U.S. Army Garrison Alaska

# FEASIBILITY STUDY

## Sears Creek Station
## Dry Well, Burn Pit, and Site Groundwater

## Revision 2 (Final)

Environmental Investigations at Haines Fuel Terminal, Sears Creek Station, Tok Fuel Terminal, Tok, and Gerstle River Test Site, Alaska

Contract No. W911KB-14-D-0006
Task Order 0005

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AAC | Alaska Administrative Code |
| ACL | alternative cleanup level |
| ADEC | Alaska Department of Environmental Conservation |
| AOC | Area of Concern |
| ARAR | applicable or relevant and appropriate requirements |
| bgs | below ground surface |
| Bristol | Bristol Environmental Remediation Services, LLC |
| BTV | background threshold value |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| COC | contaminant of concern |
| COPC | contaminant of potential concern |
| DERP | Defense Environmental Restoration Program |
| DoD | U.S. Department of Defense |
| DRO | diesel range organics |
| EC | engineering control |
| EPA | Environmental Protection Agency |
| ERA | Ecological Risk Assessment |
| FS | Feasibility Study |
| GRA | general response actions |
| GRO | gasoline range organics |
| HFP | Haines-Fairbanks Pipeline |
| HHSLRA | Human Health Screening Level Risk Assessment |
| HI | hazard index |
| IC | institutional control |
| ISCO | in situ chemical oxidation |
| LTM | long-term management |
| LTTD | low temperature thermal desorption |
| LUC | land use controls |

## ACRONYMS AND ABBREVIATIONS (continued)

| | |
|---|---|
| MCL | maximum contaminant level |
| MDC | maximum detected concentration |
| mg/Kg | milligrams per kilogram |
| mg/L | milligrams per liter |
| MNA | monitored natural attenuation |
| MW | monitoring well |
| NCP | National Contingency Plan |
| O&M | operation and maintenance |
| OIT | Organic Incineration Technology |
| ORP | oxidation-reduction potential |
| PAH | polynuclear aromatic hydrocarbon |
| PFOA | perfluorooctanoic acid |
| PFOS | perfluorooctanesulfonic acid |
| PID | photoionization detector |
| RAO | remedial action objective |
| RD/RAWP | remedial design/remedial action work plan |
| ROD | Record of Decision |
| SCS | Sears Creek Station |
| SRA | specific response action |
| SRI | Supplemental Remedial Investigation |
| SVE | soil vapor extraction |
| TMV | toxicity, mobility, or volume |
| TPV | total present value |
| UIC | Underground Injection Control |
| USACE | US Army Corps of Engineers |
| USDW | underground sources of drinking water |
| UU/UE | unlimited use and unrestricted exposure |
| VMP | vapor monitoring point |
| VOC | volatile organic compound |
| WSW | Water Supply Well |

# EXECUTIVE SUMMARY

This document presents the results of a Feasibility Study (FS) conducted based on recommendations from the 2015 Supplemental Remedial Investigation (SRI) for the Sears Creek Station (SCS). The SCS is located between Delta Junction and Tok, Alaska, near Milepost 1374 on the Alaska Highway, and operated as a booster station for the Haines-Fairbanks Pipeline (HFP) between 1961 and 1973.

The results of the soil and groundwater investigation activities and the human health and ecological risk screening process were used to provide recommendations for three areas of concern (AOCs) at the SCS. AOCs at the SCS with contaminants other than petroleum compounds and/or groundwater contamination (Dry Well, Burn Pit, and site wide groundwater) were recommended for further evaluation as part of a FS under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC Section (§) 9601et seq. as amended by the Superfund Amendments and Reauthorization Act of 1986 and, to the extent practicable, the National Oil and Hazardous Substances Contingency Place. These AOCs are the focus of this document and are summarized in Table ES-1.

**Table ES-1 SCS CERCLA AOCs**

| SCS Site Feature/AOC | Contaminants of Concern | Extent (Acres) | Contaminated Soil Volume ($yd^3$) | Comments |
|---|---|---|---|---|
| Dry Well | Arsenic and lead | 0.0023 | 20 $yd^3$ | Exceedances identified in the UIC end-point sample only at 12.5 feet bgs. |
| Burn Pit | DRO | 0.017 | 20 $yd^3$ | Exceedances identified in one soil sample between 4-5 feet bgs. |
| Groundwater | GRO, DRO, ethylbenzene, xylenes, naphthalene, 1,2,4- and 1,3,5-trimethylbenzene, 1- and 2-methylnaphthalene, and lead | 0.07 | NA | Groundwater plume size based on the exceedances identified in Burn Pit wells, since the lead exceedance was observed in the WSW only. |

Notes:

bgs = below ground surface
DRO = diesel range organics
GRO = gasoline range organics
UIC = Underground Injection Control
WSW = Water Supply Well
$yd^3$ = cubic yards

## HUMAN HEALTH AND ECOLOGICAL RISK EVALUATION RESULTS

A human health screening level risk assessment (HHSLRA) and the first two steps of the ADEC ecological risk assessment (ERA) process (Step 1 Ecological Scoping Evaluation and Step 2 Ecological Screening Evaluation) were conducted for the SCS site as part of the SRI (Bristol Environmental Remediation Services, LLC [Bristol], 2018). The scope of the screening risk assessment was to identify the potential for adverse effects to human health and the environment based on comparison of site concentrations to generic and/or site-specific screening concentrations. This risk assessment approach is intended to provide information necessary to inform the SRI and support risk management decisions.

The HHSLRA determined that use of SCS groundwater as a future drinking water source could result in unacceptable human health risk. The groundwater cumulative cancer risk was estimated to be $1 \times 10^{-3}$, which is greater than the U.S. Environmental Protection Agency's (EPA) acceptable risk range of $10^{-4}$ to $10^{-6}$ and ADEC excess cancer risk threshold of $1 \times 10^{-5}$. The groundwater cumulative noncancer risk was estimated with a hazard index (HI) of 58, greater than the EPA and ADEC HI threshold of 1.

The HHSLRA also calculated that concentrations of contaminants of potential concern (COPCs) in soil at the Dry Well AOC result in an estimated cancer risk of $3 \times 10^{-5}$, which is within the EPA's acceptable risk range but slightly exceeds the ADEC excess cancer risk threshold. The cumulative noncancer risk at the Dry Well AOC was estimated with a HI of 0.6.

The ecological evaluation concluded that exposure to residual chemicals in surface and shallow subsurface soil is potentially complete but unlikely to result in significant exposure to ecological receptors due to the small size of the AOCs, limited exposure potential, and low exceedances of conservative screening levels protective of ecological endpoints. Per ADEC decision criteria, available information is considered adequate to conclude that reported exposure (and potential risk) is negligible and there is no need for further evaluation or remedial action based on potential ecological risk.

### SITE-SPECIFIC APPROVED CLEANUP LEVELS

Site-specific alternative cleanup levels (ACLs) for contaminants in soil were calculated for the SCS based on a review of soil and groundwater contaminant concentrations and mechanisms of contaminant fate and transport (Bristol, 2018). The ACLs were determined using ADEC Method Three calculations and site-specific parameters. The calculations were based on modification to the default Method Two migration to groundwater cleanup level using the online ADEC Cleanup Levels Calculator, and the online ADEC Petroleum Cleanup Levels Calculator (ADEC, 2018b). The soil approved cleanup level was then selected based on the most conservative of the Human Health cleanup level (Title 18 Alaska Administrative Code Section [AAC] 75.341, Tables B1 and B2, under 40-inch precipitation climate zone, modified migration to groundwater ACL, or the maximum allowable concentration (for petroleum hydrocarbons only).

These approved cleanup levels represent potential applicable or relevant and appropriate requirements (ARARs). Additionally, ACLs based on the migration to groundwater pathway can assist with evaluation of where concentrations of COPCs in soil could potentially impact groundwater, which the risk assessment determined to exceed risk thresholds.

### SCS CONTAMINANTS OF CONCERN

Contaminants of concern (COCs) for the SCS are primarily the COPCs that were identified as risk drivers in the HHSLRA. For groundwater the estimated cancer risk was predominately driven by naphthalene, with ethylbenzene and 1-methynapthalene also significantly contributing to risk; the estimated noncancer risk was predominately driven by 1,2,4-trimethylbenzene, with additional significant contributions from 1,3,5-trimethylbenzene, xylenes, 2-methylnapthalene, and cobalt. Additionally, gasoline range organics (GRO) and diesel range organics (DRO) groundwater concentrations (not evaluated in cumulative risk) were above ADEC cleanup levels and may also present potential human health concerns. Lead (which is evaluated separately because the mechanisms of toxicity are different than for other metals) exceeded the EPA tap water regional screening level (RSL) in only one well, the SCS Water Supply Well (WSW). Most elevated concentrations of contaminants that contribute to risk were limited to only two wells (MW16 and MW17) in the Burn Pit AOC. For soil, with the potential exception of arsenic and lead in subsurface soil at the Dry Well AOC, COPCs in surface and subsurface soil at the SCS site are unlikely to be present in concentrations associated with potential health concerns for the human receptors evaluated in this assessment.

For the Dry Well AOC, COCs include arsenic (which the risk assessment found to have a cancer risk of $2 \times 10^{-5}$, slightly above the ADEC target risk level of $1 \times 10^{-5}$ but within EPA acceptable risk range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$) and lead (which exceeded the RSL).

At the Burn Pit AOC, the HHSLRA did not identify COCs in soil with unacceptable risk. However, the highest concentrations of COCs in groundwater were detected in monitoring wells located in the Burn Pit AOC. DRO, which is a groundwater COC, was detected in soil at the Burn Pit AOC at concentrations that exceeded the migration to groundwater ACL. For this reason, DRO in soil is a COC at the Burn Pit.

A summary of the soil COCs for the Dry Well and Burn Pit are presented in Table ES-2, and a summary of the groundwater COCs is presented in Table ES-3.

**Table ES-2 Sears Creek Station Soil Contaminants of Concern**

| COC | Site-Specific Approved Cleanup Level (mg/Kg) | Basis | AOC(s) | Maximum Site Concentration (mg/Kg) |
|---|---|---|---|---|
| DRO | 3,300 | Migration to Groundwater | Burn Pit | 7,900 |
| Arsenic | 8.8 | Human Health | Dry Well | 16 |
| Lead | 400 | Human Health | Dry Well | 1,200 |

Notes:

AOC = Area of Concern
COC = Contaminant of Concern
DRO = diesel range organics
mg/Kg = milligrams per kilogram

### Table ES-3 Sears Creek Station Groundwater Contaminants of Concern

| COC | Cleanup Level (mg/L) | Maximum Site Concentration (mg/L) |
|---|---|---|
| DRO | 1.5 | 2.27 |
| GRO | 2.2 | 4.76 |
| Ethylbenzene | 0.015 | 0.215 |
| Xylenes (total) | 0.19 | 0.69 |
| 1,2,4-Trimethylbenzene | 0.056 | 0.693 |
| 1,3,5-Trimethylbenzene | 0.06 | 0.204 |
| Naphthalene | 0.0017 | 0.18 |
| 1-Methylnaphthalene | 0.011 | 0.039 |
| 2-Methylnaphthalene | 0.036 | 0.0607 |
| Cobalt[1] | 0.006 | 0.023 |
| Lead[2] | 0.015 | 0.0982 |

Notes:

1Cobalt was identified as a risk driver in groundwater in the HHSLRA. We propose to adopt the EPA Regional Screening Level for tap water with an HQ of 1 as the cleanup level, which is consistent with the calculated ADEC cleanup level.

2Lead was detected above the cleanup level in the WSW only.

COC = contaminant of concern
DRO = diesel range organics
GRO = gasoline range organics
HQ = hazard quotient
mg/L = milligrams per liter
NE = not established

### SCS SRI RECOMMENDATIONS

The results from the SRI evaluation of COCs, the HHSRA, and the ERA were used to make recommendations for each AOC and site feature at the SCS. Three AOCs (Dry Well, Burn Pit, and Site-Wide Groundwater) were recommended for further evaluation under the CERCLA program—these AOCs are included in this FS. Two other AOCs (Valve Manifold Building/Fuel Lines and Drum Storage Area) were recommended for management as petroleum sites under 18 AAC 75—these AOCs are evaluated in a separate FS being prepared concurrently with this FS. The recommendations are presented in Table ES-4.

### Table ES-4 SCS AOC Recommendations

| SCS AOC / Site Feature | | Recommendation |
|---|---|---|
| **SRI AOC** | | |
| **Dry Well** | | **Further evaluation in a CERCLA FS** |
| Valve Manifold Building, Dewatering Tower, and Associated Fuel Lines | Valve Manifold Building | Manage as a petroleum site under 18 AAC 75 |
| | Dewatering Tower | No further evaluation – to be closed in Decision Document |
| | Fuel Lines | Manage as a petroleum site under 18 AAC 75 |
| Former Drum Storage Area | | Manage as a petroleum site under 18 AAC 75 |
| **Burn Pit** | | **Further evaluation in a CERCLA FS** |
| Disposal Line | | No further evaluation – to be closed in Decision Document |
| Diesel AST, Diesel Transfer Pump, and Adjacent Fuel Lines | | No further evaluation – to be closed in Decision Document |
| **Site-Wide Groundwater** | | **Further evaluation in a CERCLA FS** |
| Septic Tank/Leach Wells | | No further evaluation – site was closed as part of the UIC program |
| USTs | | No further evaluation – to be closed in Decision Document |
| Composite Building Sump | | No further evaluation – to be closed in Decision Document |
| Composite Building | | No further evaluation – to be closed in Decision Document |
| Scraper Trap | | No further evaluation – to be closed in Decision Document |
| Warehouse | | No further evaluation – to be closed in Decision Document |

Notes:

**BOLD** text indicates sites that were carried forward into this Feasibility Study

AAC = Alaska Administrative Code
AOC = area of concern
CERCLA = Comprehensive Environmental Response Compensation and Liability Act
FS = feasibility study
SCS = Sears Creek Station
SRI = supplemental remedial investigation
UIC = underground injection control

### SCS FEASIBILITY STUDY RESULTS

Five remedial alternatives were developed and evaluated through the FS. Briefly, these alternatives (which are detailed in Section 4.0) include:

- Alternative 1: No Action
- Alternative 2: Land use controls (LUCs) and monitored natural attenuation (MNA)
- Alternative 3: Excavation and off-site treatment or disposal of impacted soil, decommissioning existing WSW, and MNA for site groundwater
- Alternative 4: Excavation and off-site treatment or disposal of impacted soil, decommissioning existing WSW, and biosparging to treat site groundwater
- Alternative 5: Excavation and off-site treatment or disposal of impacted soil, decommissioning existing WSW, and in-situ chemical oxidation to treat site groundwater

All five remedial alternatives were evaluated with respect to seven of the nine evaluation criteria outlined by the NCP (40 CFR § 300.430)(e)(9)(iii)) and EPA (EPA, 1988b) guidance for conducting feasibility studies under CERCLA (evaluation detailed in Section 5.0). These seven criteria include two threshold criteria (which must be satisfied for a remedial alternative to be deemed acceptable) and five balancing criteria (which are used to weigh trade-offs among the alternatives that meet threshold criteria). The remaining two criteria (referred to as modifying criteria) include state and community acceptance and are evaluated during the public review process.

The preferred alternative identified by this FS is Alternative 3 (excavation and off-site treatment or disposal of impacted soil, decommissioning existing WSW, and MNA for site groundwater). Alternative 3 passed threshold criteria and had the highest score for balancing criteria. The estimated capital cost for Alternative 3 is $641,000.

# 1.0 INTRODUCTION

This Feasibility Study (FS) has been prepared to describe remedial alternatives for the Dry Well Area of Concern (AOC), the Burn Pit AOC, and the site wide groundwater AOC at the Sears Creek Station (SCS), which is located between Delta Junction and Tok, Alaska.

## 1.1 PURPOSE OF THE FEASIBILITY STUDY

The purpose of the FS is to summarize current site conditions including nature and extent of contamination, develop remedial action objectives (RAOs), and perform a detailed analysis of remedial action alternatives to address site wide groundwater contamination and soil contamination at Burn Pit and Dry Well AOCs at the SCS site subject to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. AOCs Site Groundwater, Burn Pit, and Dry Well are not listed on the National Priorities List; therefore, the Alaska Department of Environmental Conservation (ADEC) is the lead regulatory support agency. The ultimate objective of the FS is to identify the most appropriate remedial alternative(s).

Two other AOCs (Valve Manifold Building/Fuel Lines and Drum Storage Area) are being managed as petroleum sites under 18 AAC 75—these AOCs are being evaluated in a separate FS being prepared concurrently with this FS.

## 1.2 REPORT ORGANIZATION

The document is organized into the following sections and appendices:

- Section 1.0 – Introduction – including project objectives, regulatory setting, document organization, and background information
- Section 2.0 – Remedial Action Objectives – identification of remedial action objectives
- Section 3.0 – Identification and Screening of Remedial Alternatives – including general response actions, screening technologies
- Section 4.0 – Description of Remedial Alternatives
- Section 5.0 – Comparative Analysis of Alternatives

- Section 6.0 – Preferred Remedial Alternative
- Section 7.0 - References
- Appendix A – Applicable, Relevant, and Appropriate Requirements
- Appendix B – Cost Estimate Summaries

## 1.3 BACKGROUND

This section presents a brief background of the SCS site. Details regarding climate, topography, and surface water, geology, and hydrogeology are presented in the Supplemental Remedial Investigation (SRI) report (Bristol, 2018).

### 1.3.1 Site Description

The SCS site is located at Milepost 1374 on the Alaska Highway, approximately 50 miles southeast of Delta Junction, Alaska, and 60 miles northwest of Tok, Alaska. The nearest community is Dot Lake, which is approximately 12 miles to the southeast. The site location is shown on Figure 1-1.

The station encompasses approximately 11.24 acres and is owned by the U.S. Army. The land surrounding the SCS is owned by the State of Alaska Department of Natural Resources. A gravel pit used by the State of the Alaska Department of Transportation and Public Facilities is located to the northwest of the SCS. Land ownership information for the SCS and surrounding area is presented on Figure 1-2.

### 1.3.2 History and Operation of the Sears Creek Pump Station

The SCS was one of six booster stations constructed in 1961 along the Haines-Fairbanks Pipeline (HFP) to increase pressure and flow through the pipeline. With the addition of these booster stations, the maximum flow increased from 16,500 to 27,500 barrels per day. The pipeline and pumping station were deactivated in 1973.

The station included a Composite Building (including engine, pump, generator, and mechanical rooms; an office; storage and refrigeration area; and a garage), a warehouse, trailer houses for personnel lodging, a septic tank and leaching wells, two aboveground storage tanks, two underground storage tanks, fuel piping, a fuel dispenser, a diesel fuel transfer pump, a dry well, a valve manifold building, a day tank/dewatering tower, scraper trap, and a burn pit. Figure 1-3 is a 1968 aerial image that identifies the SCS facilities.

The 8-inch HFP, which is located south of the SCS, carried refined petroleum products such as JP-4 (jet fuel), two grades of aviation gasoline, DF-4 (arctic diesel), and automotive gasoline. The products were introduced into the pipeline from fuel tankers at the Haines Terminal in Haines, Alaska.

The facility is fenced and secured with a locked gate (a new perimeter chain link fence and gate were installed in 2007). Following the 2015 decommissioning, the only remaining structure is the Composite Building. The underground features associated with the fuel system (including fuel piping and a valve manifold pit) were removed in 2015 (Bristol, 2016a). The dry well, drain line to the dry well, septic tank, leach wells, and septic lines from the tank to the leach wells were removed in 2015. The septic system piping from the Composite Building to the septic tank was decommissioned in place (Bristol, 2016b).

The SCS has historically been used by the U.S. Army for industrial purposes. The SCS is currently out of operation and the site is largely vacant. Groundwater underlying the SCS is not currently used for drinking or agricultural purposes; however, the SCS Water Supply Well (WSW) installed in 1961 remains in place (the location is shown in Figure 1-3 as Well House No. 3). There are no other drinking water wells currently located in the immediate vicinity of the SCS[1].

