solidification process and representative samples would be analyzed from the solidified material to ensure long-term stability, but technical concerns still remain.

Therefore, PCB Alternative 4 would have the highest risk from technical implementability while PCB Alternative 2 would have the highest risk from administrative implementability. PCB Alternative 3 would have similar technical and administrative implementability issues, but this option would better balance them.

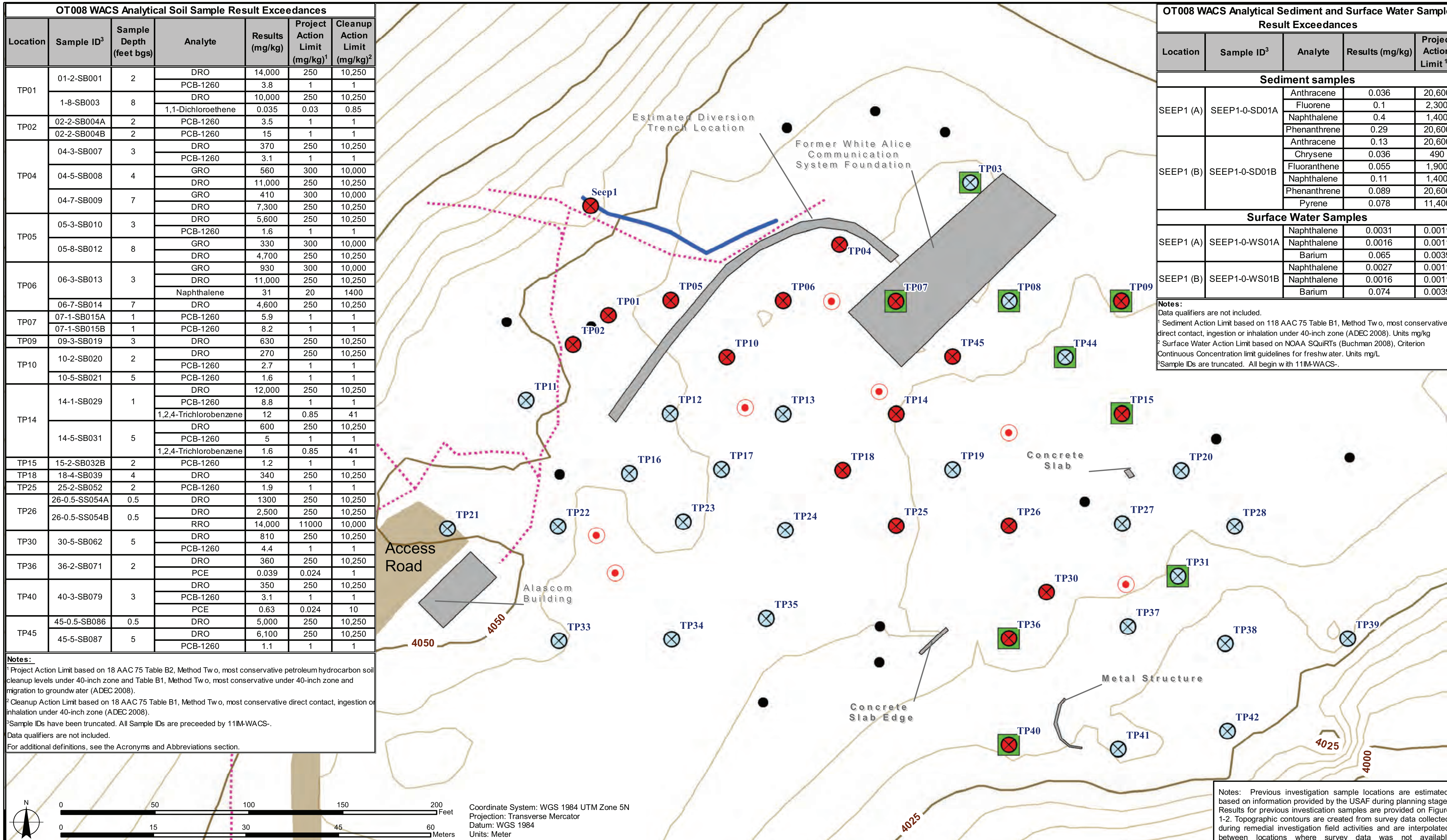
Cost: PCB Alternative 2 is the highest cost alternative, and is the most cost-sensitive to increases in fuel prices and soil volume because of the unit costs associated with transportation of the waste to an offsite disposal facility. PCB Alternative 3 would be less sensitive to increases in fuel prices and soil volumes because of the volume reduction from screening the oversize material in the soil. PCB Alternative 4 would become increasingly cost effective as the soil volume increases in comparison to PCB Alternatives 2 and 3 because it dramatically reduces the volume of soil requiring costly transportation while only incrementally increasing the labor and materials required to solidify waste.

OT008 WACS Analytical Soil Sample Result Exceedances						
Location	Sample ID[3]	Sample Depth (feet bgs)	Analyte	Results (mg/kg)	Project Action Limit (mg/kg)[1]	Cleanup Action Limit (mg/kg)[2]
TP01	01-2-SB001	2	DRO	14,000	250	10,250
			PCB-1260	3.8	1	1
	1-8-SB003	8	DRO	10,000	250	10,250
			1,1-Dichloroethene	0.035	0.03	0.85
TP02	02-2-SB004A	2	PCB-1260	3.5	1	1
	02-2-SB004B	2	PCB-1260	15	1	1
TP04	04-3-SB007	3	DRO	370	250	10,250
			PCB-1260	3.1	1	1
	04-5-SB008	4	GRO	560	300	10,000
			DRO	11,000	250	10,250
	04-7-SB009	7	GRO	410	300	10,000
			DRO	7,300	250	10,250
TP05	05-3-SB010	3	DRO	5,600	250	10,250
			PCB-1260	1.6	1	1
	05-8-SB012	8	GRO	330	300	10,000
			DRO	4,700	250	10,250
TP06	06-3-SB013	3	GRO	930	300	10,000
			DRO	11,000	250	10,250
			Naphthalene	31	20	1400
	06-7-SB014	7	DRO	4,600	250	10,250
TP07	07-1-SB015A	1	PCB-1260	5.9	1	1
	07-1-SB015B	1	PCB-1260	8.2	1	1
TP09	09-3-SB019	3	DRO	630	250	10,250
TP10	10-2-SB020	2	DRO	270	250	10,250
			PCB-1260	2.7	1	1
	10-5-SB021	5	PCB-1260	1.6	1	1
TP14	14-1-SB029	1	DRO	12,000	250	10,250
			PCB-1260	8.8	1	1
			1,2,4-Trichlorobenzene	12	0.85	41
	14-5-SB031	5	DRO	600	250	10,250
			PCB-1260	5	1	1
			1,2,4-Trichlorobenzene	1.6	0.85	41
TP15	15-2-SB032B	2	PCB-1260	1.2	1	1
TP18	18-4-SB039	4	DRO	340	250	10,250
TP25	25-2-SB052	2	PCB-1260	1.9	1	1
TP26	26-0.5-SS054A	0.5	DRO	1300	250	10,250
	26-0.5-SS054B	0.5	DRO	2,500	250	10,250
			RRO	14,000	11000	10,000
TP30	30-5-SB062	5	DRO	810	250	10,250
			PCB-1260	4.4	1	1
TP36	36-2-SB071	2	DRO	360	250	10,250
			PCE	0.039	0.024	1
TP40	40-3-SB079	3	DRO	350	250	10,250
			PCB-1260	3.1	1	1
			PCE	0.63	0.024	10
TP45	45-0.5-SB086	0.5	DRO	5,000	250	10,250
	45-5-SB087	5	DRO	6,100	250	10,250
			PCB-1260	1.1	1	1

Notes:
[1] Project Action Limit based on 18 AAC 75 Table B2, Method Two, most conservative petroleum hydrocarbon soil cleanup levels under 40-inch zone and Table B1, Method Two, most conservative under 40-inch zone and migration to groundwater (ADEC 2008).
[2] Cleanup Action Limit based on 18 AAC 75 Table B1, Method Two, most conservative direct contact, ingestion or inhalation under 40-inch zone (ADEC 2008).
[3]Sample IDs have been truncated. All Sample IDs are preceeded by 11IM-WACS-.
Data qualifiers are not included.
For additional definitions, see the Acronyms and Abbreviations section.

OT008 WACS Analytical Sediment and Surface Water Sample Result Exceedances				
Location	Sample ID[3]	Analyte	Results (mg/kg)	Project Action Limit [1,2]
Sediment samples				
SEEP1 (A)	SEEP1-0-SD01A	Anthracene	0.036	20,600
		Fluorene	0.1	2,300
		Naphthalene	0.4	1,400
		Phenanthrene	0.29	20,600
SEEP1 (B)	SEEP1-0-SD01B	Anthracene	0.13	20,600
		Chrysene	0.036	490
		Fluoranthene	0.055	1,900
		Naphthalene	0.11	1,400
		Phenanthrene	0.089	20,600
		Pyrene	0.078	11,400
Surface Water Samples				
SEEP1 (A)	SEEP1-0-WS01A	Naphthalene	0.0031	0.0011
		Naphthalene	0.0016	0.0011
		Barium	0.065	0.0039
SEEP1 (B)	SEEP1-0-WS01B	Naphthalene	0.0027	0.0011
		Naphthalene	0.0016	0.0011
		Barium	0.074	0.0039

Notes:
Data qualifiers are not included.
[1] Sediment Action Limit based on 118 AAC 75 Table B1, Method Two, most conservative direct contact, ingestion or inhalation under 40-inch zone (ADEC 2008). Units mg/kg
[2] Surface Water Action Limit based on NOAA SQuiRTs (Buchman 2008), Criterion Continuous Concentration limit guidelines for freshwater. Units mg/L
[3]Sample IDs are truncated. All begin with 11IM-WACS-.



Seep
Utilities
Index Contour (25 foot interval)
Stuctures
Road
Debris Noted in Test Pit

Previous Investigation Samples
Sample Results Below Project Action Limits
Sample Results Above Project Action Limits

2011 Test Pit Locations
Sample Results Below Project Action Limits
Sample Results Above Project Action Limits

OT008 WACS SAMPLE LOCATIONS AND SITE MAP
INDIAN MOUNTAIN LONG RANGE RADAR SITE
INDIAN MOUNTAIN, ALASKA

JACOBS

DATE:	PROJECT MANAGER:	FIGURE NO.:
29 Feb. 2012	J. WEHRMANN	5-1

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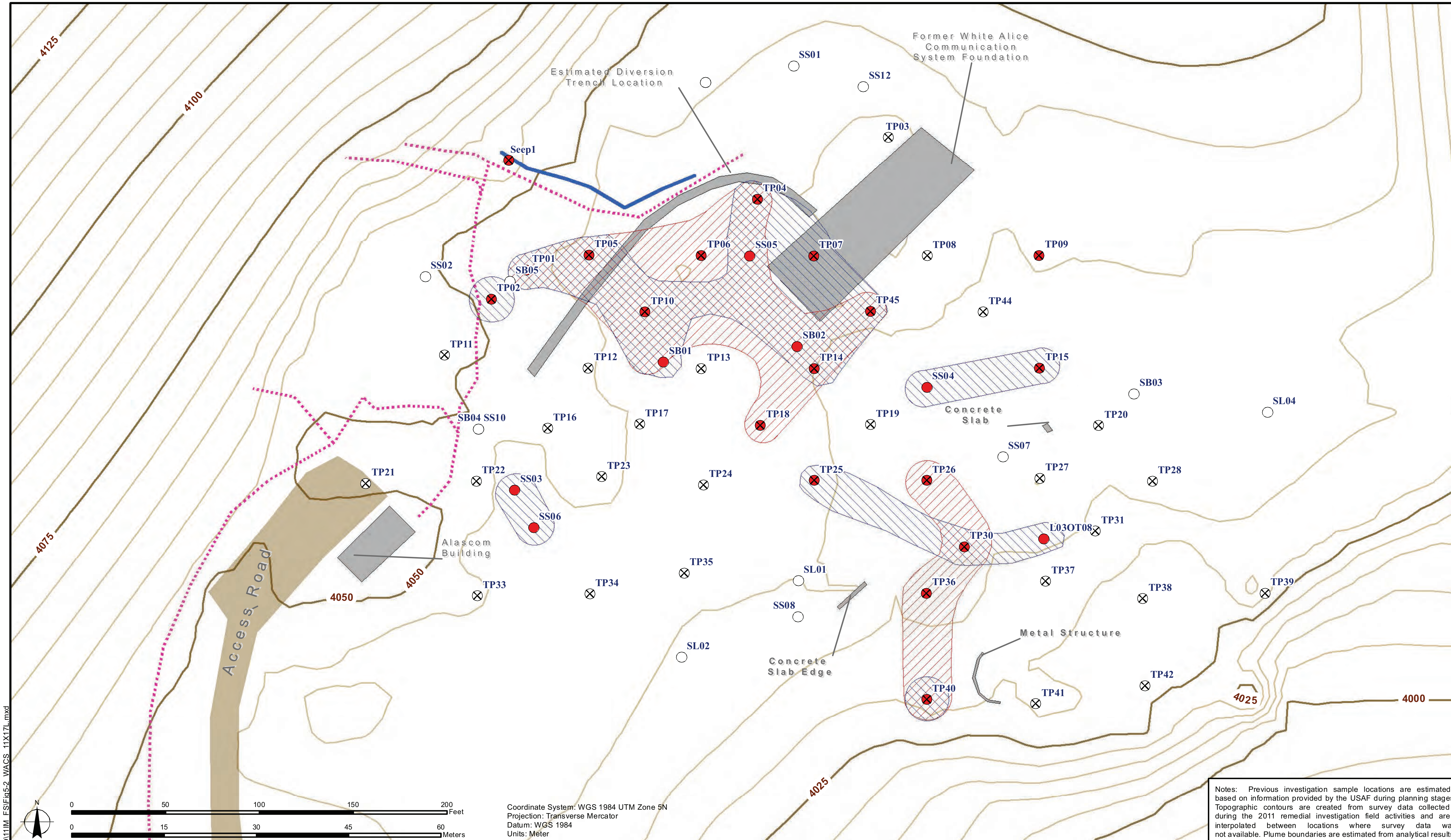

Exceedance

- ⊗ Sample Results Below Project Action Limits
- ⊗ (red) Sample Results Above Project Action Limits
- ○ Sample Results Below Project Action Limits
- ● (red) Sample Results Above Project Action Limits
- PCB Contamination Plume
- POL Contamination Plume
- Index Contour (25 foot interval)
- Seep
- Utilities
- Road
- Stuctures

OT008 WACS SOIL CONTAMINATION PLUMES
INDIAN MOUNTAIN LONG RANGE RADAR SITE
INDIAN MOUNTAIN, ALASKA

JACOBS	DATE:	PROJECT MANAGER:	FIGURE NO.:
	26 March 2012	J. WEHRMANN	5-2

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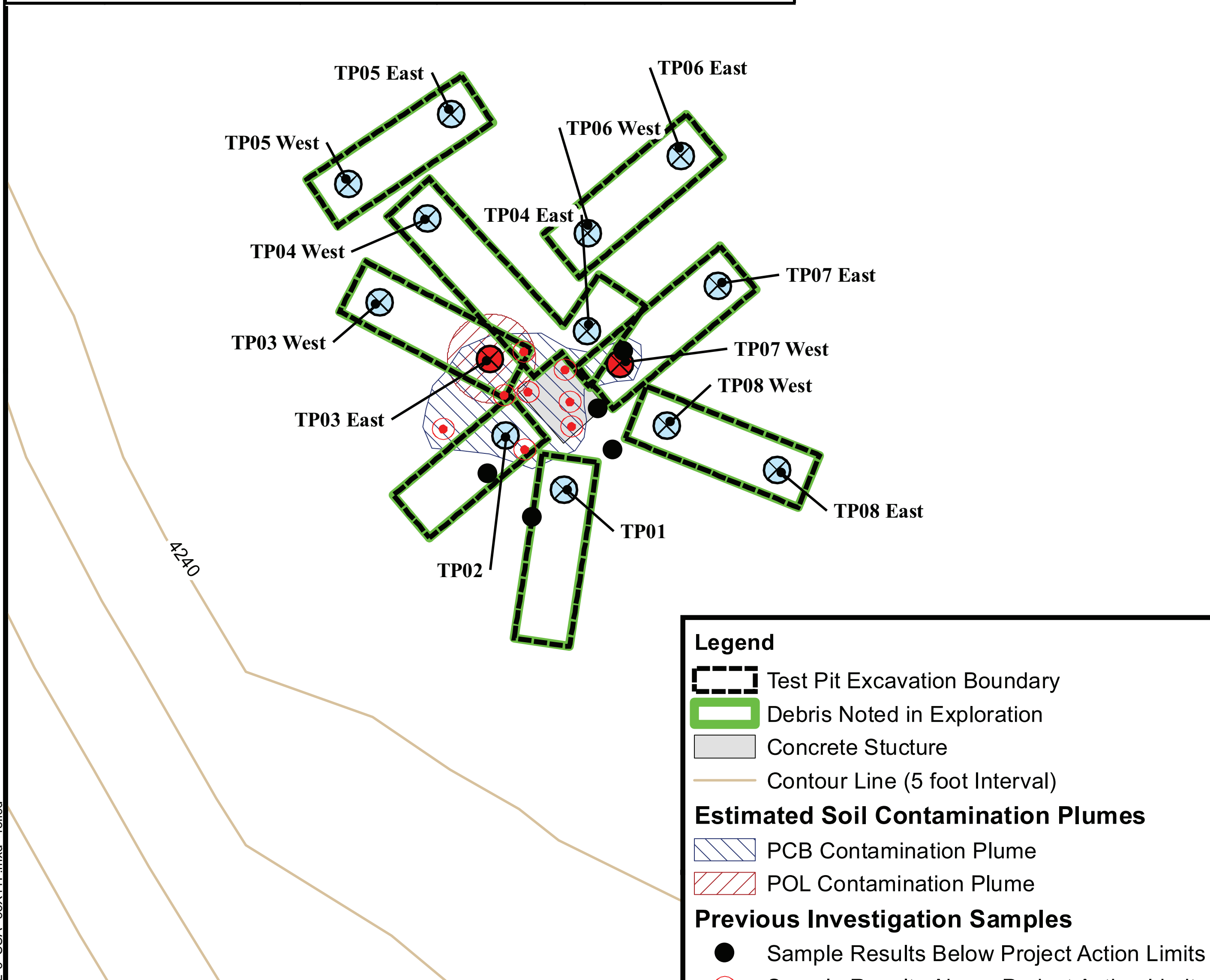
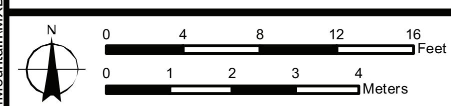
OT008 Stained Soil Area Analytical Soil Sample Result Exceedances

Location	Sample ID	Sample Depth (feet bgs)	Analyte	Results (mg/kg)	Project Action Limit (mg/kg)[1]
TP03 (East)	11IM-SSA-03-1E-SB006	1	DRO	290	250
			1,2,4-Trichlorobenzene	1.3	0.85
			PCB-1260	680	1
TP07 (West)	11IM-SSA-07-1W-SB025	1	PCB-1260	21	1

Notes:
[1]18 AAC 75 Table B2, Method Two, Most Conservative Petroleum Hydrocarbon Soil Cleanup Levels 'Under 40 Inch Zone' and Table B1, Method Two, Most Conservative 'Under 40 Inch Zone' and 'Migration to Groundwater' (ADEC 2008).
For additional definitions, see the Acronyms and Abbreviations section.



