DEPARTMENT OF THE AIR FORCE
90TH MISSILE WING (AFGSC)

31 Aug 10

MEMORANDUM FOR MS. DEBRA CAILLOUET
Alaska Dept of Environmental Conservation
555 Cordova Street
Anchorage AK 99501

FROM: 90 MW/EM
300 Vesle Drive, Ste 600
F. E. Warren AFB WY 82005

SUBJECT: Final Record of Decision for Site 13

1. Attached for your approval is a copy of the Final Site 13 (SS012) Contaminated Soil Record of Decision at Clear AFS, Alaska dated August 2010.

2. If you have any questions or need additional information, please contact me at (307) 773-4147, at your convenience.

for JOHN L. WRIGHT, Civ, DAF
Chief, Environmental Restoration Management

Attachment:
ROD

cc:
Dan Rodriguez, 21 CES/CEA
John Moylan, 13 SWS/CENV

FINAL

SITE 13 (SS012)
CONTAMINATED SOIL
RECORD OF DECISION

Clear Air Force Station, Alaska

August 2010

F I N A L

SITE 13 (SS012) CONTAMINATED SOIL RECORD OF DECISION

CLEAR AIR FORCE STATION, ALASKA

Prepared for
Clear Air Force Station
Alaska

And

Air Force Center for Engineering and the Environment
Brooks City-Base, Texas

Prepared by

URS Group, Inc.
560 East 34th Avenue, Suite 100
Anchorage, Alaska 99503

August 2010

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Acronyms

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
AFCEE	Air Force Center for Engineering and the Environment
AFS	Air Force Station
ARARs	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
CDI	chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
COCs	chemicals of concern
COPCs	chemicals of potential concern
COPECs	chemicals of potential ecological concern
CSM	conceptual site model
1,1-DCE	1,1-dichloroethene
DD	Decision Document
DDD	4,4'-dichlorodiphenyldichloroethane
DDE	4,4'-dichlorodiphenyldichloroethylene
DDT	4,4'-dichlorodiphenyltrichloroethane
DERP	Defense Environmental Restoration Program
DoD	Department of Defense
DRMO	Defense Reutilization and Marketing Office
EPCs	exposure-point concentrations
ERA	ecological risk assessment
ERBSCs	ecological risk-based screening concentrations
ERP	Environmental Restoration Program
ESD	Explanation of Significant Differences
°F	degrees Fahrenheit
FS	Feasibility Study
ft	feet
ft^2	square feet
HI	Hazard Index
HQ	hazard quotient
HHRA	human health risk assessment
IEUBK	Integrated Exposure Uptake Biokinetic
IRP	Installation Restoration Program
LUCs	land use controls
mg/kg	milligram per kilogram

mg/kg-day	milligram per kilogram per day
mg/L	milligrams per liter
NCP	National Oil and Hazardous Substances Contingency Plan
NFA	no further action
NOAEL	no observed adverse effect level
NPL	National Priorities List
O&M	operations and maintenance
PAH	polynuclear aromatic hydrocarbon
PCBs	polychlorinated biphenyls
PP	Proposed Plan
PPE	personal protective equipment
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
RACER	Remedial Action Cost Engineering and Requirements software
RAOs	remedial action objectives
RBSCs	risk-based screening concentrations
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RI	Remedial Investigation
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SF	slope factor
SI	Site Investigation
SSPARS	Solid State Phased Array Radar System
SVOCs	semivolatile organic compounds
TBC	to be considered
Tech	Technical
UCL	upper confidence limit
USAF	United States Air Force
USAMDC	United States Army Missile Defense Command
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOCs	volatile organic compounds
yds^3	cubic yards

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1.0 Declaration

1.1 Site Name and Location

Clear Air Force Station (AFS) occupies approximately 11,500 acres of federally-owned land in east central Alaska, approximately 80 miles southwest of Fairbanks and 250 miles north of Anchorage, in the Tanana Valley. This Record of Decision (ROD) addresses remedial actions for soil for Site 13 at Clear AFS. Site 13 (hereinafter referred to as SS012) is an Installation Restoration Program (IRP) site that was used to store four to six drums reportedly containing 4,4'-dichlorodiphenyltrichloroethane (DDT) from approximately 1972 until they were removed by the United States Air Force (USAF) in the early 1980s. The area of the site that was actually utilized for drum storage is small, estimated at approximately 400 square feet (ft^2). Clear AFS does not have any sites listed on the National Priorities List (NPL), but the Department of Defense (DoD) follows the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) process to investigate and clean up sites on DoD facilities. Therefore, there is no associated National Superfund Database (e.g., Comprehensive Environmental Response, Compensation, and Liability Information System [CERCLIS]) identification number for SS012; however, Clear AFS as a whole is listed on CERCLIS.

1.2 Statement of Basis and Purpose

This decision document presents the Selected Remedy for SS012, at Clear AFS, Alaska, which was chosen in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and to the extent practicable, the National Oil and Hazardous Substances Contingency Plan (NCP). This decision is based on the Administrative Record for this site. This Administrative Record file is available for review at the Anderson Village Library located in Anderson, Alaska, and at the Noel Wien Library located in Fairbanks, Alaska.

This document is issued by the USAF, as the lead agency. The USAF is managing remediation of contamination at SS012 in accordance with Alaska state law and CERCLA as required by the Defense Environmental Restoration Program (DERP).

As the lead agency, the USAF has selected the remedy for the site. The Alaska Department of Environmental Conservation (ADEC) agrees that the selected remedy, when completed, will meet the cleanup requirements of ADEC Title 18, Alaska Administrative Code (AAC), Chapter 75, including state program requirements for the cleanup of petroleum products. The United States Environmental Protection Agency (USEPA) has been given the opportunity to review this document and has chosen to defer to the ADEC for regulatory oversight of the Environmental Restoration Program (ERP) at Clear AFS.

1.3 Assessment of Site

The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. Areas within SS012 cannot support unrestricted use due to DDT, 4,4'-dichlorodiphenyldichloroethane (DDD), 1,1-dichloroethene (1,1-DCE), methylene chloride, 2-

methylnaphthalene, and napthlene in excess of ADEC cleanup levels remaining in soil.

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

1.4 Description of Selected Remedy

Remedial alternatives for SS012 were developed and evaluated in the *Feasibility Study (FS) Report for Site 13* (USAF, 2009b) and in *Amendment 1 to the Final FS Report for Site 13* (USAF, 2010a). Based on the results of the FS and Amendment 1 to the Final FS Report, the USAF selected Alternative 4C - Human Health Risk and Migration to Groundwater Based Cleanup/Off-Site Disposal as the preferred alternative for SS012. The major component of the selected response action is presented below.

- **Soil Excavation**: Excavation of approximately 133 cubic yards (yds^3) of contaminated soil to remove soil containing exceedances of all State of Alaska default cleanup levels (Migration to Groundwater and Direct Contact), based on 18 AAC 75; to reduce human health risks under a residential exposure scenario to acceptable levels (below 1×10^{-5} cancer risk, and an hazard quotient (HQ) of 1 or less for non-cancer hazards); and, to reduce overall potential ecological hazards.
- Because no residual exceedances of cleanup levels would remain, no land use controls (LUCs) would be required.
- **Confirmation Sampling**: Confirmation samples would be collected from the base and sides of the excavation following removal of contaminated soil to confirm that no residual cleanup level exceedances remain. The excavation under this alternative would not be backfilled until confirmatory sample data confirms that remedial action objectives (RAOs) have been met.
- The excavation would be backfilled with clean fill soil, obtained from an on-site source (i.e., borrow area), to bring the area level with the surrounding ground surface. The final grade would be revegetated through hydro-seeding.
- **Disposal**: The excavated soil would be disposed at an appropriate permitted off-site disposal facility. Based on contaminant concentrations from the RI, it is estimated that approximately 133 yds^3 (173 tons) of excavated soil would require transport and disposal as hazardous waste to a Resource Conservation and Recovery Act (RCRA) Subtitle C landfill (e.g., Chem Waste in Arlington, Oregon).

SS012 is one of 29 IRP sites at Clear AFS. Twenty-five locations are environmental sites and four locations are munitions sites. The overall cleanup strategy for Clear AFS involves removal and/or source management. The selected alternative for SS012 fits into the overall site management plan by management of the contaminated soil through removal.

The principal wastes for SS012 are the DDT-, DDD-, 1,1-DCE-, methylene chloride-, 2-methylnaphthalene-, and naphthalene-contaminated soils. These contaminated soils will be addressed by the selected alternative through excavation/source removal and disposal of soil exceeding human health risk and ADEC soil cleanup levels.

1.5 Statutory Determinations

The selected remedy for SS012 is protective of human health and the environment, complies with promulgated requirements that are applicable or relevant and appropriate to the remedial action, and is cost effective. The selected remedy represents the maximum extent to which permanent solutions can be used in a practicable manner at the site. It provides the best balance of trade-offs in terms of balancing criteria while also considering state and community acceptance.

The selected remedy for SS012 does not satisfy the statutory preference for treatment as a principal element of the remedy because it involves source removal and disposal. RAOs will be met following implementation of the selected remedy.

Because this remedy will not result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unrestricted use, a 5-year review will not be required for this remedial action.

1.6 Data Certification Checklist

The following information is included in the Decision Summary section of this ROD (Section 2). Additional information can be found in the Administrative Record file for Clear AFS, Alaska which can be found at the Anderson Village Library located in Anderson, Alaska, and at the Noel Wien Library located in Fairbanks, Alaska.

- List of chemicals of concern (COCs) and their respective concentrations (Section 2.7 amd 2.12)
- Baseline risk represented by the COCs (Section 2.7)
- Cleanup levels established for COCs and the basis for these levels (Sections 2.7, 2.8, and 2.12)
- How source materials constituting principal threats will be addressed (Section 2.11)
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD (Section 2.6)
- Potential land and groundwater use that will be available at the site as a result of the selected remedy (Sections 2.9 and 2.12)
- Estimated capital, annual operations and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (Sections 2.9 and 2.12)
- Key factor(s) that led to selecting the remedy (i.e., describe how the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (Sections 2.10 and 2.12)

1.7 Authorizing Signatures

This signature sheet documents the USAF and ADEC approval of the remedy selected in this ROD for SS012, Clear AFS, Alaska. By signing this declaration, ADEC concurs that proper implementation of the selected remedy will comply with state and environmental laws. This decision will be reviewed and may be modified in the future if information becomes available that indicates the presence of contaminants or exposures that may cause unacceptable risk to human health or the environment.

23 Nov 10

STEPHEN N. WHITING
Colonel, United States Air Force
Air Force Space Command
Commander, 21st Space Wing

Date

12/15/2010

John Halverson
Environmental Program Manager
Federal Facilities Section, Contaminated Sites Program
Alaska Department of Environmental Conservation

Date

2.0 Decision Summary

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

2.1 Site Name, Location, and Description

Clear AFS is located on approximately 11,500 acres of federally owned land and is approximately 80 miles southwest of Fairbanks and 250 miles north of Anchorage on the George Parks Highway (Highway 3) in central Alaska (Figure 2-1). The installation is divided into four main areas: the Composite Area, where most administrative, recreational, and living quarters are located; the Old Camp Area, which is comprised of civil engineering, maintenance shops, and security forces; the Old Technical (Tech) Site, which is the former radar site; and the Solid State Phased Array Radar System (SSPARS), where the current radar and related equipment area is located (Figure 2-2). Of the 11,500 acres that compose the installation, approximately 3,800 acres are developed. The installation is bordered to the east by the George Parks Highway; to the south by the Alaska Range; to the north by Lake Sansing and the community of Anderson; and to the west by the Nenana River.

SS012 is located in the southern portion of Clear AFS (Figure 2-2). SS012 is in a clearing surrounded on three sides by spruce-birch forest, and on the fourth side by an access road adjacent to the former Site 2 landfill (Figure 2-3). The site was used to store four to six drums reportedly containing DDT from approximately 1972 until they were removed by the USAF in the early 1980s. The drums apparently leaked, based on documented impacts to underlying soil. The overall cleared area of SS012 is generally flat. The central part of the site that was used to store the drums, and which comprises the primary impacted area, measures approximately 20 feet (ft) by 20 ft or 400 ft^2. The only documented source of impacts to the site is the former storage of DDT-containing drums.

As the lead agency for remedial activities, the USAF has conducted environmental restoration investigations at SS012 in accordance with CERCLA under DERP which was established by Section 211 of SARA.

As the support agency, ADEC provides primary oversight of the environmental restoration actions, in accordance with the State of Alaska Oil and Hazardous Substances Pollution Control regulations found in 18 AAC 75 (ADEC, 2008a).

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

2.2 Site History and Enforcement Activities

This section provides background information and summarizes the series of previous site activities and investigations that led to the ROD. It describes the CERCLA response actions undertaken at SS012.

2.2.1 Clear Air Force Station

Clear AFS was established after World War II for use as a bombing range. In 1960, a radar station was constructed at Clear AFS. The primary mission of Clear AFS is to detect and provide an early warning of a ballistic missile attack against the North American continent. (United States Army Missile Defense Command [USAMDC], 2002). Additional information about the history of operations at Clear AFS and environmental settings can be found in previous environmental reports, including *Installation Restoration Program, Records Search for Clear Air Force Station, Alaska* (CH2M Hill, 1981); *Clear Air Force Station General Plan* (USAF, 2005a); and *Final Work Plan for Remedial Investigations at Sites 11, 13, and 21: and Investigation to Support Feasibility Study at Site 22* (USAF, 2006).

2.2.2 SS012

SS012 consists of a small cleared area about one mile south of the Clear AFS power plant, and immediately west and adjacent to former Landfill 2 (Figure 2-2). The site, also known as Site 13, was used to store four to six drums reportedly containing DDT between approximately 1972 and 1984, when they were removed by the USAF. The drums apparently leaked, based on documented impacts to underlying soil. The overall cleared area of SS012 is generally flat, and measures approximately 25 to 40 ft wide and approximately 75 ft long. The central part of the site that was used to store the drums, and which comprises the primary impacted area, measures approximately 20 ft by 20 ft. Specific SS012 features are shown on Figure 2-3. The only documented source of impacts to the site is the former storage of DDT-containing drums. Other potential offsite sources of impacts to SS012 may exist, including Landfill 2, Landfill 3, and the Clear AFS power plant.

During a Phase I Preliminary Assessment inspection in 1981, SS012 was identified as a potentially hazardous site, along with 16 other sites at Clear AFS (CH2M Hill, 1981).

In 1984, Dames and Moore conducted a Phase II Stage 1 study of five IRP sites at Clear AFS, including SS012 (USAF, 1986). The investigation included the collection and analysis of surface and subsurface soil samples from the former drum storage area and subsurface soil samples from a location approximately 50 ft northeast of the former drum storage area (USAF, 1986). Two soil borings (W-5 and W-6) were drilled to depths of 26.5 ft below ground surface (bgs). Data collected during the 1984 investigation was evaluated for usability, and pesticide data from boring W-6 is considered unusable due to the lack of location information.

A follow-on Phase II investigation conducted in 1986 included collection and analysis of near-surface soil samples from depths of 0 to 1 ft bgs at 10-ft intervals across a grid covering the site, and at closer intervals where the soil was most contaminated (USAF, 1990) . Measured concentrations of DDT greater than 50 milligrams per kilogram (mg/kg) were found in near-surface soil (less than 1 ft bgs) within an approximately 200 ft^2 area, and within that area, there was approximately 100 ft^2 in which DDT concentrations exceeded 1,000 mg/kg. The maximum measured DDT concentrations was 39,000 mg/kg. One monitoring well (GW-5E) was installed to characterize groundwater quality downgradient of the site (USAF, 1990). A trace amount (0.003 milligrams per liter [mg/L]) of the pesticide Dieldrin was detected.

In 1986 through 1988, seven additional boreholes were drilled at SS012 in an attempt to delineate the vertical extent of DDT contamination (United States Geological Survey [USGS], 1988a; USAF, 1990). The boreholes were numbered W-5, B-5A, B-5B, B-5C, B-5D, W-13A,

and W-13B. Samples were collected from depths of up to 80 ft bgs. Borings W-13A and W-13B were converted to in-source monitoring wells to facilitate additional groundwater characterization at SS012. Samples from these two wells, in addition to well GW-5E, were analyzed for dissolved lead, pesticides, polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and petroleum hydrocarbons. No DDT or associated isomers were detected in groundwater (USAF, 1990). An evaluation of the usability of data collected between 1986 and 1988 concluded that data for persistent analytes in soil (pesticides and inorganics) is potentially usable. Groundwater data is usable as an indication of historic groundwater conditions only.

In September 1989, the most heavily DDT-contaminated areas of SS012 were excavated to a depth of about 1 ft bgs (USAF, 1990). The excavated soil, which reportedly contained approximately 9,000 mg/kg of DDT, was containerized into twenty-seven 55-gallon drums and turned over to the Defense Reutilization and Marketing Office (DRMO) for disposal. Post-removal sampling determined that residual DDT contamination remained at the site, and a Decision Document (DD) prepared in 1990 for SS012 provided technical rationale to support additional DDT-contaminated soil removal to a total depth of 3 ft bgs (USAF, 1990).

In September 1990, the excavation was deepened by approximately 2 ft to a total depth of about 3 ft bgs in accordance with the DD, and 25 additional drums were filled with contaminated soil that reportedly averaged approximately 1,400 mg/kg of DDT (USGS, 1993). Post-removal sampling indicated that although DDT concentrations continued to decrease with depth, significant concentrations of DDT remained. Residual DDT concentrations up to 16,000 mg/kg were reported at the base of the 3 ft excavation, although exact locations of these detections were not well documented. The excavation was reportedly covered with a 28-by-28 ft polyvinyl chloride (PVC) liner as a precautionary measure to prevent water from infiltrating the remaining soils and wind from dispersing any DDT in the vicinity, and backfilled with fill material. The liner extended about 5 ft beyond the excavation edges (USGS, 1993).

It should be noted that the PVC liner covering the area of impacted subsurface soil is not considered to be a remedy, but is considered a site feature. It should also be noted that while available descriptions of the excavation activity suggest that the fill material placed over the excavation was “clean fill,” subsequent analysis of soil samples from that material indicate the presence of detectable concentrations of pesticides in some locations.

In 1994, the USAF continued investigations at several sites as part of base-wide Phase II Remedial Investigations (RIs) to further define conditions and to address issues raised by USEPA and ADEC (USGS, 1996). Two new borings (W-13C and W-13D) were drilled at SS012 to depths of 8 ft below the existing ground surface. Chromium concentrations in soil samples from beneath the previous excavations ranged from 10.3 to 15.9 mg/kg, and lead concentrations ranged from 3.7 to 6.2 mg/kg. The soil samples contained DDT and associated isomers, with the highest DDT concentration (420 mg/kg) detected from sample W-13C at a 4.5 ft bgs. Limited VOCs and SVOCs were also detected in subsurface soil. Data from this investigation was evaluated for usability, and it was determined that inorganics and persistent organics data was of sufficient quality and adequately representative of current conditions to be used in the RI. Soil borings W-13C and W-13D are shown on Figure 2-4.

In 2004, ADEC requested that the USAF provide additional information on the Clear IRP sites in order to ensure continued protection of human health and the environment. Due to the extended

time period over which IRP activities had occurred and the amount of associated data collected, the USAF compiled Site Summaries (USAF, 2005b) as a first step in refining this process, with the ultimate objective of timely site closure or remediation. That document concluded that DDT impacts remaining at SS012 warranted additional study. The USAF recommended SS012 for additional investigation to determine if the conclusions made in the 1994 RI remained valid (USAF, 2005b).

The USAF initiated a Supplemental RI (USAF, 2009a) for SS012 in 2006. The initial 2006 phase of the Supplemental RI included the installation of two additional groundwater monitoring wells (S13-MW01 was located upgradient and S13-MW02 was located downgradient of the source area), and collection and analysis of soil and groundwater samples. Data collected was used in the assessment of the presence and extent of impacts relative to applicable State cleanup levels, evaluation of fate and transport mechanisms and processes, and evaluation of potential risk to human and ecological receptors from chemical constituents at the site. A second phase of the Supplemental RI study was designed to enhance the 2006 data set, fill data gaps, and support appropriate site characterization and risk assessment activities. The second phase of the study was conducted in 2008, and included collection and analysis of additional soil and groundwater samples, evaluation of the extent of impacts relative to applicable State of Alaska cleanup levels, and completion of human health and ecological risk assessments. Confirmation samples for soil and groundwater from 2006 and 2008 were primarily analyzed for pesticides, RCRA-listed metals, and VOCs. RI soil sample locations are shown on Figure 2-4. Monitoring wells sampled during the RI are shown on Figure 2-5.

A FS (USAF, 2009b) to evaluate remedial alternatives to address the soil contamination was performed in 2009, and followed by an Amendment to the FS (USAF, 2010a) in 2010. The FS evaluated six remedial alternatives, including a no action alternative, and the Amendment to the FS evaluated an additional two remedial alternatives. Based on that evaluation, a preferred remedy was selected as discussed in the Proposed Plan (PP, USAF, 2010b). The Alaska Department of Environmental Conservation (ADEC) reviewed and approved the FS and FS Amendment.

2.3 Community Participation

The USAF has prepared and implemented a Community Involvement Plan (USAF, 2008) in accordance with CERCLA requirements. The Community Involvement Plan describes community involvement activities that the USAF will undertake during remedial activities at Clear AFS. The USAF has followed the requirements of the Community Involvement Plan, including offering public meetings and providing the opportunity for public comment throughout the cleanup process.

NCP Section 300.430(f)(3) establishes a number of public participation activities that the lead agency must conduct following preparation of the PP and review by the support agency. Components of these items and documentation of how each component was satisfied for SS012 are described in Tables 2-1 and 2-2.

The RI (USAF, 2009a), FS (USAF, 2009b), Amendment to the Final FS Report (USAF, 2010a), PP (USAF, 2010b), and other investigative reports have been made available to the public and can be found in the Administrative Record at the following locations:

Anderson Village Library
Reference Section
First Street
Anderson, Alaska 99744
Phone: (907) 582-2628

Noel Wien Library
Reference Section
1215 Cowles Street
Fairbanks, Alaska 99701
Phone: (907) 459-1024

Hours of Operation:
10:00 am to 9:00 pm (Monday - Thursday)
10:00 am to 6:00 pm (Friday - Saturday)

A public comment period for the PP (USAF, 2010b) was held from May 10 through June 9, 2010. The USAF received no requests to extend the public comment period. In addition, the public was offered an opportunity to request a public meeting to discuss the preferred remedy and all of the alternatives evaluated in the FS Report and Amendment 1 to the FS Report for SS012. No one from the public requested a public meeting, and as described in the Responsiveness Summary (Section 3), no written or verbal comments were received during the public comment period that would change the remedy selection process.

2.4 Scope and Role of Operable Unit or Response Action

As with many large sites, the environmental problems at Clear AFS are complex. As a result, the USAF, with concurrence from ADEC, has organized the environmental restoration work at Clear AFS into 29 IRP Sites as described below.

- Site 1 – Landfill 1 (1959 – 1968): Filled landfill depressions in 2007 per 1990 DD; continued long-term management and LUCs.
- Site 2 – Landfill 2: Filled landfill depressions in 2007 per 1990 DD; Site closed with restrictions on use; monitored LUCs.
- Site 3 – Landfill 3: Closed under Compliance Program via permit.
- Site 4 – Landfill 4: Removed surficial debris in 2006 per 1990 DD; closed with no restrictions.
- Site 5 – Coal Storage Area: ADEC and USAF agreed was not an IRP site; no action required.
- Site 6 – Drying Beds (Imhoff): Nature and extent of contamination (PCBs and lead) determined in 2006; FS initiated in 2009.
- Site 7 – 50,000 gallon oil spill: Site inspection efforts conducted in 2007 confirmed no contamination exists above state cleanup standards; site closed with no further action (NFA).
- Site 8 – 200 gallon fuel spill: Biovented (1995-2001); site inspection efforts conducted in 2007 confirmed no contamination exists above state cleanup standards; site closed with NFA.

- Site 9 – MOGAS tanks: Biovented (1998-2000); confirmation samples collected in 2006 indicated no contaminants remain at levels above ADEC cleanup standards; site closed with NFA.
- Site 10 – Radioactive Material Storage Building: Site inspection efforts conducted in 2006 indicated no release occurred; site closed with NFA.
- Site 11 – Fire Training Area: Excavated and landfarmed; confirmation sampling conducted in 2007 indicated cleanup levels were reached; site closed requiring no further monitoring.
- Site 12 – Drums at Gravel Pit: The remaining drum was removed in 2005 and sampled; contents were not hazardous; site closed with NFA required.
- Site 13 (SS012) – DDT Drums One Mile South of Power Plant: Excavated and liner placed; FS and PP completed; the subject of this ROD.
- Site 14 – Construction Camp Disposal Area: Investigated; FS through ROD initiated.
- Site 15 – Lake Sansing: Investigated; no risk above acceptable levels; PP and ROD initiated.
- Site 16 – PCB Transformer in Power Plant: Leaks cleaned; site closed in 2005 with NFA required.
- Site 17 – Power Plant Oil/Water Separator: Investigated; petroleum hydrocarbons remain above ADEC's most stringent levels; PP and ROD initiated.
- Site 18 – Infiltration Pond Near Thaw Shed: Not designated an IRP Site; no cleanup required.
- Site 19 – Crib Near Motor Pool: Biovented (1995-2004); cleanup goals met; closed under 18 AAC 75; PP and ROD initiated.
- Site 20 – Destroyed Building 85: Excavated; no contaminants above cleanup levels; closed under 18 AAC 75; PP and ROD initiated.
- Site 21 – Auto Service Grease Pad: Investigated; no risks to human health or the environment; PP and ROD initiated.
- Site 22 – Auto Hobby Shop: Investigated; RI and FS completed in 2009 and PP completed in 2010; ROD initiated.
- Site 23 – Heavy Equipment Parking Garage: Excavated; concrete floor placed; PP and ROD initiated.
- Site 24 – Spill Near New Solid State Phased Array Radar System; Site Investigation (SI) completed; no indications of release; site closed in 2007 with NFA required.
- Site 26 – Former Underground Storage Tanks: Tanks removed; investigated; no contaminants above ADEC cleanup levels except at one tank; remedial pilot study initiated.
- SR401 – North Range Small Arms: Investigated and conducted a removal action for excavation and off-site disposal of lead contamination.
- SR402 – South Range Small Arms: Investigated; NFA required.
- TS403 – Former Skeet Range: Investigated a conducted a removal action for excavation and off-site disposal of polynuclear aromatic hydrocarbon (PAH) contamination.

- TS404 – Unauthorized Small Arms: Investigated; NFA required.

Remedial actions undertaken for SS012 will not impact other IRP Sites at Clear AFS.

2.5 Site Characteristics

Included in this section is a brief description of the site characteristics. Further details can be found in the *Supplemental Remedial Investigation Report for Site 13* (USAF, 2009a).

2.5.1 Physiography and Climate

Clear AFS lies in the Tanana Valley immediately north of the foothills of the Alaska Range. The Denali Fault marks the boundary between the Tanana Valley and the Alaska Range located approximately 60 miles south of the installation. Several faults in the vicinity of the installation are considered active and interior Alaska is periodically shaken by severe earthquakes. Large earthquakes (e.g., Richter magnitudes up to 7.8) have been recorded in the Fairbanks area, and recurrence is probable, according to the USGS (USAF, 2005a). Earthquake potential is the only recognized geological constraint to development at Clear AFS. Structures should be designed to withstand magnitude seven or higher events with little or no effect (USAF, 2005a).

Clear AFS is located on a large glacial outwash area, comprised primarily of medium to coarse gravel. The region is underlain by a variety of bedrock types, including schist, sandstone, and coal-bearing formations, and was partially-glaciated. Outwash from previous glaciations and the Nenana Gravels that underlie the north margin of the Alaska Range can be hundreds of feet thick within the area of Clear AFS (USAF, 2005a). The outwash is a wedge-shaped fan, sloping downward from the south (the source of the outwash) to the north. The Nenana River subsequently flows northward as well. The Nenana River breached a well-defined terminal moraine and deposited coarser gravels in an arc (making the inner fan closest to the breach) and deposited medium gravels in a middle fan further out. Clear AFS is situated on the eastern half of the fan. Clear AFS is covered with many interlaced sinuous channels, terraces, and banks, formed during glacial melt-water outwash deposition. Local elevation differences of these features are around 1.5 to 6.5 ft (USAF, 2005a).

The sub-arctic climate at Clear AFS and the surrounding area is typical of central Alaska according to the Alaska Climate Research Center. The yearly average temperature is 26.1 degrees Fahrenheit (°F), with January typically the coldest month (-8.0 °F) and July typically the warmest (61.6 °F). Daily temperature fluctuation averages are approximately 20 °F in both the summer and winter. Prevailing winds are from the north and northeast, and the average monthly wind velocity is 5 miles per hour. Relative humidity ranges from approximately 75 percent in October to approximately 50 percent in May (USAF, 2005a).

Precipitation generally occurs during the summer months. During the period of 1971 through 2001, the average annual precipitation of the Clear AFS, Alaska area was 12.88 inches. The average snowfall is about 44.2 inches per year with the highest totals occurring in mid winter and early spring (USAF, 2005a).

2.5.2 Geology

The sediments underlying Clear AFS are derived from several sources: alluvial fans developed upon the Nenana gravel pediment at the mountain front; Pleistocene glacial outwash; Holocene

alluvial sediments from the Nenana River; wind-transported silt reworked from channel bars onto terraces; and modern colluvium from water-reworked loess. The sediments underlying Clear AFS are primarily composed of sandy gravel, poorly stratified with well to poorly graded (poorly to well sorted) coarse sand. The thickness is estimated to extend several hundred feet (USAMDC, 2002). Generally, soils at Clear AFS are predominantly overlaid by a thin layer of peat.

2.5.3 Hydrogeology

Groundwater beneath Clear AFS occurs in an unconfined aquifer within unconsolidated sand and gravel with cobbles. Depth to groundwater ranges from 20 to 100 ft bgs. The aquifer is recharged by infiltration from the Nenana River and by vertical infiltration of precipitation.