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[1] http://dnr.alaska.gov/mlw/welts/#/?page=show-welts-intro-template Fairbanks Meridian, 022N005E17

## 1.4 RESULTS OF THE SUPPLEMENTAL REMEDIAL INVESTIGATION

An SRI was conducted in 2015 at the SCS site to determine if environmental contamination exceeded soil and groundwater cleanup levels at specific AOCs, and to define the horizontal and vertical extent and maximum concentration levels of contamination. A human health "screening level" risk assessment (HHSLRA) and the ADEC ecoscoping elements of an ecological risk assessment (ERA) were performed as part of the SRI, with the objectives of identifying the potential for adverse effects to human health and the environment and provide information necessary to support future risk management decisions. The SRI evaluated the results of field activities performed at the SCS site during 2015, and included an evaluation of all data collected during previous investigation and removal activities at the site to fully delineate potential contamination at each AOC.

The results from the SRI determined that eight AOCs did not require a response action under CERCLA or State of Alaska Regulations. These AOCs will be processed for No Further Action:

- Dewatering Tower
- Diesel Transfer Pump
- Above Ground Fuel Tanks and their associated Fuel Lines
- Underground Storage Tanks
- Scraper Trap
- Warehouse
- Composite Building, and
- Composite Building Sump and associated Disposal Line

Two other AOCs (the Septic Tank and Leach Wells) were closed under the Class V Underground Injection Program by the USEPA.

Petroleum releases from the Former Drum Storage Area, Valve Manifold Building, and Fuel Lines associated with the Dewatering Tower and Valve Manifold Building will be addressed under State of Alaska Regulations and are not evaluated in this FS.

Three AOCs had contaminants other than petroleum compounds and/or groundwater contamination: Dry Well, Burn Pit, and Site Wide groundwater. These sites were recommended for further evaluation as part of CERCLA and are the focus of this FS. Section 2.3 discusses the extent of media and areas requiring remediation.

### 1.4.1 Dry Well

The Dry Well was removed during a Class V underground injection control (UIC) closure action in 2015. Soil samples collected as part of the end-point sampling showed exceedances of ADEC Method Two cleanup levels for fuels, fuel-related compounds, and several metals below the former dry well (Bristol, 2016b). To characterize and delineate the extent of soil contamination identified during the Class V UIC closure activities, three soil borings were drilled in the former Dry Well area as part of the SRI, and three borings were completed along the piping that ran from the Composite Building to the Dry Well. Soil borings DW-BH1 through and DW-BH3 were located within or immediately adjacent to the Dry Well excavation area, and were drilled to depths of 55 feet below ground surface (bgs) to 57 feet bgs. Groundwater was encountered at approximately 53 feet bgs. Photoionization detector (PID) measurements exceeding background were not observed in any of the soil borings, and no other evidence of soil contamination was identified.

Three borings were completed along the piping that ran from the Composite Building to the Dry Well (DW-BH4 through and DW-BH6). The soil borings were drilled to depths of 19 to 20 feet bgs. PID measurements exceeding background were not measured in any of the soil borings, and no other evidence of soil contamination was identified. Arsenic exceeded the site-specific approved cleanup level (8.8 mg/kg) in one sample collected from soil boring DW-BH2 at a depth of 12.5 feet below the ground surface at a concentration of 16 mg/kg.

Soil boring DW-BH2 was completed as monitoring well MW9. A second monitoring well, MW12, was installed approximately 70 feet to the northwest (downgradient) of MW9. Existing well MW1 is approximately 35 feet north of MW9. Analytical results for groundwater samples collected from the three wells in September 2015, showed the only exceedance of ADEC Table C groundwater cleanup levels (ADEC, 2018a) was for arsenic in MW12.

Based on these results, it appears an area of contamination is associated with soils directly under the former Dry Well area at a depth of approximately 12.5 feet bgs. The extent of the contamination is very limited and has not impacted groundwater.

The Dry Well groundwater sampling results showed that the only exceedance of ADEC Table C groundwater cleanup levels in samples collected during the SRI was for arsenic in MW12. However, this arsenic detection was associated with naturally occurring sources as discussed in the SRI report (Bristol, 2018).

The HHSLRA also calculated that concentrations of COPCs in soil at the Dry Well AOC result in an estimated cancer risk of 3 x $10^{-5}$, which is within the EPA's acceptable risk range but slightly exceeds the ADEC excess cancer risk threshold. The cumulative noncancer risk at the Dry Well AOC was estimated with a HI of 0.6.

### 1.4.2 Burn Pit

Five surface soil samples collected from the Burn Pit during the SRI were consistent with previous sampling results (North Wind, 2010), which showed there were no exceedances of the ADEC cleanup levels for dioxins/furans. The SRI surface soil samples were also analyzed for poly- and perfluoroalkyl substances, and the results showed no detections of perfluorooctanoic acid (PFOA) or perfluorooctanesulfonic acid (PFOS), which had not been analyzed in samples collected during the previous investigations.

Subsurface soil samples collected at the Burn Pit following the SRI further delineated the extent of contaminated soil associated with fuel and fuel constituents (North Wind 2016). A majority of the contaminated soil was identified between 5 and 17.5 feet bgs, and extends into the saturated zone. A cross section showing the approximate extent of contamination in the Burn Pit area is presented in Figure 1-4.

Three soil borings were installed along the former Disposal Line from the Composite Building to the Burn Pit (outside of the Burn Pit area), and soil samples were collected from each boring between 5 and 6 feet bgs and 19 and 20 feet bgs. No contaminants were identified above site-specific approved cleanup levels.

Groundwater samples associated with the Burn Pit were collected from existing wells MW5 and MW6 and newly installed wells MW16 and MW17 in September 2015 (Figure 1-5). Analytical results showed a number of fuel-related contaminants with concentrations above the ADEC Table C cleanup levels in MW16 and MW17, located within and immediately north of the Burn Pit, respectively. The exceedances included arsenic, diesel range organics (DRO), gasoline range organics (GRO), ethylbenzene, xylenes, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene. Several additional fuel-related volatile organic compounds (VOCs) and polynuclear aromatic hydrocarbons (PAHs) analytes, and 1,2-dibromoethane, were detected in MW16 and MW17, but at concentrations below the cleanup levels. There were no detections of pesticides, PFOA/PFOS, or residual range organics in any of the samples. In downgradient well MW5, only arsenic exceeded the ADEC Table C cleanup level in the September 2015 sample. The arsenic exceedance was attributed to naturally occurring sources and not contamination.

One monitoring well, MW18, was installed adjacent to the Disposal Line near the Composite Building and sump and sampled in September 2015. No analytes exceeded ADEC Table C cleanup levels.

The only other well where exceedances were observed was downgradient well MW5. Arsenic exceeded the ADEC Table C cleanup level in 2015, but was attributed to naturally occurring sources and not contamination as discussed in the SRI report (Bristol, 2018).

The HHSLRA did not identify risk drivers in soil. However, since groundwater was found to exceed ADEC Table C cleanup values in two wells at the Burn Pit and DRO in soil was found to exceed ADEC Method Three calculated migration to groundwater cleanup levels, the SRI recommended the site be advanced to a FS.

### 1.4.3 Site Groundwater

As described in the previous section, analytical results for groundwater samples collected in 2015, exceeded ADEC Table C cleanup levels in Burn Pit wells MW16 and MW17.

The only other groundwater exceedance of the ADEC Table C cleanup levels found at the SCS site in 2015, was lead in the Composite Building WSW. However, the lead detection in this well is likely associated with the components of the water distribution system (e.g., lead well screen, lead piping, or other lead water supply system components) rather than contaminant migration. Contaminant migration is not suspected as there were no lead exceedances in soil identified in this area. Additionally, no groundwater samples collected from monitoring wells located upgradient or downgradient of the Composite Building had lead exceedances, including in the direction of the Dry Well AOC, which is the only AOC at SCS that had lead exceedances in soil. Moreover, since the screen length was unknown, the submersible pump was placed at the bottom of the well to collect a fresh formation water sample. In doing so, it is possible that lead particulates from the bottom of the well were introduced into the sample container (the sample was unfiltered), which were subsequently dissolved by acid.

The Army is planning to decommission the WSW and install a new groundwater monitoring well either at the same location or downgradient to confirm that groundwater at the WSW does not contain lead that exceeds ADEC Table C cleanup levels.

## 1.5 CONTAMINANT FATE AND TRANSPORT

The fate and transport of contaminants in soil and groundwater at the SCS is affected by a variety of physical, chemical, and biological factors in the environment; and the physical and chemical properties of each individual compound. Section 10.0 of the SRI presents a detailed explanation of these various factors (Bristol, 2018).

## 1.6 HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

Based on the HHSLRA (Appendix H, Bristol, 2018) the following AOCs and media were identified as requiring further evaluation to ensure protection of current and future site receptors:

- **Subsurface soil in the Dry Well AOC (arsenic and lead).** Maximum detected concentrations (MDCs) of arsenic and lead in soil were noted at the same sample location (primary and duplicate sample 15SCSDW03SS) at a depth of 12.5 feet bgs. The MDC of arsenic resulted in a cancer risk of 2 x $10^{-5}$, only slightly higher than the ADEC target risk level of 1 x $10^{-5}$, but within the U.S. Environmental Protection Agency's (EPA's) acceptable risk range of $10^{-6}$ to $10^{-4}$. Arsenic concentrations measured in other Dry Well AOC samples were near or below the background threshold value (BTV) developed in the SRI (Bristol, 2018). Similarly, lead concentrations measured in other Dry Well AOC samples were one to two orders of magnitude below the screening levels. Thus, soil impacts are localized to the Dry Well AOC.
- **Site-wide groundwater (lead, VOCs, PAHs, GRO, and DRO).** MDCs of the groundwater contaminants of potential concern (COPCs) resulted in cumulative cancer risk of 1 x $10^{-3}$, above the EPA's target acceptable risk range of $10^{-4}$ to $10^{-6}$, as well as the ADEC excess cancer risk threshold of $1 \times 10^{-5}$. Cumulative cancer risks are driven primarily by naphthalene and ethylbenzene. MDCs of the groundwater COPCs resulted in cumulative hazard index (HI) of 58, well above the target HI of

> 1. The MDC of lead exceeded both the tap water RSLs and ADEC groundwater cleanup level, but in only one well (the WSW). GRO and DRO exceeded the ADEC groundwater cleanup levels in only two wells (MW16 and MW17) located at the Burn Pit AOC.

Chemicals are not present at concentrations that would potentially pose human health risks or hazards to residential or industrial receptors from exposure to surface soil or subsurface soil at the Burn Pit AOC. However, due to the very conservative assumptions of the RA (i.e., use of residential RSLs and MDCs), estimated risks for the focus areas listed above are likely overestimated. Screening levels established in the HHSLRA are based on a future residential exposure scenario, and receptors spending 100 percent of their time in the affected areas. However, no residential exposures are expected, nor would any receptors spend all of their time in the affected areas. Furthermore, groundwater screening levels established in the HHSLRA are conservatively based on groundwater used as a drinking water source. However, site groundwater is not currently used as a drinking water source. In addition, most exceedances of ADEC groundwater cleanup levels were limited to only two wells (MW16 and MW17) in the Burn Pit AOC.

Soil impacts for SCS were evaluated on an AOC-by-AOC basis and so exposure frequency used in the risk evaluation was not fractionated between AOCs. Because the COPCs differed between AOCs and because of the screening nature of this RA, totaling risk from across all AOCs provides useful information on overall site-wide (aggregate) cumulative risk. If the soil risks for all AOCs are summed, the total estimated risk is $5 \times 10^{-5}$, which meets the acceptable risk range of $10^{-4}$ to $10^{-6}$ but exceeds the ADEC excess cancer risk threshold of $1 \times 10^{-5}$. The total estimated noncancer hazard for soil for all AOCs combined is three, which is only slightly above the target HI of one. Overall site-wide risks from exposure to soil and groundwater combined would be slightly higher than those calculated for groundwater alone and would still exceed target health goals. The contribution to overall site-wide risks from soil is relatively insignificant compared to groundwater. Thus, the focus areas identified for groundwater above are the primary drivers for overall site-wide risks.

The screening risk assessment only evaluated the direct contact pathways for soil and groundwater. With the potential exception of arsenic and lead in subsurface soil at the Dry Well AOC, the HHSLRA concluded that concentrations of COPCs in surface and subsurface soil at the SCS site are unlikely to be present in concentrations associated with potential health concerns for the receptors evaluated in this assessment. However, the MDCs of COPCs in groundwater were sufficiently high such that use of groundwater as a future drinking water source could result in unacceptable health risk. As detailed in the SRI, direct releases to groundwater have not occurred. Groundwater impacts are the result of vertical migration of chemicals in soil to groundwater. Thus, residual soil concentrations could be a continuing source of contamination to groundwater. The potential for vertical migration of soil contaminants (through the soil column) to groundwater was evaluated in the SRI. Groundwater impacts directly associated with COPC in soil were identified at only the Burn Pit.

### 1.6.1 Ecological Evaluation

The ecosoping elements of an ERA were performed and are presented in the SRI (Bristol, 2018). The evaluation concluded that exposure to residual chemicals in surface and shallow subsurface soil is potentially complete, but unlikely to result in significant exposure to ecological receptors. Per ADEC decision criteria, available information are considered adequate to conclude that reported exposure (and potential risk) is negligible and there is no need of further evaluation or remedial action based on potential ecological risk.

## 1.7 CONTAMINANTS OF CONCERN

COCs are the site-related contaminants that pose an unacceptable risk to human health and/or the environment. COCs provide the basis for determining what cleanup actions will be evaluated in the FS (EPA, 1999).

### Table 1-1 ADEC Method Three Calculator Results for SCS Soils

| Compound | ADEC Method Two Migration to Groundwater Cleanup Level[1] (mg/Kg) | ADEC Human Health Level[2] (mg/Kg) | ADEC Method Three Calculator Value - Migration to Groundwater[3] (mg/Kg) | Site-Specific Approved Cleanup Level[5] (mg/Kg) | SCS Maximum Concentration (mg/Kg) |
|---|---|---|---|---|---|
| **Arsenic** | **0.2** | **8.8** | **210** | **8.8** | **16[6]** |
| Benzene | 0.022 | 11 | 12 | 11 | 0.41 |
| Ethylbenzene | 0.13 | 49 | 61 | 49 | 1.9 |
| Xylenes (Total) | 1.5 | 57 | 710 | 57 | 22.9 |
| 1,2-Dichloroethane | 0.0055 | 5.5 | 3.5 | 3.5 | 0.011 |
| 1,1,2-TCA | 0.0014 | 1.6 | 0.72 | 0.72 | 0.14 |
| Naphthalene | 0.038 | 29 | 13 | 13 | 5.8 |
| 1-Methylnaphthalene | 0.41 | 68 | 130 | 68 | 34 |
| 2-Methylnaphthalene | 1.3 | 310 | 410 | 310 | 28 |
| 1,2,4-TMB | 0.61 | 43 | 590 | 43 | 34.7 |
| 1,3,5-TMB | 0.66 | 37 | 650 | 37 | 17.9 |
| **DRO** | **250** | **10,250** | **3,300[4]** | **3,300** | **11,600** |
| GRO | 300 | 1,400 | 5,000 | 1,400 | 653 |
| RRO | 11,000 | 10,000 | 130,000 | 10,000 | 76,100 |
| Cadmium | 9.1 | 92 | 9,700 | 92 | 12 |
| **Lead** | **NA** | **400** | **NA** | **400** | **1,200** |
| Mercury (elemental) | 0.36 | 3.1 | 380 | 3.1 | 0.69 |
| Selenium | 6.9 | 510 | 7,100 | 510 | 13 |

Notes:

BOLD indicates contaminant of concern for site covered in this FS.

[1] Table B1 and Table B2 (for petroleum hydrocarbons) in 18 AAC 75 (ADEC, 2018a).

[2] Human Health value based on the Under 40-inch zone in Table B1, and most conservative of the ingestion and inhalation value for the under 40-inch zone in Table B2 (for petroleum hydrocarbons) (ADEC, 2018a).

[3] Modified migration to groundwater cleanup level based on Method Three and the ADEC Cleanup Levels Calculator and the Petroleum Cleanup Levels Calculator.

[4] Maximum allowable concentrations for DRO = 12,500 mg/Kg; GRO = 1,400 mg/Kg; RRO = 22,000 mg/Kg

[5] Approved cleanup level based on the most conservative of the Human Health and Method Three Calculator value, with one exception.

[6] The site maximum concentration for arsenic is based on the concentration identified at the Dry Well, since the only statistically significant detection of arsenic was identified the Dry Well AOC (Bristol, 2018). The Dry Well AOC is the only AOC for which arsenic was retained as a COC, further discussion provided in Section 2.3.1.

DRO = diesel range organics
GRO = gasoline range organics
mg/Kg = milligrams per kilogram
NA = not applicable
RRO = residual range organics
TMB = trimethylbenzene

COCs are those contaminants that contribute significantly to the risk, are used to establish RAOs, and are used to scope/design remedial alternatives. COCs were selected based on (1) results of the risk assessment, and (2) comparing concentrations of site contaminants to applicable cleanup levels and (if applicable) BTVs. A site contaminant was retained as a COC if it was identified in the HHSLRA as being a primary contributor to the risk, or if the maximum concentration detected during previous investigations was above both the BTV and appropriate cleanup levels. Contaminants were not retained as COCs if neither of these were the case.

### 1.7.1 Soil

COCs for soil are those identified as risk drivers in the HHSLRA. A summary of the soil COCs for the Burn Pit and Dry Well AOCs is presented in Table 1-2.

**Table 1-2 SCS Soil COCs**

| COC | Site-Specific Approved Cleanup Level[1] (mg/Kg) | Basis | AOC(s) | Maximum Site Concentration (mg/Kg) |
|---|---|---|---|---|
| DRO | 3,300 | Method Three Migration to Groundwater | Burn Pit | 11,600 |
| Arsenic | 8.8 | Human Health | Dry Well | 16 |
| Lead | 400 | Human Health | Dry Well | 1,200 |

Notes:

[1] Approved cleanup levels are based upon residential cleanup levels from the SRI report (Bristol, 2018).

AOC = area of concern
DRO = diesel range organics
mg/Kg = milligrams per kilogram
RRO = residual range organics

### 1.7.2 Groundwater

COCs for Site Groundwater at the SCS were identified by comparing the maximum detected concentrations of contaminants in groundwater to the ADEC Table C values. This comparison, along with identification of groundwater contaminants identified as risk drivers in the screening level HHSLRA, was used to develop the list of groundwater COCs at the SCS. A summary of the Site Groundwater AOC COCs are presented in Table 1-3.

**Table 1-3 SCS Groundwater COCs**

| COC | ADEC Table C Cleanup Level (mg/L) | Maximum Site Concentration (mg/L) |
|---|---|---|
| DRO | 1.5 | 2.27 |
| GRO | 2.2 | 4.76 |
| Ethylbenzene | 0.015 | 0.215 |
| Xylenes (Total) | 0.19 | 0.69 |
| 1,2,4-Trimethylbenzene | 0.056 | 0.693 |
| 1,3,5-Trimethylbenzene | 0.06 | 0.204 |
| Naphthalene | 0.0017 | 0.18 |
| 1-Methylnaphthalene | 0.011 | 0.039 |
| 2-Methylnaphthalene | 0.036 | 0.0607 |
| Cobalt[1] | 0.006 | 0.023 |
| Lead[2] | 0.015 | 0.0982 |

Notes:

[1] Cobalt was identified as a risk driver in groundwater in the HHSLRA. We propose to adopt the EPA Regional Screening Level for tap water with an HQ of 1 as the cleanup level, which is consistent with the calculated ADEC cleanup level.

[2] Lead was detected above the cleanup level in the WSW only.