Notes: Previous Investigation Sample locations are estimated based on information provided by the USAF during planning stages. Previous Investigation Sample results are provided on Figure 1-3. Topographic contours are created from survey data collected during remedial investigation field activities and are interpolated between locations where survey data was not available. Plume boundaries are estimated from analytical results.



Coordinate System: WGS 1984 UTM Zone 5N
Projection: Transverse Mercator
Datum: WGS 1984
Units: Meter

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OT008 STAINED SOIL AREA SAMPLE LOCATIONS AND SITE MAP
INDIAN MOUNTAIN LONG RANGE RADAR SITE
INDIAN MOUNTAIN, ALASKA

JACOBS	DATE:	PROJECT MANAGER:	FIGURE NO.:
	29 DEC. 2011	J. WEHRMANN	5-3

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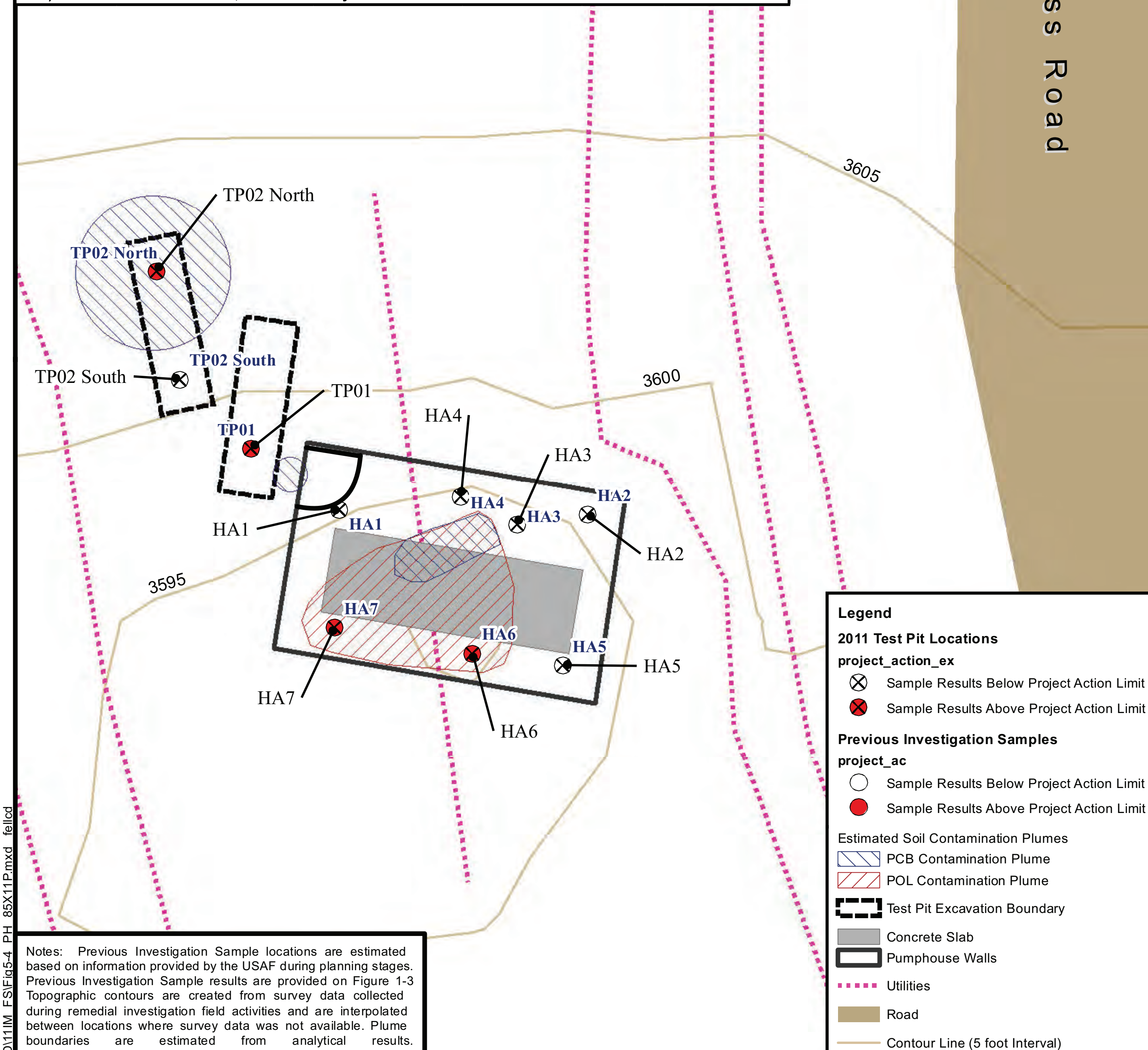
OT008 Pump House Analytical Soil Sample Result Exceedances

Location	Sample ID	Sample Depth (feet bgs)	Analyte	Results (mg/kg)	Project Action Limit (mg/kg)[1]
HA6	11IM-PH-HA6-2-SB012	2	DRO	1,800	250
HA7	11IM-PH-HA7-1-SB013	1	DRO	680	250
	11IM-PH-HA7-1.5-SB014B	1.5	DRO	370	250
TP02 (North)	11IM-PH-TP02-2N-SB019	2	DRO	1,200	250
			PCB-1016	44	1
			PCB-1260	4,500	1

Notes:

[1] 18 AAC75, Tables B1 and B2, most conservative under 40-inch zone and migration to groundwater (ADEC 2008). For additional definitions, see the Acronyms and Abbreviations section.



Notes: Previous Investigation Sample locations are estimated based on information provided by the USAF during planning stages. Previous Investigation Sample results are provided on Figure 1-3 Topographic contours are created from survey data collected during remedial investigation field activities and are interpolated between locations where survey data was not available. Plume boundaries are estimated from analytical results.

Coordinate System: WGS 1984 UTM Zone 5N
Projection: Transverse Mercator
Datum: WGS 1984
Units: Meter

Path: P:\IndianMountain\MXD\11IM_FS\Fig5-4_PH_85X11P.mxd fellcd

OT008 PUMPHOUSE SAMPLE LOCATIONS AND SITE MAP
INDIAN MOUNTAIN LONG RANGE RADAR SITE
INDIAN MOUNTAIN, ALASKA

JACOBS

DATE:	PROJECT MANAGER:	FIGURE NO.:
29 DEC. 2011	J. WEHRMANN	5-4

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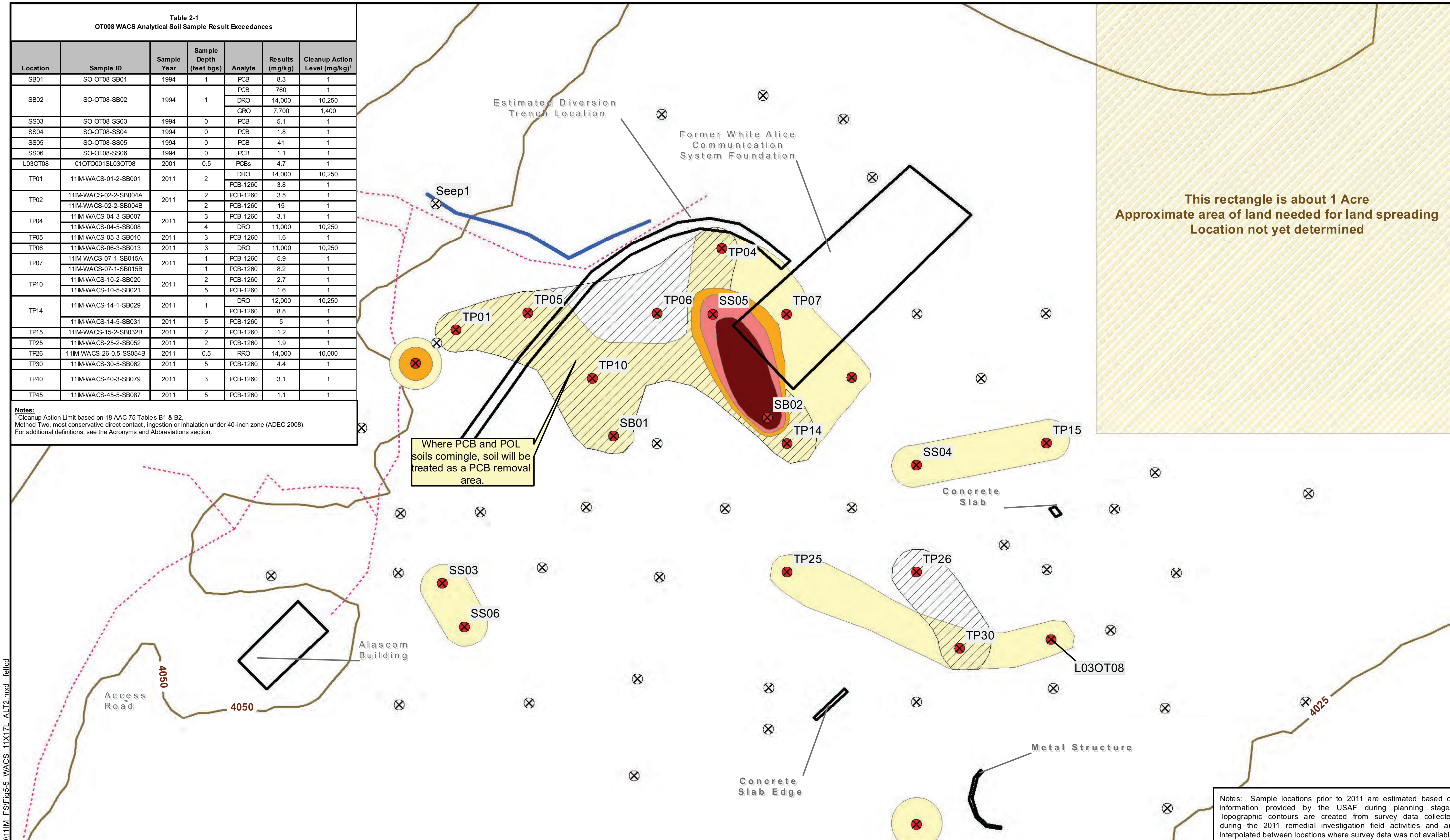
Table 2-1
OT008 WACS Analytical Soil Sample Result Exceedances

Location	Sample ID	Sample Year	Sample Depth (feet bgs)	Analyte	Results (mg/kg)	Cleanup Action Level (mg/kg)[1]
SB01	SO-OT08-SB01	1994	1	PCB	8.3	1
SB02	SO-OT08-SB02	1994	1	PCB	760	1
				DRO	14,000	10,250
				GRO	7,700	1,400
SS03	SO-OT08-SS03	1994	0	PCB	5.1	1
SS04	SO-OT08-SS04	1994	0	PCB	1.8	1
SS05	SO-OT08-SS05	1994	0	PCB	41	1
SS06	SO-OT08-SS06	1994	0	PCB	1.1	1
L03OT08	01OTO001SL03OT08	2001	0.5	PCBs	4.7	1
TP01	11IM-WACS-01-2-SB001	2011	2	DRO	14,000	10,250
				PCB-1260	3.8	1
TP02	11IM-WACS-02-2-SB004A	2011	2	PCB-1260	3.5	1
	11IM-WACS-02-2-SB004B		2	PCB-1260	15	1
TP04	11IM-WACS-04-3-SB007	2011	3	PCB-1260	3.1	1
	11IM-WACS-04-5-SB008		4	DRO	11,000	10,250
TP05	11IM-WACS-05-3-SB010	2011	3	PCB-1260	1.6	1
TP06	11IM-WACS-06-3-SB013	2011	3	DRO	11,000	10,250
TP07	11IM-WACS-07-1-SB015A	2011	1	PCB-1260	5.9	1
	11IM-WACS-07-1-SB015B		1	PCB-1260	8.2	1
TP10	11IM-WACS-10-2-SB020	2011	2	PCB-1260	2.7	1
	11IM-WACS-10-5-SB021		5	PCB-1260	1.6	1
TP14	11IM-WACS-14-1-SB029	2011	1	DRO	12,000	10,250
				PCB-1260	8.8	1
	11IM-WACS-14-5-SB031	2011	5	PCB-1260	5	1
TP15	11IM-WACS-15-2-SB032B	2011	2	PCB-1260	1.2	1
TP25	11IM-WACS-25-2-SB052	2011	2	PCB-1260	1.9	1
TP26	11IM-WACS-26-0.5-SS054B	2011	0.5	RRO	14,000	10,000
TP30	11IM-WACS-30-5-SB062	2011	5	PCB-1260	4.4	1
TP40	11IM-WACS-40-3-SB079	2011	3	PCB-1260	3.1	1
TP45	11IM-WACS-45-5-SB087	2011	5	PCB-1260	1.1	1

Notes:
[1] Cleanup Action Limit based on 18 AAC 75 Tables B1 & B2,
Method Two, most conservative direct contact, ingestion or inhalation under 40-inch zone (ADEC 2008).
For additional definitions, see the Acronyms and Abbreviations section.