Regional groundwater generally flows to the north-northwest, with a water table gradient of approximately 3 ft per mile (Air Force Center for Engineering and the Environment [AFCEE], 1997). Wells drilled at SS012 have indicated a groundwater depth of approximately 78 to 84 ft bgs and generally flows to the north. This unconfined aquifer is recharged by infiltration of precipitation.

2.5.4 Surface Water Hydrology

Surface water at the installation consists of a manmade surface drainage system of ditches, swales, and culverts, Lake Sansing, the cooling pond, several unnamed tributaries, several natural retention and detention ponds, and the Nenana River. The Nenana River is a large, braided river flowing from major glaciers in the Alaska Range, with fairly uniform flow throughout the summer. In sub-arctic Alaska, the typical hydrological pattern is dominated by snowmelt runoff in the late spring and early summer. Clear AFS has a semiarid climate, and rainfall events do not account for the highest flows. Peak snowmelt, and thus peak flows, likely occur in early summer (early to mid-June). The ice-free period on streams usually runs from mid-May until mid-October, when streams freeze over (USAF, 2005a).

Standing water bodies include Lake Sansing and the power plant cooling pond. Both are manmade resources employed in the daily operation of the station. Other small manmade depressions may contain surface water periodically during wetter periods or periods of snowmelt (USAF, 2005a).

No wetlands or surface water features occur near SS012. The nearest surface water body is Lake Sansing, approximately1.2 miles to the northwest (USAF, 2005a).

2.5.5 Ecology

The environment of the Clear AFS is characterized as the Interior Forested Lowland and Upland Subregion of the Interior Alaska Ecoregion (ADEC, 1999; Shannon & Wilson, 1999). This subregional habitat is dominated by birch and spruce forest, dry meadow, and gravel barrens. A variety of grasses, sedges, and willows are located throughout the site. The wildlife at Clear AFS is typical of the fairly undisturbed nature of the station and its vicinity. Mammals commonly observed throughout the facility include red fox, coyote, black bear, brown bear, snowshoe hare, red squirrel, porcupine, mink, marten, beaver, muskrat, and moose. Clear AFS provides foraging, migrating, and nesting habitat for a variety of bird species. Birds typically observed in the area include common raven, ruffed grouse, ptarmigan, Canada goose, mallard, cliff swallow, American robin, yellow-rumped warbler, and darkeyed junco (ADEC, 1999;

USAMDC, 2002). No reptiles live in the region, and the wood frog (Rana sylvatica) is a prevalent amphibian in Central Alaska (MacDonald, 2003).

SS012 is not a sensitive environment (as defined in ADEC, 2005b), nor are threatened or endangered species known to be present on or in close proximity to the site.

2.5.6 Previous Site Characterization Activities

Soil investigations were conducted in 2006 and 2008 to evaluate the nature and extent of contamination in surface (0 - 2 ft bgs) and subsurface (> 2 ft bgs) soil at SS012. Remedial investigation soil sample collection locations are shown in Figure 2-4. Soil borings and monitoring wells were installed using a truck-mounted, air-rotary-type drill rig.

The 2006 soil investigation included collection of surface and subsurface soil confirmation samples, and was completed in multiple phases. An initial field screening of soil for the presence of DDT was conducted to assess appropriate surface sample locations and subsurface sample intervals in soil borings for laboratory samples. Subsequently, 6 surface analytical samples and a total of 15 subsurface soil analytical samples (from four exploratory borings) were collected for laboratory testing from selected locations. All 2006 surface and subsurface soil samples were analyzed for pesticides and RCRA-listed Metals. Additionally, one 2006 subsurface soil sample was also analyzed for VOCs (SW8260B) and SVOCs (SW8270C), and herbicides (SW8151).

Screening was not performed in 2008 because initial data on the location of impacts was already available, and the primary intent of the 2008 program was to further delineate the extent of impacts and to enhance the existing data set for risk assessment purposes.

The 2008 soil investigation also included collection of surface and subsurface soil samples. In 2008, a total of 10 surface soil samples and 42 subsurface soil samples from 10 exploratory borings were analyzed for pesticides and VOCs.

An evaluation of groundwater at SS012 was conducted in 2006 and 2008, and involved groundwater monitoring well installation and development, groundwater-level measurements, and groundwater monitoring well sampling and analysis.

In addition to groundwater monitoring wells W-13A and W-13B, which were installed at SS012 in 1988 (USGS, 1988a), two monitoring wells (SS13-MW01 and S13-MW02) were installed at SS012 in 2006 to characterize groundwater upgradient and downgradient of the site. Figure 2-5 shows the location of monitoring wells sampled during the remedial investigation and indicates the measured depth to groundwater in each of the wells.

Groundwater analytical data was collected to determine whether groundwater contaminant concentrations are below ADEC 18 AAC 75 groundwater cleanup levels, risk-based cleanup levels, and regional background concentrations. Additionally, groundwater analytical data provided hydrogeologic data and groundwater chemistry data to support whether remedial actions would need to be developed to address groundwater, or if a no further action decision for groundwater was appropriate. Groundwater samples were collected using low-flow sampling procedures from all SS012 monitoring wells.

Groundwater sampling was conducted in all four site groundwater monitoring wells in 2006 and 2008. All 2006 groundwater samples were analyzed for pesticides and RCRA Metals. All 2008 groundwater samples were analyzed for pesticides and VOCs.

2.5.7 Nature and Extent of Contamination

Soil

An evaluation of potential SS012 contaminant sources and constituents present on the site was conducted. The only documented source of impacts to the site is the former storage of DDT-containing drums. Other non-site-specific potential sources of impact to SS012 may include the adjacent Landfill 2 to the east, Landfill 3 approximately 1/3 mile to the west, the Clear Air Station coal-fired power plant approximately 1 mile to the north, undocumented activities in the area around SS012 that may have occurred in the past, and transient or regional sources of potential airborne or other impacts. These potential off-site sources could have impacted SS012 media through airborne dispersion of contaminants, particularly mercury and other metals, and specific semivolatile organic compounds. In the case of groundwater, a potential exists to impact the site from upgradient sources through hydrologic transport.

Analytical data used in evaluating the current nature and extent of impacts includes inorganics and persistent organics data for soil collected in 1994, and all data collected during this Supplemental RI program performed in 2006 and 2008. Based on the comprehensive data set for SS012, measurable concentrations of specific pesticides (DDT; 4,4'-dichlorodiphenyldichloroethylene [DDE]; DDD, and Endrin), numerous VOCs, some SVOCs, and seven RCRA-listed metals (arsenic, barium, cadmium, chromium, lead, mercury, and silver) have been detected at any concentration in one or more SS012 surface and subsurface soil samples. It is believed that the metals detected in SS012 soil samples, with the exception of mercury, are naturally occurring, and not a result of human activities. The mercury detected in SS012 soil samples may be either naturally occurring, or representative of a regional impact, such as a regional impact from the Clear AFS power plant or another unknown aerial source.

Of the multiple constituents identified in SS012 soil, the following eight are present at concentrations in excess of the most stringent current 18 AAC 75 soil cleanup levels:

- DDT,
- DDD,
- 1,1-DCE,
- methylene chloride,
- 2-methylnaphthalene,
- naphthalene,
- arsenic, and
- chromium.

Arsenic and chromium concentrations in SS012 soil are believed to represent natural conditions, and those metals are not believed to represent anthropogenic impacts. Figure 2-6 shows anthropogenic constituents in excess of the most stringent ADEC cleanup levels and background levels detected in soil at SS012. Background levels are from a study on background levels completed by the USGS in 1994 (USGS, 1996).

Of the organic constituents impacting SS012 soil at concentrations in excess of cleanup levels, and believed to be anthropogenic in nature, DDT is the most extensive, with concentrations

exceeding the Migration to Groundwater cleanup level of 7.3 mg/kg over an approximately 230 ft^2 area to maximum estimated depths of approximately 14 ft bgs, impacting an estimated 90 to 100 yds^3 of soil. Additionally, DDD at concentrations in excess of the Migration to Groundwater cleanup level of 7.2 mg/kg appears to be quite limited, covering an estimated 10 ft^2 area, at an estimated maximum depth of 6 ft bgs and with an estimated volume of 2 yds^3. The extent of soil containing 1,1-DCE, methylene chloride, and 2-methylnaphthalene at concentrations in excess of their Migration to Groundwater cleanup levels (0.03 mg/kg, 0.016 mg/kg, 6.1 mg/kg, respectively) appears to be collocated and quite limited, covering an area of approximately 10 ft^2, at an estimated depth of 5 ft bgs and with an estimated volume of less than 2 yds^3. The extent of soil containing naphthalene at concentrations in excess of the Migration to Groundwater cleanup level of 20.0 mg/kg appears to be quite limited, covering an area of approximately 10 ft^2, at an estimated depth of 5 ft bgs and with an estimated volume of less than 2 yds^3. This VOC and SVOC impacted soil appears to be wholly within the DDT-impacted zone, and those constituents are believed to be daughter products of the pesticide or associated middle distillate carrier product typically associated with DDT.

At SS012, the primary contaminant of concern, DDT, is moderately resistant to chemical and physical degradation, and of relatively low mobility in the environment. Breakdown of DDT and associated contaminants at SS012 does appear to be occurring through natural attenuation processes, as indicated by the presence of daughter products, particularly DDE and DDD.

Groundwater

Groundwater samples were collected from four monitoring wells located upgradient, within, and downgradient of the former drum storage location. Groundwater cleanup levels are based on ADEC groundwater cleanup levels as listed in 18 AAC 75.345, Table C. Current groundwater data from 2006 and 2008 shows no detectable pesticides or VOCs, and metals concentrations that are consistent with expected background conditions with one exception. Lead was detected in one SS012 well at a concentration above expected background, but below the applicable regulatory cleanup level. Background levels are from a study on background levels completed by the USGS in 1994 (USGS, 1996). Lead does not appear to be present at sufficient concentration in SS012 soil, where lead concentrations are considered natural, to explain an impact on groundwater, and the apparently elevated lead concentration detected may be a natural anomaly, or may be from an unknown source, but does not appear to be related to SS012 activities. The highly adsorptive nature and low solubility of DDT reduces the potential for leaching of that contaminant into groundwater.

No exceedances of ADEC groundwater cleanup levels have been found at SS012, either in current or historical samples.

2.5.8 Conceptual Site Model

A conceptual site model (CSM) was developed in the RI Work Plan (USAF, 2006) and later revised in the RI (USAF, 2009a), to depict the potential relationship or exposure pathway between chemical sources and receptors. An exposure pathway describes the means by which a receptor can be exposed to contaminants in environmental media. The CSMs for human health and ecological receptors are shown in Figures 2-7 and 2-8, respectively. Several complete pathways exist for human and ecological receptors to interact with contaminated soil at SS012.

Based on the site's current and planned land use, future construction workers, maintenance workers, future residents, and recreational hunters were identified as potential human receptor populations. The ecological receptors of concern are plants, invertebrates, reptiles and amphibians, fish, and birds and mammals.

2.6 Current and Potential Future Land Use and Resource Uses

2.6.1 Land Use

Clear AFS consists of property that is developed for functions vital to the mission, forested, or otherwise considered as open space. The area outside of the property line surrounding Clear AFS is largely undeveloped forest land, making the perimeter indistinguishable. Due to this buffer, the existing on- and off-base land uses are compatible. The developed area on the installation consists of four defined areas: Composite Area, Old Camp Area, Old Tech Site, and the SSPARS area. These areas are distinct in function and character (USAF, 2005a).

As the lead agency, the USAF has the authority to determine the future anticipated land use of SS012. The Clear AFS General Plan (USAF, 2005a) identifies future land use in the SS012 area as open space, consistent with current use in the area. The "open space" designation indicates that the land is undeveloped, with no plans for future development, but with no restrictions or limitations on development, and is considered to be equivalent to ADEC unrestricted land use. The "open space" designation in the General Plan applies to areas with no planned future construction, and vacant space that would be created with demolition (such as the Old Tech Site and the Camp Area).

SS012 is surrounded for the most part by undeveloped forest land, with the exception of Landfill 2 to the east which is grass-covered. The site is approximately 0.5 mile from the developed Camp Site, which currently functions primarily as an industrial use area.

Surrounding land uses immediately adjacent to installation property are non-developed, recreational or open space activities with the exception of the Anderson Airport. The vast amount of open space adjacent to the installation and the reliance of people in this area on the activities of the base suggest that there is not likely to be a conflict of encroachment or incompatible uses between the installation and its neighbors (USAF, 2005a).

2.6.2 Ground and Surface Water Beneficial Uses

Groundwater beneath Clear AFS occurs in an unconfined aquifer within unconsolidated sand and gravel, typically at a depth of 20 to 100 ft bgs. Wells drilled at SS012 have indicated a groundwater depth of approximately 78 to 84 ft bgs. This unconfined aquifer is recharged by infiltration of precipitation. Regional groundwater generally flows to the north-northwest, with a relatively low water table gradient of approximately 3 ft per mile (AFCEE, 1997), or 0.0006.

SS012 groundwater is not currently used as a drinking water source and is not expected to be used as a groundwater source in the future. Groundwater beneath SS012 does not appear to be currently impacted, as indicated by 2008 groundwater data showing no measurable evidence of impacts from SS012 or other sources. Groundwater depth at SS012 is greater than 80 ft bgs. Based on the estimated vertical distribution of contaminants in soil at concentrations exceeding cleanup levels in general, and exceeding Migration to Groundwater cleanup levels in particular (Figure 2-6), the likelihood of significant groundwater impacts (above cleanup levels) from

SS012 soil constituents is low. SS012 sources are not likely to result in groundwater impacts that exceed current groundwater cleanup levels

No wetlands or surface water features occur near SS012. The nearest surface water body is Lake Sansing, approximately1.5 miles to the northwest (USAF, 2005a). The effect of surface water runoff as a significant contaminant transport mechanism at SS012 is mitigated by the relatively small area of surface exposure of site contaminants, the presence of a well developed vegetative cover on the ground surface surrounding the site, the flat nature of the site and immediately surrounding area, and the relative infrequency of surface flow events (such as heavy precipitation or spring breakup) in the area. Subsurface lithology at SS012 is typified by highly permeable coarse grained material (sand and gravel). This would tend to increase the rate of infiltration, and reduce the potential for and frequency of surface water flow.

2.7 Summary of Site Risks

This section summarizes the human health and ecological risk assessments that have been performed at SS012. The chemicals of potential concern (COPCs) are identified, as well as the potentially exposed populations and exposure pathways of primary concern. A summary of the findings of the screening level ecological risk assessment (ERA) is also presented. The risk assessments were based on human health and ecological conceptual site models developed for the site (Figures 2-7 and 2-8 for human health and ecological receptors, respectively). Under current land use (open space), no identified human health risks or hazards exist. However, based on the presence of unacceptable human health risks under a residential exposure scenario and potential hazards to ecological receptors from contact with DDT-impacted soil, remedial action is being recommended to reduce the risks.

2.7.1 Summary of Human Health Risk Assessment

The baseline risk assessment estimates what risks the site poses if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the approaches used and the results of the baseline risk assessment for this site. The human health risk assessment (HHRA) is divided into the following sections: identification of COCs (hazard assessment), exposure assessment, toxicity assessment, and risk characterization. Potential risks for both current and future site occupants are discussed. Key assumptions and uncertainties associated with the HHRA are also identified. The complete HHRA report is provided in Appendix G of the RI (USAF, 2009a).

2.7.1.1 Identification of Chemicals of Potential Concern

This section identifies those chemicals associated with potential unacceptable risk at the site and that are the basis for the proposed remedial action. Although other chemicals were detected at the site, these COPCs are the primary risk-driving chemicals. The data used in this risk assessment was deemed to be of sufficient quality and quantity for its intended use.

The screening values for groundwater and soil are one-tenth the ADEC human health soil cleanup levels presented on Table B1 from 18 AAC 75.341 and Table C from 18 AAC 75.345 for soil and groundwater, respectively. For soil, the “Under 40-inch Zone” and the lowest value from the Direct Contact or Inhalation pathway was used. ADEC cleanup levels protective of the

Migration to Groundwater pathway were not used for screening because these concentrations are not applicable to human health risks from Direct Contact with soils. The screening values were adjusted by one-tenth when necessary to represent a carcinogenic risk of 1×10^{-6} and an HQ of 0.1, as consistent with ADEC guidance for selection of COPCs (ADEC, 2008b). Screening values represent concentrations below which there is no unacceptable health risk. If the maximum concentration of a chemical was less than the screening value, the chemical was eliminated from the risk assessment because it would not have an unacceptable health risk.

The following chemicals were selected as COPCs in soil because they had a maximum concentration greater than their respective screening value:

- 4,4-DDD
- 4,4-DDE
- 4,4-DDT
- 1,1-DCE
- 2-methylnaphthalene
- 1,2,4-trimethylbenzene
- 1,3,5-trimethylbenzene
- Dieldrin
- naphthalene

Four inorganic chemicals (barium, chromium, lead, and selenium) were detected in groundwater; however, no chemicals were selected as COPCs. None of them had a maximum concentration greater than its respective screening value, except lead. Although ADEC guidance (2001a) recommends using one-tenth the Table C cleanup value, lead is evaluated differently from other chemicals. Traditional risk assessment methods are not used to characterize risks from lead (i.e., a hazard quotient is not calculated). The ADEC cleanup value for lead is protective of a target blood lead level that is calculated using the Integrated Exposure Uptake Biokinetic (IEUBK) Model and takes into account additional exposure from lead, such as lead paint or lead in tap water. Although the maximum concentration exceeded one-tenth the Alaska cleanup level, it did not exceed the ADEC cleanup value. Therefore, no detected chemicals, including lead, are present in concentrations that would represent an unacceptable health risk through the drinking water ingestion pathway and lead was not selected as a COPC.

The potential for chemicals currently present in soil to migrate to groundwater in the future was evaluated in the uncertainty section of the risk assessment (USAF, 2009a) by evaluating exceedances of Migration to Groundwater cleanup levels in soil. Although there were minor exceedances at one or two locations in surface soil, future impacts to groundwater are extremely unlikely due to the age of the spill (nearly 30 years ago), depth to groundwater of approximately 80 ft, and low solubility of some of the contaminants (e.g., DDT).

The detection frequency (number of samples in which the chemical was detected divided by the total number of samples analyzed), range of detected concentrations (maximum and minimum concentrations detected), and the screening concentration (concentration above which the chemical is believed to possibly present a risk to human health or the environment and thus

require further evaluation) for COPCs for SS012 are presented in Tables 2-3 and 2-4 for soil and groundwater, respectively. The exposure point concentrations (EPCs, the calculated or assumed concentration of the chemical at the assumed location of exposure) are presented in Table 2-5.

2.7.1.2 Exposure Assessment

Once COPCs are selected, the second step in risk assessment is an evaluation of the exposure pathways by which people could encounter chemicals. The exposure assessment identifies the populations potentially exposed to chemicals at the site, the means by which exposure occurs, and the amount of chemical received from each exposure medium (i.e., the dose). Only complete exposure pathways are quantitatively evaluated. It should be noted that the presence of a PVC liner over impacted subsurface soil is not considered as a mitigating factor in evaluating exposure pathways. Complete pathways consist of four elements: (1) a source and mechanism of chemical release, (2) a retention or transport medium (e.g., groundwater), (3) a point of potential human contact with the affected medium, and (4) a means of entry into the body at the contact point. Figure 2-7 presents the CSM, which depicts the complete pathways for this site.

Based on the site's current and potential future land use, current maintenance workers (brush cutters), future construction workers, future residents, and future recreational gatherers were identified as potential receptor populations. Recreational gatherer exposures were not quantified in this assessment based on the small size of the site, the short duration of any exposures, and the relatively low concentrations of contaminants in surface soil. The population of concern for direct exposures to soils is construction workers involved in future construction in the area (no construction activities are currently planned for the site), maintenance workers (exposed during brush clearing activities), and future residents (no residential development is planned for the site). The construction worker is considered the most likely population that could potentially be exposed to surface and subsurface contamination at this site while conducting soil disturbing activities. Future residents were also considered for potential exposure to soil contamination from yard soil. According to ADEC guidance (ADEC, 2005), human exposure of contaminants in soil should be evaluated to a depth of 15 ft. In this assessment, the construction worker and residential soil exposures were evaluated to a depth of 15 ft, and for the maintenance worker the soil exposures were evaluated in the top 2 ft and the 2 to 15 ft depth interval if subsurface soil were brought to the surface during an excavation project.

Major assumptions about exposure frequency, duration, and other exposure factors that were included in the exposure assessment are included in the HHRA, Appendix G of the RI (USAF, 2009a).

2.7.1.3 Toxicity Assessment

This section describes the carcinogenic and non-carcinogenic toxicity criteria used to calculate the potential risk for each COPC. Carcinogenic toxicity is the tendency of a chemical to cause cancer. Non-carcinogenic toxicity includes all other adverse health effects of a chemical. Toxicity data for carcinogens is presented in Table 2-6 and for non-carcinogens in Table 2-7. When available, separate toxicity criteria are listed for ingestion (oral intake, swallowing), inhalation (breathing into the lungs), and dermal (absorption through the skin) routes of exposure. For carcinogenic COCs, the toxicity criteria is the slope factor, which is a number, which when multiplied by the daily dose of the chemical, yields the expected incidence of cancer in a population. For example, a slope factor of 2 (milligrams per kilogramper day [mg/kg-day])$^{-1}$

multiplied by a daily dose of 0.001 mg/kg-day would yield a cancer incidence of 0.002 which would be 2000 cancers in a population of 1 million (See Section 2.7.1.4 for more information). The weight of evidence/cancer guideline description is a descriptor, usually provided by the USEPA classifying the degree of confidence that the chemical is a human carcinogen. Slope factors and weight of evidence/cancer guideline descriptions are listed in Table 2-6 along with the source of each slope factor and date of its publication.

For non-carcinogenic chemicals the toxicity criteria is the reference dose (RfD). The RfD is the maximum daily dose of the chemical that is not expected to cause any adverse effect on human health. The RfD is calculated from actual dosing data (experimental animals or humans) by dividing the observed dose that produces no effects by "uncertainty" or "safety" factors that range from 3 to 3000, depending on the relevance and quality of the study used, to yield a daily dose that has a high certainty of being safe for humans because it is lower than the observed "safe" dose by a factor of 3 to 3000. RfDs and the uncertainty factors used in their calculation are listed in Table 2-7 for each COC along with the target organ of the toxicity, and the sources of each RfD and date of its publication.

Dieldrin, 1,1-DCE, DDD, DDE, DDT, and napthalene were evaluated for cancer effects, and 1,1-DCE, 2-methylnaphthalene, 1,2,4-trimethlbenzene, 1,3,5-trimethylbenzene, naphthalene, DDD and DDT (where toxicity information exists) were evaluated for noncancer effects. Further detailed toxicological information is provided in the HHRA in the RI (USAF, 2009a).

2.7.1.4 Risk Characterization

This section of the risk assessment combines the results of the exposure assessment with the toxicity criteria identified for the COPCs and pathways. Carcinogenic risks and noncarcinogenic impacts for each COPC are presented for all populations and media of interest, including both current and future land and other resource use settings. Cumulative risks, including all COPCs and pathways, for all relevant pathways and populations are also described.

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

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

$$Risk = CDI \times SF$$

Where:

Risk = a unitless probability (e.g., 2×10^{-5}) of an individual's likelihood of developing cancer

CDI = chronic daily intake averaged over 70 years (mg/kg-day)

SF = slope factor, expressed as $(mg/kg\text{-}day)^{-1}$

These risks are probabilities that usually are expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-

related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all other causes has been estimated to be as high as one in three. USEPAs generally acceptable risk range for site-related exposure is 10^{-4} to 10^{-6} (1 in 10,000 to 1 in 1,000,000).

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a RfD derived for a similar exposure period. The ratio of site-related daily intake to the RfD is called a HQ.

The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD

Where: CDI = chronic daily intake

RfD = reference dose

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

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

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

Health risks associated with the COPCs were estimated for current maintenance workers, future construction workers, and future residents. Table 2-8 summarizes the risk characterization results for SS012. Target health goals were not exceeded for the construction worker scenario or maintenance worker scenarios for either cancer risks or noncancer hazards. The cumulative risk for the construction worker scenario exposure to soil was 3×10^{-7}, below the target health goal, and the cumulative noncancer hazard of 0.1 is also below ADEC's target goal of 1. The cumulative risk for the maintenance worker scenario exposure to surface soil was 8×10^{-6} and the cumulative noncancer hazard was 0.12. In subsurface soil, cumulative hazards and cancer risks were also below ADEC's target goals at 6×10^{-6} and 0.88, respectively. Exposure of construction workers and maintenance workers to DDT in soil through the ingestion pathway contributed over 90 percent to the noncancer hazard and over 90 percent to the risk results.

The cumulative cancer risk for the residential scenario exposure to soil was 1×10^{-4}, which is above the ADEC target health goal of 1×10^{-5}, and at the upper end of the USEPA acceptable range for cumulative risk (1×10^{-4}). The future land use at SS012 is designated as "open space", and therefore the likelihood of residential development or construction activity in the future is extremely low. The cumulative noncancer hazard of 3.3 for children also exceeds ADEC's noncancer target health goal of 1. Cumulative noncancer hazards were calculated to be 0.12 for adults - below the target health goal of 1. Exposure of residents to DDT in soil through the ingestion pathway contributed nearly 100 percent to the noncancer hazard and over 90 percent to the risk results.

Every aspect of the risk assessment contains multiple sources of uncertainty. Simplifying assumptions are often made so that the exact amount of uncertainty cannot be quantified. The risk assessment is intended to overestimate rather than underestimate probable risk. Therefore, the results of this assessment are likely to be protective of health despite the inherent uncertainties in the process. A detailed discussion of uncertainties in the risk assessment is provided in the HHRA, Appendix G of the RI (USAF, 2009a).

In summary, risks to construction workers and maintenance workers from exposure to chemicals in soil met ADEC target health goals (cancer risk < 1 x 10^{-5}, noncancer hazard < 1); therefore, no actions are necessary to protect worker health risks at the site. In the unlikely event that the site were to be developed in the future for residential land use, risks to residents from exposure to chemicals in soil might exceed ADEC target health goals for cancer and noncancer, and would also exceed USEPA noncancer health goals. The site cancer risk of 1 x 10^{-4} is at the upper end of USEPAs acceptable risk range. Therefore, residential land use is likely not acceptable based on the concentrations of DDT in soil. Risks from exposures to DDT concentrations in soil were assessed over a depth interval of 0 to 15 ft. The highest DDT concentrations are located in the 4-6 ft bgs depth interval. These high concentrations are driving risks at the site.

2.7.2 Summary of Ecological Risk Assessment

This section summarizes the approaches and findings of the ERA that has been performed at SS012. An ERA estimates the likelihood that adverse ecological effects (e.g., mortality, reproductive failure) will occur as a result of a release of a hazardous substance at a site. The purpose for conducting the ERA is to 1) identify and characterize the current and potential threats to the environment from hazardous substance release, 2) evaluate the ecological impacts of alternative remediation strategies, and 3) establish clean-up levels that will protect the natural resources at risk. It's a qualitative and/or quantitative appraisal of the actual or potential effects of site releases on plants and animals. The chemicals of potential ecological concern (COPECs) associated with unacceptable site risk (if any) are identified, as well as the receptors and exposure pathways of primary concern. Potentially significant ecological hazards exist from potential exposure of receptors to DDT in surface soil (0-2 ft) and shallow subsurface soil (2-6 ft).

The scope of the ERA is limited to the evaluation of potential ecological hazards associated with the potential exposure of receptors to DDT in surface soil (0-2 ft) and shallow subsurface soil (2-6 ft) , based on data collected in 1994, 2006, and 2008. The complete ERA report is provided in Appendix H of the RI (USAF, 2009a). The risk assessment procedures follow ADEC (ADEC, 1999, 2000, 2001b, 2005, 2008), USEPA (USEPA, 1997, 1998), and USEPA Region 10 (USEPA Region 10, 1997) guidance.

2.7.2.1 Identification of Chemicals of Potential Ecological Concern

This section identifies those chemicals identified as COPECs at the site. Although other chemicals were detected at the site, these COPECs are the primary risk-driving chemicals.

Identification of a chemical as a COPEC does not necessarily mean that the chemical poses unacceptable risks to ecological receptors. Identification of a chemical as a COPEC does mean, however, that the potential for unacceptable ecological risk under the assumed exposure conditions of this screening-level ERA cannot be discounted. Detected chemicals with HQs greater than or equal to 1.0 were retained as COPECs. Chemicals with HQs less than 1.0 were

considered to have an insufficient potential to pose ecological risks and were not further evaluated. Detected chemicals without available ecological risk-based screening concentrations (ERBSCs) and chemicals that are considered bioaccumulative were also retained as COPECs.

The analytes identified as screening-level COPECs for SS012 are presented in Tables 2-9 and 2-10 for soil in the 0-2 ft and 0-6 ft depth zones, respectively; as well as the detection frequency, range of detected concentrations, and the EPCs for chemicals and media of concern.

For chemicals detected in soil at 0 to 2 ft bgs, a total of 21 COPECs were identified: five exceeded their respective ADEC ERBSCs; 10 chemicals lacked ERBSCs, and so were retained as COPECs; and six were retained as COPECs due to bioaccumulation effects. No alternative ecological criteria were available for the 10 chemicals detected in soil at 0 to 2 ft bgs that lack ERBSCs.

For chemicals detected in soil at 0 to 6 ft bgs, a total of 24 COPECs were identified: seven exceeded their respective ADEC ERBSCs; 12 lacked ERBSCs, and so were retained as COPECs; and five were retained as COPECs due to bioaccumulation effects. No alternative ecological criteria were available for the 12 chemicals detected in soil at 0 to 6 ft bgs that lack ERBSCs.

Screening-level COPECs for SS012 include:

- arsenic, barium, cadmium, lead, mercury, and silver
- DDT, DDD, DDE, Dieldrin, and Endrin
- n-, sec-, and tert-butylbenzenes, carbon disulfide, 1-chlorohexane, di-n-octylphthalate, hexachlorobutadiene, isopropylbenzene, p-isopropyltoluene, 2- methylnapthalene, naphthalene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene

2.7.2.2 Exposure Assessment

This section describes the ecological setting on and near the site and types of habitat present, including any ecologically sensitive areas that have been identified. The key species at the site are identified, including any Federal or State designated rare, endangered, or threatened species. Complete exposure pathways and chemical-specific EPCs for each receptor of interest are also presented. The results of any field studies that have been conducted, as well as the assumptions, approaches, and results of any exposure modeling are presented.