COC = contaminant of concern
DRO = diesel range organics
GRO = gasoline range organics
HQ = hazard quotient
mg/L = milligrams per liter
NE = not established

## 1.8 ADEC METHOD THREE CALCULATOR ACLS AND APPROVED CLEANUP LEVELS FOR SOIL

Site-specific ACLs for contaminants in soil were calculated in the SRI for the SCS based on a review of soil and groundwater contaminant concentrations and mechanisms of contaminant fate and transport. Soil ACLs were developed for all contaminants detected above the lower of the 2018 ADEC Method Two migration to groundwater or human health clean up levels. The ACLs were determined using ADEC Method Three calculations and site-specific parameters (Bristol, 2018). The calculations were based on modification to the default Method Two migration to groundwater cleanup level using the online ADEC Cleanup Levels Calculator, and the online ADEC Petroleum Cleanup Levels Calculator (ADEC, 2018b). The soil approved cleanup level was then selected based on the most conservative of the Human Health cleanup level (Tables B1 and B2 of 18 AAC 75 for the under 40-inch zone), modified migration to groundwater ACL, or the maximum allowable concentration (for petroleum hydrocarbons only). Table 1-1 provides a comparison between the ADEC Method Two default values, the ADEC Method Three modified migration to groundwater cleanup levels, and the maximum concentration detected at the SCS. The table also includes the site-specific approved cleanup levels for the SCS site, which were based on the most conservative of the Human Health cleanup level (Tables B1 and B2 of 18 AAC 75 for the under 40-inch zone), modified migration to groundwater ACL, or the maximum allowable concentration (for petroleum hydrocarbons only).

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# 2.0 REMEDIAL ACTION OBJECTIVES AND CLEANUP GOALS

## 2.1 REMEDIAL ACTION OBJECTIVES

RAOs are specific goals for protecting human health and the environment from risks and hazards associated with site-related contamination. The RAOs must address the media-specific Applicable or Relevant and Appropriate Requirements (ARARs) identified for the site. RAOs may be achieved by reducing exposure to the contaminated media or through reduction of concentrations of COCs at exposure points to below protective concentrations. The RAOs for soil and groundwater addressed in this FS are:

- **RAO 1:** Prevent the exposure of human receptors with contaminated media that pose a cumulative carcinogenic risk greater than 1 in 100,000 or a cumulative noncarcinogenic HI greater than 1 across all exposure pathways. Specifically:
  - Reduce concentrations of arsenic and lead in soil less than 15 feet bgs to below ADEC Table B.1 CULs protective of human health. Refer to Table 1.2 for numerical cleanup goals.
- **RAO 2:** Restore groundwater to water quality standards protective of human receptors considering cumulative exposure through dermal contact, ingestion, and inhalation of volatile compounds in groundwater. Specifically:
  - Reduce concentrations of naphthalene and DRO, GRO, ethylbenzene, xylenes, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene in groundwater to below ADEC Table C CULs. Refer to Table 1.3 for numerical cleanup goals.
- **RAO 3:** Prevent further degradation of groundwater by reducing the concentrations of COCs in soil to levels protective of groundwater quality. Specifically:
  - Reduce concentrations of DRO in soil to below ACLs for protection of migration to groundwater developed using ADEC Method Three. Refer to Table 1.2 for numerical cleanup goals.

## 2.2 CLEANUP GOALS

The proposed soil cleanup levels for Burn Pit and Dry Well AOCs are the lowest applicable levels for ADEC Table B1 or B2 Method Two cleanup levels for human health per 18 AAC 75.341 (ADEC, 2018a) or, when available, the Method Three cleanup levels for migration to groundwater developed per 18 AAC 75.340 (ADEC, 2017). SCS-specific cleanup goals for contaminants detected in soil at the Dry Well and Burn Pit AOCs are the approved cleanup levels presented in Table 1-2. Cleanup levels for human health exposures (i.e., direct contact and outdoor inhalation) will be achieved up to a depth of 15 feet bgs. Migration to groundwater cleanup levels that are protective of groundwater will be achieved at all depths. Proposed groundwater cleanup levels for the Site Groundwater AOC are ADEC Table C cleanup levels per 18 AAC 75.345.

After achieving cleanup levels, the risk from hazardous substances will be evaluated to ensure it does not exceed a cumulative carcinogenic risk standard of 1 x $10^{-4}$ or a cumulative noncarcinogenic HI of 1 across all exposure pathways per 18 AAC 75.325(g) (ADEC, 2018a). The proposed groundwater cleanup levels for Site SS018 are ADEC Table C cleanup levels per 18 AAC 75.345.

## 2.3 MEDIA AND AREAS REQUIRING REMEDIATION

Concentrations of COCs in combined surface and subsurface soil (0 to 15 feet bgs) and groundwater that exceed cleanup levels require remediation or management to ensure RAOs are met.

### 2.3.1 Soil

Soil contamination exceeding cleanup levels was identified at Dry Well and Burn Pit AOCs. SCS cleanup levels for subsurface soils are presented in Table 1-2.

As part of the SRI, a BTV metals evaluation was conducted to allow for the evaluation of ADEC Method Two exceedances that may be attributable to naturally occurring metals and not potential contaminant sources. Arsenic detections at the Burn Pit and Dry Well AOCs were further evaluated due to the widespread arsenic exceedances identified across the SCS AOCs. The concentrations at each AOC were compared to the site wide concentrations using the two-sample t-test, and the results showed the Burn Pit concentration was not statistically different than the site wide concentration. However, the arsenic detection at the Dry Well was statistically different, and may be a result of a contaminant release. Based on these results, the arsenic detections at all sites except the Dry Well were assumed to be associated with naturally occurring sources (Bristol, 2018).

#### 2.3.1.1 Dry Well AOC

Soil samples collected as part of the end-point sampling during the Class V UIC closure at the Dry Well showed exceedances of ADEC Method Two cleanup levels for fuels, fuel-related compounds, and several metals below the former dry well (Bristol, 2016b). However, follow-up sampling completed during the SRI, including three soil borings within 10 feet laterally of the end-point sample location, did not identify evidence of fuel or metals contamination indicating the lateral extent of contamination is limited. Site-specific soil approved cleanup levels were only exceeded for lead and arsenic in the end point sample collected at 12.5 feet bgs.

Arsenic determined to likely be attributable to contamination, and not naturally occurring, is present at DW02 at 16 milligrams per kilogram (mg/Kg) (12.5 feet bgs) compared to the ADEC human health cleanup level of 8.8 mg/Kg. Lead (1,200 mg/Kg) exceeded the residential cleanup level of 400 mg/Kg, which is based on the ADEC Method Two cleanup level for human health.

Groundwater sampling results from the monitoring wells installed near and downgradient of the Dry Well source area showed the limited soil contamination identified in the Class V UIC closure has not impacted groundwater. The Dry Well groundwater sampling results showed that the only exceedance of ADEC Table C groundwater cleanup levels in samples collected during the SRI was for arsenic in MW12. However, this arsenic detection was associated with naturally occurring sources as discussed in the SRI report (Bristol, 2018).

Based on these results, it appears there is an area of contamination in soil requiring a response action under the former Dry Well, around the location of DW02, from a depth of approximately 12.5 feet bgs to 15 feet bgs. The approximate area is presented on Figure 2-1. The lateral extent of contamination is less than 10 feet in radius around DW02, based on the results of the SRI. The total volume of contaminated media requiring a response action is estimated to be less than 20 cubic yards based on the following calculation: a 2.5-foot-thick layer with a radius of 8 feet results is a volume of approximately 18.6 cy.

#### 2.3.1.2 Burn Pit AOC

Soil analytical results from the Burn Pit AOC that exceed ADEC Method Two cleanup levels are shown on Figure 2-2 and soil analytical results that exceed approved cleanup levels are shown on Figure 2-3. Surface soil samples collected from the Burn Pit had no exceedances of the approved cleanup levels for any of the previous investigations. Contaminated subsurface soil was identified from 4 to 40 feet bgs, beneath the Burn Pit, extending into the saturated zone. A cross section showing the approximate extent of contamination in the Burn Pit area is presented in Figure 1-4. Only DRO in the 4 to 5 feet bgs sample from boring 15SB3 exceeded its ACL. The extent of contamination exceeding approved cleanup levels is presented on Figure 2-3. However, the vertical extent of approved cleanup level exceedances in this area is uncertain as the next deepest sample was collected from 15 to 17.5 feet bgs (at nearby boring SB7B). Therefore, the vertical extent of approved cleanup level exceedances is assumed to extend to 15 feet bgs. The lateral extent of contamination exceeding approved cleanup levels is within approximately 15 feet of 15SB3

Although this was only a single approved cleanup level exceedance in soil beneath the Burn Pit, several COCs in Burn Pit groundwater were detected in soil beneath the Burn Pit at concentrations above the ADEC Method Two but below the Method Three migration to groundwater cleanup levels. The highest concentrations of groundwater

COCs (including DRO, ethylbenzene, xylenes, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, naphthalene, and 2-methylnaphthalene) were detected in soil between 4 and 17.5 feet bgs. Elevated concentrations of nearly all Burn Pit groundwater COCs, except xylenes, 1-methylnaphthalene, and 2-methylnaphthlene, persist between 17.5 and 40 feet bgs.

Laboratory results from the subsurface soil samples collected along the former Disposal Line from the Composite Building to the Burn Pit (outside of the Burn Pit area) showed only trace detections of fuel (GRO), with no analytical results above ADEC Method Two cleanup levels.

### 2.3.2 Groundwater

Site-wide groundwater contamination is addressed as the Site Groundwater AOC. Cleanup levels for groundwater are presented in Table 1-5, and areas exceeding the cleanup levels are shown on Figure 2-4.

Groundwater beneath the Burn Pit contains a number of fuel-related contaminants with concentrations above the ADEC Table C cleanup level in MW16 and MW17. The exceedances included arsenic, DRO, GRO, ethylbenzene, xylenes, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene.

The only other groundwater exceedance of the ADEC Table C cleanup levels found at the SCS site in 2015, was lead in the Composite Building WSW. However, the lead detection in this well is believed to be associated with the components of the water distribution system (e.g., lead well screen, lead piping, or other lead water supply system components) rather than contaminant migration. Contaminant migration is not suspected as there were no lead exceedances in soil identified in this area. Additionally, no groundwater samples collected from monitoring wells located upgradient or downgradient of the Composite

Building had lead exceedances, including in the direction of the Dry Well AOC, which is the only AOC at SCS that had lead exceedances in soil. Moreover, since the screen length was unknown, the submersible pump was placed at the bottom of the well to collect a fresh formation water sample. In doing so, it is possible that lead particulates from the bottom of the well were introduced into the sample container (the sample was unfiltered), which were subsequently dissolved by acid. To confirm that groundwater contaminated with lead above ADEC Table C cleanup levels is not present, the Army intends to properly decommission the WSW and install a new groundwater monitoring well either in the same location or downgradient.

## 2.4 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

Chemical-specific, location-specific, and action-specific ARARs are presented in Appendix A.

# 3.0 IDENTIFICATION AND SCREENING OF REMEDIAL ALTERNATIVES

The primary objective of this section is to identify remedial technologies and approaches suitable to address one or more elements of conditions at the Burn Pit, Dry Well, and Groundwater AOCs that warrant a response action. This section identifies general response actions (GRAs) that could possibly be used to achieve RAOs. Under each GRA, numerous specific response actions (SRAs) that could potentially be implemented are identified and screened.

## 3.1 GENERAL RESPONSE ACTIONS

The National Contingency Plan (NCP) establishes expectations for the types of remedies that will be used for addressing principal threat and low-level threat wastes. The concept of principal and low-level threat waste developed in the NCP is applied on a site-specific basis when characterizing source material. Source material is defined as material that includes or contains hazardous substances, pollutants, or contaminants and that acts as a reservoir for migration of contamination to groundwater, surface water, or air, or that acts as a source for direct exposure. Low-level threat wastes are wastes that exhibit low toxicity or low mobility in the environment or are near health-based levels. In contrast, principal threat wastes are high-toxicity or highly mobile wastes that would present a significant risk to human health or the environment should exposure occur (EPA, 1991). The waste remaining at the Burn Pit, Dry Well, and Groundwater AOCs is considered a low-level threat waste rather than a principal threat waste because the source consists of residual, low-magnitude levels of soil and groundwater contamination that is not highly toxic or highly mobile.

The NCP establishes the expectation to use:

- Treatment to address the principal threats posed by a site, wherever practicable;
- Engineering controls (EC), such as containment, for wastes that pose a relatively low long-term threat or where treatment is impractical;

- A combination of methods, as appropriate to achieve protection of human health and the environment; and
- Institutional controls (IC) such as groundwater-use restrictions (e.g., restriction on installation of groundwater wells and/or replacement of existing wells with alternative water sources) and land use restrictions (e.g., prohibiting development or residents, schools, or daycares) to supplement ECs as appropriate for short- and long-term management to prevent or minimize exposure to hazardous substances.

A GRA is a broadly defined group, class, or type of action that could possibly be used to achieve RAOs. The GRAs that were evaluated as part of this FS are:

- **No Action:** Contaminated media are left in place and nothing is done;
- **Risk and Hazard Management (Land Use Controls [LUCs]):** Contaminated media are left in place and measures are taken to prevent receptors from being exposed to contamination at concentrations that could present a hazard;
- ***In Situ* Treatment:** Contaminated media are left in place and measures are taken to reduce the toxicity, mobility, or volume (TMV) of contaminants to levels that no longer pose a potential hazard;
- **Removal:** Contaminated media are physically removed from the subsurface and are either treated or properly disposed; and
- **Containment:** Contaminated media are left in place and engineered approaches are implemented to ensure that contaminated media do not migrate outside a designated management area.

### 3.1.1 No Action

No action refers to a site remedy where no active remediation or risk and hazard management are implemented. Under the Defense Environmental Restoration Program (DERP) (U.S. Department of Defense [DoD], 2012), evaluation of a no action remedial alternative is required, pursuant to the NCP, 42 Code of Federal Regulations (CFR) § 300.430 et seq., to provide a baseline for comparison with other remedial alternatives.

### 3.1.2 Risk and Hazard Management

Risk and hazard management uses enforceable LUCs, including ICs/ECs, to prevent or limit exposure of receptors to potentially harmful concentrations of COCs. Examples of

ICs include restrictions on groundwater extraction and restrictions on excavation. Examples of ECs include physical barriers and access restrictions (e.g., fencing, locked gates, and warning signs). LUCs can be cost-effective, reliable, and immediately effective; they can be implemented either alone or with other remedial components. Inspections are typically required to document long-term effectiveness of LUCs. The administrative feasibility of and cost to implement LUCs depend on site-specific circumstances (e.g., whether a site is under the direct operational control of the federal government or has been transferred to non-federal ownership).

### 3.1.3 *In Situ* Treatment

For purposes of this FS, *in situ* treatment refers to engineered and non-engineered approaches to reduce the TMV of contaminants in the subsurface, thereby preventing or minimizing exposure of receptors to, or further degradation of natural resources by, site contamination. *In situ* treatment means that soil and groundwater are remediated in place. Biological, chemical, and physical processes may be used for *in situ* treatment. Examples of *in situ* bioremediation options include bioventing and monitored natural attenuation (MNA). Examples of physical and chemical treatment methods include soil vapor extraction (SVE) and chemical oxidation, respectively. Enhancements such as fracturing or heating the subsurface can be used to increase the efficiency or effectiveness of certain *in situ* technologies.

SVE could also be considered a mass removal technology because SVE involves the removal of soil vapor and accompanying contaminant mass for *ex situ* treatment/disposal. However, because SVE is applied by employing the same infrastructure as bioventing, for the purposes of this FS report, SVE is considered to be an *in situ* remedial technology.

Implementability and effectiveness are generally influenced by the following five factors:

1. Site function, operation, or usage;
2. Existing site features and infrastructure;

3. Site geologic, hydrogeologic, geochemical, and microbiological conditions;
4. Physiochemical properties of the COCs; and
5. Mass of contaminants present in the affected media.

The feasibility, and cost, of *in situ* treatment implementation vary widely based on these and other site-specific circumstances.

### 3.1.4 Removal

Removal actions use engineered approaches to reduce TMV of contaminants in the subsurface, thereby preventing or minimizing exposure of receptors to concentrations of site contaminants that could pose an unacceptable risk or hazard. Following removal of the contaminated media, a variety of biological, chemical, and physical technologies are available for *ex situ* treatment of the extracted media. Alternately, contaminated media may be transported from the site for treatment/disposal. Implementability and effectiveness are generally governed by the same five factors listed above for *in situ* treatment. The feasibility of, and cost to implement, contaminant removal options can vary widely based on these and other site-specific circumstances.

### 3.1.5 Containment

Containment actions use engineered approaches to ensure that contaminated media do not migrate outside an area selected to manage the contamination. Containment actions are designed to reduce mobility of contaminants to prevent or minimize exposure of receptors to concentrations of site contaminants that could pose an unacceptable risk or hazard. Containment actions are not designed to reduce the toxicity or volume of contamination, although some reduction of toxicity or volume may occur. Examples of containment actions include soil capping and hydraulic barriers or hydraulic control of groundwater. Implementability and effectiveness are generally governed by the same factors listed above for *in situ* treatment except the mass of contaminants present in the contaminated media is not usually a governing factor. The feasibility of, and cost to implement, contaminant removal options can vary widely based on these and other site-specific circumstances.

### 3.2 IDENTIFICATION OF SPECIFIC RESPONSE ACTIONS

This section presents the SRAs that could potentially be implemented to address current site conditions, protect public health and the environment, and achieve the RAOs. Taken individually, the SRAs may not address all of the RAOs; however, SRAs that pass through the screening process can be combined into remedial alternatives that would achieve the RAOs (except for the no action alternative). The SRAs under consideration for this site focus on proven technologies and approaches implemented at similar sites to meet similar RAOs. The SRAs described below can be used individually or in combination to more effectively meet specific RAOs.

The following SRAs applicable to soil were considered for screening:

- No Action;
- Risk and Hazard Management – LUCs;
- *In Situ* Treatment – Bioventing;
- *In Situ* Treatment – SVE;
- *In Situ* Treatment – Thermal Enhancement;
- Removal – Excavation and Onsite Treatment;
- Removal – Excavation and Offsite Treatment;
- Removal – Excavation and Offsite Disposal; and
- Containment – Impermeable Cap.

The following SRAs applicable to groundwater were considered for screening:

- No Action;
- Risk and Hazard Management – LUCs;
- *In Situ* Treatment – Sulfate Enhanced Biodegradation;
- *In Situ* Treatment – MNA;
- *In Situ* Treatment – Chemical Oxidation;

- *In Situ* Treatment – Air Sparging/Biosparging; and
- Containment –Hydraulic Containment of Plume.

## 3.3 SPECIFIC RESPONSE ACTION SCREENING

Evaluation results for the potential SRAs are provided in the following sections and are summarized in Table 3.1.