Path: P:\IndianMountain\MXD\11IM_FS\Fig5-5_WACS_11X17L_ALT2.mxd feltcd

Sample Results Below Project Action Limits
Sample Results Above Project Action Limits
Seep
Index Contour (25 foot interval)
Stuctures
Utilities

PCB and POL Removal Areas
PCBs at 1 - 10 mg/kg
PCBs at 10.1 - 25 mg/kg
PCBs at 25.1 - 50 mg/kg
PCBs greater than 50 mg/kg
POL greater than 10250 mg/kg

ALL LOCATIONS APPROXIMATE

N

0 50 100 150 Feet
0 15 30 45 Meters

Coordinate System: WGS 1984 UTM Zone 5N
Projection: Transverse Mercator
Datum: WGS 1984
Units: Meter

OT008 WACS PCB ALTERNATIVES 2, 3, and 4
INDIAN MOUNTAIN LONG RANGE RADAR SITE
INDIAN MOUNTAIN, ALASKA

JACOBS

DATE:	PROJECT MANAGER:	FIGURE NO.:
12 June 2012	J. WEHRMANN	5-5

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Table 2-5
OT008 Stained Soil Area
Analytical Soil Sample Result Exceedances

Location	Sample ID	Sample Year	Sample Depth (feet bgs)	Analyte	Results (mg/kg)	Cleanup Action Level (mg/kg)[1]
SS001	08UTOOT08SS001	2008	-	PCBs	3320	1
SS001d	08UTOOT08SS001d	2008	-	PCBs	6320	1
SS002	08UTOOT08SS002	2008	-	PCBs	2.41	1
SS004	08UTOOT08SS004	2008	-	PCBs	13.5	1
SS005	08UTOOT08SS005	2008	-	PCBs	8.33	1
SS006	08UTOOT08SS006	2008	-	PCBs	1.83	1
SS009	08UTOOT08SS009	2008	-	PCBs	4.05	1
SS010	08UTOOT08SS010	2008	-	PCBs	192	1
SS011	08UTOOT08SS011	2008	-	PCBs	5.96	1
TP03 (East)	11IM-SSA-03-1E-SB006	2011	1	PCB-1260	680	1
TP07 (West)	11IM-SSA-07-1W-SB025	2011	1	PCB-1260	21	1

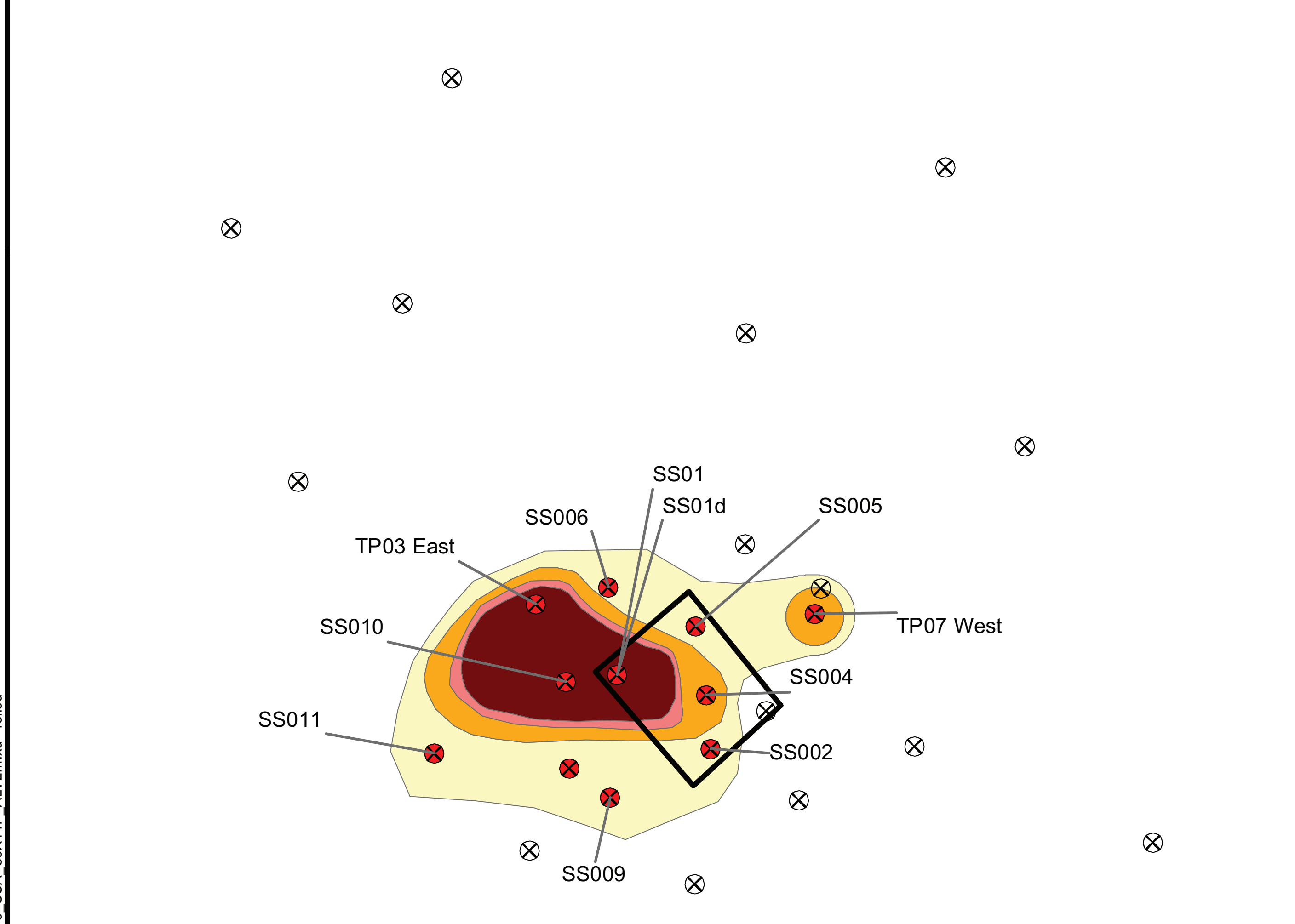
Notes:
[1] 18 AAC 75 Table B1 & B2, Method Two, most conservative direct contact, ingestion, or inhalation under 40-inch zone (ADEC 2008).
- Not available
For additional definitions, see the Acronyms and Abbreviations section.

Legend

- Sample Results Below Cleanup Action Level
- Sample Results Above Cleanup Action Level
- Concrete Stucture

Estimated Soil Contamination Plumes

- PCBs at 1 - 10 mg/kg
- PCBs at 10.1 - 25 mg/kg
- PCBs at 25.1 - 50 mg/kg
- PCBs greater than 50 mg/kg



Notes: Sample locations prior to 2011 are estimated based on information provided by the USAF during planning stages. Topographic contours are created from survey data collected during the 2011 remedial investigation field activities and are interpolated between locations where survey data was not available.

N

ALL LOCATIONS ARE APPROXIMATE

0 5 10 Feet

0 1 2 Meters

Coordinate System: WGS 1984 UTM Zone 5N
Projection: Transverse Mercator
Datum: WGS 1984
Units: Meter

Path: P:\IndianMountain\MXD\11IM_FS\Fig5-6_SSA_85X11P_ALT2.mxd fellcd

OT008 STAINED SOIL AREA (SSA) PCB ALTERNATIVES 2, 3, and 4
INDIAN MOUNTAIN LONG RANGE RADAR SITE
INDIAN MOUNTAIN, ALASKA

JACOBS	DATE: 12 June 2012	PROJECT MANAGER: J. WEHRMANN	FIGURE NO.: 5-6

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Table 2-7
OT008 Pump House Analytical Soil Sample Result Exceedances

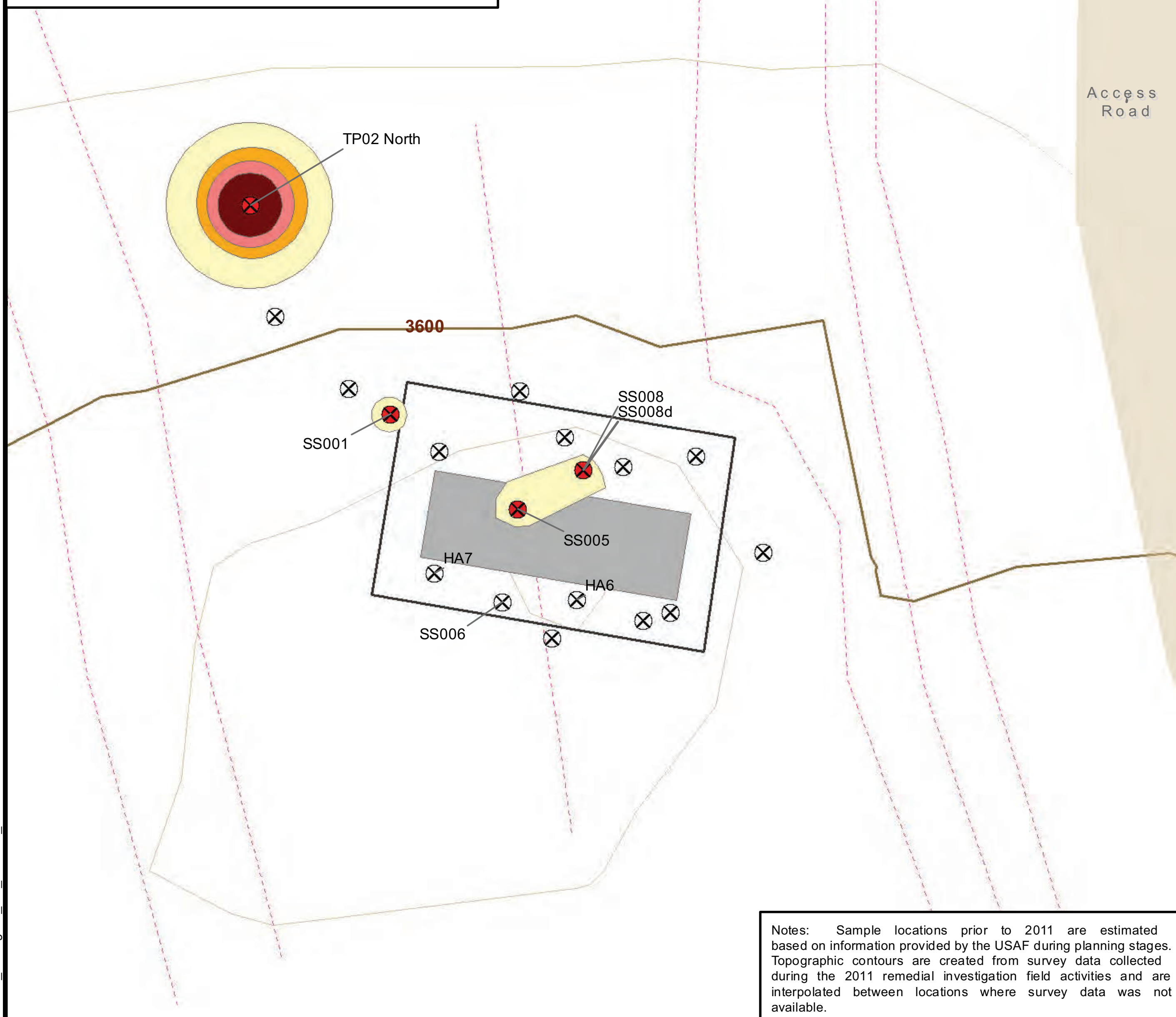
Location	Sample ID	Sample Year	Sample Depth (feet bgs)	Analyte	Results (mg/kg)	Cleanup Action Level (mg/kg)[1]
SS001	08UTOOPH01SS001	2008	-	PCBs	4.57	1
SS005	08UTOOPH01SS005	2008	-	PCBs	9.88	1
		2008		DRO	34,500	10,250
SS006	08UTOOPH01SS006	2008	-	DRO	26,000	10,250
SS008	08UTOOPH01SS008	2008	-	PCBs	3.77	1
SS008d	08UTOOPH01SS008d	2008	-	PCBs	1.11	1
HA6	11IM-PH-HA6-2-SB012	2011	2	DRO	1,800	10,250
HA7	11IM-PH-HA7-1-SB013	2011	1	DRO	680	10,250
	11IM-PH-HA7-1.5-SB014B	2011	1.5	DRO	370	10,250
TP02 (North)	11IM-PH-TP02-2N-SB019	2011	2	DRO	1,200	10,250
		2011		PCB-1016	44	1
		2011		PCB-1260	4,500	1

Notes:
[1] 18 AAC 75, Tables B1 & B2, Method Two, most conservative direct contact, ingestion or inhalation under 40-inch zone (ADEC 2008).
- not available
For additional definitions, see the Acronyms and Abbreviations section.

Legend
Sample Results Below Cleanup Action Levels
Sample Results Above Cleanup Action Levels
Utilities

Stuctures
Concrete Slab
Pumphouse Walls

PCB Removal Areas
PCBs at 1 - 10 mg/kg
PCBs at 10.1 - 25 mg/kg
PCBs at 25.1 - 50 mg/kg
PCBs greater than 50 mg/kg



Notes: Sample locations prior to 2011 are estimated based on information provided by the USAF during planning stages. Topographic contours are created from survey data collected during the 2011 remedial investigation field activities and are interpolated between locations where survey data was not available.

ALL LOCATIONS ARE APPROXIMATE
N
0 5 10 15 Feet
0 1 2 3 4 Meters

Coordinate System: WGS 1984 UTM Zone 5N
Projection: Transverse Mercator
Datum: WGS 1984
Units: Meter

Path: P:\IndianMountain\MXD\11IM_FS\Fig5-7_PH_85X11P_ALT.mxd fellcd

OT008 PUMPHOUSE PCB ALTERNATIVES 2, 3, and 4
INDIAN MOUNTAIN LONG RANGE RADAR SITE
INDIAN MOUNTAIN, ALASKA

JACOBS	DATE:	PROJECT MANAGER:	FIGURE NO.:
	12 June 2012	J. WEHRMANN	5-7

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6.0 REMEDIAL ALTERNATIVES TO ADDRESS PETROLEUM, OIL, AND LUBRICANT-CONTAMINATED SOIL

Remedial alternatives for POL-contaminated soil at the OT008 Site at Indian Mountain LRRS have been developed for detailed and comparative evaluation in this report. The alternatives described in Section 6.1 were developed based on the RAOs and general response actions identified for OT008 and on the screening of potential remedial technologies described in Section 4.0.

Implementation of these alternatives would include strict documented procedures that would be audited and evaluated during execution of the work to ensure that workers, individuals from the local community intermittently visiting the site, and the environment are protected from any potential risks.

6.1 DEVELOPMENT OF REMEDIAL ALTERNATIVES FOR PETROLEUM, OIL, AND LUBRICANT-CONTAMINATED SOIL

To develop a remedial strategy for POL-contaminated soil, a conceptual understanding of how the contamination is divided among the media and site was needed. To evaluate this, estimates of contaminant mass within each medium at the site were developed according to the following:

- Analytical and screening data for POL soils from the 2011 RI investigation and previous investigations were evaluated (USAF 2012)
- Volumes of POL-contaminated media were estimated (see Section 1.0) based on the cleanup values of 10,250 mg/kg for DRO.
- An estimated density of the soil of 1.5 tons per cubic yard was used to convert volume estimates to weight estimates

Based on initial technology identification and screening (Section 4.2) and site-specific conditions, the following alternatives were retained for detailed analysis for POL-contaminated soils:

- POL Alternative 1: No Action

- POL Alternative 2: Grain-Size Separation and Onsite Landspreading of POL-Contaminated Soils Above 10,250 mg/kg
- POL Alternative 3: Grain-Size Separation and Offsite Disposal of POL-Contaminated Soils Above 10,250 mg/kg

6.1.1 POL Alternative 1: No Action

Under the No Action Alternative, no activities would be undertaken to treat or remove the contamination present or to otherwise prevent exposure to the contamination (Figures 5-1 through 5-4). No monitoring would be conducted. A No Action Alternative is required for consideration under the NCP and serves as a baseline against which other alternatives can be compared.

6.1.2 POL Alternative 2: Grain-Size Separation and Onsite Landspreading of Petroleum, Oil, and Lubricant-Contaminated Soils Above the Direct Contact Criteria

POL Alternative 2 includes screening all POL-contaminated soil above the direct contact criteria for a variety of grain sizes using the same mechanical separation equipment and process described for the PCB-contaminated soil under PCB Alternative 3 (Section 5.3.5 and Figure 5-5). Once screening is complete, oversized soil material would be left onsite to be used as backfill for the excavation, and all fines, including the contaminated soils, would be landspread onsite to a depth of approximately 3 to 6 inches. No mechanical mixing would be performed after initial placement of the soil. A topographically flat area would be selected for the landspreading treatment area to minimize the risk of erosion of the contaminated soil and runoff of sediments to adjacent undisturbed areas. Additionally, an earthen berm using native soils at the perimeter of the landspreading area would be constructed to control stormwater runoff and runon. A temporary snowfence and signs would be erected around the landspreading area to prevent incidental contact by workers periodically visiting the Upper Camp. Refer to Figure 5-5 for a representation of the amount of land required for landspreading.

It is estimated that POL concentrations in these soil would decrease below the direct contact or ingestion levels within two full years. Therefore, a statistically defensible number of confirmation soil samples would be collected from randomly selected locations within the area at the end of the second season following completion of the creation of the landspreading treatment area and compared to the cleanup levels. If the area is determined to achieve the cleanup levels upon review by the stakeholders, the snowfence and signs would be removed and the area would be allowed to naturally revegetate. The small berms, however, would be allowed to remain to minimize runon/runoff and erosion of the soils.

6.1.3 POL Alternative 3: Grain-Size Separation and Offsite Disposal of Petroleum, Oil, and Lubricant-Contaminated Soils Above the Direct Contact Criteria

POL Alternative 3 would include screening of all POL-contaminated soil above the direct contact or ingestion levels for separation of grain sizes. Once screening is complete, oversized soil material would be left as backfill, while the finer-grained contaminated soils would be containerized and transported for offsite disposal.

6.2 SCREENING OF ALTERNATIVES FOR PETROLEUM, OIL, AND LUBRICANT-CONTAMINATED SOIL

In this section, the alternatives presented in Section 6.1 are screened based on effectiveness, implementability, and cost.

6.2.1 Screening of POL Alternative 1: No Action

The No Action Alternative is required by the NCP and serves as a baseline against which other alternatives can be compared. The No Action Alternative includes no provisions for environmental monitoring, controlling the migration of contaminants, reducing contaminant concentrations, or preventing human or ecological exposure.