As discussed in Section 2.5.5, the environment of the Clear AFS is characterized as the Interior Forested Lowland and Upland Subregion of the Interior Alaska Ecoregion (ADEC, 1999; Shannon & Wilson, 1999). This subregional habitat is dominated by birch and spruce forest, dry meadow, and gravel barrens.

Because large numbers of species are present at most sites, evaluating risks to all species present at a site is impractical. Instead, one or more target ecological receptors are selected as representative species and risks to the target receptors are evaluated. Species of potential concern in this region include terrestrial vegetation, soil invertebrates, migratory and non-migratory avian species (e.g., raven, ptarmigan, and junco), and large and small mammalian species (e.g., fox, bear, snowshoe hare, and moose) [ADEC, 1999; USAMDC, 2002]. Although there are no reptiles in the area, the wood frog, an amphibian, is prevalent in Central Alaska, and is therefore considered a potential receptor (MacDonald, 2003).

No state or federal sensitive environments exist at SS012. No threatened or endangered species are known to exist within or in close proximity to SS012.

As shown in the ecological CSM for SS012 (Figure 2-8), exposure of ecological receptors to contaminants in surface soil is considered a potentially complete and significant exposure pathway. Direct contact of soil by plants and soil invertebrates, and incidental ingestion of surface soil by invertebrates, non-burrowing birds, and non-burrowing mammals will be considered potentially complete exposure pathways for soil at 0 to 2 ft bgs. For the purposes of this revised screening-level ERA, burrowing wildlife were assumed to potentially be exposed to soil from 0 to 6 ft bgs, with incidental ingestion of soil by burrowing wildlife being the primary potentially complete exposure pathway. Non-burrowing wildlife, soil invertebrates, and plant roots at SS012 would not be expected contact soils deeper than 2 ft bgs.

Ecological exposure pathways involving soil deeper than 6 ft bgs, groundwater, surface water, and sediment are considered incomplete for SS012. In addition, inhalation of vapor and particulates and dermal contact for birds and mammals are also considered insignificant pathways.

2.7.2.3 Ecological Effects Assessment

This section summarizes the results of any toxicity tests or field studies conducted to evaluate adverse ecological effects. In addition, the assessment and measurement endpoints developed for this site are presented.

Assessment endpoints are explicit expressions of environmental values to be protected (USEPA, 1998). Typically, assessment endpoints cannot be directly quantified in the field, so one or more measures of ecological effect are evaluated for each assessment endpoint. A measure of ecological effect is defined as a measurable ecological characteristic that is related to the valued characteristics selected as assessment endpoints (Suter et al., 2000). The single assessment endpoint, measure of ecological effect, and the connection between the assessment endpoint and measures of effect for SS012 are presented in Table 2-11. Ecological effect measures in this ERA are concentrations of COPECs related to the environmental values which are to be protected. For this screening-level ERA, the initial indicators of the potential for adverse ecological effects, were developed by ADEC as ERBSCs (ADEC, 2008c). ERBSCs represent chemical concentrations in environmental media that may pose unacceptable ecological risks to exposed receptors if exceeded. In all cases, the ADEC Media-Specific ERBSCs were used as the primary ecological screening values with which to identify COPECs. In addition to the ERBSCs, alternative risk-based screening concentrations (RBSCs) based on the scientific literature, and other criteria such as background levels of inorganic constituents, were considered in the hazard interpretation step. Soil ERBSCs used for the revised screening-level ERA are presented in Tables 2-9 and 2-10 for soil in the 0-2 ft and 0-6 ft depth zones, respectively, as are the sources and derivations of the ERBSCs and alternative RBSCs.

2.7.2.4 Ecological Risk Characterization

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

The five COPECs identified in soil at 0 to 2 ft bgs that had maximum detected concentrations in

exceedance of ERBSCs are arsenic, barium, DDT, Dieldrin, and lead. For soil at 0 to 6 ft, the seven COPECs that had maximum detected concentrations in exceedance of ERBSCs are arsenic, barium, DDE, DDT, Dieldrin, lead, and naphthalene. Barium was detected at concentrations below site-related background concentrations, and was not further assessed.

Although the limited size and location of SS012 and its lack of unique habitat features suggest the ecological receptors on-site are unlikely to spend a significant amount of time there, high HQs were noted for DDT. DDT HQs of 214 and 600 based on the maximum detected concentrations in surface and shallow soils, respectively and DDT HQs of 63 and 282 based on the 95 percent upper confidence limit (UCL) were noted for surface soils and shallow soils, respectively were noted. While concentrations were noted to exceed ecological benchmarks for other chemicals, the primary COPEC was found to be 4,4-DDT.

Figure 2-9 depicts the estimated area in which the measured DDT concentration in surface and near-surface soil exceeds the ERBSC of 0.7 mg/kg. The area is estimated to be approximately 375 ft^2.

The COPECs which are bioaccumulative (arsenic, Endrin, cadmium, DDD, DDE, DDT, mercury, lead, and silver) may cause some harm to ecological receptors even at small concentrations, due to biomagnification in the food web. However, due to the limited size and location of SS012 and its lack of unique habitat features, mobile ecological receptors are unlikely to spend a significant amount of time on site.

Every aspect of the risk assessment contains multiple sources of uncertainty. Simplifying assumptions are often made so that ecological risks can be estimated quantitatively. Because the exact amount of uncertainty cannot be quantified, the revised screening-level ERA is intended to overestimate rather than underestimate probable risk. The results of this assessment, therefore, are likely to be protective of ecological receptors despite the inherent uncertainties in the process. A detailed discussion of uncertainties in the revised screening-level ERA is provided in Section 4 of Appendix H of the RI (USAF, 2009a).

2.7.3 Basis for Action

The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. The response action is based on the results from the risk assessment process (USAF, 2009a) and guidelines presented in *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents* (USEPA, 1999).

2.8 Remedial Action Objectives

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

The RAOs for SS012 are (USAF, 2009a):

- Ensure that soil containing site-related chemical impacts in excess of applicable State of Alaska cleanup levels is not relocated to other areas without ADEC review and approval.
- Manage identified potential human health risks from exposure to site-related contaminants under a residential land use scenario.

- Reduce potential ecological hazards from exposure to site-related contaminants in surface soil (0-2 ft) and shallow subsurface soil (2-6 ft) to acceptable levels.

Analytical groundwater samples indicated there were no exceedances of ADEC cleanup levels; therefore, no RAOs are proposed for groundwater.

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

2.9 Description of Alternatives

The eight remedial alternatives considered for SS012 are presented in the FS Report (USAF, 2009b) and Amendment 1 to the FS Report (USAF, 2010b) and are summarized below.

- Alternative 1 – No Action
- Alternative 2 – Land Use Controls
- Alternative 3A – Ecological Hazard Based Cleanup/Off-Site Disposal/LUCs
- Alternative 3B – Ecological Hazard and Human Health Risk Based Cleanup/Off-Site Disposal/LUCs
- Alternative 3C – Human Health Risk Based Cleanup/Off-Site Disposal/LUCs
- Alternative 4A – Full Cleanup/Off-Site Disposal
- Alternative 4B – Full Cleanup/On-Site Treatment
- Alternative 4C – Human Health Risk and Migration to Groundwater Based Cleanup/Off-Site Disposal

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

2.9.1 Description of Remedy Components

A total of eight alternatives were developed to address the RAOs for SS012. This section provides a summary overview of the components of those alternatives.

- Alternative 1 - No Action: Regulations governing the Superfund program require that a "No Action" alternative be evaluated to establish a baseline for comparison. The No Action alternative assumes no further action will be taken regarding SS012 soil. No LUCs, such as legal/management control, or cleanup actions would be implemented. This alternative is required by the NCP for baseline comparison purposes.
- Alternative 2 - Land Use Controls: LUCs are administrative, engineering, and/or physical controls employed at a site to protect human health and the environment by controlling access and exposure to contaminants. The USAF would be responsible for implementing, maintaining, reporting on, and enforcing LUCs at SS012. The LUCs for SS012 would be implemented in the Clear AFS General Plan and would prohibit future residential development of the site, and would provide notice of residual exceedances of Migration to Groundwater and Direct Contact cleanup levels in site soil. In addition, informative signs would be posed around SS012. Confirmation sampling would not be performed under this

alternative. Since this alternative does not allow unrestricted use, this alternative would be subject to review not less than every five years to evaluate the LUCs. No removal actions would be performed under this alternative.

- Alternative 3A – Ecological Hazard Based Cleanup/Off-Site Disposal/LUCs: Under Alternative 3A, all soil within 6 ft of the ground surface containing site-related impacts in excess of ERBSCs would be excavated and disposed at an off-site facility. The estimated extent of ERBSC exceedances covers an area of approximately 474 ft^2. It is estimated that approximately 116 yds^3 (bulk) of contaminated soil would be removed under this alternative. LUCs would be implemented to prohibit future residential development of the site, and provide a notice of residual soil contamination in excess of Migration to Groundwater and Direct Contact cleanup levels. Five-year reviews would also be required.

- Alternative 3B – Ecological Hazard and Human Health Risk Based Cleanup/Off-Site Disposal/LUCs: Under Alternative 3B, all soil within 6 ft of the ground surface containing site-related impacts in excess of ERBSCs, and all soil within 15 ft of ground surface containing site-related impacts in excess of Direct Contact or Outdoor Inhalation cleanup levels would be excavated and disposed at an off-site facility. It is estimated that approximately 160 yds^3 (bulk) of contaminated soil would be removed under this alternative. LUCs would be implemented to provide a notice of residual soil contamination in excess of State of Alaska Migration To Groundwater cleanup levels. Five-year reviews would also be required.

- Alternative 3C – Human Health Risk Based Cleanup/Off-Site Disposal/LUCs: Under Alternative 3C, only the amount of soil necessary to reduce human health risks to acceptable levels would be removed and disposed at an off-site facility. Approximately 70 yds^3 of contaminated soil would be excavated to reduce human health risks to acceptable levels (below 1 x 10^{-5} cancer risk, and an HQ of 1 or less for non-cancer hazards). It is anticipated that ecological HQs would be reduced to 15.2 for soil in the 0-2 ft depth zone, and 22.2 for soil in the 0-6 ft depth zone. The volume of soil containing contaminant concentrations in excess of Migration to Groundwater cleanup levels would be reduced to approximately 50 yds^3. The excavation under this supplemental alternative would cover an area of approximately 120 ft^2, and extend to a depth of approximately 9 ½ ft bgs. LUCs would be implemented to provide a notice of residual soil contamination in excess of Migration to Groundwater cleanup levels. Five-year reviews would also be required.

- Alternative 4A – Full Cleanup/Off-Site Disposal: Under Alternative 4A, all soil within 6 ft of the ground surface containing site-related impacts in excess of ERBSCs, and all soil at any depth containing site-related impacts in excess of Migration to Groundwater cleanup levels would be excavated and disposed at an off-site facility. It is estimated that approximately 204 yds^3 (bulk) of contaminated soil would be removed under this alternative. No LUCs or 5-year reviews would be necessary under this alternative. This alternative would allow for unrestricted use.

- Alternative 4B – Full Cleanup/On-Site Treatment: The excavation component of this alternative is the same as under Alternative 4A; however, the impacted soil would be treated on-site using an on-site high temperature thermal desorption process rather than disposed in a landfill. As with Alternative 4A, the application of LUCs and 5-year reviews would not be required and the site would meet the regulatory standard for unrestricted use.

- Alternative 4C – Human Health Risk and Migration to Groundwater Based Cleanup/Off-Site Disposal: Alternative 4C builds on Alternative 3C by removing more impacted soil to eliminate the residual Migration to Groundwater cleanup level exceedances that would remain under Alternative 3C. Approximately 133 yds^3 of contaminated soil would be excavated to remove soil containing exceedances of all State of Alaska default cleanup levels (Migration to Groundwater and Direct Contact), based on 18 AAC 75; to reduce human health risks under a residential exposure scenario to acceptable levels (below 1×10^{-5} cancer risk, and an HQ of 1 or less for non-cancer hazards); and, to reduce overall potential ecological hazards. It is anticipated that ecological HQs would be reduced to 5.4 for soil in the 0-2 ft depth zone, and 2.2 for soil in the 0-6 ft depth zone. Excavated soil would be disposed at an off-site facility. Because no residual exceedances of cleanup levels would remain, no LUCs or 5-year reviews would be required.

2.9.2 Common Elements and Distinguishing Features of Each Alternative and Expected Outcomes of Each Alternative

Table 2-12 provides a summary of the elements common to each alternative and features that distinguish one alternative from another; as well as the summary of the expected outcomes of each alternative.

2.10 Summary of Comparative Analysis of Alternatives

In accordance with the NCP, the alternatives for SS012 were evaluated using the nine criteria described in Section 121(a) &(b) of CERCLA and 40 Code of Federal Regulations (CFR) Section 300.430 (e) (9) (i) as cited in NCP §300.430(f)(5)(i). These criteria are classified as threshold criteria, balancing criteria, and modifying criteria.

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

- Overall protection of human health and the environment
- Compliance with, or an applicable waiver of applicable or relevant and appropriate requirements (ARARs)

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

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

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

- Community acceptance
- State/support agency acceptance

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

2.10.1 Overall Protection of Human Health and the Environment

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

Alternative 1, No Action, would not be protective of human health and the environment under current conditions. This would be the least protective of the alternatives.

Alternative 2 would provide protection to human health through prohibitions on future residential development of the site, but would not be protective of ecological receptors. The level of protection would be greater than what is provided by Alternative 1, but less than all other alternatives.

Alternative 3A would provide equal protection to human health as would Alternative 2 through the implementation of LUCs, but would also provide effective protection to ecological receptors through the excavation of soils currently posing a potential ecological hazard.

Alternative 3B would provide incrementally better protection to human health as would Alternatives 2 or 3A, and would provide effective protection to ecological receptors equal to Alternative 3A, as soils posing a potential ecological hazard or human health risk would be removed and disposed in a permitted hazardous waste landfill.

Alternative 3C would provide protection to human health, equal to or greater than Alternatives 2, 3A, and 3B. Protection to ecological receptors under Alternative 3C would be improved over current conditions, but would be less than under Alternatives 3A or 3B.

Residual ecological HQs under Alternative 3C would remain above the target goal of 1. Residual ecological HQs under Alternative 3C are expected to be 15.2 for soil in the 0-2 ft depth zone, and 22.2 for soil in the 0-6 ft depth zone. The extent of soil exhibiting residual ecological HQs greater than 1 is expected to be quite small under Alternative 3C, and it is unlikely to pose a significant ecological risk to receptor populations. Additionally, the site does not constitute a sensitive environment, and no threatened, rare, or endangered species are known to be present.

Alternatives 4A and 4B would equally provide the highest degree of protection to human health and the environment because all soil posing a potential ecological hazard, an unacceptable human health risk, or exceeding an applicable cleanup level would be removed and disposed in a permitted hazardous waste landfill or treated on-site, respectively.

Alternative 4C would provide protection to human health equal or greater than other alternatives. Protection to ecological receptors under Alternative 4C would be greater than under Alternative 3C, but somewhat less than under Alternatives 3A and 3B. Under Alternative 4C, residual ecological HQs would be 5.4 for soil in the 0-2 ft depth zone, and 2.2 for soil in the 0-6 ft depth zone, above the target goal of 1. The extent of soil exhibiting residual ecological HQs greater than 1 is expected to be quite small under Alternative 4C, and it is unlikely to pose a significant

ecological risk to receptor populations. Additionally, the site does not constitute a sensitive environment, and no threatened, rare, or endangered species are known to be present.

2.10.2 Compliance with Applicable or Relevant and Appropriate Requirements

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

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

Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility citing laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site address problems or situations sufficiently similar to those encountered at the CERCLA site (relevant) that their use is well-suited (appropriate) to the particular site. Only those State standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate.

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

Alternatives 1 and 2 would not comply with ARARs, because soil containing contaminants above cleanup levels would not be removed from the site or treated in any way. Although Alternative 2 would satisfy some of the action- or location-specific ARARs, it does not comply with chemical specific ARARs associated with soil containing contaminants above State of Alaska cleanup levels (18 AAC 75).

Alternatives 3A, 3B, and 3C would comply with potential action- or location-specific ARARs, but not all chemical-specific ARARs associated with soil containing contaminants above State of Alaska cleanup levels (18 AAC 75) and residual elevated ecological HQs. Soil exceeding applicable cleanup levels would remain on-site. Ecological HQs would be expected to be 15.2 for soil in the 0-2 ft depth zone and 22.2 for soil in the 0-6 ft depth zone.

Alternatives 4A, 4B, and 4C would comply with all potential action-, location-, and chemical-specific ARARs, with the exception that under Alternative 4C, residual ecological HQs would remain above the target goal of 1. It is expected that residual ecological HQs under Alternative 4C would be 5.4 for soil in the 0-2 ft depth zone, and 2.2 for soil in the 0-6 ft depth zone.

2.10.3 Long-Term Effectiveness and Permanence

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

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

Alternative 1 would not provide long-term effectiveness and permanence because no treatment of contamination would occur, and no controls would be put in place.

Alterative 2 would provide limited long-term effectiveness and permanence by implementing LUCs to manage human health risks, but would not provide long-term effectiveness with regard to ecological hazards or compliance with cleanup levels.

Alternatives 3A, 3B, and 3C would provide an increased degree of long-term effectiveness and permanence, but would rely on LUCs to manage some risks or residual contamination issues.

Alternative 4C would provide an increase in the long-term effectiveness and permanence over Alternatives 3A, 3B, and 3C, because all contaminated soil posing an unacceptable human health risk or exceeding an applicable cleanup level would be removed from the site. Ecological hazards would be reduced through removal of contaminated soil.

Alternatives 4A and 4B would provide the most long-term effectiveness and permanence, because all contaminated soil posing an ecological hazard, an unacceptable human health risk, or exceeding an applicable cleanup level would be removed from the site.

2.10.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

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

Only one alternative, Alternative 4B, would reduce the toxicity, mobility, or volume of contaminants through treatment. Under Alternative 4B, on-site thermal treatment would be employed to treat soil. Alternatives 3A, 3B, 3C, 4A, and 4C would simply transfer contaminated soil to an appropriate RCRA-permitted disposal facility. Under these alternatives, the volume of residual contamination at the site would be reduced; however, these alternatives would rely on an appropriate landfill repository for long-term waste management. Alternatives 1 and Alternative 2 would not provide any reduction in contaminant toxicity, mobility, or volume through treatment; nor would these alternatives reduce the volume of contaminated soil at the site.

2.10.5 Short-Term Effectiveness

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

Alternatives 1 and 2 would have the least short-term risk reduction, and the least impacts to the community, workers, or the environment because neither involves active remediation.

Alternatives 3A, 3B, 3C, 4A, 4B, and 4C would have a greater degree of short-term risk reduction, and incrementally greater impact on the community, workers, or the environment. Short-term risk reduction would be achieved through excavation and disposal or treatment of impacted soil. Workers may potentially be exposed to dust and particulates containing contaminants during excavation of contaminated soil. Appropriate personal protective equipment (PPE) and engineering controls would be needed to reduce the potential for exposure to the contaminated soil or off-site migration through airborne dust.

Alternative 4B would have the greatest potential short-term impact on the community, workers, or the environment, due to potential exposure to dust and particulates containing contaminants during excavation of contaminated soil and the on-site treatment of waste and associated hazards.

2.10.6 Implementability

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

Alternative 1 includes no action, and is therefore the easiest to implement.

Alternative 2 includes the administrative effort required to maintain LUCs in the Clear AFS General Plan, but no site activities, so is also easily implemented, although somewhat more difficult than No Action.

Alternatives 3A, 3B, and 3C are more difficult to implement than either Alternatives 1 or 2, and Alternative 3B is incrementally more difficult to implement than is Alternative 3A, which is incrementally more difficult to implement than Alternative 3C, due to the volume of soil to be excavated under each alternative.

Alternatives 4A and 4C are somewhat more difficult to implement than Alternatives 3A, 3B, or 3C because the uncertainty in the volume of soil to meet the cleanup goal is substantially greater for the cleanup level based excavation than is the case for the hazard and risk based excavations.

Alternative 4B is the most difficult to implement, because it contains the same uncertainty with regard to the excavation as does Alternative 4A, and the implementation of an on-site treatment option is significantly more difficult to employ than a landfill disposal option.

2.10.7 Cost

Cost summaries are shown on Table 2-13.

Alternative 1 - No Action, would have no associated capital or O&M costs.

Alternative 2 - Land Use Controls, would have the next lowest capital costs, but the highest O&M costs of all the alternatives. Capital costs would include labor and materials for construction of a fence and placement of warning signs around the contaminated soil area. O&M costs would include periodic updates of the LUCs in the Clear AFS General Plan, providing updates to the Restoration Advisory Board, and 5-year reviews.

Costs for Alternatives 3A, 3B, 3C, 4A, 4B, and 4C all vary incrementally based on the reliance of each alternative on excavation to remove contaminated soil and/or the use of LUCs to control the contaminated soil as described previously in Section 2.9.1.

Alternative 4B – Full Cleanup/On-Site Treatment, would have the highest capital costs and present value cost of all the alternatives. The increase in cost is associated with the application of a complex treatment process and long distance mobilization/demobilization of the required equipment to the site. Whereas costs for Alternatives 3A, 3B, 3C, 4A, and 4C are associated with the excavation and/or implementation of LUCs and off-site disposal of contaminated soil.

2.10.8 State/Support Agency Acceptance

Alternative 4C - Human Health Risk and Migration to Groundwater Based Cleanup/Off-Site Disposal, is the USAF preferred alternative for SS012. ADEC concurs that the proper implementation of this alternative complies with state laws and regulations.

2.10.9 Community Acceptance

The public comment period on the PP was held from May 10 to June 9, 2010. The USAF received no requests to extend the public comment period. In addition, the public was offered an opportunity to request a public meeting to discuss the preferred remedy and all of the alternatives evaluated in the FS and Amendment to the FS for SS012. No one from the public requested a public meeting, and no written or verbal comments were received during the public comment period that would change the remedy selection process.

2.11 Principal Threat Wastes

The NCP expects that treatment that reduces the toxicity, mobility, or volume of the principal threat wastes will be used to the extent practicable. The principal threat concept refers to the source materials at a CERCLA site considered to be highly toxic or highly mobile that generally cannot be reliably controlled in place or present a significant risk to human health or the environment should exposure occur. A source material is material that contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or air, or that acts as a source for direct exposure.

There are no principal threat wastes at SS012 as the DDT-, DDD-, 1,1-DCE-, methylene chloride-, 2-methylnaphthalene-, and naphthalene-impacted soils are not considered highly toxic or highly mobile.

2.12 Selected Remedy

The primary indicator of remedial action performance will be satisfying the RAOs for SS012 and protecting human health and the environment. Performance measures are defined herein as the RAO (see Section 2.8 – Remedial Action Objectives) plus the required actions to achieve the objectives, as defined in this section. It is anticipated that successful implementation, operation, maintenance, and completion of the performance measures will achieve a protective and legally compliant remedy for SS012.

The remedy for SS012, Alternative 4C – Human Health Risk and Migration to Groundwater Based Cleanup/Off-Site Disposal, was selected based upon its ability to provide appropriate protection to human health and the environment while complying with ARARs. This section describes the selected remedy and also provides specific performance measures for the selected remedy.

Remedy selection is based on the detailed evaluation of remedial alternatives presented in the FS (USAF, 2009b) and Amendment 1 to the FS (USAF, 2010a). It is expected that this remedy will remain in effect and be protective of human health and the environment until such time as the concentrations of the COCs decrease to, or below, applicable cleanup levels.

The USAF is responsible for implementing, maintaining, and monitoring the remedial action identified herein for the duration of the remedy selected in this ROD. The USAF will exercise

this responsibility in accordance with CERCLA and the NCP. Review and approval by ADEC is required for any modification of the remedy inconsistent with the objectives of this ROD.

2.12.1 Summary of the Rationale for the Selected Remedy

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

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

Alternative 4C would provide a high degree of protection to human health because all soil presenting a potentially unacceptable health risk would be removed. Ecological hazards would be reduced, with anticipated residual ecological HQs of 5.4 for soil in the 0-2 ft depth zone and 2.2 for soil in the 0-6 ft depth zone, and all cleanup level exceedances would be removed. Cleanup under Alternative 4C would result in compliance with all ARARs. In spite of expected elevated residual ecological HQs, it is not believed that residual impacts under Alternative 4C will pose a significant threat to any receptor populations, and no rare, threatened, or endangered species are known to be present. Alternative 4C is feasible to implement, effective in the long-term, and with a relatively low potential for significant short-term impacts (i.e., no on-site treatment of potentially contaminated soil). The cost of Alternative 4C is only marginally more than the least expensive excavation alternative.

ADEC agrees that, when completed, Alternative 4C will meet the State of Alaska cleanup requirements of 18 AAC 75.

2.12.2 Description of the Selected Remedy

Alternative 4C involves the removal of impacted soil to reduce human health risks to acceptable levels and to eliminate the residual Migration to Groundwater cleanup level exceedances at SS012. Ecological hazards would be reduced through removal of contaminated soil, but would not be the driving factor in determining the extent of the excavation.

The primary components of the selected remedy (Alternative 4C) include:

- **Soil Excavation:** Approximately 133 yds^3 of contaminated soil would be excavated to remove soil containing exceedances of all State of Alaska default cleanup levels (Migration to Groundwater and Direct Contact), based on 18 AAC 75; to reduce human health risks under a residential exposure scenario to acceptable levels; and, to reduce overall potential ecological hazards.
    - The removal of soil containing impacts in excess of default Migration to Groundwater cleanup levels would capture all soil exceeding Direct Contact cleanup levels, and residual human health risks under this alternative would be expected to be well below the ADEC "acceptable risk" threshold of 1×10^{-5} cancer risk, and an HQ of 1 for non-cancer effects. Documentation describing the process used to make the determination that human health risks would be decreased to acceptable levels with this removal can be found in Attachment 1 of Amendment 1 to the Final FS Report (USAF, 2010a).
    - After removal of soil under Alternative 4C, soil containing exceedances of ERBSCs would remain (Figure 2-9). It is anticipated that ecological HQs would be reduced to 5.4 for soil in the 0-2 ft depth zone, and 2.2 for soil in the 0-6 ft depth zone (See Attachment 2 to the Amendment to the Final FS Report [USAF, 2010a] for more details). This is substantially reduced from the existing DDT HQs of 63 for the 0-2 ft depth zone and 282 for the 0-6 ft depth zone.
    - It is anticipated that the excavation under this supplemental alternative would cover an area of approximately 265 ft^2, and extend to a depth of approximately 14 ft bgs. The location and details of the proposed excavation under this supplemental alternative are shown on Figures 2-10 and 2-11. The estimated lateral and vertical extent of excavation, and the volume of soil generated under Alternative 4C include a 30 percent contingency to account for anticipated variability in an actual excavation.
    - Because no residual exceedances of cleanup levels would remain, no LUCs or 5-year reviews would be required and unrestricted use would be allowed.
    - The excavation would be backfilled with clean fill soil, obtained from an on-site source (i.e., borrow area), to bring the area level with the surrounding ground surface. The final grade would be revegetated through hydro-seeding. Side sloping (assumed to be 1:1.5 slope) will be necessary and soil outside of the area exceeding the screening and cleanup levels will be replaced in the excavation. The volume of clean soil temporarily removed to allow for the excavation activity to proceed is not included in the volumes described previously.
- **Disposal:** The excavated soil would be disposed at an appropriate permitted off-site disposal facility. Based on contaminant concentrations from the RI, it is estimated that approximately 133 yds^3 (173 tons) of excavated soil would require transport and disposal as hazardous waste to a RCRA Subtitle C landfill (e.g., Chem Waste in Arlington, Oregon).
- **Confirmation Sampling:** Confirmation samples would be collected from the base and sides of the excavation following removal of contaminated soil to confirm that no residual cleanup level exceedances remain. As a matter of practicality, the excavation under this proposed alternative would not be backfilled until confirmatory sample data confirms that RAOs have been met. It is anticipated that 15 samples (includes quality assurance/quality control [QA/QC] samples) would be collected surrounding and within the excavated area and

submitted for laboratory analysis for the COPCs present (pesticides, VOCs, and SVOCs). In addition, waste profiling samples would be collected from the excavated soil to characterize it for disposal.

It is important to note that the remedy may change somewhat as a result of the remedial design and construction processes. Changes, if they occur, to the remedy as described in this ROD will be documented using a technical memorandum in the Administrative Record, an Explanation of Significant Differences (ESD), or ROD amendment.

2.12.3 Summary of Estimated Remedy Costs

This alternative includes the following phases: Remedial Design, Remedial Action, and Project-Close Out. The total (2010 dollar) cost for the selected remedy is estimated at $274,000. The net present value is also $274,000 once discounted at a 0.9 percent rate. The initial capital cost is estimated at $218,000 (2010 dollar) and is associated with design of the remedial action, excavation and appropriate disposal of contaminated soil. The total periodic cost is estimated at $56,000 (2010 dollar) and includes the site closure activities. The site closure costs include abandonment of four monitoring wells. A program-default timeframe of 2 years was used for the cost analysis. The Remedial Action Cost Engineering and Requirements software (RACER) cost documentation can be found in Appendix A.

The information included in the RACER cost documentation is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the Administrative Record file, an ESD, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

2.12.4 Expected Outcomes of Selected Remedy

Based on the General Plan (USAF, 2005a) anticipated future land use at SS012 will remain open space. Site conditions that require remedy include exceedances of ADEC soil cleanup levels, risk to human health under a residential land use scenario, and ecological hazards. Under current land use (open space), no identified human health risks or hazards exist. Soil excavation and disposal was selected because it is expected to achieve long-term reductions in cleanup level exceedances at the site, decrease human health risk under a residential scenario, and reduce ecological hazards through removal of the contaminated soil. It is expected that the selected remedy will take less than 1 year to implement and achieve remedial goals. Upon completion of the remedy, SS012 would meet RAOs established for the site and qualify for unrestricted land use.