## Table 3-1 Screening of Specific Response Actions

| General Response Action | Remedial Technology | Specific Response Action | Process Description | Implementability | Effectiveness | Relative Cost | Retained? |
|---|---|---|---|---|---|---|---|
| **Soil and Groundwater** | | | | | | | |
| No Action | None | No Action | None. | Readily implementable. | Will not meet remedial action objectives (RAOs). Used as a baseline for alternatives comparison. | N/A | **Yes** |
| Risk and Hazard Management | Land Use Controls (LUCs) | LUCs | Implement Engineering Controls (EC) such as fencing and security and/or Institutional Controls (IC), such as notifications, controls/ monitoring if any excavation activities were performed, as well as land use restrictions to control type of development, groundwater use, and uncontrolled reuse of soil from beneath the Site. The WSW would be decommissioned (an EC) as it is believed to be the source of lead in the sample collected from this well. | Readily implementable. | ECs and ICs are effective in preventing exposure pathways from being completed. | Low | **Yes** |
| **Soil** | | | | | | | |
| In Situ Treatment | Biological Treatment | Bioventing | Bioventing involves injecting air into, or extracting soil vapor at a low flow rate from, unsaturated soil to promote aerobic biodegradation of organic contaminants. | Implementable. Implementation of this technology would require installation of vent wells, a blower system, buried air transmission lines connecting the blower to vent wells, and connection to an electrical power source. Vapor monitoring points would be installed so that soil gas sampling could be conducted to monitor the progress of remediation. Implementation would also require establishing a power source (i.e., running power 14 miles from Dot Lake). | Effective for residual petroleum in vadose zone. Bioventing has been effective as a remedy at other sites at in Alaska. Bioventing could take several years to achieve alternative cleanup levels for diesel range organics.<br>Bioventing would not be effective in treating lead contaminated soil from the Dry Well. | Moderate | No |
| | Physical/ Chemical Treatment | Chemical Oxidation | Injection of an oxidizing agent into contaminated media to directly oxidize contaminants | Implementable. Treatment of vadose zone soils would be complex as soil mixing would be required to ensure complete contact of oxidants with contaminated media. | Relative effectiveness in unsaturated soil is expected to be high at this site due to the moderate concentrations of petroleum hydrocarbons at the site and relatively small area.<br>*In situ* chemical oxidation would not be effective in treating arsenic and lead contaminated soil from the Dry Well. | Very High | No |
| | | Soil Vapor Extraction (SVE) | Extraction of soil vapor from impacted vadose zone to remove volatile contaminants. | Implementable. Implementation of this technology would require installation of extraction vent wells, a blower system, buried air transmission lines connecting the blower to vent wells, and a connection to an electrical power source. Vapor monitoring points would be installed so that soil gas sampling could be conducted to monitor the progress of remediation. Implementation would also require establishing a power source. | The relative effectiveness of SVE at the Site is rated low because it is not effective for treating non-volatile contaminants (e.g., diesel range organics) present in the Burn Pit soil.<br>SVE would not be effective in treating lead contaminated soil from the Dry Well. | Moderate | No |
| | | Thermal Enhancement | Heating of impacted soil to increase vapor pressure of contaminants. Used in conjunction with other specific response actions (e.g., SVE) to increase the rate of removal and shorten overall life cycle. | Uncertain. Thermal or electrical heating system installation would be required. Implementation would require establishing a power source (i.e., running power 14 miles from Dot Lake). | Effective but unnecessary in increasing mass removal rates of volatile contaminants (e.g., benzene toluene, ethylbenzene, xylenes, and gasoline range organics) from impacted and vadose zone materials. May be less effective for increasing the removal rate of less volatile contaminants. | Very High | No |

## Table 3-1 Screening of Specific Response Actions (continued)

| General Response Action | Remedial Technology | Specific Response Action | Process Description Target Zone | Implementability | Effectiveness | Relative Cost | Retained? |
|---|---|---|---|---|---|---|---|
| Removal | Soil Excavation | Excavation and On-Site Treatment | Excavation of soil with contaminants above cleanup levels. Soil would be treated on-site using landfarming, biopiles, or with a portable thermal treatment unit and used as backfill. | Implementable. Depth of excavation expected to be limited to upper approximately 15 feet below ground surface of contaminated soil. Deeper excavation may require sidewall stabilization (e.g., shoring) or very large excavation to ensure sidewall stability.<br>On-site treatment would be logistically difficult and cost prohibitive for the small volumes of contaminated soil associated with the Burn Pit. | Effective for shallow petroleum hydrocarbon contaminated soil. Excavation of soil deeper than approximately 15 feet below ground surface may be infeasible. Treatment time is generally short to moderate.<br>On-site treatment would be effective on organic constituents but would be cost prohibitive and/or take long time to achieve cleanup goals.<br>On-site treatment would not be effective in treating lead contaminated soil from the Dry Well. | High | No |
| | | Excavation and Off-Site Treatment | Excavation of soil with contaminants above cleanup levels. Soil would be transported to an approved off-site facility for treatment. Excavated soil would be replaced with clean backfill material. | Implementable. See limitations described in Excavation and On-Site Treatment (above). Removal of large quantities of contaminated soil would be logistically difficult and cost prohibitive. More cost effective for smaller volumes of soil. | Effective for shallow petroleum hydrocarbon contaminated soil. Excavation of soil deeper than approximately 15 feet below ground surface may be infeasible. Treatment time is very short. Effective on all site-related organic constituents.<br>On-site treatment would not be effective in treating lead contaminated soil from the Dry Well. | Moderate | **Yes** |
| | | Excavation and Off-Site Disposal | Excavation of soil with contaminants above cleanup levels. Soil would be transported to an approved off-site disposal facility. Excavated soil would be replaced with clean backfill material. | Implementable. See limitations described in Excavation and On-Site Treatment (above). Removal of large quantities of contaminated soil would be logistically difficult and cost prohibitive. More cost effective for smaller volumes of soil. | Effective for all site-related contaminated soil including arsenic and lead contaminated soil from the Dry Well. Excavation of soil deeper than approximately 15 feet below ground surface may be infeasible. | Moderate | **Yes** |
| Containment | Soil Capping | Impermeable Cap | Construction of impermeable cap(s) over areas with contaminated soil to reduce chance of direct contact and leaching of contaminants to groundwater. | Implementable. Construction of impermeable cap could be readily accomplished. Cap would require inspection and maintenance until cleanup levels were achieved through intrinsic remediation. | Effective in short term as would immediately achieve ROAs for direct contact and leaching to groundwater. Poor long-term effectiveness as there would be no reduction in toxicity or volume of contaminated media. LUCs would be required. Cap would significantly limit future land use. | High | No |

### Table 3-1 Screening of Specific Response Actions (continued)

| General Response Action | Remedial Technology | Specific Response Action | Process Description | Implementability | Effectiveness | Relative Cost | Retained? |
|---|---|---|---|---|---|---|---|
| **Groundwater** | | | | | | | |
| *In Situ* Treatment | Biological Treatment | Sulfate Enhanced Bioremediation | Injection of sulfate source directly into targeted contaminated interval to enhance biodegradation in saturated media. Sulfate enhanced anaerobic bioremediation provides a long-lasting source of electron acceptor (sulfate) that is reduced to sulfide during anaerobic biodegradation of hydrocarbons. | Implementable. A sulfate source would be injected into the aquifer upgradient of the target treatment zone through series of direct-push borings. The sulfate source would be emplaced throughout the groundwater contaminated depth interval. The sulfate would dissolve into groundwater and be carried through the target treatment zone through advection. Remedial progress would be tracked through annual groundwater monitoring program. Because of high groundwater flux at the site, frequent reinjection of sulfate would be required. | The relative effectiveness of sulfate enhanced bioremediation is rated high. This technology has been demonstrated at other petroleum hydrocarbon sites in Alaska. Sulfate enhanced bioremediation has a high anticipated cost at Sears Creek Station because dissolved sulfate would quickly pass through the treatment zone before being fully utilized. A large initial mass or frequent reinjection would be required for this site. | High | No |
| | | Monitored Natural Attenuation | Sampling and analysis of groundwater to document natural attenuation of contaminants in groundwater. | Readily implementable. | Moderate effectiveness in monitoring plume stability or reduction. | Low | **Yes** |
| | Physical/ Chemical Treatment | Chemical Oxidation | Injection of an oxidizing agent into contaminated media to directly oxidize contaminants | Implementable. Chemical oxidants could be placed into target zone through series of direct-push borings or wells. | Relative effectiveness in groundwater and saturated zone is expected to be high at this site due to the moderate concentrations of petroleum hydrocarbons at the site and relatively small area. | Moderate | **Yes** |
| | | Air Sparging/ Biosparging | Injection of atmospheric air beneath the water table to enhance the volatilization of VOCs and/or aerobic biodegradation. Often implemented with SVE to control vapor migration in developed areas. | Implementable. Installation of sparging wells, a sparging system blower, buried air transmission lines connecting the blower to the injection wells, and a connection to an electrical power source would be required. Several vapor monitoring points could also be installed for monitoring VOCs concentrations in the vadose zone. Implementation would also require establishing a power source. | The relative effectiveness of air sparging at the Site is rated to be moderate because the primary organic contaminants in include several non-volatile petroleum hydrocarbons. The relative effectiveness of biosparging at the site is rated to be high because of the high permeability of the aquifer materials, presence of anaerobic conditions in the source area wells, and relatively small plume. Biosparging would increase oxygen concentrations in groundwater and the vadose zone aiding in biodegradation of fuel hydrocarbons.<br>Air sparging/biosparging would not be effective in treating lead contaminated soil from the Dry Well. | Moderate | **Yes** |
| Containment | Hydraulic Barriers | Hydraulic Containment of Plume | Pump groundwater to create hydraulic gradient towards the source area thereby eliminating further off-site migration of contaminants. Pumped water would require treatment. | Implementable. Installation of wells, pumps, and treatment system required. High hydraulic conductivity would result in very high flow rates. Would require establishing a power source. Pump and treat would be somewhat logistically difficult to maintain and cost prohibitive. | Effective in meeting most RAOs relating to groundwater. Treatment of extracted groundwater will result in reduction of contaminant mass although that is not primary objective of containment alternatives. | High | No |

(Intentionally blank)

### 3.3.1 No Action

This SRA involves taking no action to address the impacted media identified at the site. With the no action alternative, no formal programs would be put into place to control or monitor potential receptor exposures to site COCs. Over time, the organic contaminants will attenuate naturally. Under DERP guidance and pursuant to the NCP, evaluation of a no action remedial alternative is required to provide a baseline for comparison with other remedial alternatives. The no action alternative will not meet the RAOs.

### 3.3.2 Risk and Hazard Management – Land Use Controls

LUCs are composed of 1) ICs which are administrative management techniques, and 2) ECs which are physical measures to prevent or limit access of receptors to potentially harmful concentrations of site COCs.

LUCs could be implemented to limit human exposure to the contaminated soil and groundwater. ICs (e.g., restricting groundwater use) may be appropriate for areas with contaminated groundwater until cleanup levels are achieved. ECs could include physical barriers and access restrictions (e.g., fencing, locked gates, and warning signs) and decommissioning the WSW (the well or associated plumbing are believed to be the source of lead detected in the sample collected from the WSW).

Generally, these actions are easily implemented and monitored at active DoD installations but more difficult at inactive facility sites such as the SCS. Inspections and monitoring are typically outlined in the LUC Implementation Plan and are required to document long-term effectiveness of LUCs. LUCs can be reliable, immediately effective, and cost-effective, and can be implemented exclusively, or in combination with other SRAs. Therefore, this SRA was retained for further development and detailed consideration.

### 3.3.3 Soil Specific Response Actions

#### 3.3.3.1 *In Situ* Treatment

*In situ* treatment includes processes performed within the contaminated media to degrade, destroy, or otherwise remove contaminants from subsurface soil, soil vapor, or groundwater without removing the contaminated media. Various forms of *in situ* treatment are based on increasing oxygen concentrations in the subsurface (e.g., soil) to enhance the aerobic biodegradation of residual fuel hydrocarbons. These processes include bioventing and biosparging. Alternatively, *in situ* treatment may involve the injection of various organic substrates or geochemical modifiers to induce geochemical conditions conducive to biodegradation.

Other forms of *in situ* treatment are based on physical removal of more volatile contaminants directly from the soil through extraction of contaminant-laden soil vapor (i.e., SVE). *In situ* treatment may also be accomplished by the injection or mixing of strong chemical oxidizers, such as ozone or permanganate, to directly oxidize organic compounds to innocuous byproducts such as carbon dioxide and water. *In situ* treatment is often implemented along with other SRAs, including LUCs. Several potentially applicable *in situ* treatment processes are described in detail, along with their potential relative effectiveness.

##### *Bioventing*

Bioventing involves injecting air into, or extracting soil vapor from, vent wells at a low flow rate from contaminated vadose zone soil to promote aerobic biodegradation of organic contaminants, most commonly petroleum hydrocarbons. This technology accelerates the natural *in situ* biodegradation of aerobically degradable compounds present in unsaturated soil by providing oxygen to indigenous soil microorganisms. In contrast to SVE, bioventing uses low air-flow rates to provide enough atmospheric air to sustain soil oxygen concentrations of at least 5 percent. In addition to biodegradation of adsorbed petroleum residuals, volatile compounds (e.g., benzene) are also biodegraded as vapors move slowly through biologically active soil. In practice, some degree of dispersion and volatilization also occurs when bioventing is implemented.

Oxygen is most commonly supplied through direct air injection into residual contamination in soil. Implementation of this technology would require installation of vent wells, a small blower system, air transmission lines connecting the blower to the extraction wells, and a connection to an electrical power source. Because there is not an existing power source at the SCS, a power line would have to be run from Dot Lake, located approximately 14 miles away or an alternative onsite power source could be established. Several vapor monitoring points (VMPs) also would be installed for monitoring oxygen and VOC concentrations soil vapor as in indicator of remedial progress. Implementation logistics for this action would be moderate. Energy use would be moderate as compared to other SRAs.

Bioventing is often implemented in conjunction with one or more additional SRAs (e.g., LUCs and/or MNA). Because bioventing could take several years to achieve ACLs for DRO and because vadose zone contamination exceeding ACLs is limited to shallow soil that can easily be removed, bioventing was not retained for further development and detailed evaluation.

### *Chemical Oxidation*

Organic contaminants in the vadose zone could be destroyed via *in situ* chemical oxidation (ISCO). Chemical oxidants are introduced to the contaminated materials such that the contaminants react with the oxidant and are degraded, producing innocuous substances such as carbon dioxide, water, and inorganic chloride (where chlorinated compounds are present). Various process options for ISCO are available.

Implementing ISCO in vadose zone soil could be accomplished  through soil mixing or deep tilling to improve contact between the ISCO reagents and contaminants.

ISCO is potentially applicable over a range of contaminant concentrations from source area mass reduction to dissolved phase plume treatment for a range of COCs (Interstate Technology & Regulatory Council, 2005). There are various oxidants available, and each has its own unique advantages and disadvantages. Soil mixing would be required to effectively implement ISCO in the vadose zone to ensure contact between the oxidant and contaminants, resulting in very high costs and difficult implementation; therefore, ISCO has not been retained for vadose zone soil.

### *Soil Vapor Extraction*

SVE involves extracting soil vapor from the vadose zone at moderate to high flow rates to remove VOCs. The relative effectiveness of SVE at the site is rated low because several of the primary organic contaminants at the SCS are non-volatile petroleum hydrocarbons (e.g., DRO, 1-methylnaphthalene, 2-methylnaphthalene).

Implementation of this technology would require installation of extraction wells, a blower system, buried air transmission lines connecting the blower to the extraction wells, and a connection to an electrical power source. Because there is not an existing power source at the SCS, a power line would have to be run from Dot Lake, located approximately 14 miles away or an alternative on-site power source could be established. Exhaust treatment may be required or flow rates could be controlled to keep emissions below threshold levels. Several VMPs also would be installed for monitoring soil vapor concentrations in the vadose zone. Implementation logistics for this action would be moderate. Energy use would be moderate as compared to other SRAs.

Because the primary organic contaminants at the SCS requiring remediation include non-volatile petroleum hydrocarbons, SVE was not retained for further development and detailed evaluation.

### *Thermal Enhancement*

Thermal enhancement technologies include hot air or steam injection, electrical resistance heating, radio-frequency heating, and thermal conduction heating. The geology and subsurface features (e.g., utility lines) of the site are factors that would be considered in choosing the most appropriate thermal enhancement method. The relative effectiveness of thermal enhancement at the site is rated to be moderate; however, operation of this technology would be conducted concurrently with another *in situ* SRA (e.g., SVE). The petroleum hydrocarbon contamination in SCS media can be readily removed or biodegraded without thermal enhancement; therefore, the added expense of thermal enhancement is expected to provide only a marginal benefit at the SCS.

Implementation of this technology would require installation of the heating system and associated controls and power supply. Because there is not an existing power source at the SCS, a power line would have to be run from Dot Lake, located approximately 14 miles away. Implementation logistics for this action would be relatively high, and relative energy use would be very high. Due to the moderate effectiveness of this technology and high logistical and energy requirements, thermal enhancement was not retained for further development and detailed evaluation.

### 3.3.3.2 Removal

Source removal would involve excavation of impacted soil with various *ex situ* treatment or disposal options. Source removal using excavation can be combined with other treatment options such as *in situ* treatment of deeper soils or MNA. Excavation of soil to approximately 15 feet bgs is not expected to pose significant logistical challenges at the SCS as the facility is inactive. Deeper excavation into the sandy and silty gravel could be logistically challenging as significant side sloping or sidewall stabilization (e.g., shoring) would be required. Excavations would be backfilled with clean excavated soil and/or clean imported backfill material. Site-specific conditions, such as proximity to structures and critical utilities also affect the feasibility and cost of removal. Effectiveness of removal is rated high and contaminated soil is removed for treatment or disposal. The cost of soil removal is moderate due to the need to mobilize heavy construction equipment for earthwork and associated soil treatment and/or disposal.

### *Excavation and On-Site Treatment*

Source removal and onsite treatment is limited to petroleum-contaminated soil because of the limited treatment options available. Under this SRA, soils would be excavated and treated at the SCS facility. The excavation would be backfilled with clean excavated soil or clean imported backfill material. Onsite treatment options include:

- Petroleum-contaminated soil could be treated through biological treatment in a temporary onsite landfarm or biopile. Onsite biological treatment would be relatively logistically difficult, requiring frequent site visits, and cost prohibitive considering the relatively small volumes of soil needing treatment at the SCS.
- Petroleum-contaminated soil also could be treated using an *ex-situ* low temperature thermal desorption (LTTD) process such as Hot Air Vapor Extraction. Onsite LTTD treatment would be logistically difficult and cost prohibitive considering the relatively small volumes of soil needing treatment at the SCS.
- Petroleum-contaminated soil also could be treated using a thermal treatment unit; however, mobilizing this equipment is not practical or cost effective for the relatively small volumes of soil needing treatment at the SCS.

Because of the relatively high logistical and energy requirements, excavation and on-site treatment was not retained for further development and detailed evaluation.

### *Excavation and Offsite Treatment*

Under this SRA, soil with contamination that can be readily removed or destroyed through treatment (e.g., petroleum hydrocarbons in soil from the Burn Pit) would be excavated and transported to an approved offsite facility for treatment. Offsite treatment options for petroleum-contaminated soil include high temperature thermal oxidation at Organic Incineration Technology (OIT) located in the town of Moose Creek, Alaska. The OIT facility is located approximately 120 miles northeast of the SCS facility just off Alaska

Highway 2. Therefore, transportation of excavation soil to OIT's facility is easily implementable.

Because of its high effectiveness and implementability, excavation and offsite treatment of soil was retained for further development and detailed evaluation for soil contaminated with petroleum hydrocarbons.

#### *Excavation and Offsite Disposal*

Under this SRA, soil with contamination that cannot be readily removed or destroyed through treatment (e.g., arsenic and lead in soil from Dry Well) would be excavated and disposed of in an approved facility. Clean overburden used to backfill the 2015 excavation would be segregated, sampled to confirm it is not contaminated, and reused as backfill. Soil excavated from approximately 12 to 15 feet bgs would be excavated, characterized, and containerized for offsite disposal.

The offsite disposal option would be determined after the excavated soil was characterized. Soil excavated from the Dry Well AOC will require disposal outside of Alaska, at a facility that is certified to accept the waste. Although disposal of soil outside of Alaska is relatively expensive, there are no known options for treatment or disposal of arsenic- and lead-contaminated soil in Alaska. Because of its high effectiveness and feasibility, excavation and offsite disposal of soil was retained for further development and detailed evaluation for soil that cannot be treated using readily available technologies (i.e., arsenic and lead contaminated soil from the Dry Well).

### 3.3.3.3 Containment - Impermeable Cap

Containment uses either physical barriers (such as caps, covers, slurry walls) or hydraulic containment to prevent direct contact with contaminated media or prevent plume migration.

An engineered impermeable cap would prevent direct exposure to contaminated soil and soil vapor and minimize infiltration of water through contaminated soil into groundwater. Therefore, an engineered impermeable cap can potentially eliminate human health risk from direct contact with contaminated media and reduce the leaching of contaminants from soil into groundwater. This SRA could be implemented in conjunction with a separate SRA (MNA or sulfate enhanced bioremediation) to address groundwater contamination. This alternative would require LUCs that would restrict and limit future use of the property, routine inspections and periodic maintenance until cleanup goals are achieved through intrinsic remediation.