This alternative would not be protective of human health or the environment. POL contamination in the subsurface soils would be expected to slowly biodegrade naturally over a long time period, however not at a rate that would allow the RAOs to be achieved in a reasonable timeframe. The potential for unacceptable human or environmental exposure to site contaminants would remain for as long as contaminant concentrations remain above cleanup levels.

No technical obstacles are involved with implementing the No Action Alternative, but administrative approval is unlikely. No costs are associated with this alternative. This alternative will receive detailed analysis in accordance with 40 CFR 300.430(e)(6) for a baseline comparison to other alternatives.

6.2.2 Screening of POL Alternative 2: Grain-Size Separation and Onsite Landspreading of DRO-Contaminated Soils Above 10,250 mg/kg

Grain-size separation and onsite landspreading is an effective remedial action for POL-contaminated soil. This remediation option would include screening all POL-contaminated soil above the direct contact or ingestion levels for POLs based on grain size. If implemented, this alternative would meet the RAOs and require minimal additional follow-up action for POL-contaminated soil.

Grain-size separation is an effective way of reducing soil volume while removing the soil contamination greater than the cleanup levels. The approximate percent reduction, which is assumed to be 25 percent, is based on an estimation of rocks greater than 2 inches as documented during the 2011 RI sampling (USAF 2012) and based on a similar operation at Anvil Mountain near Nome, Alaska. The landspreading of the remaining fines would allow for volatilization and natural attenuation to take place at an accelerated rate.

Costs for this alternative would include mobilization of equipment for excavation, screening, and landspreading. No POL-contaminated soil would be removed from the site, hence reducing costs relative to POL Alternative 3, which includes transportation and offsite disposal.

This alternative has been retained for further consideration because of its effectiveness and implementability.

6.2.3 Screening of POL Alternative 3: Grain-Size Separation and Offsite Disposal of Petroleum, Oil, and Lubricant-Contaminated Soils Above 10,250 mg/kg

Grain-size separation and offsite disposal is an effective remedial action for POL-contaminated soil. This remediation option would include screening all POL-contaminated soil above the direct contact or ingestion levels for POLs based on grain size. If implemented, this alternative would meet the RAOs and require no additional action for POL-contaminated soil.

As indicated for POL Alternative 2, grain-size separation is an effective way of reducing soil volume while removing soil contamination greater than the cleanup levels. Compared to complete offsite disposal, the contaminated volume requiring offsite disposal would be decreased by approximately 25 percent and the amount of backfill required would also be minimized. The approximate percent reduction is based on estimation of rocks greater than 2 inches as documented during the 2011 RI sampling (USAF 2012) and based on a similar operation at Anvil Mountain near Nome, Alaska.

Although reduced, removing the volume of soil above the direct contact or ingestion levels from the site is still the primary challenge involved with implementing this alternative due to the remote location of the site. This alternative would require screening of soil for categorization, containerization, and transportation, and would require increased logistics for scheduling the offsite transport and disposal of the soils.

This alternative has been retained for further consideration because of its effectiveness and implementability.

6.2.4 Summary of Screening Results for Petroleum, Oil, and Lubricant-Contaminated Soil

Table 6-1 compares the effectiveness, implementability, and cost of the screened alternatives.

Table 6-1
Screening of Alternatives for Petroleum, Oil, and Lubricant-Contaminated Soil

Remedial Alternative	Effectiveness	Implementability	Cost	Retained for Detailed Analysis?
POL 1: No Action	○	○	●	Yes
POL 2: Grain-sized screening and onsite landspreading for all POL-Contaminated Soil above the direct contact or ingestion levels	●	●	◐	Yes
POL 3: Grain-sized screening and offsite disposal for all POL-Contaminated Soil above the direct contact or ingestion levels	●	◐	○	Yes

Notes:
● Highly effective, easy to implement, or low cost
◐ Somewhat effective, difficult to implement, or moderate cost
○ Not effective, very difficult to implement, or high cost

6.3 DETAILED ANALYSIS OF ALTERNATIVES FOR PETROLEUM, OIL, AND LUBRICANT-CONTAMINATED SOIL

This section evaluates remedial alternatives to address POL-contaminated soil. Based on the screening presented in Section 6.2, the following alternatives were selected for detailed analysis:

- POL Alternative 1: No Action
- POL Alternative 2: Grain-Size Separation and Onsite Landspreading of POL-Contaminated Soils Above the Direct Contact Criteria
- POL Alternative 3: Grain-Size Separation and Offsite Disposal of POL-Contaminated Soils Above the Direct Contact Criteria

Sections 6.3.1 through 6.3.3 present the detailed analysis for each selected alternative. Section 6.3.4 presents comparison of the alternatives and their ability to achieve NCP criteria.

6.3.1 POL Alternative 1: No Action

Under the No Action Alternative, no activities would be undertaken to treat or remove the contamination present or to otherwise prevent or minimize the potential for exposure to the contamination. No monitoring would be conducted. Table 6-2 summarizes the ability of this Alternative to meet the NCP criteria; values are based on the rating system described in Section 2.6. This section discusses the rationale for the values presented below.

Table 6-2
Evaluation of Alternative 1

Evaluation Criteria	Value
Overall Protection of Human Health and the Environment	Fail
Compliance with ARARs	Fail
Long-Term Effectiveness and Permanence	0
Reduction in Toxicity, Mobility, and Volume through Treatment	0
Short-Term Effectiveness	0
Implementability	5
Cost	$0

Note:
For definitions, see the Acronyms and Abbreviations section.

POL Alternative 1 – Overall Protection of Human Health and the Environment

This alternative would not be protective of HHE. The potential for unacceptable human or environmental exposure to site contaminants would remain for as long as contaminant concentrations remain above cleanup levels. This alternative does not include institutional or site controls to prevent or minimize the potential for human contact with the contamination.

Therefore, the No Action alternative would not be protective of HHE in the short or long term because the POL-contaminated soils would remain onsite providing a potential exposure pathway for human and ecological receptors. Consequently, the No Action alternative would not meet this threshold criterion and would not be an acceptable alternative.

POL Alternative 1 – Compliance with ARARs

There is a risk of human exposure to site contaminants at concentrations above cleanup limits because no action of any kind would be taken to mitigate the risks that have been identified at this site. Thus, this alternative fails to comply with chemical-specific ARARs (Appendix A).

POL Alternative 1 – Long-Term Effectiveness and Permanence

Petroleum products will naturally degrade; however, this is a very slow process, especially in subsurface soils in a predominately cold environment. This alternative would therefore not be effective as a treatment for POL-contaminated soil.

POL Alternative 1 – Reduction of Toxicity, Mobility, or Volume through Treatment

This alternative would not treat, remove, or immobilize contamination.

POL Alternative 1 – Short-Term Effectiveness

Implementing this alternative would not involve intrusive activities or other actions that would subject workers or members of the community to short-term risks. Implementation would have no negative impacts on community or worker health and safety or environmental quality. However, natural processes would not reduce contaminants to concentrations below those presented in the RAOs within a reasonable timeframe.

POL Alternative 1 – Implementability

No technical obstacles would be involved with implementing the No Action Alternative, but administrative approval is highly unlikely.

POL Alternative 1 – Costs

No costs are associated with this alternative.

6.3.2 POL Alternative 2: Grain-size Separation and Onsite Landspreading of Petroleum, Oil, and Lubricant-Contaminated Soils Above the Direct Contact Criteria

Table 6-3 summarizes the ability of POL Alternative 2 to satisfy the objectives established by the NCP. This section discusses the rationale for the values presented below.

Table 6-3
Evaluation of POL Alternative 2

Evaluation Criteria	Value
Overall Protection of Human Health and the Environment	Pass
Compliance with ARARs	Pass
Long-Term Effectiveness and Permanence	4
Reduction in Toxicity, Mobility, and Volume through Treatment	4
Short-Term Effectiveness	3
Implementability	3
Cost (in millions)	$1.6

Note:
For definitions, see the Acronyms and Abbreviations section.

POL Alternative 2 – Overall Protection of Human Health and the Environment

This alternative would effectively protect HHE. Soil containing POL contamination exceeding the direct contact or ingestion levels would be screened for grain size, and the contaminated fines posing the site risk would be landspread for treatment, allowing the RAOs to be obtained at project completion. Excavation of the soils containing the POL contamination above risk-based cleanup levels would remove the source of the risk at the site. Statistically-based confirmation soil sampling representative of the remaining soil would be performed upon completion of the excavation to ensure that an adequate level of confidence was attained that any residual site risk was within an acceptable range. No long-term administrative controls would be necessary at OT008 because all residual soil would be shown to be less than the risk-based criteria. These actions and limitations would ensure long-term overall protection of HHE at the site.

The excavated soil would be mechanically screened to remove rocks greater than approximately 2 inches, which have less surface area per unit of volume than finer-grained material and consequently less total DRO concentration per unit of mass. These larger rocks screened from the excavated soils at the site would be sampled to ensure that total DRO concentrations are less than 10,250 mg/kg. These screened materials would be used to backfill the excavation upon verification of confirmation soil sample results collected within the excavation.

The remaining screened soil less than approximately 2 inches would be landspread at the Upper Camp to allow volatilization and natural attenuation of the residual contamination. Engineering controls, such as a snowfence and signs, would prevent worker contact with the soil. Environmental impacts associated with landspreading would be relatively minor since little vegetation exists at the OT008 site. Grain-size separation will reduce the volume of soil needing to be spread, which in turn will reduce the area impacted by landspreading activities.

Short-term overall protection of HHE at the site would be controlled through strict procedures documented in work plans for any implementation of this alternative. For instance, dust suppression and control measures would be implemented during excavation and screening of the POL-contaminated soils to mitigate potential airborne dispersion of contaminated particulates. Additionally, appropriate PPE for workers would be required and site controls would be implemented to protect HHE in the short term.

POL Alternative 2 – Compliance with ARARs

POL Alternative 2 could be implemented in a manner that complies with all chemical-, location-, and action-specific ARARs (Appendix A).

This alternative would achieve chemical-specific ARARs for the POL-contaminated soils at the site by removing any soils with concentrations greater than the risk-based cleanup levels. Representative samples from the soil landspread at Upper Camp would be analyzed after approximately two years, at which time it is anticipated that the POL concentrations would be less than the cleanup levels, which would ensure compliance with the chemical-specific ARARs. This alternative would be implemented with appropriate controls to comply with any location-specific and/or action-specific ARARs. Therefore, this alternative would meet this threshold criterion and would be an acceptable possible alternative.

POL Alternative 2 – Long-Term Effectiveness and Permanence

The long-term effectiveness and performance goals would be met under this alternative because the source of the risk to HHE above the cleanup levels for POL in soil would be removed from the site and treated by landspreading. Landspreading would help to expedite the natural attenuation, including volatilization, of POL-contaminated soils. Some follow-up confirmation sampling of the landspreading area would be required to determine the rate of degradation of the contamination. POL-contaminated soil with a grain size below 2 inches would be removed from the site and treated by landspreading while the remaining material, with grain size above 2 inches and with POL concentrations verified to be less than the risk-based criterion associated with it, would remain at the site as backfill for the excavation. This would provide a permanent remedy ensuring long-term protection of HHE. Therefore, this alternative would likely prove to be effective over the long term.

POL Alternative 2 – Reduction of Toxicity, Mobility, or Volume through Treatment

Biodegradation and volatilization of the POL contamination at the landspreading area would reduce the toxicity over a two-year period to concentrations below cleanup levels. Careful consideration for a topographically flat area chosen for landspreading activities and use of an earthen berm, as detailed above, would be required to ensure contamination does not become mobile or be subject to runoff.

Grain–size separation using a mechanical process that would sort out rocks greater than approximately 2 inches would reduce the volume of soil requiring treatment by approximately 25 percent. These larger soil materials have less surface area per unit volume and unit weight than finer grain material to which potential POL could adsorb. The volume of waste reduction used, which also is used for costing purposes is based on soil descriptions recorded on boring logs for test pits at the site during the 2011 supplemental RI effort (USAF 2012).

POL Alternative 2 – Short-Term Effectiveness

The soil excavation, screening, and landspreading activities would potentially expose site workers to the contamination during landspreading treatment as well as to hazards associated with working in and around excavations, operation of the mechanical screening equipment, and handling of the waste soils. However, with careful implementation this alternative would be protective in the short term (during the remedial action).

Implementation of this alternative would include strict documented procedures that would be audited and evaluated during execution of the work to ensure that workers, individuals from the local community intermittently visiting the site, and the environment are protected from any potential risks. The time required until the remedy is in place (i.e., all POL-contaminated soil is excavated, screened, and landspread) would be within a single working season of less than one month from mobilization to demobilization; treatment is estimated to be completed within two years after landspreading is initiated. The excavation of the soil and the subsequent mechanical screening operations, stockpiling, handling, and placement of the soil for landspreading treatment each present risks to HHE. Experienced and appropriately trained and supervised workers using well maintained and inspected equipment would minimize these risks.

Excavation, screening, and soil handling would use BMPs for typical soil excavation and quarry (i.e., screening) activities but would also include procedures to protect workers from direct contact with the POL-contaminated soils and inhalation of airborne particulates, including use of PPE. Particulate matter generated during excavation, screening, and handling of the soils would be controlled using standard dust suppression measures, such as using a light water mist and applying water to surfaces where heavy equipment and trucks travel. Additionally, the mechanical soil screening operations would be designed to minimize worker exposure to particulates, such as allowing use of heavy equipment and using mechanical means to transfer materials as appropriate to maximize distance and shielding from the operations generating the dust.

Therefore, the short-term risks associated with the implementation of POL Alternative 2 would be controlled through engineering and administrative controls.

POL Alternative 2 – Implementability

Mobilization of the equipment required for excavation and screening would be the most logistically challenging task of this alternative. Additionally, limited area at the Upper Camp is available for the landspreading area, so if the actual volume of POL-contaminated soil is larger than the estimate, available space could become problematic.

The mechanical screening would require mobilization of equipment such as stationary screens (commonly known as grizzlies), powered mechanical vibrating screens, conveyors, and hoppers as described for PCB Alternative 3. Although there are some logistical concerns with the mobilization of appropriate equipment and supplies for the grain-size separation due to the remote nature of the site, the reduction in volume of soil under this alternative requiring landspreading treatment would offset these concerns. The system would only be used if PCB Alternative 3 or PCB Alternative 4 is selected.

The mechanical screening would be performed using remote loading and soil handling using heavy equipment which would limit direct worker contact with the contaminated soil as described for the PCB screening operations (refer to PCB Alternative 3). However, use of screw conveyors to move the soil across the screens and powered vibratory screens to separate soils can require maintenance. Care would need to be taken to avoid spreading contamination during screening, excavation, and containerization activities. Under this alternative, once the excavation, sorting, and landspreading activities are complete, no additional activities would be required for POL-contaminated soil.

Limited area is available in the Upper Camp for landspreading. Adequate area is available for the anticipated volume of soil, which is based on the previous characterization of the extent of contamination (USAF 2012), but a significant increase in the volume of soil could require other options, such as increasing the thickness of the POL-contaminated soil being landspread or adding the additional soil volume to the PCB-contaminated soil according to the selected PCB alternative (refer to Section 5.0). Increasing the thickness of the soil to be treated will increase the time required for treatment because the principle of landspreading is to increase the surface area of the contaminated soil exposed to the atmosphere to allow volatilization and provide oxygen to stimulate bioremediation. Increasing the soil thickness beyond 3 to 6 inches would necessitate periodically turning the soil (i.e., landfarming). If the excess POL-contaminated soil were to be combined with the PCB-contaminated soils for offsite treatment and disposal, the cost would increase since treatment and disposal costs for the PCB-contaminated soils is higher than that for POL-contaminated soils.

The anticipated current soil volume to be treated with landspreading is approximately 300 cubic yards, which would require about 16,000 square feet to spread to a 6 inch thickness. Approximately 1,000 cubic yards of POL-impacted soils requiring landspreading at a 6-inch thickness would require about 1.25 acres or 54,000 square feet. Approximately an acre is available at the site for landspreading. If the volume of soil requiring treatment exceeds 800 cubic yards, the thickness of the soil lens would increase over 6 inches over an acre area.

POL Alternative 2 can be technically and administratively implemented; however, the project must be managed to ensure timely delivery of equipment, coordinate screening activities with PCB Alternatives 3 and 4, and to ensure timely excavation and landspreading activities.

POL Alternative 2 – Costs

The estimated capital including overhead and institutional controls combined with long term monitoring costs for POL Alternative 2 would be $1,243,583 and $371,064 respectively, for an approximate total project cost of $1,614,647 in 2013 dollars (Appendix B). The total estimated cost is presented on Table 6-3. Landspreading eliminates the need to remove any soil from the site, therefore greatly reducing the cost associated with offsite treatment and disposal. Remaining costs include excavation, grain-size separation, and landspreading as well as those factors detailed in Appendix B and briefly summarized in Section 2.5.2 to achieve accuracy within +50 percent and -30 percent per EPA 1988. This alternative would require an estimated one month for completion concurrent with the selected PCB alternative and assumes a pilot study to determine the appropriate screening size and volume reduction. Following landspread activities, a round of confirmation soil samples from the landspreading area would be required to verify closure of the POL-contaminated soils. The cost for this alternative assumes landspreading of approximately 294 cubic yards of POL-contaminated soil.