The ADEC soil cleanup levels for the COCs at SS012 are listed in Table 2-14.

2.13 Statutory Determinations

Based on the information available at this time, the USAF believes the selected remedy, Alternative 4C - Human Health Risk and Migration to Groundwater Based Cleanup/Off-Site Disposal, meets the threshold criteria and provides the better balance of tradeoffs among the alternatives with respect to the balancing and modifying criteria. The selected remedy will

comply with state regulations. Alternative 4C will provide appropriate protection to human health and the environment, will comply with ARARs, will achieve cleanup for the intended use of the site, will reduce contaminant mobility, and will provide a cost-effective long-term solution.

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

2.13.1 Protection of Human Health and the Environment

Under current land use (open space), no identified human health risks or hazards exist. However, based on the presence of unacceptable human health risks under a residential exposure scenario and potential hazards to ecological receptors from contract with DDT-impacted soil, remedial action is being recommended to reduce the risks. The selected remedy will protect human health and the environment through source removal of the contaminated soil.

2.13.2 Compliance with ARARs

Remedial actions must comply with both Federal and State ARARs. ARARs are legally applicable or relevant and appropriate requirements, standards, criteria, or limitations of Federal and State environmental laws and regulations.

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

Tables 2-15, 2-16, and 2-17 summarize the chemical-, action-, and location-specific ARARs and TBCs, respectively, for the selected remedy at SS012 and describes how the selected remedy addresses each one at agreed-upon points of compliance.

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

2.13.3 Cost Effectiveness

In the USAF's judgment, the selected remedy is cost-effective and represents a reasonable value

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

Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination: long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness. Overall effectiveness was then compared to costs to determine cost-effectiveness. The overall effectiveness of the selected remedy for SS012 was demonstrated in the comparative analysis of alternatives (Section 2.10 – Summary of Comparative Analysis of Alternatives) and is summarized in Table 2-18. The estimated present worth cost of the selected remedy is $274,000.

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

2.13.4 Utilization of Permanent Solutions and Alternative Treatment Technologies

The selected remedy represents the maximum extent to which cost effective permanent solutions can be used at the site. The selected remedy removes contaminated soil from SS012 that poses an unacceptable risk to human health. In spite of expected elevated residual ecological HQs, it is not believed that residual impacts under Alternative 4C will pose a significant threat to any receptor populations, and no rare, threatened, or endangered species are known to be present. The impacted soils would not be treated to reduce toxicity. Contaminated soils would be transferred to an appropriate RCRA-permitted disposal facility; thereby controlling contaminant mobility. The volume of residual contamination at the site would be reduced. Alternative 4C would be effective in the long-term as all contaminated soil posing an unacceptable human health risk or exceeding an applicable cleanup level would be removed from the site. Ecological hazards would be reduced through removal of contaminated soil. Of those alternatives that are protective of human health and the environment and comply with ARARs, the selected remedy provides the best balance of trade-offs in terms of the five balancing criteria and two modifying criteria.

2.13.5 Preference for Treatment as a Principal Element

The NCP establishes the expectation that treatment will be used to address the principal threats posed by a site wherever practicable (40 CFR 300.430[a][1][iii][A]). The selected remedy for SS012 does not satisfy the statutory preference for treatment as a principal element of the remedy because source removal was found to be the better balance of tradeoffs among the alternatives with respect to the threshold, balancing, and modifying criteria.

2.13.6 Five-Year Review Requirements

Pursuant to CERCLA §121(c) and NCP §300.430(f)(5)(iii)(C) and USAF policy, because the selected remedy, at completion, will not result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unrestricted use, a statutory review will not be required within five years after initiation of the remedial action to verify that the remedy is protective of human health and the environment.

2.14 Documentation of Significant Changes

The PP for the ROD was released for public comment on May 10, 2010. The preferred alternative identified in the PP was Alternative 4C - Human Health Risk and Migration to Groundwater Based Cleanup/Off-Site Disposal, which was determined to be protective of human health and the environment. Because no community comments or new information was provided that alters the assumptions or conclusions used in developing the preferred alternative, the preferred alternative is the selected remedy without any changes.

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3.0 Responsiveness Summary

This section is used to provide a summary of the public comments regarding the PP for remedial action at SS012, Clear AFS and the USAF response to comments. At the time of the public review period, the USAF had selected Alternative 4C – Human Health Risk and Migration to Groundwater Based Cleanup/Off-Site Disposal as the preferred alternative for the site.

3.1 Stakeholder Comments and Lead Agency Responses

In accordance with NCP §300.430(f)(3), a public comment period on the PP for the remedy for SS012 was held from May 10 through June 9, 2010. At the time of the public comment period, the USAF had identified the preferred alternative as Alternative 4C – Human Health Risk and Migration to Groundwater Based Cleanup/Off-Site Disposal, with ADEC concurrence. A public meeting was offered in the PP and the Public Notice. No requests for a Public Meeting were received. No written or verbal comments were received during the public comment period. Because no community comments or new information was provided that alters the assumptions or conclusions used in developing the preferred alternative, the preferred alternative is the selected remedy without any changes.

3.2 Technical and Legal Issues

No technical and legal issues were identified.

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4.0 References

Alaska Department of Environmental Conservation (ADEC). 1999. *Ecoregions/Assessment Endpoint Project, Technical Background Document for Selection and Application of Default Assessment Endpoints and Indicator Species in Alaskan Ecoregions*. Alaska Department of Environmental Conservation. June.

ADEC. 2000. *Risk Assessment Procedures Manual*. Contaminated Sites Remediation Program, Alaska Department of Environmental Conservation. Juneau, AK. June 8.

ADEC. 2001a. *Technical Memorandum – 01-003: Screening Procedures for COPCs Under Method Four*. January 16.

ADEC. 2001b. *User's Guide for Risk-Based Screening in Alaskan Ecological Risk Assessment*. Submitted to Mr. Dennis Hardwood, Alaska Department of Environmental Conservation. Submitted by Shannon and Wilson, Inc. December.

ADEC. 2005. *Draft Risk Assessment Procedures Manual*. November.

ADEC. 2008a. *18 AAC 75 Regulations for Oil and Other Hazardous Substances Pollution Control, as amended through October 9, 2008*. Alaska Department of Environmental Conservation.

ADEC. 2008b. *Cleanup Levels Guidance*. Division of Spill Prevention and Response, Contaminated Sites Remediation Program. January.

ADEC. 2008c. *Ecoscoping Guidance*. Division of Spill Prevention and Response, Contaminated Sites Program, Alaska Department of Environmental Conservation. March.

Air Force Center for Environmental Excellence (now Air Force Center for Engineering and the Environment, AFCEE). 1997. *Environmental Assessment for Radar Upgrade, Clear Air Station, Alaska*.

CH_2M Hill. 1981. *Installation Restoration Program Records Search for Clear Air Force Station*. Prepared for U.S. Air Force under Contract No. F080637-80-G0010-004-01. October.

MacDonald, S.O. 2003. *Wood frog species account In The Amphibians and Reptiles of Alaska: a field handbook*. Online publication from the U.S. Fish and Wildlife Service, Juneau Field Office, and the Alaska Natural Heritage Program. Available at http://alaskaherps.info

Shannon & Wilson. 1999. *User's Guide for Selection and Application of Default Assessment Endpoints and Indicator Species in Alaskan Ecoregions*. Prepared by Shannon & Wilson, Inc., for the Alaska Department of Environmental Conservation. June.

Suter, G.W. II, R.A. Efroymson, B.E. Semple, and D.S. Jones. 2000. *Ecological Risk Assessment for Contaminated Sites*. Lewis Publishers, Boca Raton, Florida.

United States Air Force (USAF). 1986. *Installation Restoration Program Phase II – Confirmation/Quantification, Stage 1*. Prepared by Dames and Moore, Park Ridge, IL, for Alaskan Air Command, Elmendorf, AK. February 27.

USAF. 1990. *Final Decision Document for Site 13, Clear AFS, Alaska*. Prepared by the USGS, Anchorage, Alaska. June. U.S. Air Force.

USAF. 2005a. *General Plan, Clear AFS, Alaska*. March. U.S. Air Force.

USAF. 2005b. *Site Summaries for Installation Restoration Program Sites 1 through 23, Clear AFS, Alaska*. December. U.S. Air Force.

USAF. 2006. *Final Work Plan for Remedial Investigations at Sites 11, 13, and 21: and Investigation to Support Feasibility Study at Site 22, Clear Air Force Station, Alaska*. Prepared by URS Group, Inc. August.

USAF. 2008. *Environmental Restoration Management Community Involvement Plan 2008 Update*. Clear Air Force Station, Alaska. July 2008.

USAF. 2009a. *Final Supplemental Remedial Investigation Report for Site 13, Clear Air Force Station, Alaska*. Prepared by URS Group, Inc. February 2009.

USAF. 2009b. *Final Site 13 Feasibility Study Report, Clear Air Force Station, Alaska*. Prepared by URS Group, Inc. June 2009.

USAF. 2010a. *Amendment 1 to the Final Feasibility Study Report for Site 13, Clear Air Force Station, Alaska*. Prepared by URS Group, Inc. March.

USAF. 2010b. *Final Proposed Plan for Site 13, Clear Air Force Station, Alaska*. Prepared by URS Group, Inc. April.

United States Army Missile Defense Command (USAMDC). 2002. *Ground-Based Midcourse Defense Validation of Operational Concept, Environmental Assessment*.

USEPA. 1997. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*, Interim Final. EPA 540-R-97-006. June.

USEPA. 1998. *Guidelines for Ecological Risk Assessment*. EPA/630/R-95/002F. Risk Assessment Forum. April.

USEPA. 1999. *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents. EPA 540-R-98-031, OSWER 9200.1-23P*. July.

USEPA Region 10. 1997. *EPA Region 10 Supplemental Ecological Risk Assessment Guidance for Superfund*. EPA 910-R-97-005. USEPA Region 10, Office of Environmental Assessment, Risk Evaluation Unit.

U.S. Geological Survey (USGS). 1988a. *Summary and Results of Well-Drilling Program at Clear Air Force Station, Alaska. June to September 1988.*

USGS. 1993. *Summary of U.S. Air Force Installation Program, Clear Air Force Station, Alaska*. USGS Administrative Report prepared for the U.S. Air Force. 9p.

USGS. 1996. *Summary and Results of Water, Soil, and Sediment Sampling at Clear Air Station, Alaska (May to September 1994).*

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TABLES

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TABLE 2-1
PUBLIC NOTIFICATION OF DOCUMENT AVAILABILITY
CLEAR AIR FORCE STATION, ALASKA
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Requirement:	Satisfied by:
Notice of availability of the Proposed Plan and RI/FS must be made in a general circulation major local newspaper.	Notice of availability was published in the Public Notices Section of the Fairbanks Daily News-Miner.
Notice of availability must include a brief abstract of the proposed plan which describes the alternatives evaluated and identifies the preferred alternative (NCP Section 300.430(f)(3)(i)(A) . The Notice of availability should also include the following information: • Site name and location • Date and location of public meeting • Identification of lead and support agencies • Identification of preferred alternative • Request for public comments • Public participation opportunities including: – Location of information repositories and Administrative Record file – Methods by which the public may submit written and oral comments, including a contact person – Dates of public comment period	Notice of availability included all of these components.

TABLE 2-2
PUBLIC COMMENT PERIOD REQUIREMENTS
CLEAR AIR FORCE STATION, ALASKA
PAGE 1 OF 1

Requirement:	Satisfied by:
Lead agency should make document available to public for review on same date as newspaper notification.	Document was made available to the public on May 9, 2010. The notification of availability was made on May 9, 2010.
Lead agency must ensure that all information that forms the basis for selecting the response action is included as part of the Administrative Record file and made available to the public during the public comment period.	All data collected and all CERCLA primary documents produced for SS012 at Clear AFS are maintained as part of the Administrative Record. The Administrative Record is available to the public and is located in the Reference Sections of the Anderson Village Library (First Street, Anderson, AK 99744, (907) 582-2628) and of the Noel Wien Library (1215 Cowles Street, Fairbanks, Alaska 99701, (907) 459-1024).
CERCLA Section 117(a)(2) requires the lead agency to provide the public with a reasonable opportunity to submit written and oral comments on the Proposed Plan. NCP Section 300.430(f)(3)(i) requires the lead agency to allow the public a minimum of 30 days to comment on the RI/FS and the Proposed Plan and other supporting information located in the administrative record and information repository.	The AF provided a public comment period for the RI, FS, Amendment to the FS, and the Proposed Plan from May 10 to June 9, 2010.
The lead agency must extend the public comment period by at least 30 additional days upon timely request.	The AF received no requests to extend the public comment period.
The lead agency must provide the opportunity for a public meeting to be held at or near the site during the public comment period. A transcript of this meeting must be made available to the public and be maintained in the Administrative Record and information repository for the site (pursuant to NCP Section 300.430(f)(3)(i)(E)).	A public meeting was offered in the Proposed Plan and the Public Notice. No requests for a Public Meeting were received.

TABLE 2-3
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SOIL AT SS012
CLEAR AIR FORCE STATION, ALASKA
(PAGE 1 OF 1)

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Surface and Subsurface Soil
Exposure Point:	Construction Site/Trenching; Residential Yard Soil

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (2)	Screening Value (3)		Screening Value Source	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
	Total Inorganics															
7440-38-2	**Arsenic**	**2.49**	**J**	**14.8**		**mg/kg**	**S13-SS16**	**16/16**	**--**	**14.8**	**10.9**	**0.45**	**c**	**AkCL**	**NO**	**BCK**
7440-39-3	Barium	79.1		227		mg/kg	S13-SB01	16/16	--	227	457	2030		AkCL	NO	BSL
7440-43-9	Cadmium	0.052	F	0.269		mg/kg	S13-SB01	13/13	--	0.269	0.61	7.9	c	AkCL	NO	BSL
7440-47-3	**Chromium(5)**	**12.3**	**M**	**39.3**		**mg/kg**	**S13-SS27**	**16/16**	**--**	**39.3**	**41.4**	**30**		**AkCL**	**NO**	**BCK**
7439-92-1	Lead	3.9	J	17.8		mg/kg	S13-SS16	16/16	--	17.8	12	40	c	AkCL	NO	BSL
7439-97-6	Mercury	0.031	F	0.116		mg/kg	S13-SS16	12/13	0.1	0.116	NE	1.8		AkCL	NO	BSL
7440-22-4	Silver	0.45	F	1.34		mg/kg	S13-SS16	13/13	--	1.34	NE	51		AkCL	NO	BSL
	Pesticides															
72-54-8	**4,4'-DDD**	**0.00082**	**F**	**11**		**mg/kg**	**S13-SB07**	**23/49**	**0.0034 - 3.4**	**11**	**0**	**3**	**c**	**AkCL**	**YES**	**ASL**
72-55-9	**4,4'-DDE**	**0.00034**	**F**	**2.7**	**J**	**mg/kg**	**W13C**	**31/49**	**0.0034 - 3.8**	**2.7**	**0**	**2.1**	**c**	**AkCL**	**YES**	**ASL**
50-29-3	**4,4'-DDT**	**0.00081**	**F**	**420**	**BCD**	**mg/kg**	**W13C**	**43/49**	**0.0033 - 0.004**	**420**	**0**	**2.1**	**c**	**AkCL**	**YES**	**ASL**
60-57-1	**Dieldrin**	**0.0035**	**M**	**0.038**	**M**	**mg/kg**	**S13-SB09**	**4/46**	**0.0033 - 4**	**0.038**	**0**	**0.032**	**c**	**AkCL**	**YES**	**BSL**
72-20-8	Endrin	0.0021	F	0.0029	F	mg/kg	S13-SS16	2/46	0.0033 - 4	0.0029	0	0.2		AkCL	NO	BSL
	Semivolatile Organic Compounds (SVOCs)															
117-81-7	Bis(2-ethylhexyl)phthalate	0.08	F	0.08	F	mg/kg	S13-SB01	1/1	--	0.08	0	22	c	AkCL	NO	BSL
117-84-0	Di-n-octyl phthalate	0.11	F	0.11	F	mg/kg	S13-SB01	1/1	--	0.11	0	310		AkCL	NO	BSL
87-68-3	Hexachlorobutadiene	0.0061	M	0.012	M	mg/kg	S13-SB07	4/35	0.0051 - 0.98	0.012	0	0.38	c	AkCL	NO	BSL
99-87-6	p-Isopropyltoluene(6)	0.0024	F	0.21		mg/kg	S13-SB07	3/34	0.0061 - 0.014	0.21	0	6.2		AkCL	NO	BSL
	Volatile Organic Compounds (VOCs)															
75-35-4	**1,1-Dichloroethene**	**0.34**	**F**	**0.34**	**F**	**mg/kg**	**S13-SS24**	**1/33**	**0.006 - 0.014**	**0.34**	**0**	**0.085**	**c**	**AkCL**	**YES**	**ASL**
87-61-6	1,2,3-Trichlorobenzene(6)	0.0061	M	0.012	M	mg/kg	S13-SB07	4/34	0.0051 - 0.98	0.012	0	4.1		AkCL	NO	BSL
120-82-1	1,2,4-Trichlorobenzene	0.0061	M	0.012	M	mg/kg	S13-SB07	4/35	0.0051 - 0.98	0.012	0	4.1		AkCL	NO	BSL
95-63-6	**1,2,4-Trimethylbenzene**	**0.0009**	**M**	**8.4**	**M**	**mg/kg**	**S13-SB07**	**7/35**	**0.006 - 0.011**	**8.4**	**0**	**4.9**		**AkCL**	**YES**	**BSL**
108-67-8	**1,3,5-Trimethylbenzene**	**0.0061**	**M**	**4.7**	**M**	**mg/kg**	**S13-SB07**	**6/34**	**0.005 - 0.011**	**4.7**	**0**	**4.2**		**AkCL**	**YES**	**ASL**
106-46-7	1,4-Dichlorobenzene	0.04		0.04		mg/kg	S13-SB07	1/35	0.005 - 0.98	0.04	0	3	c	AkCL	NO	BSL
544-10-5	1-Chlorohexane	0.012	M	0.023	M	mg/kg	S13-SB07	4/34	0.01 - 2	0.023	0	NE		AkCL	NO	NA
91-57-6	**2-Methylnaphthalene**	**40.1**		**40.1**		**mg/kg**	**S13-SB01**	**1/1**	**--**	**40.1**	**0**	**28**		**AkCL**	**YES**	**ASL**
67-64-1	Acetone	0.026	B	1.4	J	mg/kg	S13-SB10	33/34	0.056	1.4	0	6860		AkCL	NO	BSL
71-43-2	Benzene	0.00033	F	0.0025	F	mg/kg	S13-SB08	19/34	0.0053 - 0.98	0.0025	0	1.1	c	AkCL	NO	BSL
75-15-0	Carbon Disulfide	0.00075	B	0.012		mg/kg	S13-SB12	24/34	0.012 - 3.9	0.012	0	25		AkCL	NO	BSL
108-90-7	Chlorobenzene	0.0041	F	0.0041	F	mg/kg	S13-SB07	1/34	0.0051 - 0.98	0.0041	0	20		AkCL	NO	BSL
67-66-3	Chloroform	0.128	B	0.128	B	mg/kg	S13-SS24	1/34	0.0051 - 0.012	0.128	0	0.32	c	AkCL	NO	BSL
74-87-3	Chloromethane	0.0033	F	0.0096		mg/kg	S13-SB13	3/34	0.0051 - 0.98	0.0096	0	2.5	c	AkCL	NO	BSL
100-41-4	Ethylbenzene	0.00055	F	0.0063	F	mg/kg	S13-SB07	2/34	0.0051 - 0.98	0.0063	0	11	c	AkCL	NO	BSL
98-82-8	Isopropylbenzene	0.0061	M	0.032	M	mg/kg	S13-SB07	4/34	0.0051 - 0.98	0.032	0	6.2		AkCL	NO	BSL
-81	m,p-Xylene(6)	0.08		0.08		mg/kg	S13-SB07	1/34	0.0051 - 0.49	0.08	0	6.3		AkCL	NO	BSL
78-93-3	Methyl ethyl ketone	0.0044	F	1.08	B	mg/kg	S13-SS24	16/34	0.02 - 0.037	1.08	0	2330		AkCL	NO	BSL
1634-04-4	Methyl t-butyl ether (MTBE)	0.092	B	0.092	B	mg/kg	S13-SS24	1/34	0.0051 - 0.012	0.092	0	29	c	AkCL	NO	BSL
75-09-2	Methylene chloride	1.269		1.269		mg/kg	S13-SS24	1/34	0.005 - 0.012	1.269	0	16	c	AkCL	NO	BSL
108-10-1	Methyl Isobutyl Ketone (MIBK)	0.004	F	0.004	F	mg/kg	S13-SB14	1/34	0.02 - 3.9	0.004	0	210		AkCL	NO	BSL
91-20-3	**Naphthalene**	**0.00086**	**F**	**20**	**M**	**mg/kg**	**S13-SB07**	**9/34**	**0.0051 - 0.0095**	**20**	**0**	**2.8**		**AkCL**	**YES**	**ASL**
104-51-8	n-Butylbenzene	0.0061	M	0.34	M	mg/kg	S13-SB07	4/34	0.0051 - 0.98	0.34	0	4.2		AkCL	NO	BSL
103-65-1	n-Propylbenzene	0.11		0.11		mg/kg	S13-SB07	1/34	0.0051 - 0.98	0.11	0	4.2		AkCL	NO	BSL
95-47-6	o-Xylene(6)	0.00043	F	0.088		mg/kg	S13-SB07	2/34	0.0051 - 0.49	0.088	0	6.3		AkCL	NO	BSL
85-01-8	Phenanthrene	0.1	F	0.1	F	mg/kg	S13-SB01	1/1	--	0.1	0	2060		AkCL	NO	BSL
135-98-8	sec-Butylbenzene	0.0061	M	0.1	M	mg/kg	S13-SB07	4/34	0.0051 - 0.98	0.1	0	4.1		AkCL	NO	BSL
98-06-6	tert-Butylbenzene	0.0061	M	0.017	M	mg/kg	S13-SB07	4/34	0.0051 - 0.98	0.017	0	7		AkCL	NO	BSL
127-18-4	Tetrachloroethene	0.0027	F	0.0027	J	mg/kg	S13-SB06	1/34	0.0051 - 0.98	0.0027	0	1	c	AkCL	NO	BSL
108-88-3	Toluene	0.00083	F	0.0029		mg/kg	S13-SB07	10/34	0.0051 - 0.98	0.0029	0	22		AkCL	NO	BSL

Notes:

Chemicals bolded exceeded their screening toxicity value.

(1) Minimum/maximum detected concentration.

(2) Background is assumed to be zero for SVOCs, Pesticides without USGS (1996) background values, and VOCs.
Total inorganic background values were taken from the 1996 USGS Report. See Section 2.0 for additional information about arsenic background.

(3) Screening values are the ADEC Soil Cleanup Levels (Method Two, under 40-inch zone). Soil screening values were adjusted to be protective of a noncancer hazard of 0.1 and a cancer risk of 1×10^{-6}.

(4) Rationale Codes **Selection Reason:** ASL: Above Screening Levels **Deletion Reason:** BSL: Below Screening Level BCK: Near Background Levels

(5) Chromium (Total) used for screening

(6) The following surrogate chemicals where used for screening values:

Chemical Name	Surrogate Chemical
1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene
m-, p-, o - Xylene	Xylenes (total)
p-Isopropyltoluene	isopropylbenzene

Definitions: -- = Compound has 100% detection frequency
AkCL = 1/10 th Alaska Soil Cleanup Levels, Method Two, Under 40-inch Zone, excluding migration to groundwater
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
B = Analyte concentration in sample may not be distinguishable from results reported in method blank.
c = cancer. Screening value based on carcinogenic effects.
C = Confirmed by Gas Chromatography/Mass Spectrometry
COPC = Chemical of Potential Concern
D = Analysis at a secondary dilution
F = The analyte was positively identified but the associated numerical value is below the RL.
J = estimated concentration for tentatively identified compounds or for compounds quantified to be less than the contract required quantitation limit but greater than zero.
M = A matrix effect was present.

TABLE 2-4
OCCURENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER AT SS012
CLEAR AIR FORCE STATION, ALASKA
(PAGE 1 OF 1)

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater
Exposure Point:	Groundwater used as drinking water

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (2)	Screening Value (3)	Screening Value Source	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
	Total Inorganics														
7440-39-3	Barium	125		130		ug/L	S13-MW01	4/4	--	130	82.4	200	AkCL	NO	BSL
7440-47-3	Chromium(5)	4	F	5	F	ug/L	S13-MW01	3/4	10	5	NE	10	AkCL	NO	BSL
7439-92-1	**Lead**	**10**		**10**		**ug/L**	**S13-MW02**	**1/4**	**2 - 2**	**10**	**NE**	**1.5**	**AkCL**	**NO**	**TXT**
7782-49-2	Selenium	1	F	1	F	ug/L	S13-MW02	1/4	5 - 5	1	NE	5	AkCL	NO	BSL

Notes:

Chemicals bolded exceeded their screening toxicity values.

(1) Minimum/maximum detected concentration.

(2) Total inorganic background values were taken from the 1996 USGS Report.

(3) Screening values are 1/10th of the 2008 Alaska DEC Groundwater Cleanup Levels

(4) Rationale Codes **Selection Reason:** ASL: Above Screening Level
Deletion Reason: BSL: Below Screening Level
TXT: See text, Section 2.2.1, for additional information

(5) Chromium (Total) used for screening

Definitions: -- = Compound has 100% detection frequency
AkCL = Alaska Groundwater Cleanup Levels
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
COPC = Chemical of Potential Concern
F = Analyte > MDL, <RL
NE = Not Established
ug/L = micrograms per liter

TABLE 2-5
SUMMARY OF EXPOSURE POINT CONCENTRATIONS IN SOIL
CLEAR AIR FORCE STATION, ALASKA
(PAGE 1 OF 1)

Chemical	Number of Samples	EPC (mg/kg)	Basis of EPC
Construction Worker and Resident Exposure to Soil			
DDD	49	3.478	99% KM (Chebyshev) UCL
DDE	49	0.924	99% KM (Chebyshev) UCL
DDT	49	136.5	99% KM (Chebyshev) UCL
Dieldrin	46	0.00625	95% KM (t) UCL
1,1-Dichloroethene	33 [a]	0.34	Maximum (0 to 15 feet)
1,2,4-Trimethylbenzene	35	0.768	95% KM (t) UCL
1,3,5-Trimethylbenzene	34	0.447	95% KM (t) UCL
2-Methylnaphthalene	1 [a]	40.1	Maximum (0 to 15 feet)
Naphthalene	34	6.9	99% KM (Chebyshev) UCL
Maintenance Worker Exposure to Surface Soil			
DDD	16	2.228	95% KM (BCA) UCL
DDE	16	0.556	95% KM (Chebyshev) UCL
DDT	16	51.29	95% Adjusted Gamma UCL
Dieldrin	15 [a]	0.038	Maximum (0 to 2 feet)
1,2,4-Trimethylbenzene	10 [a]	0.0073	Maximum (0 to 2 feet)
1,3,5-Trimethylbenzene	10 [a]	0.0061	Maximum (0 to 2 feet)
Naphthalene	10 [a]	0.0017	Maximum (0 to 2 feet)
Maintenance Worker Exposure to Subsurface Soil			
DDD	33	3.282	99% KM (Chebyshev) UCL
DDE	33	1.205	99% KM (Chebyshev) UCL
DDT	33	190.8	99% KM (Chebyshev) UCL
Dieldrin	31	0.0039	95% KM (t) UCL
1,1-Dichloroethene	23 [a]	0.34	Maximum (0 to 15 feet)
1,2,4-Trimethylbenzene	25	1.096	95% KM (t) UCL
1,3,5-Trimethylbenzene	24	0.64	95% KM (t) UCL
2-Methylnaphthalene	1 [a]	40.1	Maximum (0 to 15 feet)
Naphthalene	24	2.556	95% KM (t) UCL

Notes:
[a] Although a sufficient number of samples were collected to calculate a UCL95, only 1 or 2 detections were reported in the data set. Therefore, the maximum detected concentration was used as the EPC for these chemicals.
mg/kg = milligrams per kilogram
EPC = exposure point concentration
KM = Kaplan-Meier Model
UCL = upper confidence limit

TABLE 2-6
CARCINOGENIC TOXICITY CRITERIA FOR THE CHEMICALS OF POTENTIAL CONCERN
CLEAR AIR FORCE STATION, ALASKA
(PAGE 1 OF 1)

Chemical	Oral Cancer: Slope Factor $(mg/kg\text{-}day)^{-1}$	Inhalation Cancer: Slope Factor $(mg/kg\text{-}day)^{-1}$	Tumor Type	EPA Cancer Classification[a]	Reference
1,1-Dichloroethene	0.6	0.175	--	Group C	IRIS (USEPA, 2008b) ADEC 2008
1,2,4-Trimethylbenzene	None	None	--	EPA Group D Carcinogen	IRIS (USEPA, 2008b)
1,3,5-Trimethylbenzene	None	None	--	EPA Group D Carcinogen	IRIS (USEPA, 2008b)
2-Methylnaphthalene	None	None	--	--	--
4,4 - DDD	0.24	None	Liver tumors	Group B2	IRIS (USEPA, 2008b)
4,4 - DDE	0.34	None	Heptacellular carcinomas	Group B2	IRIS (USEPA, 2008b)
4.4 - DDT	0.34	0.34	Liver tumors	Group B2	IRIS (USEPA, 2008b)
Dieldrin	16	16	Liver (mice)	Group B2	IRIS (USEPA, 2008b)
Naphthalene	None	0.12	Nasal tumors in rats	Group C	ADEC 2008b, OEHHA 2004, IRIS (EPA 2008b)

Notes:

[a] USEPA's Weight-of-Evidence Classification System:

Group A - human carcinogen (sufficient evidence in humans)
Group B1 - probable human carcinogen (limited human data available)
Group B2 - probable human carcinogen (sufficient evidence in animals, inadequate or no evidence in humans)
Group C - possible human carcinogen (limited evidence in animals)
Group D - not classifiable as to human carcinogenicity

mg/kg-day = milligrams per kilogram per day
USEPA = United States Environmental Protection Agency

TABLE 2-7
NONCARCINOGENIC CHRONIC TOXICITY CRITERIA FOR THE CHEMICALS OF POTENTIAL CONCERN
CLEAR AIR FORCE STATION, ALASKA
(PAGE 1 OF 2)

Chemical	Chronic RfD (mg/kg-day)	Toxic Endpoint	Critical Study	Chronic RfD UF[a] and Confidence	RfD Source
Inhalation Exposures					
1,1-Dichloroethene	0.057	Liver toxicity	rat chronic inhalation study	30 medium	IRIS (USEPA 2008b)
1,2,4-Trimethylbenzene	0.0017	CNS Symptoms	Subchronic human occupational	3000 low	NCEA
1,3,5-Trimethylbenzene	0.0017	CNS Symptoms	Subchronic human occupational	3000 low	NCEA
2-Methylnaphthalene	0.004	pulmonary alveolar proteinosis	mice 81-week dietary study	1000 low	IRIS (route to route extrapolation from oral reference dose)
4,4 - DDD	none[b]	--	--	--	--
4,4 - DDE	none[b]	--	--	--	--
4.4 - DDT	none[b]	--	--	--	--
Dieldrin	none[b]	--	--	--	--
Naphthalene	0.00086	Nasal effects: hyperplasia and metaplasia in respiratory and olfactory epithelium, respectively	chronic mouse inhalation study	3000 low to medium	IRIS (USEPA 2008b)
Oral Exposures					
1,1-Dichloroethene	0.05	Liver toxicity	rat chronic drinking water study	100 medium	IRIS (USEPA 2008b)
1,2,4-Trimethylbenzene	0.05	Decreased body weight	Subchronic rats	3000 medium	NCEA
1,3,5-Trimethylbenzene	0.05	Decreased body weight	Subchronic rats	3000 medium	NCEA
2-Methylnaphthalene	0.004	pulmonary alveolar proteinosis	mice 81-week dietary study	1000 low	IRIS (USEPA 2008b)
4,4 - DDD	0.0002	--	--	--	ADEC 2008
4,4 - DDE	none[c]	--	--	--	--
4.4 - DDT	0.0005	Liver lesions	rat feeding study	100 medium	IRIS (USEPA 2008b)
Dieldrin	0.00005	Liver Lesions	2-year rat feed study	100 medium	IRIS (USEPA 2008b)
Naphthalene	0.02	Decrease terminal mean body weight in males	Subchronic oral rat study	3000 low	IRIS (USEPA 2008b)

TABLE 2-7
NONCARCINOGENIC CHRONIC TOXICITY CRITERIA FOR THE CHEMICALS OF POTENTIAL CONCERN
CLEAR AIR FORCE STATION, ALASKA
(PAGE 2 OF 2)

Notes:

[a]USEPA indicates that there are generally 5 areas of uncertainty where an application of a UF may be warranted:

1 Variation between species (applied when extrapolating from animal to human)

2 Variation within species (applied to account for differences in human response and sensitive subpopulations)

3 Use of a subchronic study to evaluate chronic exposure

4 Use of a LOAEL, rather than a NOAEL

5 Deficiencies in the data base

[b] No inhalation criteria are available for this chemical.