Implementation of this technology would require installation and maintenance of an impermeable cap that would include a low-permeability layer, such as a synthetic geomembrane or a geosynthetic clay layer. Implementation logistics for this action would be moderate but protection of the impermeable cap would limit future use of the property. Implementation of this containment remedy would have no benefit in reducing the toxicity or volume of contaminants.

An impermeable cap is expected to have a high cost to implement due to the longevity of required inspections and maintenance. Based on the expected longevity of this SRA, long-term restrictions on land use, lack of reduction of toxicity or volume of contaminated media, and the availability of cost-effective technologies to address contaminated soil, this SRA was excluded from further evaluation.

### 3.3.4 Groundwater Specific Response Actions

#### 3.3.4.1 *In Situ* Treatment

*In situ* treatment includes processes performed within the contaminated media to degrade, destroy, or otherwise remove contaminants from groundwater without removing the contaminated media. Various forms of *in situ* treatment are based on increasing oxygen concentrations in groundwater to enhance the aerobic biodegradation of residual fuel hydrocarbons. These processes include biosparging. Alternatively, *in situ* treatment may involve the injection of various organic substrates or geochemical modifiers to induce geochemical conditions conducive to biodegradation.

Other forms of *in situ* treatment are based on physical removal of more volatile contaminants directly from groundwater by air sparging. *In situ* treatment may also be accomplished by the injection of strong chemical oxidizers, such as ozone or permanganate, to directly oxidize organic compounds to innocuous byproducts such as carbon dioxide and water. *In situ* treatment is often implemented along with other SRAs, including LUCs and MNA. Several potentially applicable *in situ* treatment processes are described in detail, along with their potential relative effectiveness.

### *Sulfate Enhanced Bioremediation*

The U.S. Air Force evaluated the use of electron acceptors by natural attenuation of petroleum hydrocarbons (Parsons, 1999), and determined that nearly 75 percent of petroleum hydrocarbons are degraded through reduction of sulfate. However, when natural sulfate concentrations are low (less than 200 milligrams per liter [mg/L]), the relative contribution of sulfate reduction decreases as does the overall rate of biodegradation. Sulfate enhanced bioremediation has been implemented successfully at several sites in Alaska.

Sulfate concentrations in groundwater have not been measured at the site. However, oxidation reduction potential (ORP) in the monitoring wells MW16 and MW17, located within and immediately downgradient of the Burn Pit, were very low, ranging from -425 to -110 millivolts. This range is indicative of sulfate-reducing and methanogenic conditions. Based on this, indigenous bacteria in soil and groundwater at SCS are likely able to reduce sulfate. Adding more sulfate will increase the amount of electron acceptors in groundwater and enhance the degradation rate of petroleum contaminants.

To implement sulfate enhanced bioremediation, a sulfate mineral source would be injected into the subsurface at the upgradient end of the target treatment area. The sulfate mineral would dissolve slowly over time and groundwater would transport dissolved sulfate from the injection points throughout the target treatment area, supplying a continuous source of sulfate to the target treatment area. The optimum sulfate source should have solubility that is high enough to enhance sulfate reduction across the entire treatment area, but low enough to keep sulfate concentrations within a reasonable range for a period of several years.

Sulfate enhanced bioremediation could be implemented along with other SRAs designed to aggressively treat or remove contaminants in the source area. Implementation logistics for this action would be low to moderate, with only minor impacts to current site functions. Energy use would be low compared to other SRAs. Sulfate enhanced bioremediation generally has a low to moderate anticipated cost compared to other SRAs that would treat groundwater; however, at the SCS the relative cost is expected to be high. Because of the steep hydraulic gradient and high hydraulic permeability of aquifer materials, the estimated groundwater seepage velocity is high at this site (15 feet/day). Because of this high velocity, dissolved sulfate would advect through the treatment area before it could be fully utilized and the emplaced sulfate source would become exhausted rapidly. Because of this, either a very large mass of sulfate would have to be emplaced or sulfate would have to be refreshed frequently. Based on the high expected cost associated with keeping adequate sulfate in the treatment zone, sulfate enhanced bioremediation was not retained for further development and detailed evaluation.

### *Monitored Natural Attenuation*

Natural attenuation processes in groundwater, such as microbial biodegradation and volatilization, are monitored through the development of a monitoring plan to evaluate the reduction of contaminant mass and monitor potential migration of contaminants into unaffected areas (EPA, 1998). MNA can be implemented as a stand-alone remedy, with LUCs, or with more aggressive source treatment(s) that focus on source remediation.

The MNA monitoring plan would identify wells for sampling to track concentrations of site-related COCs over time. The length of time required to reduce contaminant concentrations to cleanup levels depends on site conditions, the physical and chemical properties of the contaminants, and whether active remedial technologies are also implemented. Select wells that are part of the existing SCS monitoring well network would be incorporated into this SRA. Based on its ease of implementation and effectiveness in monitoring plume stability or reduction, MNA was retained for further development and detailed evaluation.

#### *Chemical Oxidation*

Organic contaminants in groundwater and saturated soil below the water table, and the vadose zone could be destroyed via ISCO. Chemical oxidants are introduced to the contaminated materials such that the contaminants react with the oxidant and are degraded, producing innocuous substances such as carbon dioxide, water, and inorganic chloride (where chlorinated compounds are present). Various process options for ISCO are available.

Implementing ISCO could be accomplished using injection wells or direct push points under pressure to distribute the oxidant deeper in the aquifer. ISCO is potentially applicable over a range of contaminant concentrations from source area mass reduction to dissolved phase plume treatment for a range of COCs (Interstate Technology & Regulatory Council, 2005). There are various oxidants available, and each has its own unique advantages and disadvantages. ISCO was retained for further evaluation due to its potential effectiveness at rapidly reducing the highest concentrations of petroleum hydrocarbons in groundwater and saturated soil.

### *Air Sparging/Biosparging*

Air sparging involves a process by which air is injected into groundwater through a series of sparge wells at a controlled volume and pressure with the primary purpose of volatilizing the contaminants present in the saturated zone. Biosparging involves the same process but with the primary objective of increasing dissolved oxygen in the saturated zone to enhance aerobic biodegradation. SVE is frequently employed with sparging technologies to control movement of VOCs in soil vapor to avoid creating a vapor intrusion hazard. The relative effectiveness of air sparging at the site is rated moderate because the primary organic contaminants in groundwater at the SCS requiring remediation include several non-volatile petroleum hydrocarbons; however, the relative effectiveness of biosparging is rated high because of the high permeability of the aquifer materials, presence of anaerobic conditions in the source area wells, and relatively small plume. Sparging the saturated zone may also provide oxygen to the overlying contaminated vadose zone soil.

Implementation of this technology would require installation of vertical sparging wells, a sparging system blower, buried air transmission lines connecting the blower to the injection wells, and a connection to an electrical power source. Because there is not an existing power source at the SCS, a power line would have to be run from Dot Lake, located approximately 14 miles away, or an alternative power source (e.g., onsite generator and fuel tanks) would have to be installed. Several VMPs could also be installed to monitor soil vapor concentrations in the vadose zone. Implementation logistics for this action would be moderate, with minimal impacts to current site functions. Energy use would be moderate compared to other SRAs.

Because aquifer materials are sufficiently permeable and uniform, and conditions in the plume are anaerobic, biosparging was retained for further development and detailed evaluation.

### 3.3.5 Containment - Hydraulic Containment of Plume

Containment uses either physical barriers (such as caps, covers, slurry walls) or hydraulic containment to prevent direct contact with contaminated media or prevent plume migration.

With hydraulic containment, contaminant migration in groundwater could be contained by pumping groundwater extraction wells at rates sufficient to cause all contaminated groundwater within the target volumes to flow to the extraction wells. If hydraulic containment of a target volume is achieved and maintained, the contaminated groundwater within the target volume will eventually be captured by the extraction wells, preventing or limiting contaminant migration to other wells or sensitive receptors.

Implementation of this technology would require installation of one or more extraction wells and pumping system(s), buried water transfer lines, an air stripper and/or granular activated carbon system to treat contaminated groundwater, and a treated water infiltration gallery for disposal of the treated water. Connection to an electrical power source would also be required. Because there is not an existing power source at the SCS, a power line would have to be run from Dot Lake, located approximately 14 miles away.

Hydraulic containment is often implemented in conjunction with a separate SRA (LUCs, MNA, or other source control measures) at sites with groundwater contamination requiring remedy. Implementation logistics for this action would be moderate, with only minor impacts to current site functions. The high hydraulic conductivity of the aquifer materials and steep hydraulic gradient would result in high flow rates for hydraulic containment to effectively contain the dissolved phase plume. The COCs in groundwater have relatively low mobility and/or are amenable to natural attenuation. The groundwater plume at the Burn Pit is localized and appears stable to decreasing and implementation of a containment remedy would have no benefit in reducing the toxicity or mobility of contaminants.

Hydraulic containment is expected to have a relatively high cost to implement due to the longevity of required hydraulic control, high flow rates, and high power consumption costs. Based on relatively high cost of this SRA and the availability of lower cost and more effective technologies for addressing the plume, this SRA was excluded from further evaluation.

## 3.4 RETAINED SPECIFIC RESPONSE ACTIONS

Based on the above-described evaluation, the SRAs listed below were retained for assembly into remedial alternatives (Section 4.0) and subsequent detailed and comparative analysis (Section 5.0). Retained SRAs are numbered in accordance with Table 3.1, and this numbering will be carried forward into subsequent sections of this FS. Rough order of magnitude cost estimates for each retained SRA are provided in Appendix B.

The retained SRAs applicable to both soil and groundwater are as follows:

- No Action;
- LUCs (including decommissioning of the WSW);

The retained SRAs for groundwater are as follows:

- MNA;
- Chemical Oxidation (ISCO);
- Biosparging

The retained SRAs for soil are as follows:

- Excavation and Offsite Treatment; and
- Excavation and Offsite Disposal.

## 4.0 DESCRIPTION OF REMEDIAL ALTERNATIVES

Remedial alternatives were developed for the Dry Well, Burn Pit and Site Groundwater through assembly of SRAs to create remedies that are effective, implementable, and have reasonable costs to address site contamination and mitigate potential risks. SRAs were previously identified and screened to reduce the number of SRAs to be carried forward for further analysis.

This section develops remedial alternatives for the Dry Well, Burn Pit and Site Groundwater that are further evaluated in the following sections. The following remedial alternatives were developed for evaluation:

- Alternative 1: No Action
- Alternative 2:
  - Dry Well Soil: LUCs
  - Burn Pit Soil: LUCs
  - Site Groundwater: Lead confirmation sampling (WSW), MNA (Burn Pit), and LUCs (including decommissioning existing WSW)
- Alternative 3:
  - Dry Well Soil: Excavation and off-site disposal
  - Burn Pit Soil: Excavation of petroleum-contaminated soil and offsite treatment
  - Site Groundwater: Lead confirmation sampling (WSW), MNA (Burn Pit), LUCs (including decommissioning existing WSW)
- Alternative 4:
  - Dry Well Soil: Excavation and offsite disposal
  - Burn Pit Soil: Excavation of petroleum-contaminated soil and offsite treatment
  - Site Groundwater: Lead confirmation sampling (WSW), Biosparging (Burn Pit), and LUCs (including decommissioning existing WSW)
- Alternative 5:
  - Dry Well Soil: Excavation and offsite disposal
  - Burn Pit Soil: Excavation of petroleum-contaminated soil and offsite treatment

- Site Groundwater: Lead confirmation sampling (WSW), ISCO (Burn Pit), and LUCs (including decommissioning existing WSW)

The following text describes the five remedial alternatives. Estimates of the time frame required for each remedial alternative to meet the RAOs were based on site data, site conditions, and professional judgment. Assumptions regarding the number of wells, volume of soil to be treated and other details are estimates that are presented to provide a basis for the cost analysis. The selected alternative will be developed in detail in a remedial design/remedial action work plan (RD/RAWP) following approval of the Record of Decision (ROD). Cost estimates for each alternative (including summary and detailed cost information) are provided in Appendix B.

## 4.1 NO ACTION

The no action alternative is included as required under the NCP to provide a baseline comparison with other actions (40 CFR 430(e)(6)). No formalized LUCs would be established or monitored to control potential receptor exposures to site-related COCs, and no active remediation would be performed. The cost of Alternative 1 is $0. Alternative 1 would not achieve the RAOs.

## 4.2 LAND USE CONTROLS AND MONITORED NATURAL ATTENUATION

Remedial Alternative 2 would include LUCs to control exposure to COCs where unacceptable risk or hazard is possible and groundwater monitoring to document reductions in COC concentrations/mass and plume stability or contraction via natural attenuation processes (e.g., MNA).

ICs would be used to prevent uncontrolled exposure of potential receptors to contaminated media. Controls/monitoring would be required if any excavation activities were performed. In addition, land use would be restricted to preclude development (residential, commercial, or industrial) in areas with exceedances of CULs for human health and preclude withdrawal of groundwater for any beneficial use over the groundwater plume. Any structures built at the site near source areas containing VOCs would have to be designed and constructed to mitigate vapor intrusion concerns. Under this alternative, the WSW would be decommissioned (an EC) to prevent future use and potential exposure to lead and a monitoring well installed and sampled to determine if lead concentrations at this location are above or below cleanup levels.

Implementation of Remedial Alternative 2 would require documentation of the LUCs, maintenance of administrative controls through review of work clearance permits, periodic inspections of the site, and corrective action for LUC violations. The U.S. Army would be responsible for documenting, monitoring, maintaining, and enforcing the LUCs.

MNA would be used to verify that COC concentrations in groundwater at the Burn Pit AOC are stable or decreasing and that COCs in groundwater are not threatening potential receptors. The protectiveness of the remedy would be evaluated during CERCLA Five-Year Reviews. If the remedy is not protective of human health or the environment, it would be reviewed and modified as necessary.

### 4.2.1 Description of Remedy Components

The following remedy components were used to develop the cost for this alternative:

- LUCs
    - Develop a LUC implementation plan.
    - Decommission the WSW in accordance with State of Alaska requirements under 18 AAC 80.015(e) and adopted guidance (Groundwater Protection and Water Wells Stakeholder Workgroup, 2017).
    - Conduct annual inspections and complete an annual inspection report to document the continuing effectiveness of the LUCs. A total period of 100 years is assumed for LUC inspections and reporting because the arsenic- and lead-contaminated soil at the Dry Well will remain on site.

  - Complete CERCLA Five-Year Reviews. A total period of 100 years is assumed for LUC inspections and reporting because the arsenic and lead contaminated soil at the Dry Well will remain on site.
- Site Groundwater at WSW: Confirmation Sampling
  - Install one additional groundwater monitoring well near the WSW.
  - Conduct quarterly sampling for one year to determine if lead concentrations in groundwater are above or below the groundwater cleanup level.
- MNA
  - Evaluate the locations and construction of the existing monitoring wells for use for MNA sampling. Assume that one additional groundwater monitoring well would be required for MNA, and that three wells will be sampled annually for five years and then reduced to once every five years to correspond with the CERCLA Five-Year Review process. A total period of 40 years is assumed for groundwater monitoring.
  - Inspect wells and conduct annual maintenance. It is assumed that wells would require replacement every 20 years.
  - Conduct periodic soil sampling (every 20 years) to document the progress of the natural attenuation of contaminants in soil at the Burn Pit AOC.
  - Abandon all monitoring wells in accordance with ADEC *Monitoring Well Guidance* (ADEC, 2013 or most current version) once cleanup levels are reached. The U.S. Army would seek ADEC concurrence prior to well abandonment.

### 4.2.2 Common Elements and Distinguishing Features

For developing the cost estimate, it was assumed that long-term management (LTM) of LUCs would be required because no active treatment or removal of contaminated soil is proposed with this remedy. CERCLA Five-Year Reviews, annual LUC inspections, and LUC maintenance are assumed to occur for a period of 100 years for cost estimating purposes. This duration was chosen because arsenic- and lead-contaminated soil will remain at the Dry Well AOC. Any LUC deficiencies or failures would be documented and rectified. Groundwater sampling is assumed to occur for a period of 40 years. The SCS was has been inactive since 1973 and groundwater contamination beneath the Burn Pit still contains naphthalene at concentrations greater than 100 times its ADEC Table C cleanup levels. The actual time needed for monitoring will be estimated once sufficient data are available to conduct trend analyses. The cost estimate assumes the contaminant plume in groundwater does not migrate and concentrations decrease over time. After 40 years, the groundwater monitoring network would be abandoned. Soil samples would be collected from the Burn Pit every 20 years to monitor the progress on natural attenuation in soil. No soil samples would be collected from the Dry Well AOC as arsenic and lead concentrations in soil are not expected to change over time.

With Alternative 2, RAO 1 would not be achieved after implementing LUCs; LUCs may prevent exposure but will not reduce concentrations below ADEC Table B.1 CULs protective of human health. RAO 2 (restore groundwater to drinking water quality standards) would be achieved once groundwater monitoring confirms the ADEC Table C cleanup levels have been achieved. RAO 3 (prevent further degradation of groundwater) would be achieved once contaminant concentrations in soil are reduced to concentrations protective of groundwater through natural attenuation. LUCs and MNA would not achieve RAOs 2 and 3 in the short term; however, LUCs should effectively protect human receptors from exposure to COCs at concentrations that could pose a hazard. RAOs 2 and 3 would eventually be met through MNA.

### 4.2.3 Expected Outcome (i.e., Exit Strategy)

Alternative 2 is expected to document compliance with the Table C cleanup levels for groundwater at the WSW after WSW decommissioning and four quarters of confirmation sampling of the new monitoring well are complete. Site Groundwater and Burn Pit soil are assumed to achieve cleanup levels through MNA in approximately 40 years (based on professional judgement). After 40 years, LUCs and CERCLA Five-Year Reviews would be required in perpetuity to manage soil at the Dry Well AOC with concentrations of contaminants greater than the approved cleanup levels because arsenic and lead would not attenuate. A time period of 100 years for maintaining LUCs and conducting Five-Year Reviews was used for cost estimating purposes. Alternative 2 has an estimated total present value (TPV) cost of $1,590,000 and an estimated capital cost of $97,000 (Appendix B).

## 4.3 EXCAVATION OF CONTAMINATED SOIL, MONITORED NATURAL ATTENUATION, AND LAND USE CONTROLS

Remedial Alternative 3 combines several SRAs to achieve RAOs. This alternative would include the following components:

- **Dry Well Soil**: Excavation and offsite disposal of the arsenic and lead contaminated soil exceeding the approved cleanup levels (ADEC Method Two cleanup levels for human health).
- **Burn Pit**: Excavation and offsite treatment of the petroleum contaminated soil exceeding the approved cleanup levels.
- **Site Groundwater**: MNA and LUCs; groundwater would be monitored to document reductions in COC concentrations/mass and plume stability or contraction via natural attenuation processes. The WSW would be decommissioned and a monitoring well installed and sampled to determine if lead concentrations at this location are above or below cleanup levels.

LUCs would be implemented and maintained to prevent exposure with contaminated media until the concentrations of all COCs in soil and groundwater reach levels that allow for unlimited use and unrestricted exposure (UU/UE).

### 4.3.1 Description of Remedy Components

The following remedy components were used to develop the cost for this alternative:

- LUCs
    - Develop a LUC implementation plan.
    - Decommission the WSW in accordance with State of Alaska requirements under 18 AAC 80.015(e) and adopted guidance (Groundwater Protection and Water Wells Stakeholder Workgroup, 2017).