6.3.3 POL Alternative 3: Grain-Size Separation and Offsite Disposal of Petroleum, Oil, and Lubricant-Contaminated Soil Above the Direct Contact Criteria

Table 6-4 summarizes the ability of POL Alternative 3 to satisfy the objectives established by the NCP. The rationale for the values listed in Table 6-4 is presented below.

Table 6-4
Evaluation of POL Alternative 3

Evaluation Criteria	Value
Overall Protection of Human Health and the Environment	Pass
Compliance with ARARs	Pass
Long-Term Effectiveness and Permanence	5
Reduction in Toxicity, Mobility, and Volume through Treatment	3
Short-Term Effectiveness	3
Implementability	3
Cost (in millions)	$2.4

Note:
For definitions, see the Acronyms and Abbreviations section.

POL Alternative 3 – Overall Protection of Human Health and the Environment

This alternative would effectively protect HHE. Soil containing POL contamination exceeding the direct contact criteria would be screened for grain-size, and the contaminated fines would be disposed of offsite, allowing the RAOs to be obtained at project completion. Similar to POL Alternative 2, excavation of the soils containing the POL-contaminated soil above risk-based cleanup levels would remove the source of the risk at the site. Statistically-based confirmation soil sampling representative of the remaining soil would be performed upon completion of the excavation to ensure that any residual site risk was within an acceptable range. No administrative controls would be necessary at OT008 because all levels of POL contamination in the residual soil would be less than the risk-based criteria. These actions and limitations would ensure long-term overall protection of HHE at the site.

As with POL Alternative 2, the excavated soil would be mechanically screened to remove rocks greater than approximately 2 inches, which have less surface area per unit of volume than finer-grained material and consequently less total POL concentration per unit of mass. These larger rocks screened from the excavated soils at the site would be sampled to ensure that total POL concentrations are less than 10,250 mg/kg. These screened materials would be used to backfill the excavation upon verification of confirmation soil sample results collected within the excavation.

The screened soil less than approximately 2 inches would be containerized and transported for offsite disposal within Alaska. Grain-size separation would reduce the volume of soil needing to be disposed of, which in turn would reduce the area impacted by landspreading activities.

Short-term overall protection of HHE at the site would be controlled through strict procedures documented in work plans for any implementation of this alternative. For instance, dust suppression and control measures would be implemented during excavation and screening of the POL-contaminated soils to mitigate potential airborne dispersion of contaminated particulates. Additionally, appropriate PPE for workers would be required and site controls would be implemented to protect HHE in the short term.

<u>POL Alternative 3 – Compliance with ARARs</u>

This alternative would comply with all chemical-, location-, and action-specific ARARs (Appendix A). It would achieve chemical-specific ARARs for the POL-contaminated soils at the site by removing any soils with concentrations greater than the risk-based cleanup levels; representative samples of the material screened from the soil greater than approximately

2 inches would be analyzed to ensure compliance with the chemical-specific ARARs before being used as backfill at the site. Representative samples from the waste soil would ensure compliance with the waste acceptance criteria for the disposal facility to ensure that all regulatory and permit requirements are met. This alternative would be implemented with appropriate controls to comply with any location-specific and/or action-specific ARARs. Therefore, this alternative would meet this threshold criterion and would be an acceptable possible alternative.

POL Alternative 3 – Long-Term Effectiveness and Permanence

The long-term effectiveness and performance goals would be met under this alternative because the source of the risk to HHE above the cleanup levels for POL in soil would be removed from the site and disposed of in a permitted landfill. POL-contaminated soil with a grain size below 2 inches would be removed from the site and disposed of offsite while the remaining material, with grain size above 2 inches and with POL concentrations verified to be less than the risk-based criterion associated with it, would remain at the site as backfill for the excavation. This would provide a permanent remedy ensuring long-term protection of HHE.

Disposal of the soils at an offsite landfill in Alaska would be effective in the long term because a landfill appropriately permitted for POL-contaminated soil from this site is designed for long-term protection of HHE at and near the landfill. The required landfill liner, leachate collection system, daily cover requirements, restrictions on acceptable waste characteristics (e.g., chemical and physical constraints), and other operational requirements in the permit provide assurance that long-term protectiveness of HHE will be maintained.

Therefore, this alternative would prove to be effective over the long term.

POL Alternative 3 – Reduction of Toxicity, Mobility, or Volume through Treatment

Grain–size separation using a mechanical separation process that would exclude rocks greater than approximately 2 inches would reduce the volume of soil requiring offsite disposal by approximately 25 percent as indicated for POL Alternative 2. These larger soil materials have less surface area per unit volume and unit weight than finer grain material to which potential POL could adsorb. The volume of waste reduction used is based on soil descriptions recorded on boring logs for test pits at the site during the 2011 RI (USAF 2012).

Disposal of POL-contaminated soil in a permitted landfill does not reduce toxicity, mobility, or volume of POL contamination through treatment under this alternative. The mobility of the POL contamination in the soil disposed of offsite (i.e., the soil with materials less than two inches) would be reduced through isolation in the lined waste cell of the offsite landfill, which would also include use of leachate collection/treatment systems, the landfill cap, monitoring, site controls, etc.

POL Alternative 3 – Short-Term Effectiveness

The short-term effectiveness of this alternative would be similar to those described for PCB Alternative 3 (Section 5.3.3), although the associated health risks for POL are less than those for PCB, and there are fewer risks associated with transportation because the POL-contaminated soil could be disposed of in Alaska instead of the contiguous U.S. The soil screening, excavation, and containerization would potentially expose site workers to POL contamination as well as to hazards associated with working in and around excavations, operating the mechanical screening equipment, and handling the waste soils. However, with careful implementation this alternative would be protective in the short term (during the remedial action).

The time required until the remedy is in place (i.e., all POL-contaminated soil is excavated, screened, and disposed of offsite) would be within a single working season of approximately one month concurrent with the PCB remediation activities. The excavation of the soil and the subsequent mechanical screening operations, stockpiling, handling, and loading of soil containers into haul trucks, transport of the containers to the Lower Camp, transport by air from the site, and transport to the disposal facility each present risks to workers as well as potential for migration to offsite locations and risks to the community. Activities at each transfer station (e.g., the airport, the landfill, etc.) including the offloading of the waste containers and subsequent distribution and compaction of the soil within the waste cell, also present risks to workers. Experienced, appropriately licensed, and trained workers using well maintained, appropriately licensed, and inspected equipment and transportation vehicles would minimize transportation risks.

Excavation, screening, and soil handling would use BMPs for typical soil excavation and quarry (i.e., screening) activities but would also include procedures to protect workers from direct contact with the POL-contaminated soils and inhalation of airborne particulates, including use of PPE. Particulate matter generated during excavation, screening, and handling of the soils would be controlled using standard dust suppression measures, such as using a light water mist and applying water to surfaces where heavy equipment and trucks travel. Additionally, the mechanical soil screening operations would be designed to minimize worker exposure to particulates, such as allowing use of heavy equipment and using mechanical means to transfer materials as appropriate to maximize distance and shielding from the operations generating the dust. Transportation of the soil to the offsite landfill would require sealing the waste container to prevent spills of material and to minimize airborne dispersion of particulates during transit.

Therefore, the short-term risk associated with the implementation of POL Alternative 3 would be controlled through engineering and administrative controls.

POL Alternative 3 – Implementability

Implementation of this alternative would be similar to that required for PCB Alternative 3 except that the volume of waste transported for offsite disposal would be substantially less and the POL-contaminated soil would be disposed of within Alaska instead of additional transportation to the contiguous U.S., which would consequently reduce the coordination requirements discussed in Section 5.3.3. Mobilization of the equipment required for excavation and screening would require planning in order to coordinate with excavation, screening, and offsite disposal activities managed concurrently with the PCB remediation efforts. Offsite disposal of contaminated soils within Alaska would also be logistically challenging due to the remote nature of the site and would be similar to those presented for PCB Alternatives 2, 3, and 4 but of significantly lower magnitude. The reduction in volume from screening activities, and the fact that POL-contaminated soils can be disposed of in Alaska would alleviate much of the transportation and logistical concerns. Under this alternative, no additional activities would be required for POL-contaminated soil.

POL Alternative 3 can be both technically and administratively implemented, although planning and coordination is required to implement an efficient and workable screening operation, to ensure timely delivery of equipment, and to ensure timely excavation, waste containerization, waste transport, and waste disposal without delays.

POL Alternative 3 – Cost

The estimated capital including overhead and institutional controls costs for POL Alternative 3 would be $2,412,460, for an approximate total project cost of $2,412,460 in 2013 dollars (Appendix B). The estimated cost is presented on Table 6-4. Cost estimates for this alternative were based on the assumption that approximately 294 cubic yards of soil would require offsite disposal. These costs include excavation, grain-size separation, transportation, and disposal as well as factors detailed in Appendix B and briefly summarized in Section 2.5.2 to achieve accuracy within +50 percent and -30 percent per EPA 1988.

This alternative would require an estimated one month for completion concurrent with the selected PCB alternative to determine the appropriate screening size and volume reduction. The total cost for this alternative assumes transportation and offsite disposal of approximately 294 cubic yards of POL-contaminated soil after a 25 percent reduction in volume after mechanical screening.

6.3.4 Comparison of Remedial Alternatives for Petroleum, Oil, and Lubricant-Contaminated Soil

Table 6-5 summarizes the three alternatives that received detailed analysis according to their ability to comply with NCP criteria.

Threshold Criteria

POL Alternative 1 fails to comply with either of the threshold criteria. Because this alternative lacks either institutional controls or contaminant treatment or removal, a possibility exists that humans could be exposed to site contaminants at concentrations above cleanup levels. POL Alternatives 2 and 3 are protective of HHE at project completion and could be implemented in a manner that complies with all chemical-, location-, and action-specific ARARs.

Because POL Alternative 1 fails to attain the threshold criteria, it will not be considered further but it will be used as a baseline for comparison with the other alternatives. POL Alternatives 2 and 3 meet the threshold criteria and are evaluated further in this section.

Table 6-5
Comparison of Alternatives for the Petroleum, Oil, and Lubricant-Contaminated Soil

Evaluation Criteria	POL Alternative 1: No Action	POL Alternative 2: Grain-Size Separation and Onsite Landspreading of POL-Contaminated Soils Above the Direct Contact Criteria	POL Alternative 3: Grain-Size Separation and Offsite Disposal of POL-Contaminated Soil Above the Direct Contact Criteria
Overall Protection of Human Health and the Environment	Fail	Pass	Pass
Compliance with ARARs	Fail	Pass	Pass
Long-Term Effectiveness and Permanence	0	4	5
Reduction in Toxicity, Mobility, and Volume through Treatment	0	4	3
Short-Term Effectiveness	0	3	3
Implementability	2	3	3
Cost (in millions)	$0	$1.6	$2.4

Note:
For definitions, see the Acronyms and Abbreviations section.

Primary Balancing Criteria

POL Alternatives 2 and 3 both propose grain-size screening for POL-contaminated material and retaining everything above 2 inches onsite. POL Alternative 2 proposes onsite landspreading of fines separated during screening that are above the direct contact criteria. POL Alternative 3 recommends offsite disposal for all fines separated during screening that are above the direct contact criteria. POL Alternative 3 would be the most protective remedial action for potential onsite receptors because it would remove all fines separated during screening with POL contamination levels above the direct contact criteria from the site. However, it would also be the most costly and most logistically challenging alternative. Both alternatives present grain-size separation to reduce the volume of soil requiring treatment, but POL Alternative 3 would not provide any treatment to reduce toxicity or mobility whereas POL Alternative 2 would reduce toxicity through landspreading treatment. POL Alternative 3 would reduce the mobility of the POL, but the reduction in mobility would be a function of the landfill design and operation instead of through treatment. POL Alternatives 2 and 3 both would be implemented to maintain short-term effectiveness, but POL Alternative 3 would treat POL-contaminated soil onsite in a landspreading area that would require engineering controls to limit exposure. Each alternative can be technically and administratively implemented. Both alternatives would meet the RAOs.

Long-Term Effectiveness and Permanence. POL Alternatives 2 and 3 are each effective in protecting HHE over the long term while the No Action Alternative does not provide any means by which HHE would be protected. POL Alternatives 2 and 3 are permanent remedies that remove all POL-contaminated soils above the current risk-based cleanup levels, but POL Alternative 2 would treat the POL-contaminated soils through landspreading to allow natural attenuation. The time required to complete treatment is assumed to be approximately two years, but a longer period may be required due to the short summer seasons, the longer duration of snow and frozen conditions, and the weathered condition of the diesel. Eventually, POL Alternative 2 would provide a long-term and permanent solution. These uncertainties would be eliminated under POL Alternative 3 in which the POL-contaminated soils would be immediately removed from the site for disposal eliminating the risk and providing a long-term and permanent solution.

PCB Alternative 3, which includes excavation and offsite disposal, would therefore provide the most immediate, permanent, certain, and the effective long-term remedy of these alternatives because the PCB contamination in the soil above the cleanup levels are removed immediately from the site. PCB Alternative 2 would be almost equal in protectiveness because the POL-contaminated soil would also be removed and treated, but the completion of treatment by landspreading would not be immediate. Still, this solution would be permanent and effective in the long term to protect potential receptors at the site.

Reduction in Toxicity, Mobility, and Volume Through Treatment: POL Alternatives 2 and 3 effectively reduce the volume of waste soil by an assumed 25 percent for treatment and disposal, respectively, using grain-size separation. The screened soil materials greater than approximately 2 inches would be excluded from treatment or disposal. POL Alternative 2 also provides reduction in toxicity through landspread treatment and ultimately monitored natural attenuation. Offsite disposal of POL-contaminated soils under POL Alternative 3 provides no additional reduction in toxicity, mobility, or volume through treatment other than the grain-size separation shared with POL Alternative 2. Instead, landfilling of waste only moves the POL-contaminated soil from uncontrolled conditions at the site to a controlled environment where mobility can be limited through the design and operation of the landfill, i.e., using a liner system, leak detection system, leachate control, groundwater monitoring, a cap, etc.

Consequently, POL Alternative 2 provides a greater reduction in toxicity through treatment than POL Alternative 3 while both alternatives provide an equal reduction in volume.

Short-Term Effectiveness: Although both POL Alternatives 2 and 3 have the same risks associated with the excavation and grain-size separation, each alternative has different and varying degrees of impacts to site workers as well as other individuals and communities for landspreading and offsite disposal, respectively, making it problematic to rank the alternatives in comparison to each other. POL Alternative 3 loads the waste into containers and then transports them to an offsite disposal facility in Alaska, which requires transport of the waste from the Upper to Lower Camp, loading/offloading and transporting waste containers by air to a receiving airport and then to the disposal facility where the waste containers would be unloaded into the landfill. POL Alternative 2, on the other hand, would eliminate these risks but would present more risk to site workers during construction of the landspreading area, confirmation soil sampling upon completion of treatment, and from incidental exposure during treatment.

Implementability: Each of the alternatives can be both technically and administratively implemented. POL Alternative 1 (No Action) would be the easiest to implement, however it does not meet other required criteria. Both POL Alternatives 2 and 3 have the same challenges to implement the excavation and grain-size separation. POL Alternative 2 has limited technical uncertainty associated with the time required for the POL-contaminated soil to naturally attenuate after being landspread because of the short spring and summer seasons at Indian Mountain and the weathered condition of the diesel contamination. Additionally, the Upper Camp has limited space for a landspreading area, which could become problematic if the actual volume excavated upon completion of confirmation soil sampling increases substantially (i.e., if the actual extent of contamination is more than assumed from the present site characterization). Finally, administrative challenges would include gaining approval for this option. POL Alternative 3 eliminates these implementability challenges, but it has limited administrative implementability challenges because of the planning and coordination to transport and dispose of the POL-contaminated soil offsite.

Therefore, POL Alternative 2 would have the highest comparative risk from technical and administrative implementability while POL Alternative 3 would only have planning and coordination of offsite disposal as a notable challenge.

Cost: POL Alternative 3 is the highest cost alternative

Additionally, POL Alternative 3 is the most cost-sensitive to increases in fuel prices and soil volume because the most substantial unit costs are associated with transportation and offsite disposal of the waste. POL Alternative 2 would become increasingly cost effective with increasing soil volumes because the treatment costs of additional soil are less than offsite disposal.

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7.0 REFERENCES

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APPENDIX A

Applicable or Relevant and Appropriate Requirements

UNITED STATES AIR FORCE
611TH AIR SUPPORT GROUP
611TH CIVIL ENGINEER SQUADRON

JOINT BASE ELMENDORF-RICHARDSON, ALASKA

INDIAN MOUNTAIN LONG-RANGE RADAR SITE

FEASIBILITY STUDY FOR SITE OT008

APPENDIX A: APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

INDIAN MOUNTAIN, ALASKA
FINAL
MAY 2012

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TABLES

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ACRONYMS AND ABBREVIATIONS

A	applicable
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ARAR	applicable or relevant and appropriate requirement
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
EPA	U.S. Environmental Protection Agency
mg/kg	milligrams per kilogram
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
POL	petroleum, oil, and lubricants
RA	relevant and appropriate
RCRA	Resource Conservation and Recovery Act
TBD	to be determined
USC	United States Code

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1.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Environmental conditions at Site OT008 at the Indian Mountain Long-Range Radar Site (LRRS) may trigger reporting and cleanup requirements under a number of environmental statutes and regulations targeted at specific constituents or situations. Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), these requirements are referred to as applicable or relevant and appropriate requirements (ARAR).