[c] No ingestion criteria are available for this chemical.

mg/kg-day = milligrams per kilogram per day

IRIS = USEPA's Integrated Risk Information System (on-line data base) (USEPA, 2006)

NCEA= USEPA's National Center for Environmental Assessment

LOAEL = lowest-observed-adverse-effect level

NOAEL = no-observed-adverse-effect level

RfD = Reference dose

UF = Uncertainty factor

TABLE 2-8
SUMMARY OF REASONABLE MAXIMUM EXPOSURE CANCER RISKS AND HAZARDS FOR SS012 EXPOSURES TO SOIL
CLEAR AIR FORCE STATION, ALASKA
(PAGE 1 OF 2)

Chemicals of Potential Concern	Total	
	HQ/HI	CR
Construction Worker to Soil		
DDD	0.001	3.5E-09
DDE	--	1.3E-09
DDT	0.08	1.9E-07
Dieldrin	0.00005	5.9E-10
1,1-Dichloroethene	0.0003	4.6E-08
2-Methylnaphthalene	0.010	--
1,2,4-Trimethylbenzene	0.002	--
1,3,5-Trimethylbenzene	0.002	--
Naphthalene	0.01	1.6E-08
Total	**0.11**	**3.E-07**
Maintenance Worker to Surface Soil (0-2 feet)		
DDD	0.0012	2.1E-07
DDE	--	7.5E-08
DDT	0.11	7.0E-06
Dieldrin	0.0012	3.5E-07
1,2,4-Trimethylbenzene	0.000032	--
1,3,5-Trimethylbenzene	0.000066	--
Naphthalene	0.0000053	1.9E-10
Total	**0.12**	**8.E-06**
Maintenance Worker to Subsurface Soil (2-15 feet)		
DDD	0.0018	6.3E-08
DDE	--	3.3E-08
DDT	0.43	5.2E-06
Dieldrin	0.000127	7.2E-09
1,1-Dichloroethene	0.000623	4.5E-07
2-Methylnaphthalene	0.0007	--
1,2,4-Trimethylbenzene	0.002829	--
1,3,5-Trimethylbenzene	0.43501	--
Naphthalene	0.00809	5.8E-08
Total	**0.88**	**6.E-06**

TABLE 2-8
SUMMARY OF REASONABLE MAXIMUM EXPOSURE CANCER RISKS AND HAZARDS FOR SS012 EXPOSURES TO SOIL CLEAR AIR FORCE STATION, ALASKA (PAGE 2 OF 2)

Chemicals of Potential Concern	Child HQ/HI	Adult HQ/HI	Lifetime CR
Residential to Soil			
DDD	0.019	0.0022	2.2E-06
DDE	--	--	8.2E-07
DDT	3.0	0.34	1.2E-04
Dieldrin	0.0019	0.00024	2.6E-07
1,1-Dichloroethene	0.0016	0.0016	4.7E-06
2-Methylnaphthalene	0.17	0.0480	--
1,2,4-Trimethylbenzene	0.009	0.0085	--
1,3,5-Trimethylbenzene	0.012	0.0052	--
Naphthalene	0.059	0.024	1.5E-06
Total	**3.3**	**0.43**	**1.E-04**

Notes:

CR = cancer risk
HI = hazard index
HQ = hazard quotient
-- toxicity criteria are not available or chemical is not carcinogenic to quantify exposures by this pathway.

TABLE 2-9
SS012 CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN IDENTIFIED FOR SURFICIAL SOIL (0-2 FT BGS)
CLEAR AIR FORCE STATION, ALASKA
(PAGE 1 OF 1)

Detected Compound	Date	Location of Maximum Detected Concentration	Beginning Depth (ft)	Ending Depth (ft)	Minimum Detected Concemtration (mg/kg)	Maximum Detected Concentration (mg/kg)	# Detected Concentrations	# Total Samples Analyzed	Detection Frequency	Soil ERBSC (mg/kg)	HQ	COPEC?	Bioaccumulative Effects? [A]	Background Concentrations of Inorganics [b] (mg/kg)	Does maximum detected concentration exceed background?	ORNL Soil PRGs[c] (mg/kg)	Does maximum detected concentration exceed criterion?	ORNL Benchmarks, Soil and Litter Invertebrates[d] (mg/kg)	Does maximum detected concentration exceed criterion?	USEPA EcoSSLs[e] (mg/kg)	Does maximum detected concentration exceed criterion?	Dutch Target Values[f] (mg/kg)	Does maximum detected concentration exceed criterion?
Chemicals Identified as Chemicals of Potential Ecological Concern Based on Exceedance of Maximum Detected Concentration by ERBSCs																							
Arsenic	8/14/2006	S13-SS16	1.2	1.25	4.61	14.8	6	6	100	0.25	**59**	Yes	Yes	10.9 [g]	Yes	9.9	Yes	60	No	18	No	29	No
Barium	8/14/2006	S13-SS20	0.8	1.1	92.2 M	225 M	6	6	100	5	**45**	Yes	--	457 [h]	No	283	No	3,000	No	330	No	160	Yes
4,4'-DDT	06-Jun-08	S13-SB07	0	1.7	0.00081 F	150	17	17	100	0.7	**214**	Yes	Yes	--	NA	--	NA	--	NA	0.093	Yes	0.01	Yes
Dieldrin	09-Jun-08	S13-SB09	0	1.1	NA	0.038 M	1	15	7	0.011	**3.45**	Yes	Yes	--	NA	--	NA	--	NA	0.022	Yes	0.0005	Yes
Lead	8/14/2006	S13-SS16	1.2	1.25	5.7	17.8	6	6	100	9.36	**1.9**	Yes	Yes	12 [i]	Yes	40.5	No	500	No	11	Yes	85	No
Chemicals Identified as Chemicals of Potential Ecological Concern Based on Lack of ERBSCs																							
Carbon Disulfide	09-Jun-08	S13-SB09	0	1.1	0.0011 F	0.0054 F	3	10	30	NA	-->	Yes	--	--	--	--	--	--	--	--	--	--	--
Hexachlorobutadiene	06-Jun-08	S13-SB07	0	1.7	NA	0.0061 M	1	10	10	NA	-->	Yes	--	--	--	--	--	--	--	--	--	--	--
Isopropylbenzene	06-Jun-08	S13-SB07	0	1.7	NA	0.0061 M	1	10	10	NA	-->	Yes	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene	6/6/2008	S13-SB07	0	1.7	0.002 F	0.0073 M	2	10	20	NA	**-->**	Yes	--	--	--	--	--	--	--	--	--	--	--
1,3,5-Trimethylbenzene	6/6/2008	S13-SB07	0	1.7	NA	0.0061 M	1	10	10	NA	**-->**	Yes	--	--	--	--	--	--	--	--	--	--	--
1-Chlorohexane	06-Jun-08	S13-SB07	0	1.7	NA	0.012 M	1	10	10	NA	**-->**	Yes	--	--	--	--	--	--	--	--	--	--	--
n-Butylbenzene	06-Jun-08	S13-SB07	0	1.7	NA	0.0061 M	1	10	10	NA	-->	Yes	--	--	--	--	--	--	--	--	--	--	--
p-Isopropyltoluene	14-Jun-08	S13-SB06	0	0.3	NA	0.0024 F	1	10	10	NA	-->	Yes	--	--	--	--	--	--	--	--	--	--	--
sec-Butylbenzene	06-Jun-08	S13-SB07	0	1.7	NA	0.0061 M	1	10	10	NA	-->	Yes	--	--	--	--	--	--	--	--	--	--	--
tert-Butylbenzene	06-Jun-08	S13-SB07	0	1.7	NA	0.0061 M	1	10	10	NA	-->	Yes	--	--	--	--	--	--	--	--	--	--	--
Chemicals Identified as Chemicals of Potential Ecological Concern Based on Bioaccumulative Effects																							
Cadmium	8/14/2006	S13-SS39	1.1	1.25	0.052 F	0.14 F	6	6	100	0.2	0.70	Yes	Yes	0.509 [g]	No	4	No	20	No	0.36	No	0.8	No
Endrin	8/14/2006	S13-SS16	1.2	1.25	NA	0.0029F	1	15	7	0.083	0.03	Yes	Yes	--	NA	--	NA	--	NA	--	NA	0.00004	Yes
4,4'-DDD	06-Jun-08	S13-SB07	0	1.7	0.0014 M	11	10	17	59	34	0.324	Yes	Yes	--	NA	--	NA	--	NA	0.093	Yes	0.01	Yes
4,4'-DDE	06-Jun-08	S13-SB07	0	1.7	0.00034 F	1.3 F	14	17	82	1.3	1.0	Yes	Yes	--	NA	--	NA	--	NA	0.093	Yes	0.01	Yes
Mercury	8/14/2006	S13-SS16	1.2	1.25	0.031 F	0.116	6	6	100	0.3	0.39	Yes	Yes	--	NA	0.00051	Yes	0.1	Yes	--	NA	0.3	No
Silver	8/14/2006	S13-SS16	1.2	1.25	0.45 F	1.34	6	6	100	2	0.67	Yes	Yes	--	NA	2	No	50	No	4.2	No	--	NA

Soil data includes samples collected in 1994, 2006, and 2008.
HQ = hazard quotient which is the ratio of the maximum detected concentration over the ERBSC.
COPECs = chemicals of potential ecological concern.
ERBSC = Alaska Department of Environmental Conservation Ecological Risk-Based Screening Concentrations (Ecoscoping Guidance 2008).
[A] = chemicals with bioaccumulative effects are those that have octanol-water partition coefficients greater than 3.5 (ADEC 2008 Ecoscoping Guidance).

b = Obtained from Table 6-1 of *Final Work Plan for Remedial Investigations at Sites 11, 13, and 21: and Investigation to Support Feasibility Study Development at Site 22, Clear Air Force Station* . URS Corporation, August 2006.
c = *Preliminary Remediation Goals for Ecological Endpoints.* R.A. Efroymson, et al. Oak Ridge National Laboratory. August 1997.

d = *Toxicological Benchmarks for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision* . R.A. Efroymson, et al. Oak Ridge National Laboratory. November 1997.
e = *Ecological Soil Screening Levels, Guidance and Documents* . Current as of 2007. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response.
f = *Circular on Target Values and Intervention Values for Soil Remediation, Netherlands Ministry of Housing, Spatial Planning, and Environment. February 4, 2000.*

g = Radian (1995) background data sample represents mean of up to 8 samples. From Table 6-1 of *Final Work Plan for Remedial Investigations at Sites 11, 13, and 21: and Investigation to Support Feasibility Study Development at Site 22, Clear Air Force Station* . URS Corporation, August 2006.

h = From Table 6-1 of *Final Work Plan for Remedial Investigations at Sites 11, 13, and 21: and Investigation to Support Feasibility Study Development at Site 22, Clear Air Force Station* . URS Corporation, August 2006.
i = From U.S. Geological Survey, 1996: *Summary and Results of Water, Soil, and Sediment Sampling at Clear Air Force Station, Alaska, May to September 1994.*
M = matrix interference during analysis. Data still usable.
F = The analyte was positively identified, but the associated numerical value is below the RL. Data is usable for risk assessment.
-- = no background concentration or criterion available.
NA = not applicable.

TABLE 2-10
SS012 CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN IDENTIFIED FOR SOIL (0-6 FT BGS)
CLEAR AIR FORCE STATION, ALASKA
(PAGE 1 OF 1)

Detected Compound	Date	Location of Maximum Detected Concentration	Beginning Depth (ft)	Ending Depth (ft)	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	# Detected Concentrations	# Total Samples Analyzed	Detection Frequency	Soil ERBSC (mg/kg)	HQ	COPEC?	Bioaccumulative Effects? [A]	Background Concentrations of Inorganics[b] (mg/kg)	Does maximum detected concentration exceed background?	ORNL Soil PRGs[c] (mg/kg)	Does maximum detected concentration exceed criterion?	ORNL Benchmarks, Soil and Litter Invertebrates[d] (mg/kg)	Does maximum detected concentration exceed criterion?	USEPA EcoSSLs[e] (mg/kg)	Does maximum detected concentration exceed criterion?	Dutch Target Values[f] (mg/kg)	Does maximum detected concentration exceed criterion?
Chemicals Identified as Chemicals of Potential Ecological Concern Based on Exceedance of Maximum Detected Concentration by ERBSCs																								
Arsenic	8/14/2006	S13-SS16	1.2	1.25	2.49 J	14.8	14.8	11	11	100	0.25	**59**	Yes	Yes	10.9 [g]	Yes	9.9	Yes	60	No	18	No	29	No
Barium	8/14/2006	S13-SS20	0.8	1.1	82.4	225 M	225 M	11	11	100	5	**45**	Yes	--	457 [h]	No	283	No	3,000	No	330	No	160	Yes
4,4'-DDE	8/25/1994	W13C	4.5	6.5	0.00034 F	2.7 J	2.7 J	25	33	76	1.3	**2.1**	Yes	Yes	--	NA	--	NA	--	NA	0.093	Yes	0.01	Yes
4,4'-DDT	8/25/1994	W13C	4.5	6.5	0.00081 F	420 BCD	420 BCD	32	33	97	0.7	**600**	Yes	Yes	--	NA	--	NA	--	NA	0.093	Yes	0.01	Yes
Dieldrin	09-Jun-08	S13-SB09	0	1.1	0.0069 M	0.038 M	0.038 M	2	29	7	0.011	**3.45**	Yes	Yes	--	NA	--	NA	--	NA	0.022	Yes	0.0005	Yes
Lead	8/14/2006	S13-SS16	1.2	1.25	5.4 J	17.8	17.8	11	11	100	9.36	**1.9**	Yes	Yes	12 [i]	Yes	40.5	No	500	No	11	Yes	85	No
Naphthalene	06-Jun-08	S13-SB07	5	6.4	0.00086 F	20 M	20 M	7	22	32	0.1	**200**	Yes	--	--	NA	--	NA	--	NA	--	NA	--	NA
Chemicals Identified as Chemicals of Potential Ecological Concern Based on Lack of ERBSCs																								
n-Butylbenzene	06-Jun-08	S13-SB07	5	6.4	0.0061 M	0.34 M	0.34 M	2	21	10	NA	-->	Yes	--	--	NA	--	NA	--	NA	--	NA	--	NA
sec-Butylbenzene	06-Jun-08	S13-SB07	5	6.4	0.0061 M	0.1 M	0.1 M	2	22	9	NA	-->	Yes	--	--	NA	--	NA	--	NA	--	NA	--	NA
tert-Butylbenzene	06-Jun-08	S13-SB07	5	6.4	0.0061 M	0.017 M	0.017 M	2	21	10	NA	-->	Yes	--	--	NA	--	NA	--	NA	--	NA	--	NA
Carbon Disulfide	05-Jun-08	S13-SB12	5	6	0.0011 F	0.012 F	0.012 F	12	21	57	NA	-->	Yes	--	--	NA	--	NA	--	NA	--	NA	--	NA
1-Chlorohexane	06-Jun-08	S13-SB07	5	6.4	0.012 M	0.023 M	0.023 M	2	21	10	NA	-->	Yes	--	--	NA	--	NA	--	NA	--	NA	--	NA
Di-n-octyl phthalate	8/16/2006	S13-SS24	3.0	5.0	NA	0.11 F	0.11 F	1	1	100	NA	-->	Yes	--	--	NA	--	NA	--	NA	--	NA	--	NA
Hexachlorobutadiene	06-Jun-08	S13-SB07	5	6.4	0.0061 M	0.012 M	0.012 M	2	22	9	NA	-->	Yes	--	--	NA	--	NA	--	NA	--	NA	--	NA
Isopropylbenzene	06-Jun-08	S13-SB07	5	6.4	0.0061 M	0.032 M	0.032 M	2	21	10	NA	-->	Yes	--	--	NA	--	NA	--	NA	--	NA	--	NA
p-Isopropyltoluene	06-Jun-08	S13-SB07	5	6.4	0.0024 F	0.21	0.21	3	21	14	NA	-->	Yes	--	--	NA	--	NA	--	NA	--	NA	--	NA
2-Methylnaphthalene	8/16/2006	S13-SS24	3.0	5.0	NA	40.1	40.1	1	1	100	NA	-->	Yes	--	--	NA	--	NA	--	NA	--	NA	--	NA
1,2,4-Trimethylbenzene	06-Jun-08	S13-SB07	5	6.4	0.002 F	8.4 M	8.4 M	5	22	23	NA	-->	Yes	--	--	NA	--	NA	--	NA	--	NA	--	NA
1,3,5-Trimethylbenzene	06-Jun-08	S13-SB07	5	6.4	0.0061 M	4.7 M	4.7 M	4	22	18	NA	-->	Yes	--	--	NA	--	NA	--	NA	--	NA	--	NA
Chemicals Identified as Chemicals of Potential Ecological Concern Based on Bioaccumulative Effects																								
Cadmium	8/14/2006	S13-SS39	1.1	1.25	0.052 F	0.14 F	0.14 F	9	9	100	0.2	0.70	Yes	Yes	0.509 [g]	No	4	No	20	No	0.36	No	0.8	No
Endrin	8/14/2006	S13-SS16	1.2	1.25	NA	0.0029 F	0.0029F	1	15	7	0.083	0.03	Yes	Yes	--	NA	--	NA	--	NA	--	NA	0.00004	Yes
4,4'-DDD	06-Jun-08	S13-SB07	0	1.7	0.00082 F	11	11	18	33	55	34	0.324	Yes	Yes	--	NA	--	NA	--	NA	0.093	Yes	0.01	Yes
Mercury	8/14/2006	S13-SS16	1.2	1.25	0.031 F	0.116	0.116	8	9	89	0.3	0.39	Yes	Yes	--	NA	0.00051	Yes	0.1	Yes	--	NA	0.3	No
Silver	8/14/2006	S13-SS16	1.2	1.25	0.45 F	1.34	1.34	9	9	100	2	0.67	Yes	Yes	--	NA	2	No	50	No	4.2	No	--	NA

Soil data includes samples collected in 1994, 2006, and 2008.
HQ = hazard quotient which is the ratio of the maximum detected concentration over the ERBSC.
COPECs = chemicals of potential ecological concern.
ERBSC = Alaska Department of Environmental Conservation Ecological Risk-Based Screening Concentrations (Ecoscoping Guidance 2008).
[A] = chemicals with bioaccumulative effects are those that have octanol-water partition coefficients greater than 3.5 (ADEC 2008 Ecoscoping Guidance).
b = Obtained from Table 6-1 of *Final Work Plan for Remedial Investigations at Sites 11, 13, and 21: and Investigation to Support Feasibility Study Development at Site 22, Clear Air Force Station* . URS Corporation, August 2006.
c = *Preliminary Remediation Goals for Ecological Endpoints.* R.A. Efroymson, et al. Oak Ridge National Laboratory. August 1997.
d = *Toxicological Benchmarks for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision* . R.A. Efroymson, et al. Oak Ridge National Laboratory. November 1997.
e = *Ecological Soil Screening Levels, Guidance and Documents* . Current as of 2007. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response.
f = *Circular on Target Values and Intervention Values for Soil Remediation, Netherlands Ministry of Housing, Spatial Planning, and Environment. February 4, 2000.*
g = Radian (1995) background data sample represents mean of up to 8 samples. From Table 6-1 of *Final Work Plan for Remedial Investigations at Sites 11, 13, and 21: and Investigation to Support Feasibility Study Development at Site 22, Clear Air Force Station* . URS Corporation, August 2006.
h = From Table 6-1 of *Final Work Plan for Remedial Investigations at Sites 11, 13, and 21: and Investigation to Support Feasibility Study Development at Site 22, Clear Air Force Station* . URS Corporation, August 2006.
i = From U.S. Geological Survey, 1996: *Summary and Results of Water, Soil, and Sediment Sampling at Clear Air Force Station, Alaska, May to September 1994.*
M = matrix interference during analysis. Data still usable.
F = The analyte was positively identified, but the associated numerical value is below the RL. Data is usable for risk assessment.
-- = no background concentration or criterion available.
NA = not applicable.

TABLE 2-11
ASSESSMENT ENDPOINTS AND MEASURES OF EFFECT
FOR THE ECOLOGICAL RISK ASSESMENT OF SS012
CLEAR AIR FORCE STATION, ALASKA
(PAGE 1 OF 1)

Assessment Endpoint	Measure of Effect	Connection Between Assessment Endpoint and Measure of Effect
Survival, reproduction and health of avian and mammalian wildlife	Comparison of measured chemicals of potential ecological concern (COPECs) concentrations in surface soil to conservative soil risk-based screening concentrations (RBSCs) derived from a number of benchmarks designed to protect biota and/or their food resources.	Benchmarks typically represent no-observed-adverse-effect levels (NOAELs) for COPECs.

Notes:
COPEC = chemicals of potential ecological concern
NOAEL = no-observed-adverse-effect level
RBSC = risk-based screening concentration

TABLE 2-12
COMMON ELEMENTS AND DISTINGUISHING FEATURES AND EXPECTED OUTCOMES OF ALTERNATIVES
CLEAR AIR FORCE STATION, ALASKA

	Alternative 1	Alternative 2	Alternative 3A	Alternative 3B	Alternative 3C	Alternative 4A	Alternative 4B	Alternative 4C
Common Elements and Distinguishing Features of Each Alternative								
Key ARARs associated with alternative	Not applicable	ADEC soil cleanup levels (18 AAC 75.340; 75.341, Tables B1 and B2) & ADEC Ecoscoping Guidance (Appendix D)	ADEC soil cleanup levels (18 AAC 75.340; 75.341, Tables B1 and B2) & ADEC Ecoscoping Guidance (Appendix D)	ADEC soil cleanup levels (18 AAC 75.340; 75.341, Tables B1 and B2) & ADEC Ecoscoping Guidance (Appendix D)	ADEC soil cleanup levels (18 AAC 75.340; 75.341, Tables B1 and B2) & ADEC Ecoscoping Guidance (Appendix D)	ADEC soil cleanup levels (18 AAC 75.340; 75.341, Tables B1 and B2) & ADEC Ecoscoping Guidance (Appendix D)	ADEC soil cleanup levels (18 AAC 75.340; 75.341, Tables B1 and B2) & ADEC Ecoscoping Guidance (Appendix D)	ADEC soil cleanup levels (18 AAC 75.340; 75.341, Tables B1 and B2) & ADEC Ecoscoping Guidance (Appendix D)
Long-term reliability of remedy	Not reliable as no action would be taken.	Would be reliable in the long-term. Because this alternative does not allow for unrestricted use (site soil could not be moved to another location without restrictions to protect water quality in those locations), this alternative would be subject to review every five years.	Would be reliable in the long-term. Because this alternative does not allow for unrestricted use (site soil could not be moved to another location without restrictions to protect water quality in those locations), this alternative would be subject to review every five years.	Would be reliable in the long-term. Because this alternative does not allow for unrestricted use (site soil could not be moved to another location without restrictions to protect water quality in those locations), this alternative would be subject to review every five years.	Would be reliable in the long-term. Because this alternative does not allow for unrestricted use (site soil could not be moved to another location without restrictions to protect water quality in those locations), this alternative would be subject to review every five years.	Would be reliable in the long-term. Upon completion of the remedy, would provide for unrestricted use.	Would be reliable in the long-term. Upon completion of the remedy, would provide for unrestricted use.	Would be reliable in the long-term. Upon completion of the remedy, would provide for unrestricted use.
Quantity of untreated waste and treatment residuals to be disposed off-site or managed on-site in a containment system and the degree of hazard remaining in such material	Not applicable	Contaminants cover an estimated surface area of approximately 375 square feet and would be managed with LUCs.	An estimated 116 cubic yards of pesticide- and VOC-contaminated soil would be excavated, treated, and disposed of off-site. Although they would be reduced, exceedances of human health risks and ADEC soil cleanup levels would remain on-site.	An estimated 160 cubic yards of pesticide- and VOC-contaminated soil would be excavated, treated, and disposed of off-site. Although they would be reduced, exceedances of ADEC soil cleanup levels would remain on-site.	An estimated 70 cubic yards of pesticide- and VOC-contaminated soil would be excavated, treated, and disposed of off-site. Although they would be reduced, hazards to ecological receptors and exceedances of ADEC soil cleanup levels would remain on-site.	An estimated 204 cubic yards of pesticide- and VOC-contaminated soil would be excavated, treated, and disposed of off-site. No untreated waste would remain on-site.	An estimated 204 cubic yards of pesticide- and VOC-contaminated soil would be excavated and treated on-site with a thermal desorption unit. No untreated waste would remain on-site.	An estimated 133 cubic yards of pesticide- and VOC-contaminated soil would be excavated, treated, and disposed of off-site. Although they would be reduced, hazards to ecological receptors would remain on-site.
Estimated time for design and construction	Not applicable	6 months	1 year	1 year	1 year	1 year	1 year	1 year
Estimated time to reach remediation goals	Not applicable	30 years*	30 years*	30 years*	30 years*	1 year	1 year	1 year
Estimated capital cost	$0	$9,000	$200,000	$258,000	$152,000	$302,000	$793,000	$218,000
Estimated annual O&M cost	$0	$312,000	$310,000	$119,000	$119,000	$56,000	$56,000	$56,000
Estimated total present worth	$0	$321,000	$510,000	$377,000	$271,000	$358,000	$849,000	$274,000
Discount rate	Not applicable	2.7%	2.7%	2.7%	2.7%	0.9%	0.9%	0.9%
Number of years over which cost is projected	Not applicable	30 years	30 years	30 years	30 years	2 years	2 years	2 years
Use of presumptive remedies and/or innovative technologies	No Action	LUCs	Source Removal, Off-Site Disposal, LUCs	Source Removal, Off-Site Disposal, LUCs	Source Removal, Off-Site Disposal, LUCs	Source Removal, Off-Site Disposal	Source Removal, On-Site Treatment	Source Removal, Off-Site Disposal
Expected Outcomes of Each Alternative								
Available uses of land upon achieving cleanup levels	Cleanup levels would not be achieved	Non-residential land use/soil transport restrictions	Non-residential land use/soil transport restrictions	Unrestricted land use/soil transport restrictions	Unrestricted land use/soil transport restrictions	Unrestricted Use	Unrestricted Use	Unrestricted Use
Time frame to achieve available land use	Not applicable	6 months	1 year	1 year	1 year	1 year	1 year	1 year
Available uses of groundwater upon achieving cleanup levels	Groundwater impacts do not exceed cleanup levels.	Groundwater impacts do not exceed cleanup levels.	Groundwater impacts do not exceed cleanup levels.	Groundwater impacts do not exceed cleanup levels.	Groundwater impacts do not exceed cleanup levels.	Groundwater impacts do not exceed cleanup levels.	Groundwater impacts do not exceed cleanup levels.	Groundwater impacts do not exceed cleanup levels.
Time frame to achieve available groundwater use	Groundwater use is currently unrestricted	Groundwater use is currently unrestricted	Groundwater use is currently unrestricted	Groundwater use is currently unrestricted	Groundwater use is currently unrestricted	Groundwater use is currently unrestricted	Groundwater use is currently unrestricted	Groundwater use is currently unrestricted
Other impacts or benefits associated with alternative	None	None	None	None	None	None	None	None

NOTE:
*** An assumed 30 year O&M period was used for evaluating alternatives.**

TABLE 2-13
MATRIX OF COST AND EFECTIVENESS DATA FOR SS012
CLEAR AIR FORCE STATION, ALASKA
PAGE 1 OF 1

Alternative	Capital Cost	O&M Cost	Present-Value Cost
1 – No Action	$0	$0	$0
2 – LUCs	$9,000	$312,000	$321,000
3A - Ecological Hazard Based Cleanup/Off-Site Disposal/LUCs	$200,000	$310,000	$510,000
3B - Ecological Hazard and Human Health Risk Based Cleanup/Off-Site Disposal/LUCs	$258,000	$119,000	$377,000
3C - Human Health Risk Based Cleanup/Off-Site Disposal/LUCs	$152,000	$119,000	$271,000
4A - Full Cleanup/Off-Site Disposal	$302,000	$56,000	$358,000
4B - Full Cleanup/On-Site Treatment	$793,000	$56,000	$849,000
4C - Human Health Risk and Migration to Groundwater Based Cleanup/Off-Site Disposal	$218,000	$56,000	$274,000

TABLE 2-14
CLEANUP LEVELS FOR CHEMICALS OF CONCERN AT SS012
CLEAR AIR FORCE STATION, ALASKA
PAGE 1 OF 1

Media: Soil
Site Area: Site 13
Available Use: Open Space
Controls to Ensure Restricted Use (if applicable): Not applicable

Chemical of Concern	Cleanup Level in mg/kg (ppm)	Basis for Cleanup Level	Risk at Cleanup Level
DDT	7.3 [a] ,21 [b]	Compliance with ADEC Migration to Groundwater and Direct Contact soil cleanup levels	Would allow for unrestricted use.
DDD	7.2	Compliance with ADEC Migration to Groundwater soil cleanup level	Would allow for unrestricted use.
1,1-DCE	0.03	Compliance with ADEC Migration to Groundwater soil cleanup level	Would allow for unrestricted use.
methylene chloride	0.016	Compliance with ADEC Migration to Groundwater soil cleanup level	Would allow for unrestricted use.
2-methylnaphthalene	6.1	Compliance with ADEC Migration to Groundwater soil cleanup level	Would allow for unrestricted use.
naphthalene	20.0	Compliance with ADEC Migration to Groundwater soil cleanup level	Would allow for unrestricted use.