  - Conduct annual LUC inspections and complete an annual inspection report to document the continuing effectiveness of the LUCs. A total period of 20 years is assumed for LUC inspections and reporting.
  - Complete CERCLA Five-Year Reviews. A total period of 20 years is assumed.
- Site Groundwater at WSW: Verification Sampling
  - Install one additional groundwater monitoring well near the WSW.
  - Conduct quarterly sampling for one year to determine if lead concentrations in groundwater are above or below the groundwater cleanup level.
- Dry Well Soil:
  - Excavation to 15 feet bgs is assumed to achieved cleanup levels protective of human health.
  - Clean overburden used to backfill the 2015 excavation would be segregated, sampled to confirm it is not contaminated, and reused as backfill.
  - Soil in an area approximately 10 feet in diameter around sample DW02 from approximately 12 to 15 feet bgs would be excavated, characterized, and containerized for offsite disposal. Offsite disposal of a total of 20 cubic yard is assumed for the cost estimate.
  - Collect soil confirmation samples in accordance with ADEC's *Field Sampling Guidance for Contaminated Sites and Leaking Underground Storage Tank Sites* (ADEC, 2019) to confirm that all soil exceeding approved cleanup levels has been removed.
  - The waste disposal facility would be determined based on results of waste characterization sampling. For the purpose of the cost estimate it was assumed that soil excavated from the Dry Well AOC would require disposal outside of Alaska, at a facility that is certified to accept the waste.
- Burn Pit:
  - Clean soil removed to ensure sidewall stability would be segregated, sampled to confirm it is not contaminated, and reused as backfill.
  - Soil in an area approximately 35 feet by 35 feet in the center of the Burn Pit to 15 feet bgs would be excavated and hauled to OIT for offsite treatment. Offsite treatment of a total of 700 cubic yards is assumed for the cost estimate.

  - Collect soil confirmation samples in accordance with ADEC's *Field Sampling Guidance* (ADEC, 2019) to confirm that all soil exceeding approved cleanup levels has been removed.
  - Backfill the excavation with clean fill material.
- Site Groundwater at Burn Pit: MNA
  - Install one additional groundwater monitoring well.
  - Conduct baseline and periodic groundwater monitoring until it can be demonstrated that contamination in groundwater is attenuating and protectiveness of the MNA remedy. For cost estimating purposes, it is assumed that groundwater monitoring will occur quarterly for the first two years, annually for the years 3 through 5, then every 5 years for a total duration of 20 years.
  - Abandon all monitoring wells in accordance with ADEC *Monitoring Well Guidance* (ADEC, 2013 or most current version) once cleanup levels are reached. The U.S. Army would seek ADEC concurrence prior to well abandonment.

### 4.3.2 Common Elements and Distinguishing Features

As with Alternative 2, Alternative 3 includes MNA and LUCs; however, this alternative includes removal of arsenic- and lead-contaminated soil from the Dry Well AOC and petroleum-contaminated soil exceeding approved cleanup levels at the Burn Pit AOC. Arsenic- and lead-contaminated soil from the Dry Well AOC would be disposed of at Chemical Waste Management Columbia Ridge Landfill in Arlington, Oregon. Petroleum-contaminated soil at the Burn Pit would be excavated and transported to OIT in Moose Creek, Alaska, for offsite treatment.

Alternative 3 assumes that the approved cleanup levels for soil are achieved at the Dry Well and Burn Pit AOCs in the initial year of remediation. The only approved cleanup level exceedance for soil at the Burn Pit was in a sample from 4 to 5 feet bgs; however, the next deepest sample in this area was collected from 15 to 17 feet bgs. Therefore, it is conservatively assumed for cost estimating purposes that excavation to 15 feet bgs would be necessary to remove all soil exceeding the approved cleanup levels. If the upper 15 feet of the petroleum source are removed from the Burn Pit AOC, approximately 20 feet of soil with exceedances of 2018 ADEC Method Two cleanup levels for several fuel-related contaminants would remain between the bottom of the excavation and groundwater; however, these soils had no exceedances of the approved cleanup levels.

Because there is active remediation of source area soils at the Burn Pit, it is assumed for the cost estimate that groundwater cleanup levels will be achieved through MNA in 20 years for Alternative 3 (as compared to 40 years for Alternative 2). Because the arsenic- and lead-contaminated soil are being removed from the Dry Well AOC, annual LUC inspections, and LUC maintenance, and CERCLA Five-Year Reviews are only assumed to be required through the duration of the groundwater MNA program (20 years as compared to 100 years for Alternative 2).

With Alternative 3, RAO 1 would be achieved upon excavation of soil from the Dry Well and Burn Pit AOCs and implementation of LUCs. RAO 3 (prevent further degradation of groundwater) would be achieved following excavation of soil from the Burn Pit that exceeds approved cleanup levels. RAO 2 (restore groundwater to drinking water quality standards) would be achieved once groundwater monitoring confirms the ADEC Table C cleanup levels have been achieved. RAO 2 would not be achieved in the short term; however, LUCs should effectively protect human receptors from exposure to COCs at concentrations that could pose a hazard. All RAOs would eventually be met through treatment, removal, or MNA of contaminated media and the entire site would be eligible for UU/UE.

### 4.3.3 Expected Outcome (i.e., Exit Strategy)

Alternative 3 is expected to achieve the approved cleanup levels for soil at the Dry Well and Burn Pit AOCs immediately after removal actions are completed. Alternative 3 is expected to document compliance with the Table C cleanup levels for groundwater at the WSW after WSW decommissioning and four quarters of confirmation sampling of the new monitoring well are complete. After active remediation is complete, it is expected that only MNA and LUCs would be required for Site Groundwater beneath the Burn Pit AOC. A total of 20 years is assumed to reduce concentrations of COCs in groundwater to Table C cleanup levels and achieve Cleanup Complete (without ICs).

The site is expected to achieve Cleanup Complete (without ICs) within 20 years. Alternative 3 has an estimated TPV cost of $1,185,000 and estimated capital cost of $641,000.

## 4.4 EXCAVATION OF CONTAMINATED SOIL, BIOSPARGING, AND LAND USE CONTROLS

Remedial Alternative 4 is similar to Alternative 3 except that biosparging would be implemented to treat groundwater beneath the Burn Pit AOC instead of relying on MNA.

### 4.4.1 Description of Remedy Components

All other components of this remedy are identical to Alternative 3 except:

- Site Groundwater at Burn Pit: Biosparging:
  - Install an estimated four air injection sparge wells across the Burn Pit plume, perpendicular to groundwater flow.
  - Install one additional groundwater monitoring well.
  - Install an estimated three VMPs to monitor soil gas in the contaminated vadose zone beneath the Burn Pit.
  - Install a blower in an aboveground enclosure, electrical lines, and piping to the sparge wells.
  - Procure and place a generator and fuel tank on site.
  - Conduct baseline and semi-annual performance monitoring (i.e., groundwater sampling for COCs and field parameters including dissolved oxygen and ORP) to monitor the progress of the remedy.
  - Continue groundwater monitoring after completion of biosparging until Table C cleanup levels for groundwater have been achieved.
  - It is assumed that 3 years of biosparging followed by 3 years of groundwater monitoring would be required to achieve Table C cleanup levels in groundwater;

however, groundwater monitoring would continue until Table C cleanup levels are achieved.

- Abandon all monitoring wells in accordance with ADEC *Monitoring Well Guidance* (ADEC, 2013 or most current version) once cleanup levels are reached. The U.S. Army would seek ADEC concurrence prior to well abandonment.

LUCs would be implemented and maintained to prevent exposure with contaminated media until the concentrations of all COCs in soil and groundwater reach levels that allow for UU/UE.

### 4.4.2 Common Elements and Distinguishing Features

Alternative 4 is identical to Alternative 3 except that biosparging would be implemented to treat the Burn Pit groundwater plume instead of relying on MNA alone. Groundwater data from wells MW16 and MW17 indicate that despite the high groundwater flux, conditions in the plume are highly reduced (ORP ranging from -425 to -110 millivolts). Biosparging would increase dissolved oxygen in the plume to facilitate aerobic degradation of dissolved fuel hydrocarbons, remove some VOCs through direct volatilization, and would likely stimulate aerobic biodegradation in the contaminated vadose zone soils above the plume. Because biosparging uses low air injection rates and because there are no current indoor air receptors on site, it is assumed that the biosparging design would not include an extraction system to capture soil vapors in the vadose zone above the target treatment area.

As with Alternatives 2 and 3, LUCs and CERCLA Five-Year Reviews would be conducted until Cleanup Complete is achieved. For purposes of the cost estimate, it is estimated that Cleanup Complete (without ICs) would be achieved within 6 years of implementation of the Alternative 4 remedy. This estimate includes 3 years of biosparging followed by 3 years of groundwater monitoring.

With Alternative 4, RAO 1 would be achieved upon excavation of soil from the Dry Well and Burn Pit AOCs and implementation of LUCs. RAO 3 (prevent further degradation of groundwater) would be achieved following excavation of soil from the Burn Pit that exceeds approved cleanup levels. RAO 2 (restore groundwater to drinking water quality standards) would be achieved once groundwater monitoring confirms the ADEC Table C cleanup levels have been achieved. RAO 2 would not be achieved in the short term; however, LUCs should effectively protect human receptors from exposure to COCs at concentrations that could pose a hazard. All RAOs would eventually be met through treatment, removal, or MNA of contaminated media and the entire site would be eligible for UU/UE.

### 4.4.3 Expected Outcome (i.e., Exit Strategy)

Alternative 4 is expected to achieve the approved cleanup levels for soil at the Dry Well and Burn Pit AOCs immediately after removal actions are completed. Alternative 4 is expected to document compliance with the Table C cleanup levels for groundwater at the WSW after WSW decommissioning and four quarters of confirmation sampling of the new monitoring well are complete. After completion of these removal actions, it is expected that only biosparging and LUCs would be required for Site Groundwater beneath the Burn Pit AOC. A total of 3 years of biosparging and 3 additional years of groundwater monitoring are assumed to reduce concentrations of COCs in groundwater to Table C cleanup levels and achieve Cleanup Complete (without ICs).

The site is expected to achieve Cleanup Complete (without ICs) within 6 years. Alternative 4 has an estimated TPV cost of $1,516,000 and estimated capital cost of $1,100,000.

## 4.5 EXCAVATION OF CONTAMINATED SOIL, ISCO, AND LAND USE CONTROLS

Remedial Alternative 5 is similar to Alternatives 3 and 4 except that groundwater and saturated zone soil are treated with ISCO.

### 4.5.1 Description of Remedy Components

All other components of this remedy are identical to Alternatives 3 and 4 except:

- Site Groundwater at Burn Pit: ISCO:
  - Install one additional groundwater monitoring well.
  - Treat the upper approximately 10 feet of the saturated zone beneath the Burn Pit with ISCO. The ISCO injection program would be designed to achieve Table C cleanup levels in groundwater considering the residual mass of COCs in saturated soil.
  - Per the ISCO vendor’s recommendation, apply ISCO in two separate events:
    - Apply at the beginning of the first field season.
    - Monitor groundwater during the field season to evaluate effectiveness (two monitoring events assumed).
    - Apply ISCO again at beginning of second field season; the mass of ISCO would be tailored based on results from performance monitoring.
  - Conduct groundwater monitoring at the Burn Pit wells to confirm Table C cleanup levels have been achieved and confirm concentrations do not rebound. For cost estimating purposes, it is assumed that groundwater monitoring will occur for 3 years, including one year of semiannual sampling and 2 years of annual sampling, after the second ISCO application. A total of six groundwater monitoring events over four years (including monitoring between ISCO applications) is assumed.
  - Abandon all monitoring wells in accordance with ADEC *Monitoring Well Guidance* (ADEC, 2013 or most current version) once cleanup levels are reached. The U.S. Army would seek ADEC concurrence prior to well abandonment.

LUCs, including decommissioning of the WSW, would be implemented and maintained to prevent exposure with contaminated media until the concentrations of all COCs in soil and groundwater reach levels that allow for UU/UE.

### 4.5.2 Common Elements and Distinguishing Features

Alternative 5 is identical to Alternatives 3 and 4 except that instead of relying on MNA or biosparging to treat groundwater, ISCO would be used to treat the saturated zone to expedite attainment of Table C cleanup levels in groundwater beneath the Burn Pit AOC and site closure.

ISCO reagents would be mixed on site and injected through direct-push tooling into the aquifer in a series of vertical intervals beginning approximately 10 feet below and progressing up to the top of the saturated zone. ISCO would be applied through a grid of injection points to cover the footprint of the plume beneath the Burn Pit.

An ISCO vendor estimated a total mass of approximately 50,700 pounds of sodium persulfate and 73,600 pounds of alkaline activation regent (sodium hydroxide) to remove the estimated contaminant mass in the saturated zone beneath the Burn Pit. Because the ISCO reagents may persist for several weeks before being depleted, and considering the high groundwater flux, application in two separate events is recommended. The first event would ideally be at the beginning of the first field season so groundwater could be monitored later that season to determine the effectiveness. Results from the post-application monitoring would be used to refine the mass of ISCO reagents required during the second application.

The upper approximately 10 feet of the saturated zone beneath the Burn Pit would be treated with ISCO to achieve groundwater cleanup levels; so MNA would not be required. Post treatment groundwater sampling would be required to confirm the success of ISCO treatment. For cost estimating purposes, it is assumed that groundwater monitoring will occur for three years (one year of semiannual and two years of annual sampling) after the second ISCO application. If groundwater cleanup levels are not achieved, additional ISCO treatment or MNA could be implemented as a contingency.

Alternative 5 assumes that the approved cleanup levels for soil are achieved at both the Dry Well and Burn Pit AOCs in the initial year of remediation and the Table C cleanup levels for groundwater would be achieved in approximately three years. As with Alternatives 2, 3, and 4, LUCs and CERCLA Five-Year Reviews would be conducted until Cleanup Complete is achieved.

With Alternative 5, RAO 1 would be achieved upon excavation of soil from the Dry Well and Burn Pit AOCs and implementation of LUCs. RAO 2 (restore groundwater to drinking water quality standards) would be achieved once groundwater confirmation sampling confirms the ADEC Table C cleanup levels have been achieved. RAO 3 (prevent further degradation of groundwater) would be achieved following excavation of soil from the Burn Pit that exceeds approved cleanup levels. All ROAs would be achieved in the short term (approximately three years from initial implementation of ISCO). LUCs should effectively protect human receptors from exposure to COCs at concentrations that could pose a hazard. All RAOs would be met through treatment or removal of contaminated media and the entire site would be eligible for UU/UE sooner than with the other remedial alternatives.

### 4.5.3 Expected Outcome (i.e., Exit Strategy)

Alternative 5 is expected to achieve the approved cleanup levels for soil at the Dry Well and Burn Pit AOCs immediately after removal actions are completed. Alternative 5 is expected to document compliance with the Table C cleanup levels for groundwater at the WSW after WSW decommissioning and four quarters of confirmation sampling of the new monitoring well are complete. Alternative 5 is expected to achieve Table C cleanup levels for groundwater beneath the Burn Pit within several month of completing the second ISCO treatment. After completion of ISCO treatment, it is expected that three years of groundwater monitoring (one year or semi-annual sampling and two years of annual sampling) would be required to document COCs in Site Groundwater beneath the Burn Pit AOC are below Table C cleanup levels and achieve Cleanup Complete (without ICs).

The site is expected to achieve Cleanup Complete (without ICs) within approximately four years. Alternative 5 has an estimated TPV cost of $1,353,000 and estimated capital cost of $1,086,000.

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# 5.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section summarizes information necessary to evaluate the remedial alternatives in accordance with CERCLA and NCP requirements and presents a comparative analysis of the remedial alternatives.

## 5.1 EVALUATION CRITERIA

The remedial alternatives were evaluated with respect to seven of the nine evaluation criteria outlined by the NCP (40 CFR § 300.430)(e)(9)(iii)) and EPA (EPA, 1988b) guidance for conducting feasibility studies under CERCLA. The nine criteria are briefly described in Table 5-1. The remaining two criteria are state and community acceptance of the proposed remedial alternatives. These criteria are evaluated during the public review process.

The first two criteria are threshold criteria, which must be satisfied for a remedial alternative to be acceptable. Criteria 3 through 7 are primary balancing criteria, which are used to weigh major trade-offs among the remedial alternatives that meet the threshold criteria. Criteria 8 and 9 are modifying criteria, which will be considered once state and community comments are received on the preferred remedial alternative identified in the proposed plan. Table 5-2 evaluates each remedial alternative with respect to the threshold and primary balancing criteria.

## 5.2 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

### 5.2.1 Threshold Criteria

The two threshold criteria (overall protection of human health and the environment, and compliance with ARARs) reflect the emphasis on these criteria over other evaluation criteria (EPA, 1988b). Remedial alternatives that fail to meet the threshold criteria were removed from further evaluation and not evaluated with respect to the balancing criteria. Table 5-3 summarizes the comparative analysis of the remedial alternatives, applying both the threshold and balancing criteria.

### Table 5-1 Criteria for Detailed Evaluation of Remedial Alternatives

| Criterion | | How the Criterion is Applied |
|---|---|---|
| **Threshold Criteria** | | |
| 1 | Overall Protection of Human Health and the Environment | Assesses the ability of a remedial alternative to eliminate, reduce, or control the risks associated with exposure pahtways, including direct contact, potential migration, and risks to ecosystems. |
| 2 | Compliance with Applicable or Relevant and Appropriate Requirements (ARAR) | Evaluates the potential of a remedial alternative to comply with chemical-specific, location-specific, and action-specific ARARs. Compliance with other to-be-considered criteria is also evaluated, but it not mandatory. |
| **Primary Balancing Criteria** | | |
| 3 | Long-Term Effectiveness and Permanence | Measures the ability of a remedial alternative to permanently protect human health and the environment. |
| 4 | Reduction of Toxicity, Mobility, or Volume (TMV) Through Treatment | Evaluates the ability of a remedial alternative to permanently or significantly reduce the TMV of the constituents, particularly through treatment. |
| 5 | Short-Term Effectiveness | Assesses the protection of human health and the environment during implementation of a remedial alternative. |
| 6 | Implementability | Evaluates technical feasibility and the difficulty of applying the remedial alternative at the site, the reliability of the technology, the unknowns associated with the remedial alternative, and the need for treatability studies.<br>Assesses administrative requirements, including regulatory agency approval and the need for permits and waivers.<br>Assesses mobilization needs and the accessibility of equipment and trained personnel required to implement the remedial alternative. |
| 7 | Cost | Assesses the capital, operation, and maintenance costs of each remedial alternative. |
| **Modifying Criteria** | | |
| 8 | State Acceptance | Evaluates the technical and administrative issues and concerns the State may have regarding the remedial alternative. |
| 9 | Community Acceptance | Evaluates the issues and concerns the public may have regarding the remedial alternative. |

Source: 40 CFR 300.430(e)(9)

#### 5.2.1.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment is measured by whether the RAOs are achieved. Achievement of RAOs could not be demonstrated by Alternative 1 (No Action), and therefore this alternative fails to meet this threshold criterion. Alternative 2 (LUCs and MNA) would protect human health through implementation of LUCs and would ultimately achieve RAOs 2 and 3 through natural attenuation processes, although some recalcitrant COCs (e.g., DRO) will take many years to naturally attenuate. However, Alternative 2 would not achieve RAO 1 because concentrations of arsenic and lead exceeding CULs protective of human health would remain in soil less than 15 feet bgs, and therefore this alternative fails to meet this threshold criterion.

Alternative 3 (excavation, LUCs, and MNA) would protect human health through removal actions for soil, implementation of LUCs, and would ultimately achieve RAO 2 (restore groundwater to drinking water quality standards) through natural attenuation processes but, as with Alternative 2, some recalcitrant COCs (e.g., DRO) will take many years to attenuate. Alternatives 4 (excavation, biosparging, and LUCs) and 5 (excavation, ISCO, and LUCs) would achieve all RAOs in shorter time periods through more aggressive treatment of the saturated zone and are considered protective of human health and the environment.

#### 5.2.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

Alternatives 1 and 2 do not comply with applicable ARARs. Both leave contamination in place at concentrations that are not protective of human health. Alternatives 3, 4, and 5 comply with applicable ARARs.