A requirement under CERCLA may be either "applicable" or "relevant and appropriate" but not both. "Applicable" requirements are those standards, controls, and other criteria that specifically address a substance, remedial action, or circumstance. "Relevant and appropriate" requirements are those standards, controls, and other criteria that address situations sufficiently that their application is well suited to the situation in question.

While ARARs are promulgated, enforceable requirements, other types of information may be useful in determining what is protective at a specific contaminated site. These "to be considered" (TBC) criteria may be used to address a particular situation identified during the investigation, or if existing ARARs do not provide a sufficient level of protection, TBC criteria may be used to establish cleanup targets.

ARARs are chemical-specific, action-specific, or location-specific, and they can be in the form of regulations enforceable by federal, state, or local law or by regulatory guidance. Chemical-specific ARARs are health-based, risk-based, and technology-based numerical values that, when applied to site-specific conditions, establish an acceptable amount or concentration of contaminant that may be found in, or discharged to, the environment. Location-specific ARARs are special requirements or standards that apply because of the site location. Action-specific ARARs are limitations or requirements that apply to specific technologies or activities, particularly with respect to hazardous waste.

Remedial alternatives must be designed to comply with federal, state, and local environmental laws, regulations, standards, requirements, and criteria that are legally applicable or relevant and appropriate to the situation. Initial identification of ARARs, followed by continuous screening and refinement, is required for site activities conducted in accordance with the Installation Restoration Program/CERCLA at U.S. Department of Defense installations.

2.0 CHEMICAL-SPECIFIC ARARS

Chemical-specific ARARs provide numerical values that establish the acceptable contaminant concentrations that may be found in or discharged to the environment (Table A-1).

Table A-1
Chemical-Specific Applicable or Relevant and Appropriate Requirements

Regulation	Description	A or RA	Rationale
RCRA as amended, Subtitles C and D, other than corrective action requirements (42 USC 6901)	Establishes protections and protocols for the creation and recycling of waste including cradle to grave manifesting.	RA	Excavated materials designated as waste (e.g., contaminated soils) are subject to the requirements of RCRA.
Toxic Substances Control Act (40 CFR 761)	Regulates storage and disposal requirements, including onsite storage limitations for PCB wastes. Specifies notification and recordkeeping requirements for PCB disposal.	A	Concentrations of PCBs greater than 50 mg/kg are present at the site.
Alaska Oil and Other Hazardous Substance Pollution Control regulations (18 AAC 75)	Governs discharge of oil and hazardous substances and state cleanup requirements.	A	The site is known to be affected by a release of PCBs and DRO. Alternative soil cleanup levels may be applied.

Note:
For definitions, see the Acronyms and Abbreviations section.

Soil at the site is regulated under the Alaska Administrative Code (AAC), Title 18, Chapter 75, Article 3, *Oil and Hazardous Substances Pollution Control Regulations - Discharge Reporting, Cleanup, and Disposal of Oil and Other Hazardous Substances*. These regulations provide four methods of establishing cleanup criteria for soil: Methods One and Two derive cleanup criteria from standard tables, and Methods Three and Four derive site-specific cleanup criteria.

Method Two soil cleanup criteria [18 AAC 75.341(c) and (d) – Tables B1 and B2] apply to soil contaminated with petroleum hydrocarbons or other chemicals. The regulation tabulates soil cleanup criteria for diesel-range organics and polychlorinated biphenyls (PCB). The standards applicable at the Indian Mountain LRRS are for sites located in a non-arctic zone with annual precipitation of less than or equal to 40 inches.

Human exposure can occur directly (by ingestion or inhalation) or indirectly (via migration from contaminated soil to groundwater). Different cleanup criteria are presented for each of three exposure routes: direct contact or ingestion, inhalation, and migration to groundwater. Groundwater is not known to exist at Site OT008, therefore, migration to groundwater does not act as a transport mechanism for site contaminants, and only the more stringent of the standards for the direct contact (or ingestion) and outdoor inhalation exposure pathways are applicable for cleanup.

3.0 LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Location-specific ARARs are restrictions developed on the conduct of activities at specific locations (Table A-2). These ARARs may restrict or preclude certain remedial actions, or they may apply only to certain portions of an installation. Location-specific factors that may require the identification of ARARs include sensitive habitats, floodplains, wetlands, endangered species habitat, fault locations, and historic or archeological resources.

Table A-2
Location-Specific Applicable or Relevant and Appropriate Requirements

Regulation	Description	A or RA	Rationale
Bald Eagle Protection Act (16 USC 668-668c) Migratory Bird Act of 1972 (Code of Federal Regulations [CFR], Title 50, Sections 10, 20 and 21)	Protects bald eagles/habitat in the area and provides for permitted activities.	Potentially applicable	Bald eagles have not been identified in the project area, but the possibility for their presence exists.
U.S. Fish and Wildlife Conservation Act of 1980 (16 USC 2901; 50 CFR 83)	Requires submittal of conservation plans outlining provisions to conserve non-game fish and wildlife. Approved conservation plans are enforced by state agencies.	Potentially applicable	Considered for possible impacts to wildlife at Indian Mountain.
Protection of Fish and Game (AS 16.05.870; 5 AAC 95.010)	Provides for Alaska Department of Fish & Game consultation on actions affecting fish and wildlife	Potentially applicable	Considered for possible impacts to wildlife at Indian Mountain.
Fish and Wildlife Coordination Act (16 USC 661)	Provides for USFWS consultation on actions affecting fish and wildlife	Potentially applicable	Considered for possible impacts to wildlife at Indian Mountain.
Migratory Bird Treaty Act (37 Stat. 878, Ch. 45; 16 USC 703-712; 50 CFR Parts 10, 20, 21)	Prohibits taking or possession of any migratory bird listed, including parts, nests, or products.	Potentially applicable	Considered for possible impacts to birds at Indian Mountain.
National Historic Preservation Act (16 USC 470 et seq.; 36 CFR 65)	Provides for the protection of cultural sites; requires coordination with State Historic Preservation Officer and National Park Service.	Potentially applicable	No known historic artifacts are present at the site.

Note:
For definitions, see the Acronyms and Abbreviations section.

4.0 ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Action-specific ARARs are requirements that apply to specific investigative or remedial actions (Table A-3). Action-specific requirements do not in themselves determine remedial alternatives; they indicate how a selected alternative must be achieved. Action-specific ARARs are refined during remedial design as specific information becomes available.

Table A-3
Action-Specific Applicable or Relevant and Appropriate Requirements

Regulation	Description	A or RA	Rationale
Alaska Spill Reporting and Notification (18 AAC 75)	ADEC has authority for specifying soil, surface water, and groundwater cleanup levels resulting from the discharge of an oil or a hazardous substance.	A	18 AAC 75.360 lists requirements for cleanup work plans.
Alaska Air Quality Control Regulations (18 AAC 50, 15) and CAA (40 CFR 230, 33 CFR 320-330)	Regulations governing identification, prevention, abatement, and control of air pollution	A	Cleanup methods will require the use of heavy machinery and trucks for transporting soil.
U.S. Department of Transportation Regulations (49 CFR 170-199; 40 CFR 263) Alaska Hazardous Waste Regulations (18 AAC 62)	Governs the packaging, marking, labeling, recordkeeping, transportation, and transporters of hazardous materials.	A	Monitoring samples are transported from the project area.
Toxic Substances Control Act (40 CFR 761)	Regulates storage and disposal requirements, including onsite storage limitations for PCB wastes. Specifies notification and recordkeeping requirements for PCB disposal.	A	PCBs greater than 50 mg/kg are present at the site.
National Environmental Policy Act (14 USC 4321-4337)	Ensures that presently unquantified environmental amenities and values are given appropriate consideration in decision making along with economic and technical considerations.	RA	CERCLA requirements parallel National Environmental Policy Act requirements
Occupational Safety and Health Act of 1970 (29 CFR 1910) Alaska Occupational Safety and Health (Subchapter 10, Hazardous waste operations and Emergency Response Code; 8 AAC 61)	Sets standards for safety in the work environment.	A	40-hour HAZWOPER training and annual 8-hour refreshers are required for site workers.
Solid Waste Management Regulations (40 CFR 257, 40 CFR 264, 49 CFR 265, 40 CFR 266, 40 CFR268, 40 CFR 270, 40 CFR 261, 40 CFR 262) Alaska Solid Waste Management Regulations (18 AAC 60, 18 AAC 75, 18 AAC 62)	Governs the management of solid wastes generated during remedial activity. Specifies restrictions on land disposal of specific types of hazardous waste based on levels achievable by current technology.	A	Excavated soils and monitoring samples may be generated from the project area. Remedial alternatives may create contaminated media to be removed from the site.

Note: For definitions, see the Acronyms and Abbreviations section.

5.0 POTENTIAL OTHER CRITERIA OR GUIDELINES TO BE CONSIDERED

The National Contingency Plan (40 CFR Part 300) requires that local ordinances, unpromulgated criteria, advisories, or guidance that do not meet the definition of ARARs but that may assist in the development of remedial objectives be included as TBCs.

Federal guidelines applicable to the Indian Mountain LRRS include the following TBCs:

- U.S. Environmental Protection Agency (EPA) *Soil Screening Guidance*, 17 May 1996
- Applicable EPA Resource Conservation and Recovery Act guidance documents

The State of Alaska guidelines applicable to the Indian Mountain LRRS include the following TBCs:

- Alaska Department of Environmental Conservation (ADEC) *Cleanup Levels Guidance*, June 2008
- ADEC Contaminated Sites Remediation Program Handbook, undated
- ADEC Site Closure Policy and Procedures, October 2008

APPENDIX B

Cost Estimates

Indian Mountain Long-Range Radar Site
Alternative Costs Summary Table

Alternative	Estimated Contaminated Soil Quantity (CY) To Be Removed	Estimated Duration Initial Construction Activities Onsite (Days)	Estimated Cost for Alternative (+50% / -30%)
PCB Alternative 1	0	not applicable	$0
PCB Alternative 2	2,269	44	$11,547,835
PCB Alternative 3	1,670	42	$9,010,597
PCB Alternative 4	118	67	$4,414,467
POL Alternative 1	0	0	$0
POL Alternative 2	294	6	$1,633,669
POL Alternative 3	294	8	$2,431,482

Notes:
Costs are based on subcontractor quotes, construction drawings, and engineering estimates.

Indian Mountain Long-Range Radar Site
Feasibility Study Cost Analysis Summary Table

Alternative	Alternative Description	Estimated Contaminated Soil Quantity Removed (CY)	Estimated Duration of Soil Removal Activities Onsite (Days)	Estimated Cost for Alternative (+50% / -30%)
COMMON ACTIONS				
5-year review	PCB Alternatives 3 and 4, and POL Alternative 2, presented for the Indian Mountain LRRS FS, do not meet the residential (unrestricted land-use requirements); therefore, site inspections and reviews must be conducted every 5 years, for a period of 30 years as part of these alternatives.	not applicable	not applicable	$371,064
PCB ALTERNATIVES				
PCB Alternative 1	No Action.	0	0	$0
PCB Alternative 2	Under PCB Alternative 2, all PCB-contaminated soil (greater than 1 mg/kg) will be excavated. Excavated soil will be transported to a TSDF outside of Alaska for disposal. PCB Alternative 2 assumes that all excavation areas will be backfilled with clean, unclassified fill.	2,269	44	$11,547,835
PCB Alternative 3	Under PCB Alternative 3, all PCB-contaminated soil (greater than 1 mg/kg) will be excavated. Excavated soil contaminated with PCBs between 1mg/kg and 10mg/kg will be screened and separated based on grain-size. Any soils with grain-size >2inches will remain on site. All PCB contaminated soils <2inches, and above 1 mg/kg, will be transported to a TSDF outside of Alaska for disposal. PCB Alternative 3 assumes that all excavation areas will be backfilled with clean, unclassified fill.	1,670	42	$9,010,597
PCB Alternative 4	Under PCB Alternative 4, all PCB-contaminated soil (greater than 1 mg/kg) will be excavated. Excavated soil will be screened and separated based on grain-size. Any soils with grain-size >2inches will remain on site. All PCB contaminated soils <2inches, and above 25 mg/kg, will be transported to a TSDF outside of Alaska for disposal. All PCB contaminated soils <2inches, and between 1 and 25 mg/kg will be solidified and covered with a cap. PCB Alternative 4 assumes that all excavation areas will be backfilled with clean, unclassified fill.	118	67	$4,414,467
POL ALTERNATIVES				
POL Alternative 1	No Action.	0	0	$0
POL Alternative 2	Under POL Alternative 2, all POL-contaminated soil (greater than 10,250 mg/kg) will be excavated. Excavated soil will be screened and separated based on grain-size. Any soils with grain-size >2inches will remain on site. All POL contaminated soils <2inches, and above 10,250 mg/kg, will be landspread onsite. POL Alternative 2 assumes that all excavation areas will be backfilled with clean, unclassified fill.	294	6	$1,633,669
POL Alternative 3	Under POL Alternative 3, all POL-contaminated soil (greater than 10,250 mg/kg) will be excavated. Excavated soil will be screened and separated based on grain-size. Any soils with grain-size >2inches will remain on site. All POL contaminated soils <2inches, and above 10,250 mg/kg, will be transported to Anchorage for treatment. POL Alternative 3 assumes that all excavation areas will be backfilled with clean, unclassified fill. A 2-foot soil cap will be spread across the site.	294	8	$2,431,482

Notes:

Costs are based on subcontractor quotes, construction drawings, and engineering estimates

Soil with comingled contamination will be treated as PCB-contaminated

Indian Mountain Long-Range Radar Site
Cost Analysis for Site-Wide Tasks

All Tasks		Units	Unit Cost	Qty	# of Resources	Cost
Office/Offsite Labor	Administrator	HR	$ 83.11	5	1	$ 416
Field Labor	Site Manager / SSHO	HR	$ 107.48	48	1	$ 5,159
Institutional Controls						
Planning		HR	$ 77.85	60	2	$ 9,342
Map Design		HR	$ 77.85	40	2	$ 6,228
Documentation		HR	$ 77.85	80	2	$ 12,456
Permeable cap						
Backfill material		CY	$ 129.75	590		$ 76,553
Construction		HR	$ 77.85	39	3	$ 9,186
Management and Support						
Professional Services		HR	$ 77.85	21	2	$ 3,270
	Subtotal for ICs					**$ 122,609**

ICs Cost Summary	
Subtotal ICs Costs	$ 122,609
Project Management (9%)	$ 11,035
Contractor's Fee (10%)	$ 12,261
Total Cost for ICs	**$ 145,905**

Indian Mountain Long-Range Radar Site
Cost Analysis for PCB Alternative 2

Under PCB Alternative 2, all PCB-contaminated soil (greater than 1 mg/kg) will be excavated. Excavated soil will be transported to a TSDF outside of Alaska for disposal. PCB Alternative 2 assumes that all excavation areas will be backfilled with clean, unclassified fill.