Notes

[a] Migration to Groundwater ADEC soil cleanup levels (18 AAC 75.341, Method 2 Tables B1 and B2 "Under 40 Inch Zone", ADEC, October 9, 2008).

[b] Direct Contact ADEC soil cleanup levels (18 AAC 75.341, Method 2 Tables B1 and B2 "Under 40 Inch Zone", ADEC, October 9, 2008).

mg/kg = milligrams per kilogram
ppm = parts per million

TABLE 2-15
CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)
CLEAR AIR FORCE STATION, ALASKA

Requirement, Criteria, or Limitation	Citations	Description	Potentially Applicable/ Relevant and Appropriate Requirements	Comments
STATE OF ALASKA				
ALASKA OIL AND HAZARDOUS SUBSTANCES POLLUTION CONTROL REGULATIONS	18 AAC 75.340; 75.341, Tables B1 and B2; 18 AAC 75.345, Table C	ADEC regulatory cleanup levels for soil and groundwater.	Yes/Yes	ADEC regulatory cleanup levels. Primary criteria for determining human health risk, and establishing human health risk -based and cleanup level based cleanup parameters.

Notes:

AAC - Alaska Administrative Code
ADEC - Alaska Department of Environmental Conservation
ARARs – applicable or relevant and appropriate requirements

TABLE 2-16
ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)
CLEAR AIR FORCE STATION, ALASKA
PAGE 1 OF 2

Requirement, Criteria, or Limitation	Citations	Description	Potentially Applicable/ Relevant and Appropriate Requirements	Comments
FEDERAL				
RESOURCE CONSERVATION AND RECOVERY ACT - 42 USC Sec. 6901 et seq..				
RCRA Subtitle C: Hazardous Waste Management (Identification, Generation, Transportation, Treatment, Storage, and Land Disposal)	40 CFR 261, 262, 263, 264, and 268	RCRA Subtitle C addresses the identification, treatment, storage, and land disposal of hazardous wastes. To the extent hazardous waste, as defined by RCRA, is removed from soil and/or extracted from the groundwater and to the extent air emissions result from treatment operations, the selected remedies will comply with the requirements of 40 CFR 261, 262, 263, and 264.	Yes/Yes	Potentially applicable or relevant and appropriate for remedial actions resulting in the generation of RCRA-listed hazardous waste. Hazardous waste generated in conjunction with the selected remedies (soil, decontamination water, etc.) will be stored and disposed of or recycled at a RCRA approved facility in accordance with the USEPA rule for off-site disposal of CERCLA waste (40 CFR 300.440).
SOLID WASTE DISPOSAL ACT - 42 USC Sec. 6901-6987				
CERCLA Waste Off-Site Rule	40 CFR 300.440	The purpose of the Off-Site Rule is to prevent wastes generated from remedial activities conducted under CERCLA from contributing to present or future environmental problems at off-site waste management facilities that receive them.	Yes/No	The Off-Site Rule requires that off-site facilities receiving CERCLA wastes meet established acceptability criteria.
STATE OF ALASKA				
Alaska Oil and Hazardous Substances Pollution Control Regulations	18 AAC 75	ADEC regulatory cleanup levels for soil and groundwater.	Yes/Yes	ADEC regulatory cleanup levels. Primary criteria for determining human health risk, and establishing human health risk-based and cleanup level based cleanup parameters.
Alaska Solid Waste Management Regulations	18 AAC 60	Describes the regulatory management of solid waste in Alaska.	Yes/Yes	Requires disposal of hazardous waste at an approved facility.
Monitoring Well Design and Construction for Investigation of Contaminated Sites	ADEC, February 2008	Specifies construction standards for monitoring well installation, development and maintenance, and decommissioning.	Yes/Yes (TBC)	Potential TBC during remedial actions involving the construction or decommissioning of monitoring wells.

TABLE 2-16
ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)
CLEAR AIR FORCE STATION, ALASKA
PAGE 2 OF 2

Notes:

ADEC - Alaska Department of Environmental Conservation
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
CFR - Code of Federal Regulations
et seq. - and the following
RCRA - Resource Conservation and Recovery Act
Sec. - Section
TBC - to be considered
USC - United States Code
USEPA - United States Environmental Protection Agency

TABLE 2-17
LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)
CLEAR AIR FORCE STATION, ALASKA
PAGE 1 OF 1

Standard, Requirement, Criteria, or Limitation	Citation	Description	Potentially Applicable/ Relevant and Appropriate Requirements	Comments
FEDERAL				
ARCHAEOLOGICAL AND HISTORIC PRESERVATION ACT - 16 USC 469 et seq.				
Preservation of Historic and Archaeological Data	40 CFR 6.301(c)	Establishes procedures to provide for preservation of historic and archaeological data that might be destroyed through alteration of terrain as the result of a federal construction project or a federally licensed activity or program.	Yes/NA	Presence or absence of historic or archaeological data on the site must be verified. If historic or archaeological artifacts are present in remediation areas, the remedial actions must be designed to minimize adverse effects on the artifacts. If artifacts are encountered, work will stop immediately and the State Historic Preservation Office (SHPO) and local native tribes will be consulted.
ARCHAEOLOGICAL RESOURCES PROTECTION ACT - 16 USC 470aa et seq.				
Protection of Archaeological Resources	43 CFR 7 et seq.	ARPA and implementing regulations prohibit the unauthorized disturbance of archaeological resources on public and Native American lands.	Yes/Yes	ARPA and implementing regulations are potentially applicable for the conduct of any selected remedial actions that may result in ground disturbance. Presence or absence of archaeological resources at SS012 is not known. If artifacts are encountered, work will stop immediately, and local native tribes will be consulted.
NATIVE AMERICAN GRAVES PROTECTION AND REPATRIATION ACT - 25 USC 3001 et seq.				
Protects Native American burial sites and funerary objects.	43 CFR 10 et seq.	If Native American graves are discovered within remediation areas, project activities must cease and consultation must take place between the Department of Interior and the affected tribe.	Yes/No	Potentially applicable. This program is applicable to ground-disturbing activities such as soil grading and removal. Presence of Native American burial sites has not been identified. If burial sites or artifacts are encountered, work will stop immediately, and local native tribes will be consulted.

Notes:
ARARs - applicable or relevant and appropriate requirements
ARPA - Archaeological Resources Protection Act
CFR - Code of Federal Regulations
et seq. - and the following
NA - not applicable

TABLE 2-18
COST AND EFFECTIVENESS SUMMARY FOR SS012
CLEAR AIR FORCE STATION, ALASKA
PAGE 1 OF 2

Alternative	Present -Value Cost	Long-Term Effectiveness and Permanence	Reduction of TMV Through Treatment	Short-Term Effectiveness
1 – No Action	$0	* No reduction in long-term risk to human health and the environment.	* No reduction of toxicity, mobility, or volume..	* No short-term impacts to the community, workers, or the environment. * Remedial goals would only be achieved through natural attenuation.
2 – LUCs	$321,000	+ Increased protection to human health due to LUC implementation. = No reduction in long-term risk to the environment.	= No reduction of toxicity or volume. + Reduction in mobility off the site through LUCs.	+ Less than 1 year to implement. = No short-term impacts to the community, workers, or the environment. = Remedial goals would only be achieved through natural attenuation.
3A - Ecological Hazard Based Cleanup/Off-Site Disposal/LUCs	$510,000	= Increased protection to human health due to LUC implementation. + Highest reduction in long-term risk to the environment through source removal.	= No reduction in toxicity. = Reduction in mobility off the site through LUCs. + Reduction in volume through source removal.	= Less than 1 year to implement. - Will have impacts to the community, workers, or the environment during source removal. + Remedial goals would only be fully achieved through natural attenuation.
3B - Ecological Hazard and Human Health Risk Based Cleanup/Off-Site Disposal/LUCs	$377,000	+ Increased protection to human health due to source removal and LUC implementation. = Highest reduction in long-term risk to the environment through source removal.	= No reduction in toxicity. = Reduction in mobility off the site through LUCs. + Reduction in volume through source removal.	= Less than 1 year to implement. - Will have impacts to the community, workers, or the environment during source removal. = Remedial goals would only be fully achieved through natural attenuation.
3C - Human Health Risk Based Cleanup/Off-Site Disposal/LUCs	$271,000	+ Increased protection to human health due to source removal and LUC implementation. - No reduction in long-term risk to the environment.	= No reduction in toxicity. = Reduction in mobility off the site through LUCs. - Reduction in volume through source removal.	= Less than 1 year to implement. - Will have impacts to the community, workers, or the environment during source removal. = Remedial goals would only be fully achieved through natural attenuation.

TABLE 2-18
COST AND EFFECTIVENESS SUMMARY FOR SS012
CLEAR AIR FORCE STATION, ALASKA
PAGE 2 OF 2

Alternative	Present -Value Cost	Long-Term Effectiveness and Permanence	Reduction of TMV Through Treatment	Short-Term Effectiveness
4A - Full Cleanup/Off-Site Disposal	$358,000	+ Highest protection to human health due to source removal. + Highest reduction in long-term risk to the environment through source removal.	= No reduction in toxicity. + Reduction in mobility and volume through source removal.	= Less than 1 year to implement. - Will have impacts to the community, workers, or the environment during source removal. + Remedial goals achieved in less than 1 year.
4B - Full Cleanup/On-Site Treatment	$849,000	= Highest protection to human health due to source removal and treatment. = Highest reduction in long-term risk to the environment through source removal. - Potential for remedy failure due to application of innovative technology.	+ Highest reduction of toxicity, mobility, and volume through source removal and treatment.	= Less than 1 year to implement. - Will have impacts to the community, workers, or the environment during source removal and treatment. =Remedial goals achieved in less than 1 year.
4C - Human Health Risk and Migration to Groundwater Based Cleanup/Off-Site Disposal	$274,000	= Highest protection to human health due to source removal. - Reduction in long-term risk to the environment through source removal.	- No reduction in toxicity. - Reduction in mobility and volume through source removal..	= Less than 1 year to implement. - Will have impacts to the community, workers, or the environment during source removal. =Remedial goals achieved in less than 1 year.

Cost Effectiveness Summary

- Alternatives 1, 3A, and 4B are not considered to be cost effective.
- While Alternatives 2, 3B, 3C, 4A, and 4C are considered to be cost effective, Alternative 4C provides a potentially greater return on investment.

Key
* - Baseline characteristic
- - Less “effective” compared to previous alternative
+ - More “effective” compared to previous alternative
= - No change compared to previous alternative

FIGURES

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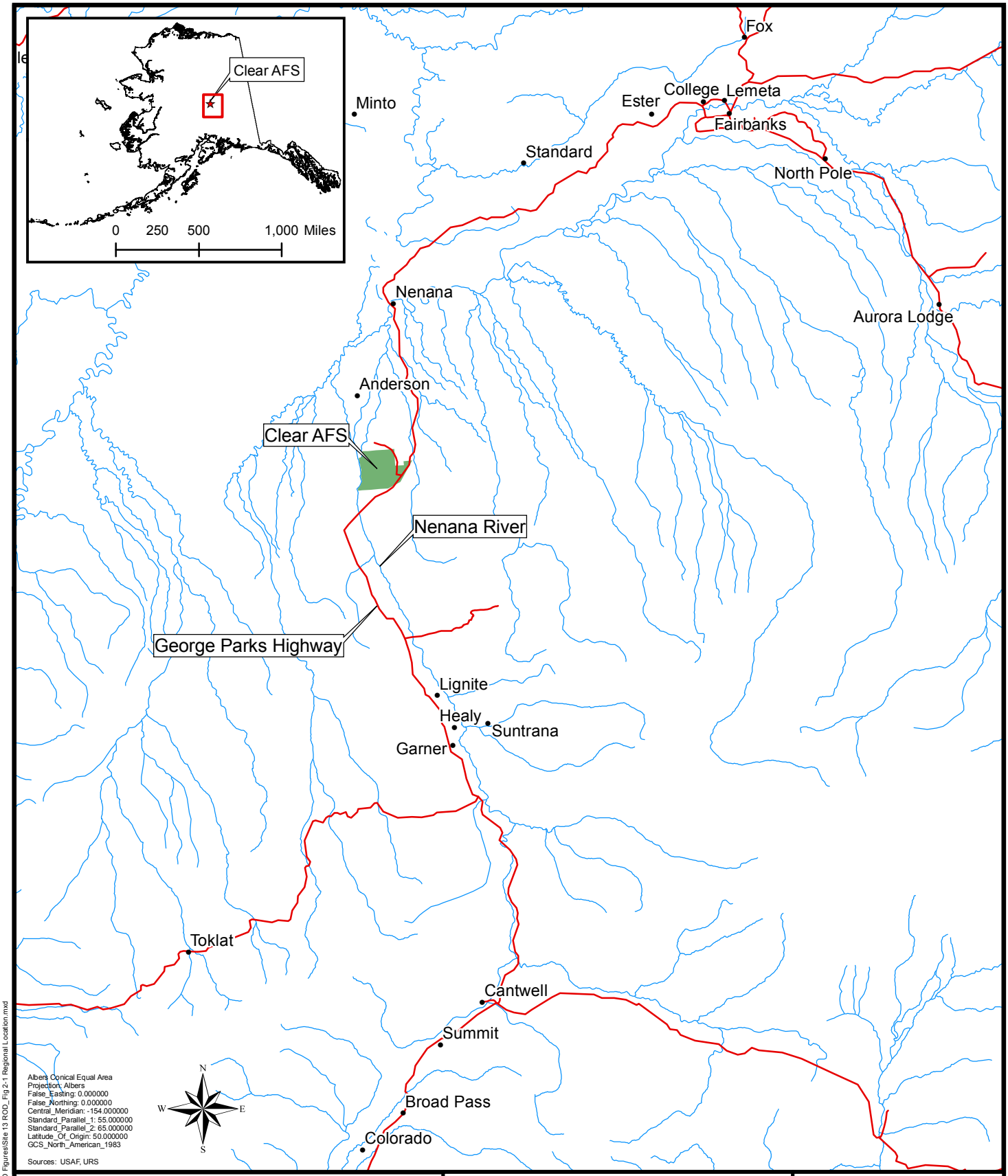


Legend

- Towns/Villages
- Major Roads
- Rivers
- Clear AFS

Approximate Scale

0 10 20 40 Miles

REGIONAL LOCATION

CLEAR AFS, ALASKA

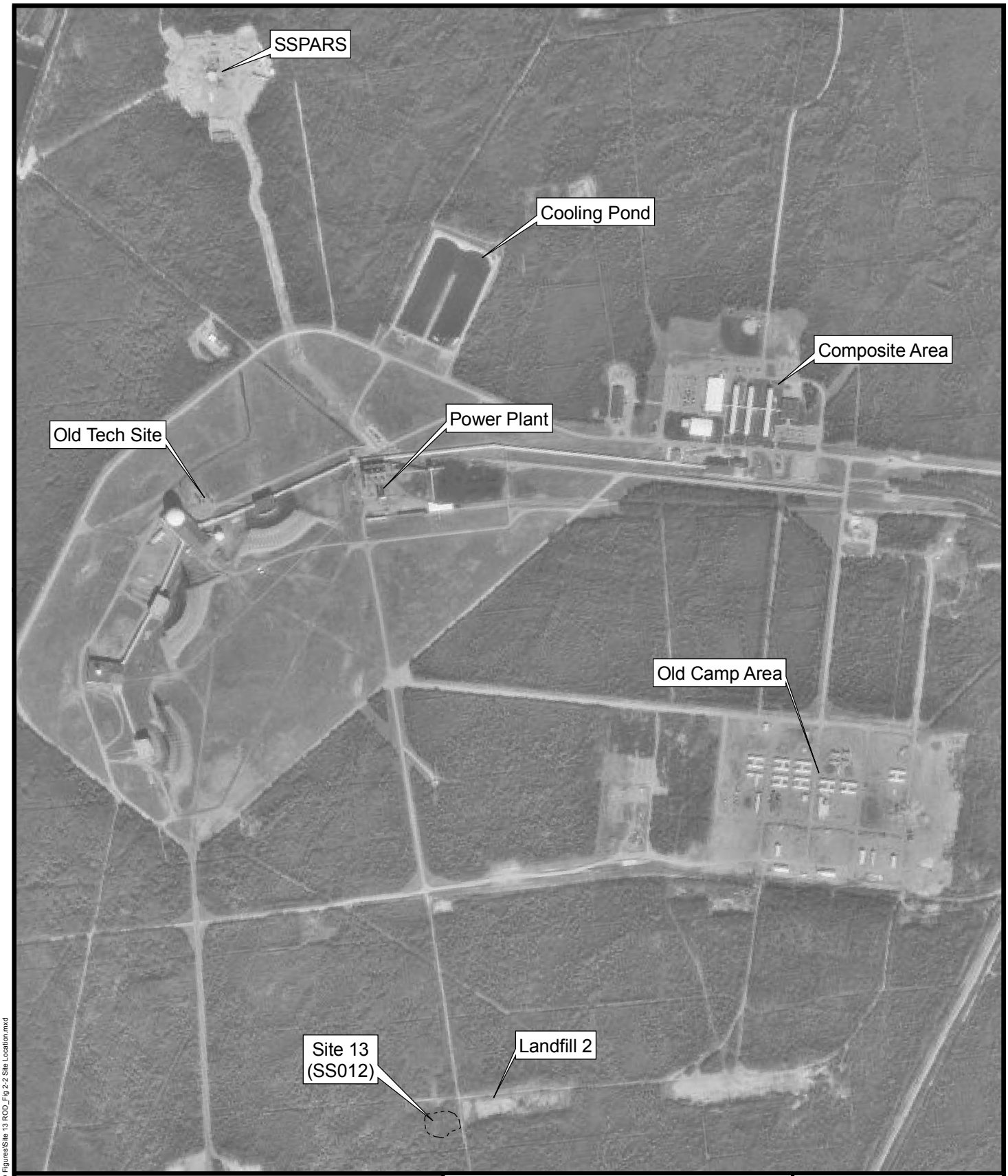
JOB NO:	26219882	DRAWN:	CGK
DATE:	6/10/2010	FILE:	SEE PATH

URS

FIGURE 2-1

CLE000381.pdf

M:\Projects\Federal\Clear AFS\mxd\TO0009\Site 13 ROD Figures\Site 13 ROD_Fig 2-1 Regional Location.mxd



Albers Conical Equal Area
Projection: Albers
False_Easting: 0.000000
False_Northing: 0.000000
Central_Meridian: -154.000000
Standard_Parallel_1: 55.000000
Standard_Parallel_2: 65.000000
Latitude_Of_Origin: 50.000000
GCS_North_American_1983

Sources: USAF, URS

Notes:
SSPARS = Solid State
Phased Array Radar System

N
W E
S

Approximate Scale

0 1,000 2,000 Feet

SITE LOCATION

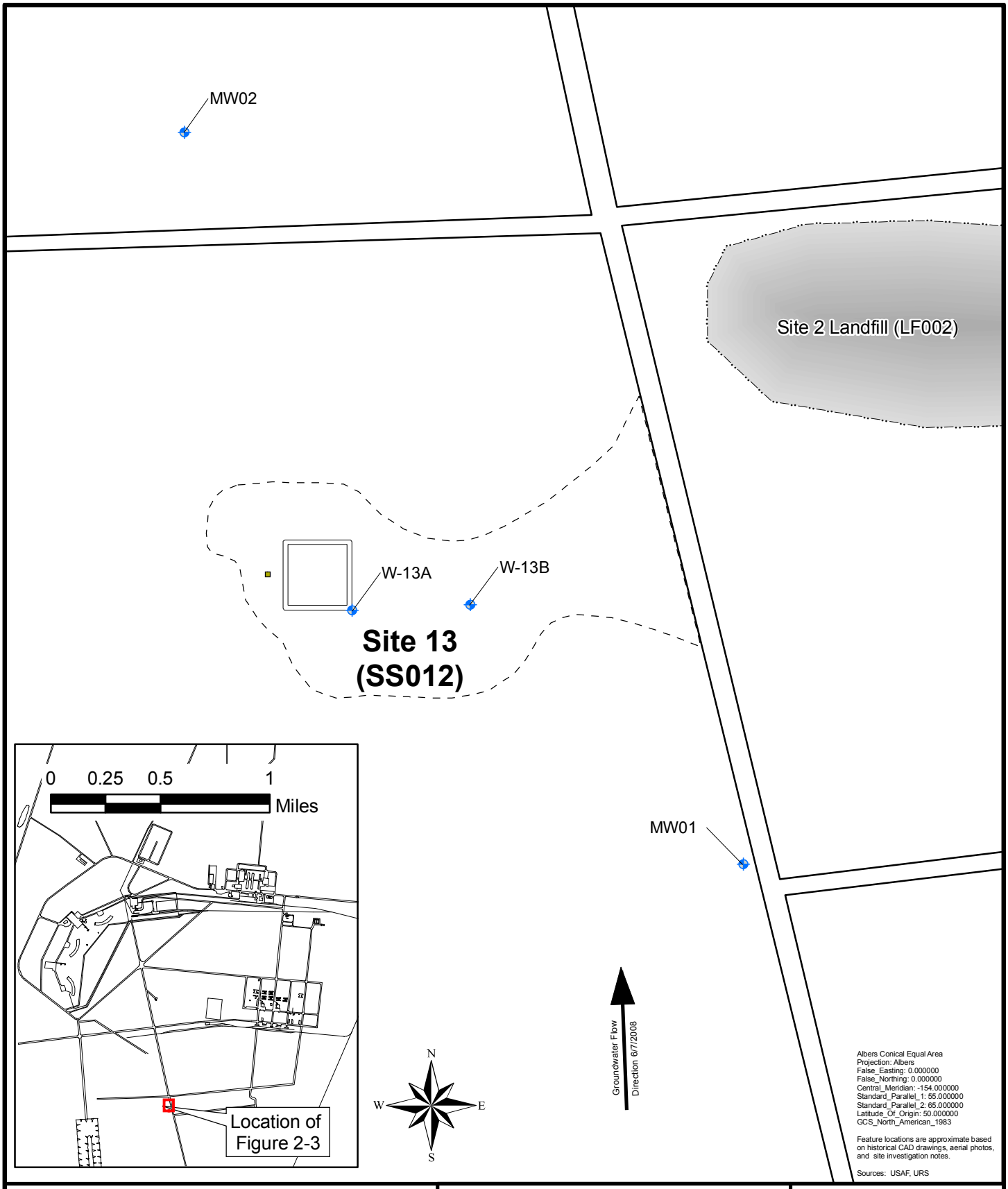
CLEAR AFS, ALASKA

URS
560 East 34th Avenue, Suite 100
Anchorage, Alaska 99503
(907) 562-3366

JOB NO:	26219882	DRAWN:	CGK
DATE:	6/10/2010	FILE:	SEE PATH

FIGURE 2-2

M:\Projects\Federal\Clear AFS\mxd\TO0009\Site 13 ROD Figures\Site 13 ROD_Fig 2-2 Site Location.mxd



Legend

- Monitoring Well
- Boundary of Forested Area
- Previously Excavated Area (with PVC liner)
- Reference Post

Approximate Scale

0 30 60 Feet

SITE 13 (SS012) FEATURES

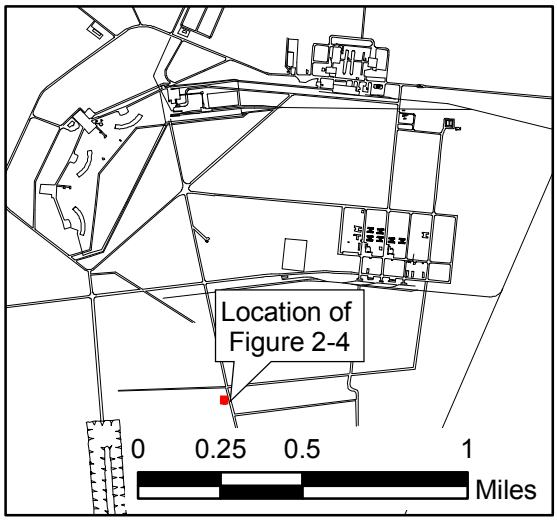
CLEAR AFS, ALASKA

URS
560 East 34th Avenue, Suite 100
Anchorage, Alaska 99503
(907) 562-3366

JOB NO:	26219882	DRAWN:	CGK
DATE:	6/10/2010	FILE:	SEE PATH

FIGURE 2-3

M:\Projects\Federal\Clear AFS\mxd\TO0009\Site 13 ROD Figures\Site 13 ROD_Fig 2-3 Features.mxd



S13-SB12
S13-SB13
S13-SB14
S13-SS35
S13-SB11R
S13-SS20
S13-SB10
S13-SB09
S13-SB01
S13-SB01R
S13-SB03
S13-SB02
W-13C
S13-SB08
S13-SB07
W-13D
S13-SS16
S13-SB06
S13-SB04
S13-SS27
S13-SS39
S13-SS37
S13-SB05

Albers Conical Equal Area
Projection: Albers
False_Easting: 0.000000
False_Northing: 0.000000
Central_Meridian: -154.000000
Standard_Parallel_1: 55.000000
Standard_Parallel_2: 65.000000
Latitude_Of_Origin: 50.000000
GCS_North_American_1983

Feature locations are approximate based on historical CAD drawings, aerial photos, and site investigation notes.

Sources: USAF, URS

Legend

- Soil Boring
- Discrete Soil Sample
- Boundary of Forested Area
- Previously Excavated Area
- Reference Post

Approximate Scale
0 10 20 Feet

SITE 13 (SS012)
REMEDIAL INVESTIGATION
SOIL SAMPLING LOCATIONS

CLEAR AFS, ALASKA

URS
560 East 34th Avenue, Suite 100
Anchorage, Alaska 99503
(907) 562-3366

JOB NO:	26219882	DRAWN:	CGK
DATE:	6/16/2010	FILE:	SEE PATH

FIGURE 2-4

CLE000381.pdf

M:\Projects\Federal\Clear AFS\mxd\TO0009\Site 13 ROD Figures\Site 13 ROD_Fig 2-4 RI Soil Sampling Locations.mxd

GW-5E
not measured
not measured

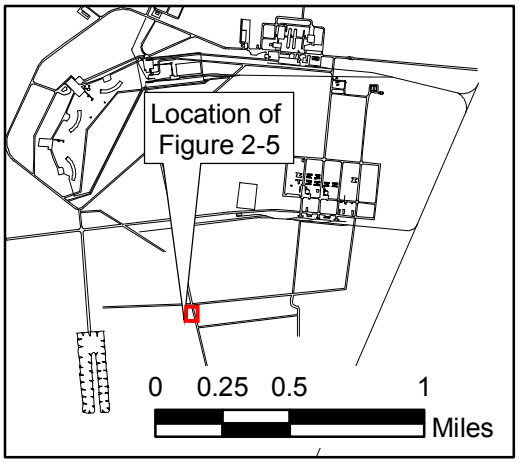
MW02
521.16
516.07

Groundwater Flow Direction 6/7/2008

Groundwater Flow Direction 9/17/2006

W-13A
521.14
516.04

W-13B
521.14
516.04



MW01
521.28
516.21

N
W E
S

Albers Conical Equal Area
Projection: Albers
False_Easting: 0.000000
False_Northing: 0.000000
Central_Meridian: -154.000000
Standard_Parallel_1: 55.000000
Standard_Parallel_2: 65.000000
Latitude_Of_Origin: 50.000000
GCS_North_American_1983

Feature locations are approximate based on historical CAD drawings, aerial photos, and site investigation notes.