### 5.2.2 Balancing Criteria

Remedial Alternatives 1 and 2 failed to meet the threshold criteria and were removed from further evaluation and not evaluated with respect to the balancing criteria. A numerical ranking system was developed for comparison and ranking of the remedial alternatives that pass the threshold criteria. The primary balancing criteria, excepting cost, are weighted to provide a maximum possible 5 points each for a maximum score of 20 points. Cost is not included in the ranking system, but total estimated costs are presented for comparison. Modifying criteria (state and community acceptance) are not included in the ranking system but will be considered in the selection of the final remedy. Ranking assignments were simplified to provide relative indications of low (1), low-moderate (2), moderate (3), moderate-high (4), or high (5) conformance with the specified criteria. Table 5-3 summarizes the comparative analysis of the remedial alternatives and lists their numerical scores against the evaluation criteria

### 5.2.2.1 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of the remedial alternative to maintain reliable protection of human health and the environment over time. This criterion includes the consideration of residual risk that would remain on site following remediation (if any), and the adequacy and reliability of controls. Alternative 3 was scored “moderate” (3) because this alternative actively removes contamination in soil exceeding approved cleanup levels at the Dry Well and Burn Pit but relies on MNA for treatment of groundwater; it is estimated that with some source area removal (e.g., excavation to 15 feet bgs) MNA will take 20 years to achieve cleanup levels for groundwater. Because both Alternatives 4 and 5 actively treat or remove contamination in soil and groundwater to ultimately achieve cleanup levels and Cleanup Complete in a shorter time period, both alternatives were scored “high” (5).

### 5.2.2.2 Reduction in Toxicity, Mobility, or Volume through Treatment

Reduction in TMV through treatment refers to the anticipated performance of the treatment technologies that may be included as part of the remedial alternative.

Alternative 3 would remove contaminated soil for offsite treatment or disposal in a controlled environment, thereby reducing TMV related to soil. However, because Alternative 3 would rely on natural attenuation for treatment of groundwater it was scored "low-moderate" (2).

Both Alternatives 4 and 5 would remove contaminated soil for offsite treatment or disposal in a controlled environment and use an *in situ* treatment technology to reduce site-related COC concentrations in groundwater and saturated soil. Alternatives 4 and 5 would result in the greatest reduction in TMV through treatment so were both scored "high" (5) because they actively treat contaminants and would ultimately achieve Cleanup Complete.

#### 5.2.2.3 Short-Term Effectiveness

Short-term effectiveness addresses the time needed to implement the remedy and any adverse impacts on workers, the community, and the environment during construction and operation of the remedy. Short-term effectiveness also includes the time until remedial response objectives are met.

Alternatives 3, 4, and 5 all include excavation and transportation of contaminated soil for offsite treatment or disposal. Alternative 4 involves additional construction associated with implementation of the biosparging. Due to the construction activity, there are risks posed to construction workers, the community, and the environment; however, these tasks are routine construction activities and are considered low-risk activities. RAO 1 (prevent human receptor exposure) would be achieved for each of Alternatives 3, 4, and 5 after excavation of contaminated soil. RAOs 2 and 3 (restore groundwater quality and prevent further degradation of groundwater) would not be achieved for an estimated 20 years under Alternative 3 but are expected to be achieved within approximately 4 to 6 years under Alternatives 4 and 5. Because of the longer duration to achieve all RAOs, Alternative 3 was scored "moderate" (3) against this criterion. Because of the relatively low risk during implementation and shorter duration to achieve all RAOs, Alternative 4 was scored "moderate-high" (4) against this criterion. In addition to construction activity, Alternative 5 involves transportation, handling, and injection of chemical oxidants and an alkaline activator. These activities pose additional risk to workers, the community, and the environment during remedy implementation; therefore, Alternative 5 was scored "low-moderate" (2) against this criterion.

#### 5.2.2.4 Implementability

Implementability addresses the technical and administrative feasibility of a remedial alternative 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 3 involves excavation and offsite treatment or disposal of soil in addition to MNA, and implementation of LUCs. Because of the relatively small size of the excavations, Alternative 3 also has relatively few logistical challenges. There are no buildings or other utilities present that would prevent excavation from removing the contamination. Excavation at these sites can be easily implemented, so Alternative 3 was also scored "high" (5) against this criterion.

In addition to soil excavation, groundwater monitoring, and implementation of LUCs, Alternative 4 also involves installation and operation and maintenance (O&M) of a biosparge system. Alternative 4 would also require establishing an electrical power source at the site and maintaining the power source through the period of biosparging operation. Therefore, Alternative 4 was scored "low" (1) against this criterion.

In addition to soil excavation, groundwater monitoring, and implementation of LUCs, Alternative 5 also involves injection of ISCO reagents into the saturated zone. Multiple ISCO applications may be required. Therefore, Alternative 5 was scored "moderate" (3) against this criterion.

#### 5.2.2.5 Cost

The estimated TPV costs for the remedial alternatives that passed the threshold criteria are:

| | |
|---|---|
| Remedial Alternative 3: | $1.18M |
| Remedial Alternative 4: | $1.52M |
| Remedial Alternative 5: | $1.35M |

Although it is anticipated to take 20 years to achieve RAOs, Alternative 3 had the lowest total cost. Despite the shorter expected duration to achieve RAOs (6 years), the cost for Remedial Alternative 4 is second highest because of the combination of high capital costs (biosparge system, Tier 4-compliant generator, and installation) and annual biosparge O&M costs. The cost for Remedial Alternative 5 is third highest because of the combination of high capital cost of the ISCO products and the cost of injection.

The TPV cost summaries for each remedial alternative are provided in Table 5-2. The TPV cost is based on a 0.6 percent discount rate, which is the most recent 30-year real discount rate published by the White House Office of Management and Budget in Circular A-94 Appendix B (White House Office of Management and Budget, 2018). Cost estimates were developed following EPA (July 2000) guidance and are considered accurate to within -30 percent to +50 percent of actual expected costs. Detailed cost estimates and the basis of the costs are provided in Appendix B.

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## Table 5-2 Evaluation of Remedial Alternatives

| Criterion | | Remedial Alternative 1 No Action | Remedial Alternative 2 Land Use Controls and Monitored Natural Attenuation | Remedial Alternative 3 Excavation of Petroleum Contaminated Soil (Burn Pit) and Arsenic and Lead Contaminated Soil (Dry Well), Monitored Natural Attenuation, and Land Use Controls | Remedial Alternative 4 Excavation of Petroleum Contaminated Soil (Burn Pit) and Arsenic and Lead Contaminated Soil (Dry Well), Biosparging for Burn Pit Groundwater, and Land Use Controls | Remedial Alternative 5 Excavation of Petroleum Contaminated Soil (Burn Pit) and Arsenic and Lead Contaminated Soil (Dry Well), *In Situ* Chemical Oxidation for Burn Pit Groundwater, and Land Use Controls |
|---|---|---|---|---|---|---|
| **Threshold Criteria** | | | | | | |
| 1 | Overall Protection of Human Health and the Environment | Provides no protection of human health and the environment. | Relies on natural attenuation of organic constituents of concern (COC) in soil and groundwater. Protection of human health and natural attenuation is verified through Monitored Natural Attenuation (MNA) monitoring to verify concentrations of COCs in groundwater are stable or decreasing, and that the dissolved contaminant plume in groundwater is not migrating to potential receptors.<br>Utilizes land use controls (LUC), including institutional controls (IC) and engineering controls (EC) to control receptor exposure to contaminated media including lead and arsenic at the Dry Well. WSW would be decommissioned as an EC. A new monitoring well would be installed in the vicinity of the WSW and be sampled to determine if lead is present above its cleanup level. | Protection of human health and the environment is provided by removal of contaminated soil through excavation and off-site treatment or disposal. MNA will be used to address contaminants in groundwater and saturated soils. Protection of human health and natural attenuation are verified through monitoring to verify contaminant concentrations in groundwater are stable or decreasing, and that the dissolved contaminant plume in groundwater is not migrating to potential receptors.<br>Utilizes LUCs, including ICs and ECs to control receptor exposure to contaminated media until excavation and MNA have achieved cleanup levels. WSW would be decommissioned as an EC. A new monitoring well would be installed in the vicinity of the WSW and be sampled to determine if lead is present above its cleanup level. | As with Alternatives 2 and 3, protection of human health and the environment is provided by removal of contaminated soil through excavation and off-site treatment or disposal. Additional protection of human health is provided by treating contaminants in groundwater and saturated soil using biosparging. Treatment of residual contaminants in vadose zone soil overlying the biosparge system would provide further protection. Treatment of groundwater and saturated soil and protection of human health are verified through groundwater monitoring.<br>Utilizes LUCs, including ICs and ECs to control receptor exposure to contaminated media until biosparging has achieved cleanup levels. WSW would be decommissioned as an EC. A new monitoring well would be installed in the vicinity of the WSW and be sampled to determine if lead is present above its cleanup level. | As with Alternatives 2, 3, and 4, protection of human health and the environment is provided by removal of contaminated soil through excavation and off-site treatment or disposal. Additional protection of human health is provided by treating contaminants in groundwater and saturated soil using *in situ* chemical oxidation (ISCO). Treatment of groundwater and saturated soil and protection of human health are verified through groundwater monitoring.<br>Utilizes LUCs, including ICs and ECs to control receptor exposure to contaminated media until ISCO has achieved cleanup levels. WSW would be decommissioned as an EC. A new monitoring well would be installed in the vicinity of the WSW and be sampled to determine if lead is present above its cleanup level. |
| 2 | Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) | Does not comply with the identified ARARs and To-Be Considered (TBC) criteria. | Complies with the identified ARARs and TBC criteria. | Complies with the identified ARARs and TBC criteria. | Complies with the identified ARARs and TBC criteria. | Complies with the identified ARARs and TBC criteria. |
| **Primary Balancing Criteria** | | | | | | |
| 3 | Long-Term Effectiveness and Permanence | Does not meet Threshold Criteria | MNA will verify that contaminant concentrations in groundwater are stable or decreasing, and that the dissolved contaminant plume in groundwater is not migrating to potential receptors.<br>LUCs will ensure that receptor exposure to contaminated media is controlled and that potential routes for exposure are considered in the event of future land use changes. LUCs would be required in perpetuity as COCs at the Dry Well AOC will not naturally attenuate. | Excavation of soils at the Dry Well and Burn Pit AOCs exceeding approved cleanup levels is effective and permanent. Excavation for removal of contamination provides high level of confidence that contaminant levels at the site will be reduced below the approved cleanup levels, enhancing long-term effectiveness and permanence.<br>Contaminant levels in Site Groundwater will eventually be reduced below the Table C cleanup levels through MNA providing long-term effectiveness and permanence. | Long-term effectiveness and permanence are greater than Alternative 3 and comparable to Alternative 5 (may be somewhat higher if biosparging enhances biodegradation of COCs in the vadose zone).<br>Excavation of soils at the Dry Well and Burn Pit AOCs is effective and permanent. Excavation for removal of contamination provides high level of confidence that contaminant levels at the site will be reduced below the approved cleanup levels, enhancing long-term effectiveness and permanence.<br>Contaminant levels in Site Groundwater will eventually be reduced below the Table C cleanup levels through treatment providing long-term effectiveness and permanence. | Long-term effectiveness and permanence are greater than Alternative 3 and comparable to Alternative 4.<br>Excavation of soils at the Dry Well and Burn Pit AOCs is effective and permanent. Excavation for removal of contamination provides high level of confidence that contaminant levels at the site will be reduced below the approved cleanup levels, enhancing long-term effectiveness and permanence.<br>Contaminant levels in Site Groundwater will eventually be reduced below the Table C cleanup levels through treatment providing long-term effectiveness and permanence. |

## Table 5-2 Evaluation of Remedial Alternatives (continued)

| Criterion | | Remedial Alternative 1 No Action | Remedial Alternative 2 Land Use Controls and Monitored Natural Attenuation | Remedial Alternative 3 Excavation of Petroleum Contaminated Soil (Burn Pit) and Arsenic and Lead Contaminated Soil (Dry Well), Monitored Natural Attenuation, and Land Use Controls | Remedial Alternative 4 Excavation of Petroleum Contaminated Soil (Burn Pit) and Arsenic and Lead Contaminated Soil (Dry Well), Biosparging for Burn Pit Groundwater, and Land Use Controls | Remedial Alternative 5 Excavation of Petroleum Contaminated Soil (Burn Pit) and Arsenic and Lead Contaminated Soil (Dry Well), *In Situ* Chemical Oxidation for Burn Pit Groundwater, and Land Use Controls |
|---|---|---|---|---|---|---|
| **Primary Balancing Criteria (continued)** | | | | | | |
| 4 | Reduction in Toxicity, Mobility, or Volume Through Treatment | Does not meet Threshold Criteria | Does not meet Threshold Criteria | Reduction in toxicity, mobility, or volume (TMV) is occurring through natural processes in soil (Burn Pit AOC) and Site Groundwater. The effects of natural attenuation over time will be monitored to ensure that contamination is reduced to levels that achieve compliance with cleanup goals.<br>Excavation will effectively and efficiently remove contamination from the subsurface to the total depth of excavation. Off-site treatment of soil from the Burn Pit will reduce TMV of contaminants via thermal oxidation in a controlled setting. The TMV of soil excavated from the Dry Well would be reduced as mobility would be controlled at the off-site disposal facility. | TMV reduction for soils to the total depth of excavation at the Dry Well and Burn Pit AOCs is the same as described for Alternative 3.<br>Active, engineered treatment of the saturated zone will more rapidly reduce the TMV of site-related COCs in both saturated soil and groundwater relative to Alternative 3. Biosparging may also reduce TMV of contaminants in the vadose zone at the Burn Pit above the biosparging system. | TMV reduction for soils to the total depth of excavation at the Dry Well and Burn Pit AOCs is the same as described for Alternatives 3 and 4.<br>Active, ISCO treatment of the saturated zone will more rapidly reduce the TMV of site-related COCs in both saturated soil and groundwater relative to Alternative 3. |
| 5 | Short-Term Effectiveness | Does not meet Threshold Criteria | Does not meet Threshold Criteria | Short-term remedy effectiveness would be realized as soon as LUCs are in place, including decommissioning of the WSW.<br>Short-term effectiveness for soil is high as result of rapid removal of contaminated soil via excavation .<br>There are some operational hazards associated with soil excavation, transportation of soil, and treatment/disposal; however, these are routine construction activities and pose relatively low implementation risk to workers, the community, and the environment.<br>RAO 1 (prevention of human exposure) would be achieved for soil upon completion of excavation; however, RAOs 2 and 3 (restore groundwater quality and prevent further degradation of groundwater) would not be achieved for approximately 20 years. LUCs will ensure that receptor exposure to contaminated media that remains on site (e.g., Site Groundwater) is controlled in the short-term while the MNA portion of the remedy is being implemented. | Short-term remedy effectiveness would be realized as soon as LUCs are in place, including decommissioning of the WSW.<br>Short-term effectiveness for soil is equivalent to Alternatives 3 and 5.<br>There are some operational hazards associated with installation of the biosparging system and soil excavation, transportation of soil, and treatment/disposal; however, these are routine construction activities and pose relatively low implementation risk to workers, the community, and the environment.<br>RAO 1 (prevention of human exposure) would be achieved for soil upon completion of excavation. RAOs 2 and 3 (restore groundwater quality and prevent further degradation of groundwater) are expected to be achieved within an approximately 6 years of implementing the remedy. LUCs will ensure that receptor exposure to contaminated media that remains on site (e.g., Site Groundwater) is controlled in the short-term while the biosparging portion of the remedy is being implemented. | Short-term remedy effectiveness would be realized as soon as LUCs are in place, including decommissioning of the WSW.<br>Short-term effectiveness for soil is equivalent to Alternatives 3 and 4.<br>ISCO application poses a relatively low implementation risk to the community and the environment.<br>Transportation, handling, and injection of ISCO (a strong oxidizer) and the alkaline activator pose additional hazards to the community, workers, and the environmental. The greatest hazards are to the injection crews and would be managed through administrative and engineering controls, and personal protective equipment.<br>RAO 1 (prevention of human exposure) would be achieved for soil upon completion of excavation. RAOs 2 and 3 (restore groundwater quality and prevent further degradation of groundwater) are expected to be achieved within approximately four years of implementing the remedy. LUCs will ensure that receptor exposure to contaminated media that remains on site (e.g., Site Groundwater) is controlled in the short-term while the biosparging portion of the remedy is being implemented. |

## Table 5-2 Evaluation of Remedial Alternatives (continued)

| **Criterion** | | **Remedial Alternative 1 No Action** | **Remedial Alternative 2 Land Use Controls and Monitored Natural Attenuation** | **Remedial Alternative 3 Excavation of Petroleum Contaminated Soil (Burn Pit) and Arsenic and Lead Contaminated Soil (Dry Well), Monitored Natural Attenuation, and Land Use Controls** | **Remedial Alternative 4 Excavation of Petroleum Contaminated Soil (Burn Pit) and Arsenic and Lead Contaminated Soil (Dry Well), Biosparging for Burn Pit Groundwater, and Land Use Controls** | **Remedial Alternative 5 Excavation of Petroleum Contaminated Soil (Burn Pit) and Arsenic and Lead Contaminated Soil (Dry Well), *In Situ* Chemical Oxidation for Burn Pit Groundwater, and Land Use Controls** |
|---|---|---|---|---|---|---|
| **Primary Balancing Criteria (continued)** | | | | | | |
| 6 | Implementability | Does not meet Threshold Criteria | Does not meet Threshold Criteria | Implementation of soil excavation and subsequent off-site treatment and disposal is technically feasible and executable. No major site modifications would be necessary.<br>Implementation of MNA and LUCs is technically feasible and readily executed. | Implementability of soil excavation and subsequent off-site treatment and disposal is technically feasible and equivalent to Alternatives 3 and 5.<br>Implementation of biosparging is technically feasible and readily executed but requires more technical and logistical coordination than Alternative 3 including establishing an electrical power source.<br>Implementation of LUCs is technically feasible and readily executed. | Implementability of soil excavation and subsequent off-site treatment and disposal is technically feasible and equivalent to Alternatives 3 and 4.<br>Implementation of ISCO is technically feasible and readily executed but requires more technical and logistical coordination than Alternative 3 but does not require establishing a power source like Alterative 4.<br>Implementation of LUCs is technically feasible and readily executed. |
| 7 | **Total Present Value Cost** | **$0** | Does not meet Threshold Criteria | **$1,185,000** | **$1,516,000** | **$1,353,000** |

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#### 5.2.2.6 Summary of Comparative Analysis

Table 5-3 shows the total scores assigned to the five alternatives evaluated for the Dry Well, Burn Pit and Site Groundwater AOCs. Alternative 4 was the highest scoring with a total of 15 points based on high scores for long-term effectiveness and reduction in TMV and moderate-high score for short-term effectiveness. Alternative 3 scored 14 points based on high scores for implementability and moderate scores for long- and short-term effectiveness, and reduction in TMV. Alternative 4 also scored 14 points based on high scores for long-term effectiveness and reduction in TMV and moderate score for implementability.

Remedial alternatives 3, 4, and 5 scored very close to each other. Based on results of this analysis, and considering the estimated costs for each remedial alternative, the preferred remedial alternative is Alternative 3, which involves excavation at the Dry Well and Burn Pit AOCs to remove soil with exceedances of approved cleanup levels and offsite treatment or disposal. MNA would be implemented for groundwater contamination associated with the Burn Pit AOC. LUCs (including decommissioning the WSW) would be implemented to protect against exposure to contaminated media, including groundwater, until cleanup levels for all media are achieved. The preferred alternative is described in greater detail in Section 6.0.

### 5.2.3 Modifying Criteria

Formal input from ADEC, the local community, and the public will be solicited upon issue of the proposed plan and that feedback will be incorporated into the ROD. In addition, before issue of the proposed plan, the U.S. Army will coordinate with ADEC, the local community, and the public to incorporate their input into this FS.