Task	Category	Item	Unit	Unit Cost	QTY	Cost
All Tasks						
	Office/Offsite Labor	Administrator	HR	$ 45.32	5	$ 227
	Field Labor	Project Manager	HR	$ 140.89	528	$ 74,389
		Site Manager / SSHO	HR	$ 107.48	528	$ 56,752
		Project Engineer / CQC	HR	$ 83.11	516	$ 42,886
		Lead Sampler	HR	$ 60.36	516	$ 31,146
		Field Sampler	HR	$ 54.80	516	$ 28,275
Excavation						
	Mobilization/Planning	Mobilization (see tab)	LS	$ 8,063,281.16	1	$ 8,063,281
		Supervising for Safety	LS	$ 9,134.40	1	$ 9,134
	Subcontractor	Site Superintendent	ST	$ 89.27	352	$ 31,422
			OT	$ 108.99	88	$ 9,591
		Operator (3 ea)	ST	$ 87.19	1056	$ 92,075
			OT	$ 107.95	264	$ 28,499
		Laborer 1 (2 ea)	ST	$ 71.62	704	$ 50,422
			OT	$ 92.38	176	$ 16,259
	Additional Equipment	Excavator, 30,000 lb class	WK	$ 2,955.19	8	$ 24,627
		Excavator Frost Bucket	WK	$ 259.50	8	$ 2,163
		Loader w/blade and forks 25,000 lb class	WK	$ 2,630.29	8	$ 21,919
		Tractor	WK	$ 3,343.48	8	$ 27,862
		Crew Truck (2 ea)	WK	$ 1,038.80	16	$ 16,275
		16 CY End Dump Truck	DY	$ 1,359.71	11	$ 15,365
		Manlift	WK	$ 1,696.10	8	$ 14,134
		Misc. Tools and Materials	LS	$ 1,557.00	1	$ 1,557
		PID	WK	$ 311.40	8	$ 2,595
		GPS/RTK	WK	$ 1,188.51	8	$ 9,904
	Transportation	Supervising for Safety	LS	$ 134.94	1	$ 135
		Driver 1	HR	$ 86.15	271	$ 23,365
		Driver 1 OT	HR	$ 106.91	68	$ 7,249
	Per Diem	ARS FY12 Costs (converted to FY13)	DY	$ 223.17	264	$ 58,917

Indian Mountain Long-Range Radar Site
Cost Analysis for PCB Alternative 2

Task	Category	Item	Unit	Unit Cost	QTY	Cost
Materials						
	Non-Consumables	Fencing	EA	$ 778.50	1	$ 779
	Consumables	PPE	MD	$ 50.33	106	$ 5,315
		Fuel	GAL	$ 4.67	440.0	$ 2,055
		Super Sak	EA	$ 35.29	2269.0	$ 80,078
	Other Direct Costs					
Waste Disposal						
	Out-of-state disposal	See Disposal tab	LS	$ 581,514.91	1.0	$ 581,515
Laboratory						
	Analytical	See Analytical Tab				$ 63,059
Work Plan and Reporting						
	Work Plan and Final Report		LS	$88,230	1	$88,230
Institutional Controls						
	Details provided in ICs sheet					$ 122,609
	Subtotal For PCB Alternative 2					$ 9,704,063

PCB Alternative 2 Cost Summary (+50% / - 30%)	
Subtotal PCB Alternative 2 Costs	$ 9,704,063
Project Management (9%)	$ 873,366
Contractor's Fee (10%)	$ 970,406
Total Cost for PCB Alternative 2	**$ 11,547,835**

Indian Mountain Long-Range Radar Site
Cost Analysis for PCB Alternative 3

Task	Category	Item	Unit	Unit Cost	QTY	Cost
All Tasks						
	Office/Offsite Labor	Administrator	HR	$ 45.32	5	$ 227
	Field Labor	Project Manager	HR	$ 140.89	504	$ 71,007
		Site Manager / SSHO	HR	$ 107.48	504	$ 54,172
		Project Engineer / CQC	HR	$ 83.11	492	$ 40,891
		Lead Sampler	HR	$ 60.36	492	$ 29,697
		Field Sampler	HR	$ 54.80	492	$ 26,960
Excavation						
	Mobilization/Planning	Mobilization (see tab)	LS	$ 6,084,592.31	1	$ 6,084,592
		Supervising for Safety	LS	$ 9,134.40	1	$ 9,134
	Subcontractor	Site Superintendent	ST	$ 89.27	336	$ 29,994
			OT	$ 108.99	84	$ 9,155
		Operator (3 ea)	ST	$ 87.19	1008	$ 87,890
			OT	$ 107.95	252	$ 27,204
		Laborer 1 (2ea)	ST	$ 71.62	672	$ 48,130
			OT	$ 92.38	168	$ 15,520
	Equipment	Excavator, 30,000 lb class	WK	$ 2,955.19	8	$ 23,641
		Excavator Frost Bucket	WK	$ 259.50	8	$ 2,076
		Grizzly Screen	WK	$ 4,858.13	8	$ 38,865
		Loader w/blade and forks 25,000 lb class	WK	$ 2,630.29	8	$ 21,042
		Tractor	WK	$ 3,343.48	8	$ 26,748
		Crew Truck (2 ea)	WK	$ 1,038.80	15	$ 15,582
		16 CY End Dump Truck	DY	$ 1,359.71	8	$ 11,422
		Manlift	WK	$ 477.77	8	$ 3,822
		Misc. Tools and Materials	LS	$ 1,557.00	1	$ 1,557
		PID	WK	$ 311.40	8	$ 2,491
		GPS/RTK	WK	$ 1,188.51	8	$ 9,508
	Transportation	Supervising for Safety	LS	$ 134.94	1	$ 135
		Driver 1	HR	$ 86.15	202	$ 17,369
		Driver 1 OT	HR	$ 106.91	50	$ 5,388
	Per Diem	ARS FY12 Costs (converted to FY13)	DY	$ 194.11	252	$ 48,915

Indian Mountain Long-Range Radar Site
Cost Analysis for PCB Alternative 3

Task	Category	Item	Unit	Unit Cost	QTY	Cost
Materials						
	Non-Consumables	Fencing	EA	$ 778.50	1	$ 779
	Consumables	PPE	MD	$ 50.33	101	$ 5,073
		Fuel	GAL	$ 4.67	420.0	$ 1,962
		Super sak	EA	$ 35.29	1670.0	$ 58,938
	Other Direct Costs					
Institutional Controls						
	Details provided in ICs sheet					$ 122,609
Waste Disposal						
	Out-of-state disposal	See Disposal tab	LS	$ 471,616.51	1.0	$ 471,617
Laboratory						
	Analytical	See Analytical tab				$ 59,588
Work Plan and Reporting						
	Work Plan and Final Report		LS	$88,230	1	$88,230
	Subtotal For PCB Alternative 3					$ 7,571,931

PCB Alternative 3 Cost Summary (+50% / - 30%)	
Subtotal Alternative C3 Costs	$ 7,571,931
Project Management (9%)	$ 681,474
Contractor's Fee (10%)	$ 757,193
Total Cost for Alternative C3	**$ 9,010,597**

Indian Mountain Long-Range Radar Site
Cost Analysis for PCB Alternative 4

Under PCB Alternative 4, all PCB-contaminated soil (greater than 1 mg/kg) will be excavated. Excavated soil will be screened and separated based on grain-size. Any soils with grain-size >2inches will remain on site. All PCB contaminated soils <2inches, and above 25 mg/kg, will be transported to a TSDF outside of Alaska for disposal. All PCB contaminated soils <2inches, and between 1 and 25 mg/kg will be solidified and covered with a cap. PCB Alternative 4 assumes that all excavation areas will be backfilled with clean, unclassified fill.

Tas	Category	Item	Unit	Unit Cost	QTY	Cost
All Tasks						
	Office/Offsite Labor	Administrator	HR	$ 45.32	5	$ 227
	Field Labor	Project Manager	HR	$ 140.89	804	$ 113,274
		Site Manager / SSHO	HR	$ 107.48	804	$ 86,418
		Project Engineer / CQC	HR	$ 83.11	792	$ 65,825
		Lead Sampler	HR	$ 60.36	792	$ 47,805
		Field Sampler	HR	$ 54.80	792	$ 43,398
Excavation						
	Mobilization/Planning	Mobilization (see tab)	LS	$ 1,843,942.37	1	$ 1,843,942
		Supervising for Safety	LS	$ 9,134.40	1	$ 9,134
	Subcontractor	Site Superintendent	ST	$ 89.27	536	$ 47,848
			OT	$ 108.99	134	$ 14,605
		Operator (3 ea)	ST	$ 87.19	1608	$ 140,205
			OT	$ 107.95	402	$ 43,397
		Laborer 1 (2ea)	ST	$ 71.62	1072	$ 76,779
			OT	$ 92.38	268	$ 24,758
	Equipment	Equipment	WK	$ 2,955.19	12	$ 35,955
		Excavator Frost Bucket	WK	$ 259.50	12	$ 3,157
		Grizzly Screen	WK	$ 4,858.13	12	$ 59,107
		Loader 2500lb class	WK	$ 2,630.29	12	$ 32,002
		Tractor	WK	$ 3,343.48	12	$ 40,679
		Crew Truck (2 ea)	WK	$ 1,038.80	23	$ 24,239
		16 CY End Dump Truck	DY	$ 1,359.71	1	$ 816
		Manlift	WK	$ 1,696.10	12	$ 20,636
		Misc. Tools and Materials	LS	$ 1,557.00	1	$ 1,557
		PID	WK	$ 311.40	12	$ 3,789
		GPS/RTK	WK	$ 1,188.51	12	$ 14,460
	Transportation	Supervising for Safety	LS	$ 134.94	1	$ 135
		Driver 1	HR	$ 86.15	14	
		Driver 1 OT	HR	$ 106.91	4	
	Per Diem	ARS FY12 Costs (converted to FY13)	DY	$ 194.11	402	$ 78,031

Tas	Category	Item	Unit	Unit Cost	QTY	Cost
Materials						
	Non-Consumables	Fencing	EA	$ 778.50	1	$ 779
	Consumables	PPE	MD	$ 50.33	161	$ 8,093
		Fuel	GAL	$ 4.67	670.0	$ 3,130
		Super Saks	EA	$ 35.29	118.0	$ 4,164
	Other Direct Costs					
Waste Disposal						
	Out-of-state disposal	See Disposal tab	LS	$ 65,371.08	1.0	$ 65,371
Laboratory						
	Analytical	See Analytical tab				$ 50,332
Work Plan and Reporting						
	Work Plan and Final Report		LS	$88,230	1	$88,230
Institutional Controls						
	Details provided in ICs sheet					$ 122,609

Indian Mountain Long-Range Radar Site
Cost Analysis for PCB Alternative 4

Tas	Category	Units	Unit Cost	Qty	# of Resources	Cost
5-Year Review						
	Community Involvment and Notification	HR	$ 77.85	30	2	$ 4,671
	Document Review	HR	$ 77.85	80	2	$ 12,456
	Data Review and Analysis	HR	$ 77.85	40	1	$ 3,114
	Site Inspection	HR	$ 77.85	30	2	$ 4,671
	Site Inspection - Travel	Person-Trip	$ 2,896.02	1	2	$ 5,792
	Interviews	HR	$ 77.85	20	2	$ 3,114
	Protectiveness Determination	HR	$ 77.85	180	2	$ 28,026
	Subtotal 5-Year Review					$61,844
	Subtotal of 6 reviews over 30 years					**$371,064**
	Subtotal For PCB Alternative 4					$ 3,709,636

PCB Alternative 4 Cost Summary (+50% / - 30%)	
Subtotal PCB Alternative 4 Costs	$ 3,709,636
Project Management (9%)	$ 333,867
Contractor's Fee (10%)	$ 370,964
Total Cost for PCB Alternative 4	**$ 4,414,467**

Indian Mountain Long-Range Radar Site
Cost Analysis for POL Alternative 2

Under POL Alternative 2, all POL-contaminated soil (greater than 10,250 mg/kg) will be excavated. Excavated soil will be screened and separated based on grain-size. Any soils with grain-size >2inches will remain on site. All POL contaminated soils <2inches, and above 10,250 mg/kg, will be landspread onsite. POL Alternative 2 assumes that all excavation areas will be backfilled with clean, unclassified fill.

Task	Category	Item	Unit	Unit Cost	QTY	Cost
All Tasks						
	Office/Offsite Labor	Administrator	HR	$ 45.32	5	$ 227
	Field Labor	Project Manager	HR	$ 140.89	72	$ 10,144
		Site Manager / SSHO	HR	$ 107.48	72	$ 7,739
		Project Engineer / CQC	HR	$ 83.11	72	$ 5,984
		Lead Sampler	HR	$ 60.36	72	$ 4,346
		Field Sampler	HR	$ 54.80	72	$ 3,945
Excavation						
	Mobilization/Planning	Mobilization (see tab)	LS	$ 512,512.50	1	$ 512,513
		Supervising for Safety	LS	$ 9,134.40	1	$ 9,134
	Subcontractor	Site Superintendent	ST	$ 89.27	48	$ 4,285
			OT	$ 108.99	12	$ 1,308
		Operator (2 ea)	ST	$ 87.19	96	$ 8,370
			OT	$ 107.95	24	$ 2,591
		Laborer 1 (2 ea)	ST	$ 71.62	96	$ 6,876
			OT	$ 92.38	24	$ 2,217
	Equipment	Excavator, 30,000 lb class	DY	$ 2,955.19	6	$ 17,731
		Excavator Frost Bucket	DY	$ 259.50	6	$ 1,557
		Grizzly Screen	DY	$ 1,575.58	6	$ 9,453
		Loader w/blade and forks 25,000 lb class	DY	$ 781.68	6	$ 4,690
		Tractor	DY	$ 1,026.89	6	$ 6,161
		Crew Truck (2 ea)	DY	$ 302.46	12	$ 3,630
		16 CY End Dump Truck	DY	$ 1,359.71	2	$ 2,040
		Manlift	DY	$ 477.77	6	$ 2,867
		Misc. Tools and Materials	LS	$ 1,557.00	1	$ 1,557
		PID	WK	$ 311.40	1	$ 311
		GPS/RTK	WK	$ 1,868.40	1	$ 1,868
	Transportation	Supervising for Safety	LS	$ 134.94	1	$ 135
		Driver 1	HR	$ 86.15	36	$ 3,102
		Driver 1 OT	HR	$ 106.91	9	$ 962
	Per Diem	ARS FY12 Costs (converted to FY13)	DY	$ 194.11	36	$ 6,988
Task	**Category**	**Item**	**Unit**	**Unit Cost**	**QTY**	**Cost**
Materials						
	Non-Consumables	Fencing	EA	$ 778.50	1	$ 779
	Consumables	PPE	MD	$ 50.33	14	$ 725
		Fuel	GAL	$ 4.67	10.0	$ 47
	Other Direct Costs					
Laboratory						
	Analytical	See Analytical tab				$ 22,959
Work Plan and Reporting						
	Work Plan and Final Report		LS	$88,230	1	$88,230
Institutional Controls						
	Details provided in ICs sheet					$ 122,609

Indian Mountain Long-Range Radar Site
Cost Analysis for POL Alternative 2

Under POL Alternative 2, all POL-contaminated soil (greater than 10,250 mg/kg) will be excavated. Excavated soil will be screened and separated based on grain-size. Any soils with grain-size >2inches will remain on site. All POL contaminated soils <2inches, and above 10,250 mg/kg, will be landspread onsite. POL Alternative 2 assumes that all excavation areas will be backfilled with clean, unclassified fill.

Task	Units	Unit Cost	Qty	# of Resources	Cost
5-Year Review					
Community Involvment	HR	$ 77.85	30	2	$ 4,671
Document Review	HR	$ 77.85	80	2	$ 12,456
Data Review and Analy	HR	$ 77.85	40	1	$ 3,114
Site Inspection	HR	$ 77.85	30	2	$ 4,671
Site Inspection - Trave	Person-Trip	$ 2,896.02	1	2	$ 5,792
Interviews	HR	$ 77.85	20	2	$ 3,114
Protectiveness Determ	HR	$ 77.85	180	2	$ 28,026
Subtotal 5-Year Review					$61,844
Subtotal of 6 reviews over 30 years					**$371,064**
Subtotal For POL Alternative 2					$ 1,372,831

POL Alternative 2 Cost Summary (+50% / - 30%)	
Subtotal POL Alternative 2 Costs	$ 1,372,831
Project Management (9%)	$ 123,555
Contractor's Fee (10%)	$ 137,283
Total Cost for POL Alternative 2	**$ 1,633,669**

Indian Mountain Long-Range Radar Site
Cost Analysis for POL Alternative 3

Under POL Alternative 3, all POL-contaminated soil (greater than 10,250 mg/kg) will be excavated. Excavated soil will be screened and separated based on grain-size. Any soils with grain-size >2inches will remain on site. All POL contaminated soils <2inches, and above 10,250 mg/kg, will be transported to Anchorage for treatment. POL Alternative 3 assumes that all excavation areas will be backfilled with clean, unclassified fill. A 2-foot soil cap will be spread across the site.