Sources: USAF, URS

Legend

- Monitoring Well
- 521.28 2006 Groundwater Elevation in Feet Above Mean Sea Level
- 516.21 2008 Groundwater Elevation in Feet Above Mean Sea Level
- Boundary of Forested Area
- Previously Excavated Area
- Reference Post

Approximate Scale

0 30 60 Feet

SITE 13 (SS012) REMEDIAL INVESTIGATION MONITORING WELLS AND GROUNDWATER FLOW CHARACTERISTICS

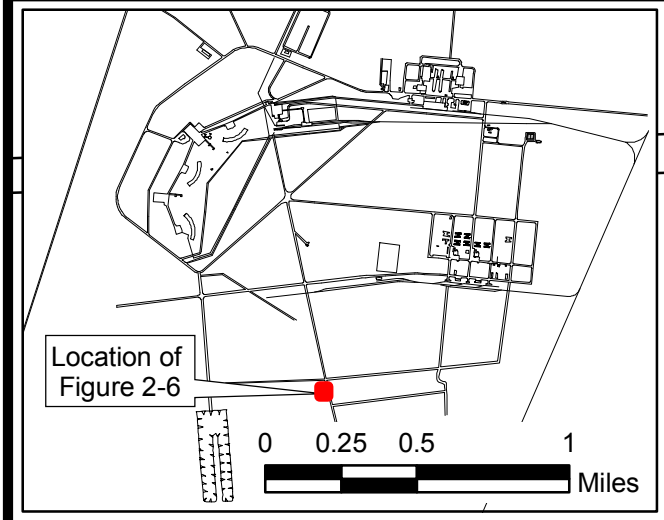
CLEAR AFS, ALASKA

URS
560 East 34th Avenue, Suite 100
Anchorage, Alaska 99503
(907) 562-3366

JOB NO:	26219882	DRAWN:	CGK
DATE:	6/16/2010	FILE:	SEE PATH

FIGURE 2-5

M:\Projects\Federal\Clear AFS\mxd\TO0009\Site 13 ROD Figures\Site 13 ROD_Fig 2-5 Monitoring Well Locations and Groundwater Flow Characteristics.mxd



SB01
1,1-DCE= 0.34F, DDT = 145.9,
methylene chloride = 1.269,
2-methylnaphthalene = 40.1 [3.0-5.0 ft bgs]

SS20
DDT = 12.51J [0.8-1.08 ft bgs]

SB07
DDD = 11, DDT = 150 [0-1.7 ft bgs]
DDD = 8.4, DDT = 76, naphthalene = 20M [5.0-6.4 ft bgs]

SB10
DDT = 16 [0-0.75 ft bgs]

W-13C
DDT = 420BCD [4.5-6.5 ft bgs]

SB08
DDT = 9.2 [0-0.5 ft bgs]

W-13D
DDT = 310BCD [4.5-7.5 ft bgs]
DDT = 56BCD [8.0-10.0 ft bgs]

ADEC soil cleanup levels (in mg/kg)
1,1-DCE = 0.03
DDD = 7.2
DDT = 7.3
methylenen chloride = 0.016
2-methylnaphthalene = 6.1
naphthalene = 20.0

Notes:
Figure depicts locations of constituents in excess of cleanup levels and background levels. Figure does not include exceedances of naturally occuring constituents.

Concentrations exceeding ADEC Method 2 soil cleanup levels are shown in **red**.
All results are in milligrams per kilogram (mg/kg).
Depth intervals are in brackets, i.e. [1.1-1.34 ft bgs].
ft bgs = feet below ground surface
B = Method blank contamination.
C = Pesticide confirmed.
D = Dilution sample.
F = The analyte was positively identified, but the associated numerical value was below the reporting limit.
J = The analyte was positively idenitified, but the result is estimated.
M = A matrix effect was present.

N
W
E
S

Albers Conical Equal Area
Projection: Albers
False_Easting: 0.000000
False_Northing: 0.000000
Central_Meridian: -154.000000
Standard_Parallel_1: 55.000000
Standard_Parallel_2: 65.000000
Latitude_Of_Origin: 50.000000
GCS_North_American_1983

Feature locations are approximate based on historical CAD drawings, aerial photos, and site investigation notes.

Sources: USAF, URS

Legend
- Surface Soil Sample
- Soil Boring
- Boundary of Forested Area
- Previously Excavated Area
- Reference Post

Approximate Scale
0 20 40 Feet

SITE 13 (SS012)
1994, 2006, AND 2008
SOIL ANALYTICAL RESULTS EXCEEDING ADEC CLEANUP LEVELS
CLEAR AFS, ALASKA

URS
560 East 34th Avenue, Suite 100
Anchorage, Alaska 99503
(907) 562-3366

JOB NO:	262197882	DRAWN:	SDR
DATE:	6/16/2010	FILE:	SEE PATH

FIGURE 2-6

M:\Projects\Federal\Clear AFS\mxd\T00009\Site 13 ROD Figures\Site 13 ROD_Fig 2-6 Analytical Results Exceeding Cleanup Levels for Inorganics.mxd

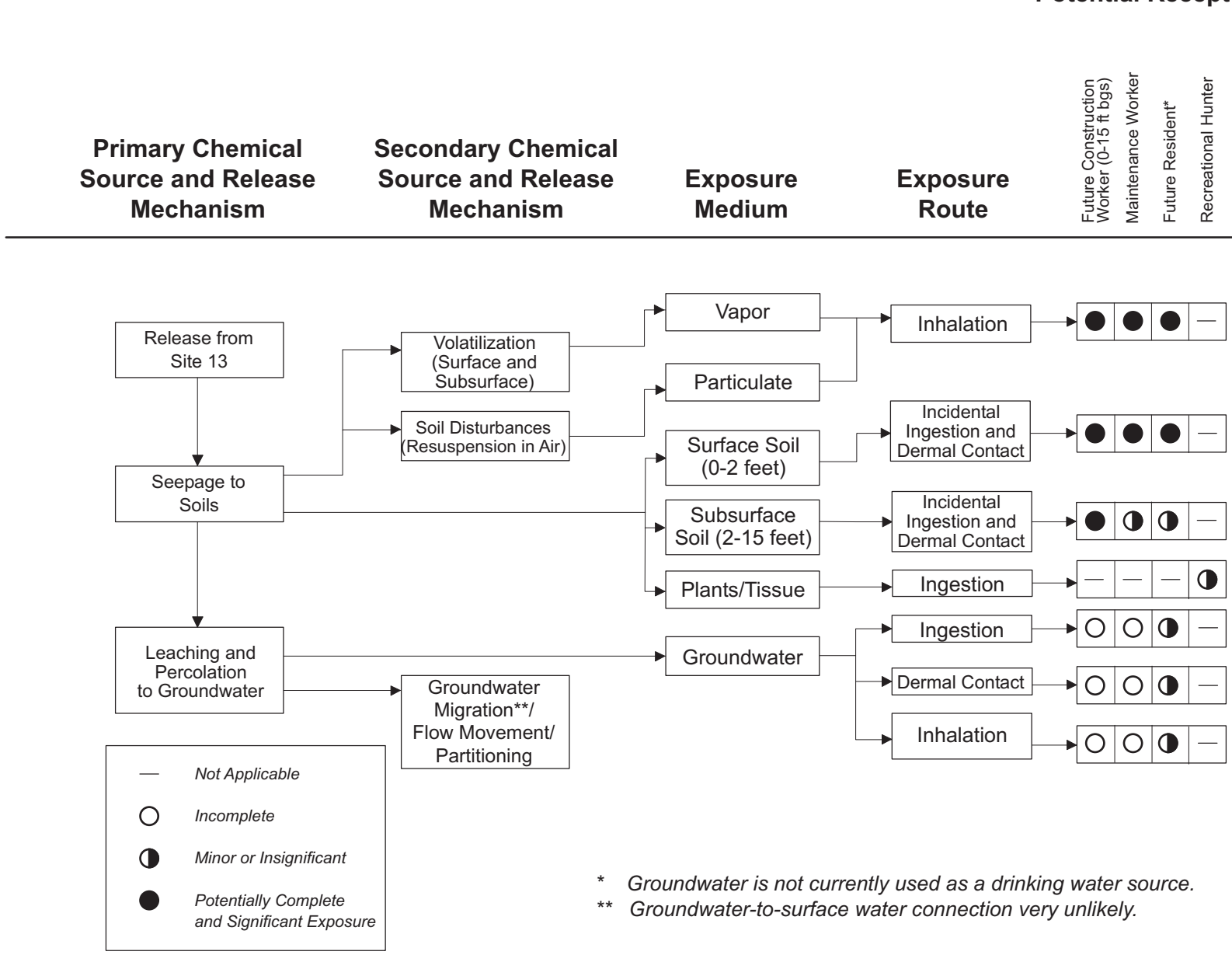
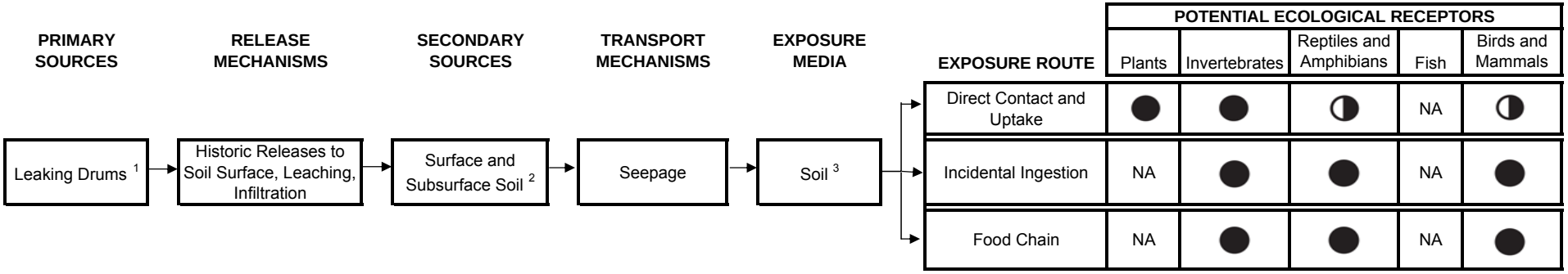


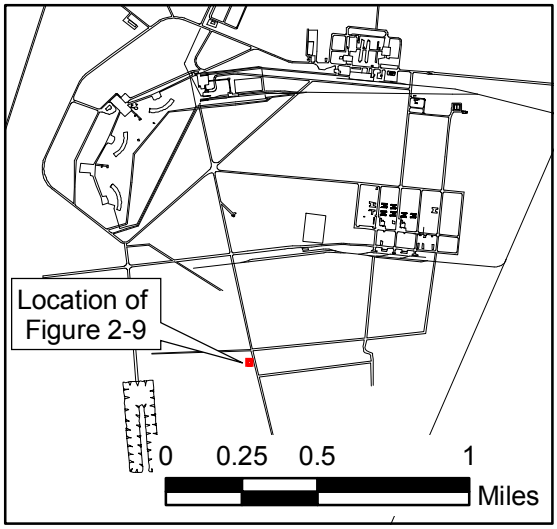
FIGURE 2-7. HUMAN HEALTH CONCEPTUAL SITE MODEL FLOWCHART, SITE 13 (SS012)



KEY:
1 = Drums were removed in the early 1980s, and followup excavation and investigation work ensued.
2 = Surface soil at 0 to 2 feet bgs is assumed to be accessible to plants, invertebrates, and non-burrowing wildlife; soil from 0 to 6 feet bgs is assumed to be accessible to burrowing wildlife.
3 = Soil is the only relevant medium to consider at this site. Refer to Notes, below.
● = Potentially complete exposure pathway.
◑ = Minor exposure pathway.
NA = Not applicable (see Notes, below).

Notes: The site does not contain surface water or sediment. Groundwater is present at approximately 80 feet below ground surface and does not appear to be nor is expected to be impacted by chemicals in soil. Groundwater is assumed to be too deep to discharge to surface water bodies in site vicinity. The primary chemicals of potential ecological concern, DDT and DDE, are not volatile, and thus will not result in ecological receptors being exposed to volatiles in air.

FIGURE 2-8. ECOLOGICAL CONCEPTUAL SITE MODEL FLOWCHART, SITE 13 (SS012)



S13-SB12
S13-SB13
S13-SB14
S13-SS35
S13-SB11R
S13-SS20
S13-SB10
S13-SB09
S13-SB01
S13-SB01R
S13-SB03
S13-SB02
W-13C
S13-SB08
S13-SB07
W-13D
S13-SS16
S13-SB06
S13-SB04
S13-SS27
S13-SS39
S13-SS37
S13-SB05

Legend

- Soil Boring
- Discrete Soil Sample
- Boundary of Forested Area
- Previously Excavated Area
- Reference Post
- Extent of Soil Removal to Reduce the Human Health Risk to < $1X10^{-5}$
- Extent of Impacts in Excess of Migration to Groundwater Cleanup Levels
- Extent of Impacts in Excess of Ecological Risk Based Screening Concentrations

Albers Conical Equal Area
Projection: Albers
False_Easting: 0.000000
False_Northing: 0.000000
Central_Meridian: -154.000000
Standard_Parallel_1: 55.000000
Standard_Parallel_2: 65.000000
Latitude_Of_Origin: 50.000000
GCS_North_American_1983

Feature locations are approximate based on historical CAD drawings, aerial photos, and site investigation notes.

Sources: USAF, URS

Approximate Scale

0 10 20 Feet

SITE 13 (SS012)
EXTENT OF DDT IMPACTS

CLEAR AFS, ALASKA

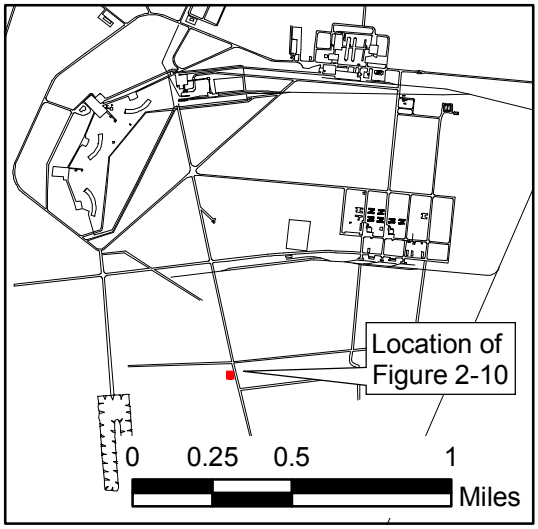
URS
560 East 34th Avenue, Suite 100
Anchorage, Alaska 99503
(907) 562-3366

JOB NO:	26219882	DRAWN:	CGK
DATE:	6/16/2010	FILE:	SEE PATH

FIGURE 2-9

CLE000381.pdf

M:\Projects\Federal\Clear AFS\mxd\TO0009\Site 13 ROD Figures\Site 13 ROD_Fig 2-9 Extent of DDT Impacts.mxd



S13-SB12
S13-SB13
S13-SB14
S13-SS35
S13-SB11R
S13-SS20
S13-SB10
S13-SB09
S13-SB01
S13-SB01R
S13-SB03
S13-SB02
W-13C
S13-SB08
S13-SB07
W-13D
S13-SS16
S13-SB06
S13-SB04
S13-SS27
S13-SS39
S13-SS37
S13-SB05

Legend

- Soil Boring
- Discrete Soil Sample
- Boundary of Forested Area
- Previously Excavated Area
- Reference Post
- Alternative 4C Proposed Excavation Extent (265 square feet)
- Extent of Impacts in Excess of Migration to Groundwater Cleanup Levels
- Extent of Impacts in Excess of Ecological Risk Based Screening Concentrations

Albers Conical Equal Area
Projection: Albers
False_Easting: 0.000000
False_Northing: 0.000000
Central_Meridian: -154.000000
Standard_Parallel_1: 55.000000
Standard_Parallel_2: 65.000000
Latitude_Of_Origin: 50.000000
GCS_North_American_1983

Feature locations are approximate based on historical CAD drawings, aerial photos, and site investigation notes.

Sources: USAF, URS

Approximate Scale

0 10 20 Feet

SITE 13 (SS012)
ALTERNATIVE 4C
EXTENT OF EXCAVATION

CLEAR AFS, ALASKA

URS
560 East 34th Avenue, Suite 100
Anchorage, Alaska 99503
(907) 562-3366

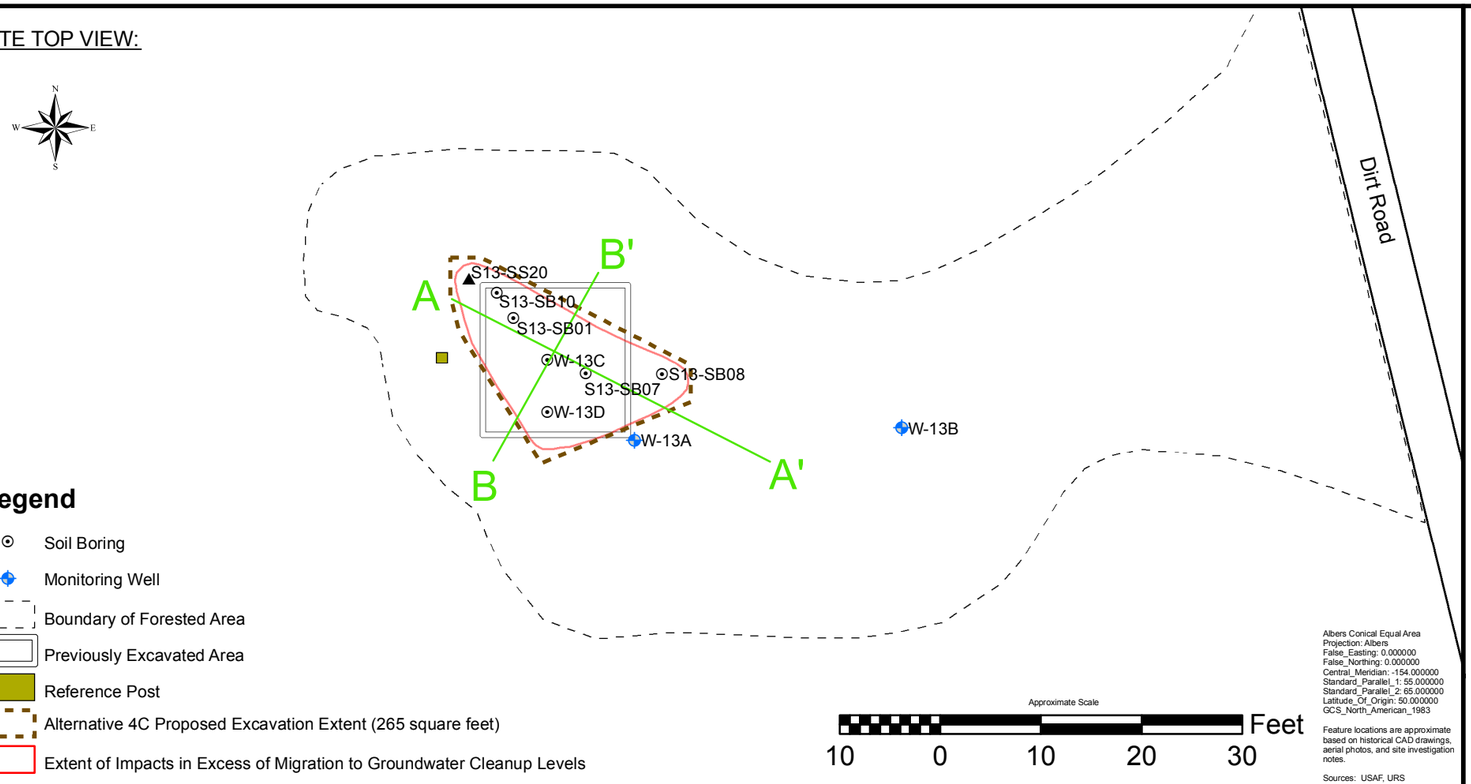
JOB NO:	26219882	DRAWN:	CGK
DATE:	6/16/2010	FILE:	SEE PATH

FIGURE 2-10

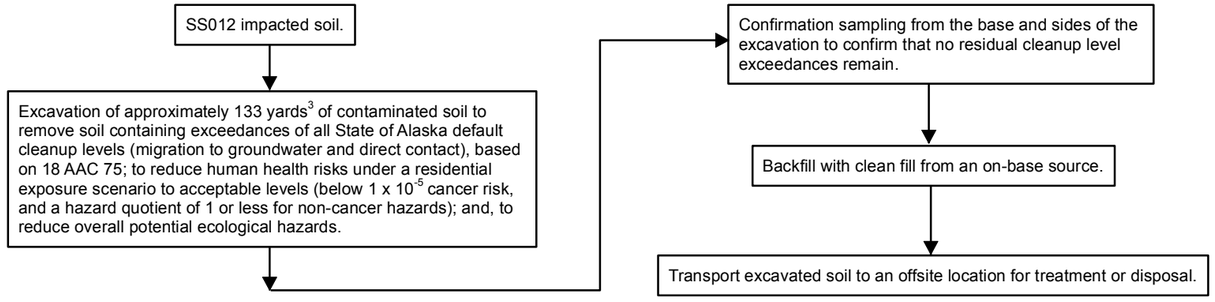
CLE000381.pdf

M:\Projects\Federal\Clear AFS\mxd\T00009\Site 13 ROD Figures\Site 13 ROD_Fig 2-10 Alt 4C Extent of Excav.mxd

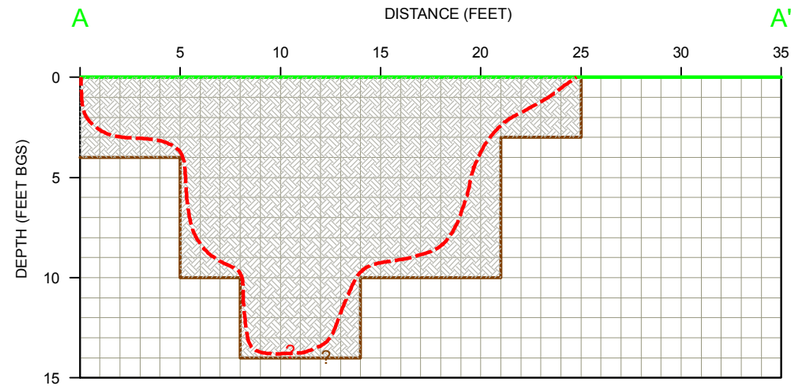
SITE TOP VIEW:

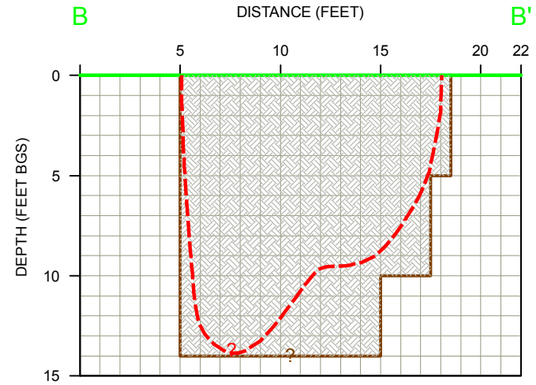


ALTERNATIVE FLOW DIAGRAM:



CROSS-SECTIONS A-A' AND B-B':





Legend

- Cross-section Surface
- Extent of Impacts in Excess of Migration to Groundwater Cleanup Levels (DDT = 7.3 mg/kg)
- Extent of Soil to be Excavated

Notes:
Profiles presented are intended to support a comparative analysis. The actual excavation would depend upon confirmation sample results.

Notes:

AAC = Alaska Administrative Code
BGS = below ground surface

SITE 13 (SS012)
ALTERNATIVE 4C
REMEDIAL DESIGN DETAILS

CLEAR AFS, ALASKA

URS
560 East 34th Avenue, Suite 100
Anchorage, Alaska 99503
(907) 562-3366

JOB NO:	26219882	DRAWN:	CGK
DATE:	6/16/2010	FILE:	SEE PATH

FIGURE 2-11

M:\Projects\Federal\Clear AFS\mxd\TO0009\Site 13 ROD Figures\Site 13 ROD_Fig 2-11 Site 13 Alt 4C.mxd

APPENDIX A

RACER Documentation for Alternative 4C

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The Base year used in calculating costs in the RACER program is 2007. Costs calculated in 2007 dollars were converted to 2010 dollars on the "Summary of Present Value Analysis" spreadsheet. The 2010 costs were then used in calculating the Present Value Cost on the "Present Value Analysis" spreadsheet.

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Alternative 4C: Human Health and MTG Cleanup Level Based Excavation; off-site disposal
Summary of Present Value Analysis
Site 13
Clear AFS, Alaska

	Present Value Costs*
Capital	$218,000
O&M	$0
Periodic	$56,000
Total	**$274,000**

* 0.9% discount factor used. Cost rounded to nearest $1,000.

Cost Details[1]

Capital

Description in RACER	Notes	Capital Cost (2007 dollars)	Capital Cost (2010 dollars)[2]
Remedial Design	Calculated as percentage of total capital cost	$17,910	$19,081
Excavation	Excavation and backfill of 133 cubic yards of soil to remove all soil containing exceedances of migration to groundwater cleanup levels, to reduce human health risks to acceptable levels, and to reduce overall potential ecological hazards	$35,091	$37,386
Residual Waste Management	Disposal of decontamination water	$4,511	$4,806
Load and Haul	Loading of excavated soil into roll-off bins	$863	$919
Decontamination Facilities	Decontamination facilities during excavation	$5,804	$6,184
Cleanup and Landscaping	Cleanup and landscaping following excavation and backfill	$892	$950
User-Defined Estimate (Off-Site T&D)	Transportation and disposal to Subtitle C facility in Oregon. Based on vendor quote for Site 6.	$115,660	$123,224
Professional Labor Management	Calculated as percentage of total capital cost	$24,095	$25,671
Sub-Total			**$218,222**

Close-Out Costs (a periodic cost in last year of project)

Description in RACER	Notes	Unit Cost (2007 dollars)	Unit Cost (2010 dollars)[2]
Close-Out Report	Costs incurred in last year and include well abandonment, documentation, and report generation.	$52,616	$56,057
			$56,057

1. Refer to RACER technology cost detail reports for derivation of costs.
2. Assumes that project is funded in FY 2010 (Year 0 for the present worth calculation).

Alternative 4C: Human Health and MTG Cleanup Level Based Excavation; off-site disposal
Present Value Analysis
Site 13
Clear AFS, Alaska

$$PV_{total} = \sum_{t=1}^{t=n} \frac{x_t}{(1+i)^t}$$

PV = present value
t = time, year
x = annual cost
i = discount rate

Discount Rate[1] = **0.9%**
Present Value = **$274,000**

							Present Value [5]			
Year	**Fiscal Year**	**Capital Cost[2]**	**O&M Cost[3]**	**Periodic Cost[4]**	**Annual Cost**	**Discount Factor**	**Capital Cost**	**O&M Cost**	**Periodic Cost**	**Total Present Value**
0	2010	218,222	-	-	218,222	1.000	218,222	-	-	218,222
1	2011	-	-	56,057	56,057	0.991	-	-	55,557	55,557
TOTAL		218,000	-	56,000	274,000		218,000	-	56,000	274,000

[1] Real discount rate taken from Office of Management and Budget (OMB) Circular A-94, Appendix C, updated December 2008. Rate for 3-year projects, which is the minimum length of time listed in the circular.

[2] Capital costs include cost of excavation, backfill, and off-site transportation and disposal.

[3] No O&M costs are included in this alternative.

[4] Periodic costs are for a close-out report.

[5] First-year costs (not costs escalated over time) are used as inputs in the present worth calculation per *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA 540-R-00-002, July 2000).

Notes:
"For Federal Facility sites being cleaned up using Superfund authority, it is generally appropriate to apply the real discount rates found in Appendix C of OMB Circular A-94. A real discount rate of 7% should generally be used for all non-Federal facility sites." -*A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA 540-R-00-002, July 2000).
"Real Discount Rates. A forecast of real interest rates from which the inflation premium has been removed and based on the economic assumptions from the OMB Budget Baseline. These real rates are to be used for discounting constant-dollar flows, as is often required in cost-effectiveness analysis." - Office of Management and Budget (OMB) Circular A-94, Appendix C.

Estimate Documentation Report

System:

RACER Version: 9.1.0
Database Location: T:\Racer\Racer.mdb

Folder:

Folder Name: Clear AFS

Project Documentation:

Project ID: Clear AF Station Site 13
Project Name: Clear AF Station Site 13
Project Category: None

Location
State / Country: ALASKA
City: CLEAR

Location Modifiers	Default	User
Material:	*1.743*	1.743
Labor:	*1.475*	1.475
Equipment:	*1.161*	1.161

Options
Database: System Costs
Cost Database Date: 2007
Report Option: Fiscal

Description Alternatives for Site 13 at Clear Air Force Station, Alaska.

Estimate Documentation Report

Site Documentation:

Site ID: Site 13, Alternative 4c
Site Name: Site 13, Alternative 4c soil removal and disposal
Site Type: Waste disposal

Phase Names

Pre-Study: ☐
PA, SI, PA/SI, RI, FS, RI/FS: ☐
RD: ☑
IRA-C: ☐
RA-C: ☑
IRA-O, RA-O: ☐
LTM: ☐
PCO: ☑

Documentation

Description: Evaluation of Alternative 4c (excavation of 133 CY to remove soil exceeding migration to groundwater cleanup levels; off-site disposal; no LUCs, no 5 year review necessary) for Site 13 at Clear Air Force Station.
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: Paul Bitter
Estimator Title: Senior Environmental Engineer
Agency/Org./Office: URS Corp.
Business Address: 756 East Winchester Street, Suite 400
Salt Lake City, UT 84107
Telephone Number: 801-904-4000
Email Address: paul_bitter@urscorp.com
Estimate Prepared Date: 12/15/2007

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name: Jeremy Cox
Reviewer Title: Environmental Engineer
Agency/Org./Office: URS Corp.
Business Address: 756 East Winchester Street, Suite 400
Salt Lake City, UT 84107
Telephone Number: 801-904-4000
Email Address: jeremy_cox@urscorp.com
Date Reviewed: 12/15/2007

Estimate Documentation Report

Reviewer Signature: _____ **Date:** _____

Estimated Costs:

Phase Names		Direct Cost	Marked-up Cost
RD		$0	$17,910
RA-C		$130,765	$186,917
PCO		$19,987	$52,616
	Total Cost:	$150,753	$257,443
	Escalation:	$10,305	$18,010
	Total Site Cost:	$161,058	$275,453

Estimate Documentation Report

Phase Documentation:

Phase Type: Design Percent Method
Phase Name: RD
Description: Design costs for Alternative 4c. 11% of capital costs.