Task	Category	Item	Unit	Unit Cost	QTY	Cost
All Tasks						
	Office/Offsite Labor	Administrator	HR	$ 45.32	5	$ 227
	Field Labor	Project Manager	HR	$ 140.89	96	$ 13,525
		Site Manager / SSHO	HR	$ 107.48	96	$ 10,319
		Project Engineer / CQC	HR	$ 83.11	96	$ 7,979
		Lead Sampler	HR	$ 60.36	96	$ 5,795
		Field Sampler	HR	$ 54.80	96	$ 5,260
Excavation						
	Mobilization/Planning	Mobilization	LS	$ 1,584,153.87	1	$ 1,584,154
		Supervising for Safety	LS	$ 9,134.40	1	$ 9,134
	Subcontractor	Site Superintendent	ST	$ 89.27	64	$ 5,713
			OT	$ 108.99	16	$ 1,744
		Operator (2 ea)	ST	$ 87.19	192	$ 16,741
			OT	$ 107.95	48	$ 5,182
		Laborer 1 (2 ea)	ST	$ 71.62	128	$ 9,168
			OT	$ 92.38	32	$ 2,956
	Equipment	Excavator, 30,000 lb class	DY	$ 2,955.19	8	$ 23,641
		Excavator Frost Bucket	DY	$ 259.50	8	$ 2,076
		Grizzly Screen	DY	$ 1,575.58	8	$ 12,605
		Loader w/blade and forks 25,000 lb class	DY	$ 781.68	8	$ 6,253
		Tractor	DY	$ 1,026.89	8	$ 8,215
		Crew Truck (2ea)	DY	$ 302.46	16	$ 4,839
		16 CY End Dump Truck	DY	$ 1,359.71	8	$ 10,878
		Manlift	DY	$ 477.77	8	$ 3,822
		Misc. Tools and Materials	LS	$ 1,557.00	1	$ 1,557
		PID	WK	$ 311.40	8	$ 2,491
		GPS/RTK	WK	$ 1,868.40	1	$ 1,868
	Transportation	Supervising for Safety	LS	$ 134.94	1	$ 135
		Driver 1	HR	$ 107.95	36	$ 3,886
		Driver 1 OT	HR	$ 86.15	9	$ 775
	Per Diem	ARS FY12 Costs (converted to FY13)	DY	$ 194.11	8	$ 1,553

Indian Mountain Long-Range Radar Site
Cost Analysis for POL Alternative 3

Task	Category	Item	Unit	Unit Cost	QTY	Cost
Materials						
	Non-Consumables	Fencing	EA	$ 778.50	1	$ 779
	Consumables	PPE	MD	$ 50.33	19	$ 966
		Fuel	GAL	$ 4.67	10.0	$ 47
	Other Direct Costs					
Waste Disposal						
	Disposal	Non hazardous (<1000 mg/kg DRO)	LS	$ 45,180.71	1.0	$ 45,181
Laboratory						
	Analytical	See Analytical tab				$ 22,959
Work Plan and Reporting						
	Work Plan and Final Report		LS	$88,230	1	$88,230
Institutional Controls						
	Details provided in ICs sheet					$ 122,609
	Subtotal For POL Alternative 3					$ 2,043,262

POL Alternative 3 Cost Summary (+50% / - 30%)	
Subtotal POL Alternative 3 Costs	$ 2,043,262
Project Management (9%)	$ 183,894
Contractor's Fee (10%)	$ 204,326
Total Cost for POL Alternative 3	**$ 2,431,482**

Duration Estimates

POL Alternative 2

Estimated Qty	# of Trips to landspreading site	Total Time (hours)	Backfill (hours)	Misc. Time (hours)	Grain-size Separation (hours)	Days	Work Hours	Notes
294	17	13	15	11	12	6	60	

POL Alternative 3

Estimated Qty (cy)	# of Super Sacks	Total Time (hours)	Backfill (hours)	Misc. Time (hours)	Grain-size Separation (hours)	Days	Work Hours	Notes
294	20	40	15	13	12	8	80	

PCB Alternative 2

Estimated Qty (cy)	# of Super Sacks	Total Time (hours)	Backfill (hours)	Misc. Time (hours)	Grain-size Separation (hours)	Days	Work Hours	Notes
2,269	152	304	113	16	0	44	440	

PCB Alternative 3

Estimated Qty (cy)	# of Super Sacks	Total Time (hours)	Backfill (hours)	Misc. Time (hours)	Grain-size Separation (hours)	Days	Work Hours	Notes
1,670	112	224	84	18	90.76	42	420	

PCB Alternative 4

Estimated Qty (cy)	# of Super Sacks	Total Time (hours)	Backfill (hours)	Misc. Time (hours)	Grain-size Separation (hours)	Days	Work Hours	Notes
118	8	16	6	18	629	67	670	

Assumptions

Screening and loading the sack is the bottleneck, not exc
Use loader to fill sack and fork lift to load truck.
Fork lift will follow truck and unload at the airstrip
No true compaction of backfill
2 hour average round trip to airstrip carrying 15 supersak
Backfill roundtrip = 1 hour to gravel pit for 15 CY
Does not include downtime waiting for characterization sample
Grain-size sep & Backhaul rate is 25 CY/hr
Solidification rate is 4 CY/hr

Misc. Additional Time	
Tailgate	2
Mobilization	4
Demobilization	3
Site Setup	2
Ramp Const.	2
Bin Issues	3
Moving around site	2

Treatment at ASR (POL Soils Only)

	Estimated QTY soil (CY)	Estimated QTY Soil (Tons)	Unit Price (Tons)	Total Cost
POL-Alternative 3	294	441	$102.45	$45,180.71

Assumptions:

All waste is treated in a permitted facility in Anchorage.
No segregation of POL soils; all soil sent to treatment facility.
5% fuel surcharge per ton

Out-of-State Disposal (CERCLA waste only)

PCB-Alternative 2	QTY Soil (cy): 2,269	QTY Soil (tons): 3,404

Description	Units	Estimated QTY	Unit Price	Sub Total	Notes
Waste Documentation and Management					
Pre-shipment Preparation and Submittals	LS	1	$ 539.50	$ 539.50	
Prepare and Submit Complete Manifest Packages	EACH	12	$ 54.50	$ 672.74	Total # of bins. Bins contain sacks and drums
Waste Container Management and Tracking	LS	1	$ 539.50	$ 539.50	
Waste-Specific Transportation and Disposal/Recycle Activities					
PCB-Contaminated Soil/Sediment (non-TSCA) - Transportation	TON	3,350	$ 70.84	$ 237,290.30	
PCB-Contaminated Soil/Sediment (Non TSCA) - Disposal	TON	3,350	$ 87.19	$ 292,049.60	
PCB-Contaminated Soil/Sediment (TSCA) - Transportation	TON	54	$ 87.19	$ 4,708.37	
PCB-Contaminated Soil/Sediment (TSCA) - Disposal	TON	54	$ 239.78	$ 12,948.01	
PCB-Contaminated Purge/Decontamination Water (non-TSCA) - Transportation	DRUM	5	$ 87.19	$ 174.38	55-gal drums
PCB-Contaminated Purge/Decontamination Water (non-TSCA) - Disposal	DRUM	5	$ 163.49	$ 817.43	55-gal drums
PCB/POL Sampling Waste - Transportation	TON	1	$ 70.84	$ 70.84	
PCB/POL Sampling Waste - Disposal	TON	1	$ 87.19	$ 87.19	
3.0 Optional Waste Containers					
Top-Load 20-foot Intermodal Container Rental	DAY	246.9	$ 8.82	$ 2,178.40	Assume 20 days per container, 10 sacks per connex.
Chassis 20-foot	WEEK				
Liner (suitable for Hazardous Waste)	EACH	227	$ 67.47	$ 15,308.94	
4.0 Other					
Fuel Surcharge on transportation of containers	LS	1	$ 7,891.08	$ 7,891.08	
Mark up on Fuel	LS	10%	$ 7,891.08	$ 789.11	
Bond Cost	LS	1	$ 5,449.50	$ 5,449.50	
Total				**$ 581,514.91**	

Out-of-State Disposal (CERCLA waste only)

PCB-Alternative 3	QTY Soil (cy):	1,670	QTY Soil (tons):	2,505

Description	Units	Estimated QTY	Unit Price	Sub Total	Notes
Waste Documentation and Management					
Pre-shipment Preparation and Submittals	LS	1	$ 539.50	$ 539.50	
Prepare and Submit Complete Manifest Packages	EACH	167	$ 54.50	$ 9,100.67	Total # of bins. Bins contain sacks and drums
Waste Container Management and Tracking	LS	1	$ 539.50	$ 539.50	
Waste-Specific Transportation and Disposal/Recycle Activities					
PCB-Contaminated Soil/Sediment and/or Concrete (Non TSCA) - Transportation	TON	2,451	$ 70.84	$ 173,637.42	
PCB-Contaminated Soil/Sediment and/or Concrete (Non TSCA) - Disposal	TON	2,451	$ 87.19	$ 213,707.59	
PCB-Contaminated Soil/Sediment (TSCA) - Transportation	TON	54	$ 87.19	$ 4,708.37	
PCB-Contaminated Soil/Sediment (TSCA) - Disposal	TON	54	$ 239.78	$ 12,948.01	
PCB-Contaminated Purge/Decontamination Water - Transportation	Drum	5	$ 87.19	$ 435.96	55-gal drums
PCB-Contaminated Purge/Decontamination Water - Disposal	Drum	5	$ 163.49	$ 817.43	55-gal drums
PCB/POL Sampling Waste - Transportation	TON	2	$ 70.84	$ 141.69	
PCB/POL Sampling Waste - Disposal	1 CY SUPER SACK	2	$ 87.19	$ 174.38	
3.0 Optional Waste Containers					
Top-Load 20-foot Intermodal Container Rental	DAY	3340	$ 8.82	$ 29,468.82	Assume 20 days per container, 10 sacks per connex.
Chassis 20-foot	WEEK				
Liner (suitable for Hazardous Waste)	EACH	167	$ 67.47	$ 11,267.49	
4.0 Other					
Fuel Surcharge on transportation of containe	LS	1	$ 7,891.08	$ 7,891.08	
Mark up on Fuel	LS	10%	$ 7,891.08	$ 789.11	
Bond Cost	LS	1	$ 5,449.50	$ 5,449.50	
Total				**$471,616.51**	

Out-of-State Disposal (CERCLA waste only)

PCB-Alternative 4	QTY Soil (cy):	118	QTY Soil (tons):	177

Description	Units	Estimated QTY	Unit Price	Sub Total	Notes
Waste Documentation and Management					
Pre-shipment Preparation and Submittals	LS	1	$ 539.50	$ 539.50	
Prepare and Submit Complete Manifest Packages	EACH	12	$ 54.50	$ 643.04	Total # of bins. Bins contain sacks and drums
Waste Container Management and Tracking	LS	1	$ 539.50	$ 539.50	
Waste-Specific Transportation and Disposal/Recycle Activities					
PCB-Contaminated Soil/Sediment and/or Concrete (Non TSCA) - Transportation	TON	123	$ 70.84	$ 8,713.75	
PCB-Contaminated Soil/Sediment and/or Concrete (Non TSCA) - Disposal	TON	123	$ 87.19	$ 10,724.62	
PCB-Contaminated Soil/Sediment (TSCA) - Transportation	TON	54	$ 87.19	$ 4,708.37	
PCB-Contaminated Soil/Sediment (TSCA) - Disposal	TON	54	$ 239.78	$ 12,948.01	
POL-Contaminated Purge/Decontamination Water - Transportation	DRUM	5	$ 87.19	$ 435.96	55-gal drums
POL-Contaminated Purge/Decontamination Water - Disposal	DRUM	5	$ 163.49	$ 817.43	55-gal drums
PCB/POL Sampling Waste - Transportation	TON	5	$ 70.84	$ 354.22	
PCB/POL Sampling Waste - Disposal	TON	5	$ 87.19	$ 435.96	
3.0 Optional Waste Containers					
Top-Load 20-foot Intermodal Container Rental	DAY	236	$ 8.82	$ 2,082.23	Assume 20 days per container, 10 sacks per connex.
Chassis 20-foot	WEEK				
Liner (suitable for Hazardous Waste)	EACH	123	$ 67.47	$ 8,298.81	
4.0 Other					
Fuel Surcharge on transportation of containe	LS	1	$ 7,891.08	$ 7,891.08	
Mark up on Fuel	LS	10%	$ 7,891.08	$ 789.11	
Bond Cost	LS	1	$ 5,449.50	$ 5,449.50	
Total				**$65,371.08**	

Assumptions

1.5 cubic yards of soil per ton of soil

Capacity of Herc= 33,000 pounds

Number of drums for decontamination water will be the same for both alternatives

Averaged from Waste Management Contractors in Anchorage

Transportation costs only include Anchorage to final TSDF

Unit rates increased by 3.8% to account for inflation in 2013

Cost Estimates for Sampling and Analysis

Alternative	# excavation samples	# waste samples	Total Samples	Unit Price (per sample)[1]	Total Esitmated Cost
PCB Alternative 1	0	0	0	$578.53	$0.00
PCB Alternative 2	81	28	109	$578.53	$63,059.49
PCB Alternative 3	81	22	103	$578.53	$59,588.33
PCB Alternative 4	81	6	87	$578.53	$50,331.89
POL Alternative 1	0	0	0	$468.55	$0.00
POL Alternative 2	41	8	49	$468.55	$22,959.02
POL Alternative 3	41	8	49	$468.55	$22,959.02

Laboratory Pricing

Method	TAT	Price[2]	Del. Chrg.[3]	Total
AK101	14 day	$127.88		$127.88
AK102/103	14 day	$140.67		$140.67
SW8082	14 day	$109.98		$109.98
Total				$378.53

PCB Sampling Assuming comingled includes > 10,250mg/kg

Excavation	Area (ft^2)	Floor Samples[4]	Perimeter (ft)	Wall Samples[3]	Total Composite Samples
WACS	10,025	45	410	28	73
SSA	143	1	50	4	5
PumpHouse	22	1	20	2	3
Total					**81**

POL Sampling Assuming comingled includes > 10,250mg/kg

Excavation	Area (ft^2)	Floor Samples[3]	Perimeter (ft)	Wall Samples[3]	Volume
WACS	2659	30	210	11	419
SSA	0	0	0	0	0
PumpHouse	0	0	0	0	0
Total Samples					**419**

1 - includes labor for sample collection and shipping

2 - Rates increased by 3.8% to account for inflation in 2013

3 - assumes shipping is on the air charter (cost already incurred)

4 - assumes floor sample frequency at 1/225 sq ft and wall samples at 1/15 LF

APPENDIX C

Responses to Comments

PROJECT: Indian Mountain LRRS
DOCUMENT: Draft FS for Sites OT008, Indian Mountain Long Range Radar Site, Indian Mountain, Alaska Draft, April 2012
REVIEW COMMENTS

DATE: 05/04/2012 **REVIEWER:** Tamar Stephens (ADEC)

Item No.	Location (page, par., sen.)	COMMENTS	Review A – Comment Accepted W – Comment Withdrawn N - Noted	Contractor Response
1.	5-18	The first paragraph of this page says that the estimated costs associated with PCB alternative 2 assumes two five – year reviews. If all soil with PCB concentrations exceeding 1 mg/kg is removed from the site, five year reviews shouldn't be necessary.	A	Agreed. The text and costs associated with the five-year reviews will be removed from Alternative 2.
2.	5-25	The first partial paragraph on this page assumes two five-year reviews for PCB alternative 3. As per the previous comment, five year reviews shouldn't be necessary.	A	Agreed. The text and costs associated with five-year reviews will be removed from Alternative 3.
3.	5-25	a) In this section, and elsewhere in the report as applicable, why was the soil PCB concentration range of 1 – 25 mg/kg selected as the target range for solidification? b) If solidification is used as part of the remedy at this site, please consider that DEC will require a clean cap over the treated soil. Please make sure the cost of a cap is added in to the total estimated costs.	A	a) Agreed. The 25 mg/kg PCB soil concentration was a compromise on the PCB cleanup level agreed to at Anvil Mountain and an attempt to be conservative based on the results of the 2006 Indian Mountain Risk Assessment. The cleanup level will be re-evaluated based on the results of the risk assessment and consultation with the DEC and TSCA. Based on initial discussion, we would recommend a cleanup level of 50 mg/kg with a suitable cap, enforceable institutional controls, and regulatory agency concurrence. b) Agreed. The solidified material will be capped with soil suitable for re-vegetation. The description of this alternative will be clarified and mentioned in the evaluation of the alternative to clarify and to explain the benefits (and detriments) of harvesting soil locally from undisturbed areas or importing soil. The total estimated costs will be updated to include the cost of a cap over the treated soil.

PROJECT: Indian Mountain LRRS
DOCUMENT: Draft FS for Sites OT008, Indian Mountain Long Range Radar Site, Indian Mountain, Alaska Draft, April 2012
REVIEW COMMENTS

DATE: 05/04/2012 **REVIEWER:** Tamar Stephens (ADEC)

Item No.	Location (page, par., sen.)	COMMENTS	Review A – Comment Accepted W – Comment Withdrawn N - Noted	Contractor Response
4.	5-38	The first paragraph on this page concludes by saying that PCB contamination adhering to the surface of oversize materials could potentially leach and become bioavailable. One way to address this situation is to be more conservative and only remove oversize material from soil with lower concentrations of PCBs. For example, during a recent cleanup at Anvil Mountain, the work plan allowed fro segregation of oversize material only from soil with concentrations between 1 and 10 mg/kg.	A	Agreed. To increase protectiveness, Alternative 3 will be modified to screen for oversize material (< 2 inches) in areas with PCB concentrations less than 10 mg/kg. This criteria may be modified in the field (with DEC approval) if it is found that little to no fines are adhering to the oversize material.
5.	6-0	In the first paragraph on this page – A pilot study would probably not be necessary for screening out oversize material for POL contamination. DEC does not require confirmation sampling for oversize rock material greater than two inch diameter provided the contaminants are limited to petroleum, the material is not porous with the potential to hold excessive amounts of product, and the material does not contain visible product on the surface. Please see DEC Contaminated Site Programs Technical Memorandum " Petroleum Hydrocarbon Cleanup for Oversize Material," which can be found on the Contaminated Sites Program website at http://dec.alaska.gov/spar/csp/guidance/tm_oversize_material.pdf.	A	Agreed. The pilot study for screening oversized POL-contaminated material will be removed from the text and the cost estimates.
6.	6-14	The beginning of the second paragraph says: "Limited area is available at the Upper Camp for landspreading." Please include in this discussion the approximate area available and approximately area needed for landspreading, along with the assumption about depth of the landspreading soil.	A	Agreed. The surface area and depth of potential soil to be treated through landspreading will be evaluated for three different volumes of impacted soil. This information will be added to the text.