Total Capital Costs are the marked up costs for the Phase, excluding the Professional Labor Management, Administrative Land Use Controls, and Operations and Maintenance technologies. Only the first year costs are included for cost-over-time technologies.

Phase Name	Phase Date	Design Approach	Total Capital Cost	Design %	Design Costs	Design Cost Year
RA-C	September, 2010	Ex Situ Removal - Off-site Treatment or Disposal	$162,822	11.00	$17,910	2010

Total Design Cost: $17,910

Estimate Documentation Report

Phase Documentation:

Phase Type: Remedial Action
Phase Name: RA-C
Description: Alternative 4c for Site 13 at Clear AF Station

Media/Waste Type
Primary: Soil
Secondary: N/A

Contaminant
Primary: Pesticides
Secondary: Volatile Organic Compounds (VOCs)

Approach: Ex Situ
Start Date: September, 2010

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Residual Waste Management	Yes	100	0
Load and Haul	Yes	100	0
Professional Labor Management	Yes	100	0
Decontamination Facilities	Yes	100	0
Cleanup and Landscaping	Yes	100	0
USER-DEFINED ESTIMATE (OFF-SITE T&D)	Yes	100	0
Excavation	Yes	100	0

Total Marked-up Cost: $186,917

Technologies:

Estimate Documentation Report

Technology Name: **Residual Waste Management (# 1)**

Description	*Default*	*Value*	*UOM*
System Definition			
Required Parameters			
Safety Level		D	n/a
Disposal			
Required Parameters			
Non-Hazardous Bulk Liquid: Total Quantity		600	GAL
Non-Hazardous Bulk Liquid: Distance to Disposal Facility		69	Miles
Non-Hazardous Bulk Liquid: Waste Stabilization Required		No	n/a
Non-Hazardous Bulk Liquid: Disposal Fee	2	2.39	$/GAL
Non-Hazardous Bulk Liquid: State Tax / Fees		0	$/GAL

Comments: Disposal of decontamination water from excavation. Assumes disposal of decon water at a POTW in Fairbanks, 69 miles from Clear AF Station.

Technology Name: **Load and Haul (# 1)**

Description	*Default*	*Value*	*UOM*
System Definition			
Required Parameters			
Truck Type		Off Highway	n/a
Volume		133	CY
One-way Haul Distance		500	FT
Dump Charge		0	$/CY
Safety Level		D	n/a

Comments: Loading of 133 CY of excavated soil into on-site roll-offs provided by T&D company. No hauling component, since T&D company will transport the roll-offs from the site to the disposal facility.

Estimate Documentation Report

Technology Name: **Professional Labor Management (# 1)**

Description	*Default*	*Value*	*UOM*
System Definition			
Required Parameters			
Method		Percentage Method	n/a
RA Complexity		Low	n/a
Percentage Defaults			
Secondary Parameters			
Project Management Percent		1.75	%
Project Management Weighted Dollar Amount		2,149	$
Planning Documents Percent		1.75	%
Planning Documents Weighted Dollar Amount		2,149	$
Construction Oversight Percent		1.5	%
Construction Oversight Weighted Dollar Amount		1,842	$
Reporting Percent		0.25	%
Reporting Weighted Dollar Amount		306.961	$
As-Built Drawings Percent		0.25	%
As-Built Drawings Weighted Dollar Amount		306.961	$
Permitting Percent		1	%
Permitting Weighted Dollar Amount		1,228	$

Comments: Professional labor management (PLM) for excavation and off-site disposal of contaminated soil exceeding ecological clean-up standards from Site 13. RACER calculates PLM as a percentage of the total capital cost. However, the majority of the capital cost for this alternative is derived from the transportation and disposal (T&D) of the excavated soil, and most of the oversight for the T&D would be handled by a subcontractor; the cost of this oversight was included in the subcontractor quote for the T&D. For this reason, the PLM percentages were reduced by 50% or more for most of the RACER default percentages of total capital cost for PLM, assuming a low complexity project. The default and actual percentages are as follows: project management (3.75% vs. 1.75%), planning documents (3.5% vs. 1.75%), construction oversight (3.00% vs. 1.5%), reporting (0.50% vs. 0.25%), as-built drawings (0.50% vs. 0.25%), public notice (0.15% vs. 0%), site close activities (0% vs. 0%) (handled separately in project close-out costs), and permitting (5% vs. 1%).

Estimate Documentation Report

Technology Name: **Decontamination Facilities (# 1)**

Description	*Default*	*Value*	*UOM*
System Definition			
Required Parameters			
New Decontamination Facility Pad Construction		Yes	n/a
Equipment Rating		Light Equipment Rating	n/a
Equipment Decontamination Operations		Yes	n/a
Equipment Decontamination Operations: Duration		1	weeks
Personnel Decontamination Trailers		No	n/a
Personnel Decontamination Trailers: Average Crew Size		0	per shift
Personnel Decontamination Trailers: Duration		0	weeks
Safety Level		D	n/a
Decon Pad			
Secondary Parameters			
Area of Decontamination Pad	300	300	SF
Use Flexible Membrane Liner	Yes	No	n/a
Percentage of Time Decontamination Pad in Use	25	25	%
Work Shifts			
Secondary Parameters			
Equipment Decontamination		One Shift per Day	n/a
Personnel Decontamination		n/a	n/a

Comments: Decontamination facilities during excavation and loading.

Estimate Documentation Report

Technology Name: **Cleanup and Landscaping (# 1)**

Description	*Default*	*Value*	*UOM*
System Definition			
Required Parameters			
Type of Site Preparation		Cleanup and Landscape	n/a
Preparation Area		0.1	AC
Safety Level		D	n/a
Cleanup			
Secondary Parameters			
Cleanup Type	Area Cleanup	Area Cleanup	n/a
Cleanup Area	100	100	%
Landscaping			
Secondary Parameters			
Landscaping Type	Seeding	Seeding	n/a
Landscaping Area	100	100	%

Comments: Cleanup and landscaping of 0.1 acres following excavation and backfill. Assumes larger area needing restoration than actual excavation area due to movement of heavy equipment around excavation area.

Technology Name: **User Defined Estimate (# 1)**
User Name: **USER-DEFINED ESTIMATE (OFF-SITE T&D)**

Description	*Default*	*Value*	*UOM*
System Definition			
Required Parameters			
Model Name		USER-DEFINED ESTIMATE (OFF-SITE T&D)	n/a
WBS Type		ECES	n/a
Selected WBS		4.33.07	n/a
Safety Level		D	n/a

Comments: Transportation and disposal of 133 CY (173 tons) of excavated soil to a RCRA Subtitle C facility. Facility asumed to be located in Arlington, OR. Defined by Aug. 26, 2008 quote and Aug. 27, 2008 e-mail from Tutka, LLC of Anchorage for soil disposal from Site 6. Roll-off cost if for $15/day rental of each bin for total of approximately 76 days, including time for excavation, sample analysis, and transport. Assumes that soil loaded on-site onto roll-offs provided by Tutka, and that Tutka transports roll-offs off-site to disposal facility. Loading costs included in load & haul module. RACER applied up to 34% markup to vendor estimate.

Estimate Documentation Report

Technology Name: **Excavation (# 1)**

Description	*Default*	*Value*	*UOM*
System Definition			
Required Parameters			
Excavation Length		20.4	FT
Excavation Width		12.6	FT
Excavation Depth		14	FT
Rock Requiring Blasting		No	n/a
Rock Requiring Ripping		No	n/a
% of Excavation		0	%
Drum Removal Required		No	n/a
Number of Drums to be Excavated		0	EA
Soil Type		Gravel/Gravel Sand Mixture	n/a
Sidewall Protection		Side Slope (Rise : Run)	n/a
Side Slope (Rise : Run) 1:		1.5	n/a
Excavation Dewatering Required		No	n/a
Duration of Dewatering		0	Days
Perform Ground Penetrating Radar		No	n/a
Number of Days for Performing Ground Penetrating Radar		0	Days
Number of Soil Samples		15	EA
Soil Analytical Template		System Soil-Pesticides	n/a
Safety Level		D	n/a
Excavation			
Secondary Parameters			
% of Excavated Material To Be Used as Backfill		69	%
Source of Additional Fill		Offsite	n/a
Existing Cover		Soil/Gravel	n/a
Replacement Cover		Soil/Gravel	n/a

Comments: Excavation of soil exceeding exceeding migration to groundwater levels at Site 13. Excavation to depth of ~14 feet. Length and width approximated to obtain the desired excavation volume of 133 CY, which includes a 30% contingency on the calculated excavation volume. Assumes that backfill is obtained from an on-base source. RACER assumed a volume expansion of approximately 25% for the excavated soil. Assumes a 1:1.5 slope, and that soil outside of the area exceeding the screening standards (approximately 69% of the total estimated excavation volume) is later replaced in the excavation. Assumes 13 confirmation soil samples, plus two QA/QC samples. Cost of excavating and replacing

slope cut is significantly less than cost of installing, removing, and decontaminating sheeting. Also includes cost for abandoning one monitoring well, assumed to be 90 feet deep, within area of excavation.

Estimate Documentation Report

Phase Documentation:

Phase Type: Site Closeout
Phase Name: PCO
Description: Project close-out for Site 13 under Alternative 4c. Assumes close-out in 2011.

Media/Waste Type
Primary: N/A
Secondary: N/A

Contaminant
Primary: None
Secondary: None

Start Date: January, 2011

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Site Close-Out Documentation	Yes	100	0

Total Marked-up Cost: $52,616

Technologies:

Estimate Documentation Report

Technology Name: **Site Close-Out Documentation (# 1)**

Description	*Default*	*Value*	*UOM*
System Definition			
Required Parameters			
Meetings		Yes	n/a
Work Plans and Reports		Yes	n/a
Documents		Yes	n/a
Abandon Wells		Yes	n/a
Site Close-Out Complexity		Low	n/a
Meetings			
Required Parameters			
Kick Off/Scoping Meetings		Yes	n/a
Kick Off/Scoping Meetings: Number of Meetings	1	1	EA
Kick Off/Scoping Meetings: Travel		No	n/a
Review Meetings		Yes	n/a
Review Meetings: Number of Meetings	1	1	EA
Review Meetings: Travel		No	n/a
Regulatory Review Meetings		Yes	n/a
Regulatory Review Meetings: Number of Meetings	1	1	EA
Regulatory Review Meetings: Travel		No	n/a
Work Plans & Reports			
Required Parameters			
Work Plans		Yes	n/a
Draft Work Plan		Yes	n/a
Final Work Plan		Yes	n/a
Reports		Yes	n/a
Draft Close-Out Report		Yes	n/a
Draft Final Close-Out Report		Yes	n/a
Final Close-Out Report		Yes	n/a
Progress Reports		Yes	n/a
Project Duration	8	8	months
Documents			
Required Parameters			
Draft Decision Document		Yes	n/a
Draft Final Decision Document		Yes	n/a

Estimate Documentation Report

Technology Name: **Site Close-Out Documentation (# 1)**

Description	*Default*	*Value*	*UOM*
Documents			
Required Parameters			
Final Decision Document		Yes	n/a
Long Term Document Storage		No	n/a
Abandon Wells			
Secondary Parameters			
Abandon Wells: Travel		No	n/a
Abandon Wells: Sub Contract Cost		No	n/a
Field Work		No	n/a

Comments: Site close-out work plan and report. Also includes costs for abandoning three monitoring wells, each assumed to be 90 feet deep, for a total of 270 lf.

Phase Technology Cost Detail Report
(with Markups)

System:

RACER Version: 9.1.0
Database Location: T:\Racer\Racer.mdb

Folder:

Folder Name: Clear AFS

Project:

Project ID: Clear AF Station Site 13
Project Name: Clear AF Station Site 13
Project Category: None

Location
State / Country: ALASKA
City: CLEAR

Location Modifiers	Default	User
Material:	*1.743*	1.743
Labor:	*1.475*	1.475
Equipment:	*1.161*	1.161

Options
Database: System Costs
Cost Database Date: 2007
Report Option: Fiscal

Description Alternatives for Site 13 at Clear Air Force Station, Alaska.

Phase Technology Cost Detail Report
(with Markups)

Site:

Site ID: Site 13, Alternative 4c
Site Name: Site 13, Alternative 4c soil removal and disposal
Site Type: Waste disposal

Phase Names

Pre-Study: ☐
PA, SI, PA/SI, RI, FS, RI/FS: ☐
RD: ☑
IRA-C: ☐
RA-C: ☑
IRA-O, RA-O: ☐
LTM: ☐
PCO: ☑

Documentation

Description: Evaluation of Alternative 4c (excavation of 133 CY to remove soil exceeding migration to groundwater cleanup levels; off-site disposal; no LUCs, no 5 year review necessary) for Site 13 at Clear Air Force Station.
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: Paul Bitter
Estimator Title: Senior Environmental Engineer
Agency/Org./Office: URS Corp.
Business Address: 756 East Winchester Street, Suite 400
Salt Lake City, UT 84107
Telephone Number: 801-904-4000
Email Address: paul_bitter@urscorp.com
Estimate Prepared Date: 12/15/2007

Phase Technology Cost Detail Report (with Markups)

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name: Jeremy Cox
Reviewer Title: Environmental Engineer
Agency/Org./Office: URS Corp.
Business Address: 756 East Winchester Street, Suite 400
Salt Lake City, UT 84107
Telephone Number: 801-904-4000
Email Address: jeremy_cox@urscorp.com
Date Reviewed: 12/15/2007

Reviewer Signature: _____ **Date:** _____

Phase Technology Cost Detail Report (with Markups)

Phase:

Phase Type: Design Percent Method
Phase Name: RD
Description: Design costs for Alternative 4c. 11% of capital costs.

Total Capital Costs are the marked up costs for the Phase, excluding the Professional Labor Management, Administrative Land Use Controls, and Operations and Maintenance technologies. Only the first year costs are included for cost-over-time technologies.

Phase Name	Phase Date	Design Approach	Total Capital Cost	Design %	Design Costs	Design Cost Year
RA-C	September, 2010	Ex Situ Removal - Off-site Treatment or Disposal	$162,822	11.00	$17,910	2010

Phase Technology Cost Detail Report (with Markups)

Technology: Design Costs

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost	Cost Override	Markups Applied
32032001	Remedial Design Professional Labor	1.00	EA	0.00	17,910.00	0.00	$17,910.00	☐	☑

Total Element Cost	**$17,910.00**
Total 1st Year Technology Cost	**$17,910.00**
Total Phase Cost	**$17,910.00**

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Phase Technology Cost Detail Report
(with Markups)

System:

RACER Version: 9.1.0
Database Location: T:\Racer\Racer.mdb

Folder:

Folder Name: Clear AFS

Project:

Project ID: Clear AF Station Site 13
Project Name: Clear AF Station Site 13
Project Category: None

Location
State / Country: ALASKA
City: CLEAR

Location Modifiers	Default	User
Material:	*1.743*	1.743
Labor:	*1.475*	1.475
Equipment:	*1.161*	1.161

Options
Database: System Costs
Cost Database Date: 2007
Report Option: Fiscal

Description Alternatives for Site 13 at Clear Air Force Station, Alaska.

Phase Technology Cost Detail Report
(with Markups)

Site:

Site ID: Site 13, Alternative 4c
Site Name: Site 13, Alternative 4c soil removal and disposal
Site Type: Waste disposal

Phase Names

Pre-Study: ☐
PA, SI, PA/SI, RI, FS, RI/FS: ☐
RD: ☑
IRA-C: ☐
RA-C: ☑
IRA-O, RA-O: ☐
LTM: ☐
PCO: ☑

Documentation

Description: Evaluation of Alternative 4c (excavation of 133 CY to remove soil exceeding migration to groundwater cleanup levels; off-site disposal; no LUCs, no 5 year review necessary) for Site 13 at Clear Air Force Station.
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: Paul Bitter
Estimator Title: Senior Environmental Engineer
Agency/Org./Office: URS Corp.
Business Address: 756 East Winchester Street, Suite 400
Salt Lake City, UT 84107
Telephone Number: 801-904-4000
Email Address: paul_bitter@urscorp.com
Estimate Prepared Date: 12/15/2007

Phase Technology Cost Detail Report (with Markups)

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name: Jeremy Cox
Reviewer Title: Environmental Engineer
Agency/Org./Office: URS Corp.
Business Address: 756 East Winchester Street, Suite 400
Salt Lake City, UT 84107
Telephone Number: 801-904-4000
Email Address: jeremy_cox@urscorp.com
Date Reviewed: 12/15/2007

Reviewer Signature: _____ **Date:** _____

Phase Technology Cost Detail Report
(with Markups)

Phase:

Phase Type: Remedial Action
Phase Name: RA-C
Description: Alternative 4c for Site 13 at Clear AF Station

Media/Waste Type
Primary: Soil
Secondary: N/A

Contaminant
Primary: Pesticides
Secondary: Volatile Organic Compounds (VOCs)

Approach: Ex Situ
Start Date: September, 2010

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Residual Waste Management	Yes	100	0
Load and Haul	Yes	100	0
Professional Labor Management	Yes	100	0
Decontamination Facilities	Yes	100	0
Cleanup and Landscaping	Yes	100	0
USER-DEFINED ESTIMATE (OFF-SITE T&D)	Yes	100	0
Excavation	Yes	100	0

Phase Technology Cost Detail Report (with Markups)

Technology: Residual Waste Management

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost	Cost Override	Markups Applied
33190101	Liquid Loading Into 5,000 Gallon Bulk Tank Truck	1.00	EA	0.00	921.91	453.86	$1,375.77	☐	☑
33190207	Transport Bulk Liquid/Sludge Hazardous Waste, Maximum 5,000 Gallon (per Mile)	69.00	MI	3.17	0.00	0.00	$218.89	☐	☐
33190317	Waste Stream Evaluation Fee, Not Including 50% Rebate on 1st Shipment	1.00	EA	1,045.87	0.00	0.00	$1,045.87	☐	☑
33197278	Commercial RCRA landfills, liquid/sludge, non-fuel, non-hazardous	600.00	GAL	3.12	0.00	0.00	$1,870.56	☑	☑

Total Element Cost	**$4,511.09**
Total 1st Year Technology Cost	**$4,511.09**

Phase Technology Cost Detail Report (with Markups)

Technology: Load and Haul

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost	Cost Override	Markups Applied
17030226	988, 7.0 CY, Wheel Loader	1.00	HR	0.00	119.66	214.41	$334.07	☐	☑
17030295	35 Ton, 769, Off-highway Truck	2.00	HR	0.00	111.51	153.17	$529.36	☐	☑
					Total Element Cost		**$863.43**		
					Total 1st Year Technology Cost		**$863.43**		

Phase Technology Cost Detail Report (with Markups)

Technology: Professional Labor Management

Element: Professional Labor Percentage

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost	Cost Override	Markups Applied
33220138	Project Management Labor Cost	1.00	LS	0.00	6,487.03	0.00	$6,487.03	☑	☑
33220139	Planning Documents Labor Cost	1.00	LS	0.00	6,487.03	0.00	$6,487.03	☑	☑
33220140	Construction Oversight Labor Cost	1.00	LS	0.00	5,560.31	0.00	$5,560.31	☑	☑
33220141	Reporting Labor Cost	1.00	LS	0.00	926.72	0.00	$926.72	☑	☑
33220142	As-Built Drawings Labor Cost	1.00	LS	0.00	926.72	0.00	$926.72	☑	☑
33220143	Public Notice Labor Cost	1.00	LS	0.00	0.00	0.00	$0.00	☐	☑
33220144	Site Closure Activities Labor Cost	1.00	LS	0.00	0.00	0.00	$0.00	☐	☑
33220145	Permitting Labor Cost	1.00	LS	0.00	3,706.88	0.00	$3,706.88	☑	☑
33220146	Responsible Party Labor Cost	1.00	LS	0.00	0.00	0.00	$0.00	☐	☑
33220147	Reimbursement Claims Preparation Labor Cost	1.00	LS	0.00	0.00	0.00	$0.00	☐	☑
33220148	Other Labor Cost	1.00	LS	0.00	0.00	0.00	$0.00	☐	☑

Total Element Cost	**$24,094.70**
Total 1st Year Technology Cost	**$24,094.70**

Phase Technology Cost Detail Report (with Markups)

Technology: Decontamination Facilities

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost	Cost Override	Markups Applied
33080532	8 oz/sy Erosion Control/Drainage Filter Fabric (80 Mil)	40.00	SY	1.62	1.19	0.04	$113.81	☐	☑
33170818	Spray washers, cold water, electric, 1800 psi, 5 GPM, 5 HP, rent/month	1.00	MO	2,330.48	0.00	0.00	$2,330.48	☐	☑
33170823	Operation of Pressure Washer, Including Water, Soap, Electricity, Labor	10.00	HR	79.01	127.20	0.00	$2,062.12	☐	☑
33170825	Railroad siding, wood tie, pressure treated, C.L. lots, 6" x 8" x 8'-6" L	9.00	EA	85.26	56.58	2.34	$1,297.67	☐	☑

Total Element Cost	**$5,804.08**
Total 1st Year Technology Cost	**$5,804.08**

Phase Technology Cost Detail Report (with Markups)

Technology: Cleanup and Landscaping

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost	Cost Override	Markups Applied
17040101	Cleaning Up, site debris clean up and removal	0.10	ACR	0.00	903.50	61.96	$96.55	☐	☑
18050101	Area Preparation, 67% Level & 33% Slope	0.10	ACR	0.00	33.68	32.49	$6.62	☐	☑
18050401	Seeding, 67% Level & 33% Slope, Hydroseeding	0.10	ACR	3,264.78	885.02	659.24	$480.90	☐	☐
18050408	Fertilizer, Hydro Spread	0.20	ACR	218.88	171.41	35.40	$85.14	☐	☑
18050413	Watering with 3,000-Gallon Tank Truck, per Pass	0.80	ACR	1.98	77.72	68.14	$118.27	☐	☑
18050415	Mowing	0.20	ACR	0.00	522.79	0.00	$104.56	☐	☑
					Total Element Cost		**$892.03**		
					Total 1st Year Technology Cost		**$892.03**		

Phase Technology Cost Detail Report (with Markups)

Technology: USER-DEFINED ESTIMATE (OFF-SITE T&D)

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost	Cost Override	Markups Applied
33100122	30 CY Open Top Roll-Off Container	9.00	EA	0.00	0.00	1,532.52	$13,792.67	☑	☑
33190202	Bulk Hazardous Waste, Minimum Charge for Shipment	9.00	EA	0.00	0.00	10,390.48	$93,514.32	☑	☑
33197263	Commercial RCRA landfills, bulk waste, solid, based on 2,000 lb/CY	173.00	TON	42.90	0.00	0.00	$7,421.70	☑	☐
33199543	Initial Waste Stream Evaluation, Non-PCB	1.00	EA	931.37	0.00	0.00	$931.37	☑	☑

Total Element Cost	**$115,660.06**
Total 1st Year Technology Cost	**$115,660.06**

Phase Technology Cost Detail Report (with Markups)

Technology: Excavation

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost	Cost Override	Markups Applied
17030276	Excavate and load, bank measure, medium material, 3/4 C.Y. bucket, hydraulic excavator	492.61	BCY	0.00	5.82	1.47	$3,591.52	☐	☑
17030415	On-Site Backfill for Large Excavations, Includes Compaction	397.24	ECY	0.09	1.38	1.17	$1,051.38	☐	☑
17030418	Delivered & Dumped, Backfill with Stone	63.09	BCY	56.23	1.51	1.38	$3,729.57	☐	☑
17030423	Unclassified Fill, 6" Lifts, Off-Site, Includes Delivery, Spreading, and Compaction	193.99	CY	14.36	1.85	1.30	$3,395.43	☐	☑
33020401	Disposable Materials per Sample	15.00	EA	19.36	0.00	0.00	$290.46	☐	☑
33021102	Testing, moisture content (209a)	15.00	EA	55.70	0.00	0.00	$835.56	☐	☑
33021717	Pesticides/PCBs, Soil Analysis	15.00	EA	284.91	0.00	0.00	$4,273.65	☐	☑
33021720	Testing, purgeable organics (624, 8260)	15.00	EA	306.94	0.00	0.00	$4,604.12	☐	☑
33021721	Testing, semi-volatile organics (625, 8270)	15.00	EA	584.33	0.00	0.00	$8,764.89	☐	☑
33080584	Plastic Laminate Waste Pile Cover	1,445.60	SF	0.32	0.07	0.00	$559.01	☐	☑
33170803	Decontaminate Heavy Equipment	1.00	EA	0.00	871.09	0.00	$871.09	☐	☑
33231822	Well Abandonment, 2" Well	90.00	LF	1.60	12.71	20.41	$3,124.58	☐	☑
				Total Element Cost			**$35,091.26**		

Phase Technology Cost Detail Report (with Markups)

Total 1st Year Technology Cost	**$35,091.26**
Total Phase Cost	**$186,916.65**

Phase Technology Cost Detail Report
(with Markups)

System:

RACER Version: 9.1.0
Database Location: T:\Racer\Racer.mdb

Folder:

Folder Name: Clear AFS

Project:

Project ID: Clear AF Station Site 13
Project Name: Clear AF Station Site 13
Project Category: None

Location
State / Country: ALASKA
City: CLEAR

Location Modifiers	Default	User
Material:	*1.743*	1.743
Labor:	*1.475*	1.475
Equipment:	*1.161*	1.161

Options
Database: System Costs
Cost Database Date: 2007
Report Option: Fiscal

Description Alternatives for Site 13 at Clear Air Force Station, Alaska.

Phase Technology Cost Detail Report
(with Markups)

Site:

Site ID: Site 13, Alternative 4c
Site Name: Site 13, Alternative 4c soil removal and disposal
Site Type: Waste disposal

Phase Names

Pre-Study: ☐
PA, SI, PA/SI, RI, FS, RI/FS: ☐
RD: ☑
IRA-C: ☐
RA-C: ☑
IRA-O, RA-O: ☐
LTM: ☐
PCO: ☑

Documentation

Description: Evaluation of Alternative 4c (excavation of 133 CY to remove soil exceeding migration to groundwater cleanup levels; off-site disposal; no LUCs, no 5 year review necessary) for Site 13 at Clear Air Force Station.
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: Paul Bitter
Estimator Title: Senior Environmental Engineer
Agency/Org./Office: URS Corp.
Business Address: 756 East Winchester Street, Suite 400
Salt Lake City, UT 84107
Telephone Number: 801-904-4000
Email Address: paul_bitter@urscorp.com
Estimate Prepared Date: 12/15/2007

Phase Technology Cost Detail Report (with Markups)

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name: Jeremy Cox
Reviewer Title: Environmental Engineer
Agency/Org./Office: URS Corp.
Business Address: 756 East Winchester Street, Suite 400
Salt Lake City, UT 84107
Telephone Number: 801-904-4000
Email Address: jeremy_cox@urscorp.com
Date Reviewed: 12/15/2007

Reviewer Signature: _____ **Date:** _____

Phase Technology Cost Detail Report
(with Markups)

Phase:

Phase Type: Site Closeout
Phase Name: PCO
Description: Project close-out for Site 13 under Alternative 4c. Assumes close-out in 2011.

Media/Waste Type
Primary: N/A
Secondary: N/A

Contaminant
Primary: None
Secondary: None

Start Date: January, 2011

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Site Close-Out Documentation	Yes	100	0

Phase Technology Cost Detail Report (with Markups)

Technology: Site Close-Out Documentation

Element: Meetings

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost	Cost Override	Markups Applied
33220102	Project Manager	14.00	HR	0.00	249.76	0.00	$3,496.70	☐	☑
33220106	Staff Engineer	13.00	HR	0.00	192.00	0.00	$2,496.01	☐	☑
33220114	Word Processing/Clerical	5.00	HR	0.00	108.20	0.00	$541.01	☐	☑
33220115	Draftsman/CADD	1.00	HR	0.00	129.62	0.00	$129.62	☐	☑
					Total Element Cost		**$6,663.32**		

Element: Work Plans & Reports

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost	Cost Override	Markups Applied
33220101	Senior Project Manager	7.00	HR	0.00	308.03	0.00	$2,156.24	☐	☑
33220102	Project Manager	61.00	HR	0.00	249.76	0.00	$15,235.60	☐	☑
33220104	Senior Staff Engineer	4.00	HR	0.00	305.78	0.00	$1,223.12	☐	☑
33220109	Staff Scientist	2.00	HR	0.00	155.31	0.00	$310.63	☐	☑
33220114	Word Processing/Clerical	49.00	HR	0.00	108.20	0.00	$5,301.85	☐	☑
33220115	Draftsman/CADD	6.00	HR	0.00	129.62	0.00	$777.70	☐	☑
					Total Element Cost		**$25,005.14**		

Element: Abandon wells

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost	Cost Override	Markups Applied
33220106	Staff Engineer	1.00	HR	0.00	192.00	0.00	$192.00	☐	☑
33220109	Staff Scientist	1.00	HR	0.00	155.31	0.00	$155.31	☐	☑

Phase Technology Cost Detail Report (with Markups)

Element: Abandon wells

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost	Cost Override	Markups Applied
33231822	Well Abandonment, 2" Well	270.00	LF	1.67	13.42	23.88	$10,522.01	☐	☑

Total Element Cost **$10,869.32**

Element: Documents

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Extended Cost	Cost Override	Markups Applied
33220102	Project Manager	9.00	HR	0.00	249.76	0.00	$2,247.88	☐	☑
33220104	Senior Staff Engineer	2.00	HR	0.00	305.78	0.00	$611.56	☐	☑
33220106	Staff Engineer	26.00	HR	0.00	192.00	0.00	$4,992.01	☐	☑
33220114	Word Processing/Clerical	11.00	HR	0.00	108.20	0.00	$1,190.21	☐	☑
33220115	Draftsman/CADD	8.00	HR	0.00	129.62	0.00	$1,036.93	☐	☑

Total Element Cost **$10,078.59**

Total 1st Year Technology Cost **$52,616.37**

Total Phase Cost **$52,616.37**