## Table 5-3 Comparative Analysis of Remedial Alternatives

| Remedial Alternative | Description of Remedial Alternative | Threshold Criteria | | Primary Balancing Criteria | | | | Total Score | Estimated Cost |
|---|---|---|---|---|---|---|---|---|---|
| | | Overall Protection of Human Health and the Environment | Compliance with ARARs | Long-Term Effectiveness and Permanence | Reduction in Toxicity, Mobility, or Volume Through Treatment | Short-Term Effectiveness | Implement-ability | | |
| 1 | No Action | Fail | Fail | N/A | N/A | N/A | N/A | **N/A** | $0 |
| 2 | LUCs and MNA | Fail | Fail | N/A | N/A | N/A | N/A | **N/A** | N/A |
| 3 | Excavation, MNA, and LUCs | Pass | Pass | 3 | 2 | 3 | 5 | **13** | $1,185,000 |
| 4 | Excavation, Biosparging, and LUCs | Pass | Pass | 5 | 5 | 4 | 1 | **15** | $1,516,000 |
| 5 | Excavation, ISCO, and LUCs | Pass | Pass | 5 | 5 | 2 | 3 | **15** | $1,353,000 |

Notes:

Scores based on the following:

Balancing Criteria: Low (1), Low-Moderate (2), Moderate (3), Moderate-High (4), or High (5)

Total Possible Score = 20

ARAR: Applicable or Relevant and Appropriate Requirement
ISCO: In Situ Chemical Oxidation
LUCs: Land Use Controls
MNA: Monitored Natural Attenuation
N/A: Not applicable because alternative failed the threshold criteria.

# 6.0 PREFERRED REMEDIAL ALTERNATIVE

This section describes the preferred alternative based on the comparative analysis presented in Section 5.0.

## 6.1 PREFERRED ALTERNATIVE

Based on the analysis the preferred alternative for the Burn Pit, Dry Well, and Site Groundwater is Alternative 3. Although Alternatives 4 and 5 scored slightly higher, Alternative 3 achieves protection of human health and the environmental at a lower cost.

With this alternative, excavation and offsite treatment or disposal would remove contaminated soil containing COCs at concentrations greater than the approved cleanup levels. Groundwater associated with the Burn Pit AOC would be treated *in situ* using MNA. The WSW would be decommissioned to eliminate the potential for exposure to lead associated with well components. LUCs would be implemented to prohibit use of groundwater near the Burn Pit plume until ADEC Table C cleanup levels are achieved through MNA. LUCs would be established and enforced by the U.S. Army. The facility is currently fenced, and the gate secured with a lock to prohibit trespassers. Work clearance for any activities at the site would require approval from the U.S. Army. Any work proposed within LUC boundaries will require an ADEC approved work plan addressing health and safety concerns, monitoring for contaminated media, and provisions for handling contaminated media, if encountered. LUC inspections, monitoring, and reporting would be outlined in a LUC Implementation Plan to document long-term effectiveness of LUCs. The U.S. Army has no plans to sell or transfer the property so will be able to maintain control over activities at the SCS for the foreseeable future.

Remedy details will be provided in the RD/RAWP, which will detail the design of the remediation systems and the performance monitoring program. The RD/RAWP will specify performance metrics and outline a plan for remedy contingencies.

## 6.2 REMEDY COSTS

The TPV cost of Remedial Alternative 3, based on a discount rate of 0.6 percent, is $1.18M. The estimated capital cost is $641,000. Remedy costs assume a 20-year period for reaching the ADEC Table C cleanup levels for groundwater. The estimated capital, O&M, and periodic costs, as well as the basis of the costs, are provided in Appendix B.

## 6.3 EXPECTED OUTCOME

With Alternative 3, the remedy is expected to be implemented (e.g., soil excavation complete, WSW decommissioned, and LUCs and MNA implemented) within two years of finalizing the ROD. Alternative 3 is expected to achieve the site-specific approved cleanup levels for soil after the excavation is complete. These include approved cleanup levels for human health to a depth of 15 feet bgs at the Dry Well AOC and ACLs for migration to groundwater at Burn Pit AOC. Alternative 3 is expected to achieve the ADEC Table C cleanup levels for groundwater after approximately 20 years of MNA.

The time-frame for achieving Cleanup Complete (without ICs) is expected to be approximately 20 years. LUCs and Five-Year Reviews will be required until Cleanup Complete is achieved.

After completing site cleanup, the risk from hazardous substances will be evaluated to ensure that it does not exceed a cumulative carcinogenic risk standard of 1 in 100,000 or a cumulative noncarcinogenic risk standard HI of 1 across all exposure pathways, per 18 AAC 75.325(g).

## 7.0 REFERENCES

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# FIGURES

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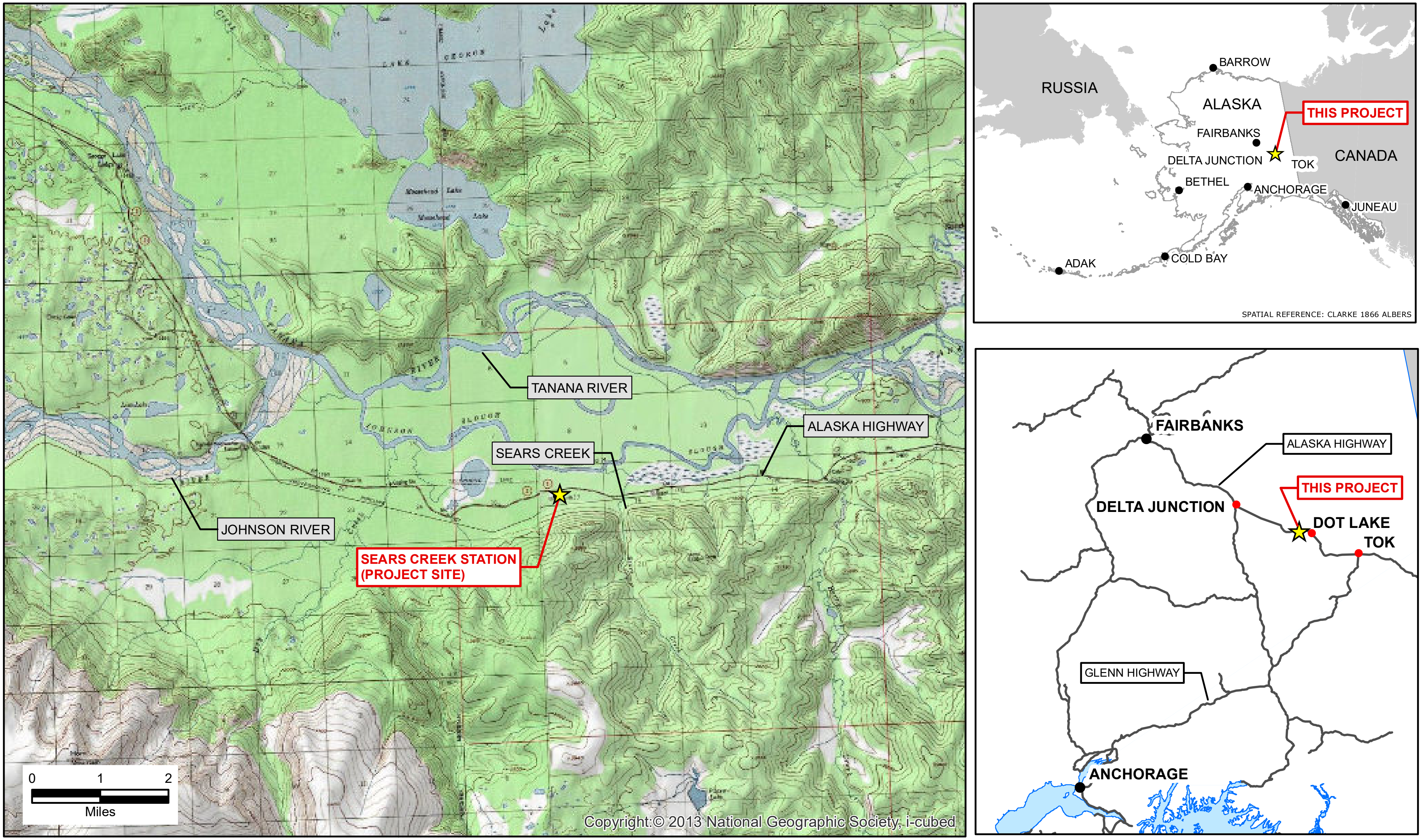

**REFERENCES:**

Background Map is WMS Feed from ARCGIS Online World Relief and USA TOPOS 1:63,360

**LOCATION:**

Project Site Located in Quadrangle: Mount Hayes, AK, 1975, 1:250,000
Latitude 63.6876 N Longitude: 144.4933 W
Section 17, Township 22 North, Range 5 East, Copper River Meridian
Project Site Located in UTM Zone 6 North, at approximately 7064650 Meters Northing, 623945 Meters Easting

N
W
E
S

## Figure 1-1
## Site Location

Dry Well, Burn Pit, and Site Groundwater Feasibility Study
Sears Creek Station, Alaska

Bristol
ENVIRONMENTAL REMEDIATION SERVICES, LLC
Phone (907)563-0013
Fax (907)563-6713

DATUM: WGS84
SYSTEM: UTM ZONE 6 N
Project No. 34150037

DATE OCT 2017
DWN. CB
SCALE AS SHOWN
APPRVD. JA

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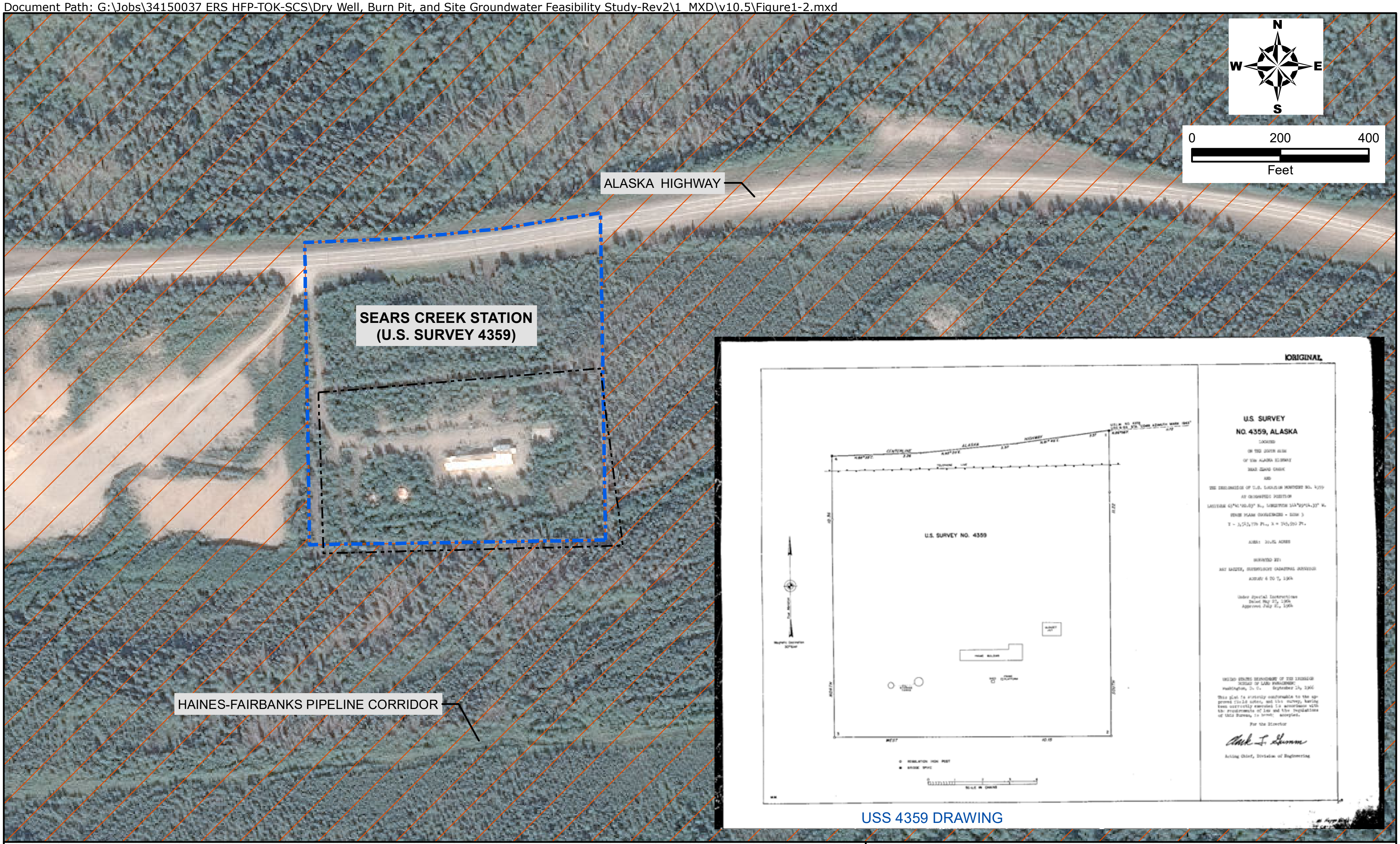


**LEGEND:**

- - - - FENCE (APPROXIMATE - LINEWORK FROM OTHERS)

▭ SEARS CREEK STATION (MILITARY OWNED) PROPERTY BOUNDARY (U.S. SURVEY 4359)

▨ STATE OF ALASKA PROPERTY

**NOTES:**

1. Background Imagery is from E-TERRA 6 July 2013.

2. The Sears Creek Station Property is based on U.S. Survey 4359 Downloaded from BLM SDMS and Re-constructed in NAD27 Alaska State Plane Zone 3, U.S. Feet, Consistent with the Survey Drawing and Survey Notes.

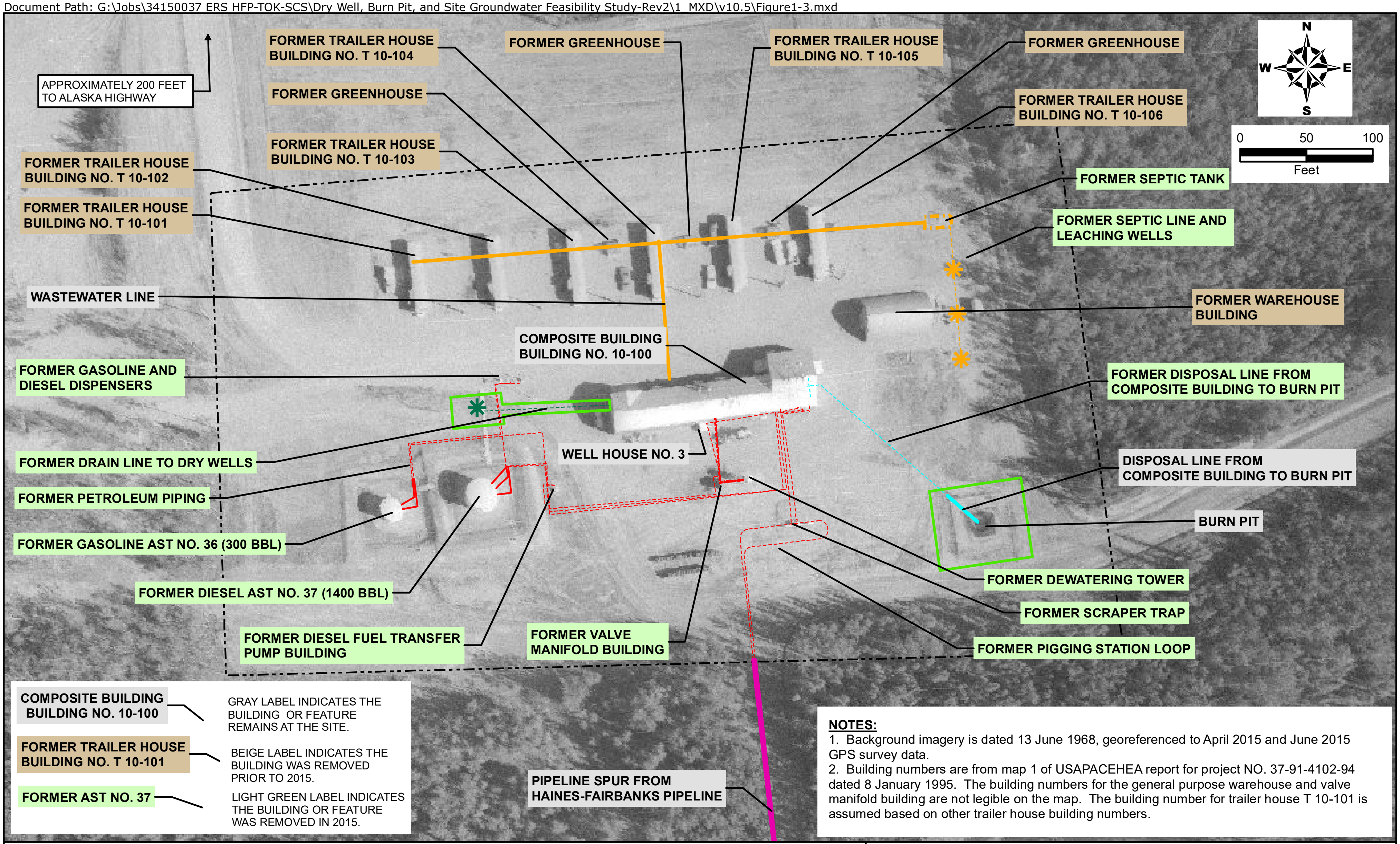
## Figure 1-2
## Sears Creek Station Area Land Ownership
Dry Well, Burn Pit, and Site Groundwater Feasibility Study
Sears Creek Station, Alaska

Bristol
ENVIRONMENTAL REMEDIATION SERVICES, LLC
Phone (907)563-0013
Fax (907)563-6713

DATUM: WGS84
SYSTEM: UTM ZONE 6 N
Project No. 34150037

DATE OCT 2017
DWN. CB
SCALE AS SHOWN
APPRVD. JA

Document Path: G:\Jobs\34150037 ERS HFP-TOK-SCS\Dry Well, Burn Pit, and Site Groundwater Feasibility Study-Rev2\1_MXD\v10.5\Figure1-3.mxd



**COMPOSITE BUILDING BUILDING NO. 10-100** — GRAY LABEL INDICATES THE BUILDING OR FEATURE REMAINS AT THE SITE.

**FORMER TRAILER HOUSE BUILDING NO. T 10-101** — BEIGE LABEL INDICATES THE BUILDING WAS REMOVED PRIOR TO 2015.

**FORMER AST NO. 37** — LIGHT GREEN LABEL INDICATES THE BUILDING OR FEATURE WAS REMOVED IN 2015.

**NOTES:**

1. Background imagery is dated 13 June 1968, georeferenced to April 2015 and June 2015 GPS survey data.
2. Building numbers are from map 1 of USAPACEHEA report for project NO. 37-91-4102-94 dated 8 January 1995. The building numbers for the general purpose warehouse and valve manifold building are not legible on the map. The building number for trailer house T 10-101 is assumed based on other trailer house building numbers.

**LEGEND:**

- ✱ FORMER DRY WELL (REMOVED JUNE 2015)
- ✱ FORMER SEPTIC LEACHING WELL (REMOVED JUNE 2015)
- ------ FORMER DRY WELL PIPING (REMOVED IN 2015)
- ━━ WASTEWATER LINE REMAINING IN PLACE
- ------ WASTEWATER LINE (REMOVED IN 2015)
- ▭ FEASIBILITY STUDY AREA OF CONCERN
- ▭ FORMER SEPTIC TANK (REMOVED IN 2015)
- ━━ DISPOSAL LINE REMAINING IN PLACE
- ------ FORMER DISPOSAL LINE (REMOVED IN 2015)
- ━━ FORMER ABOVEGROUND FUEL LINES (REMOVED IN 2015)
- ------ FORMER UNDERGROUND FUEL LINES (REMOVED IN 2015)
- ━━ FUEL LINES REMAINING IN PLACE
- -·-·- FENCE

## Figure 1-3
## Sears Creek Station Facility Map
Dry Well, Burn Pit, and Site Groundwater Feasibility Study
Sears Creek Station, Alaska

Bristol
ENVIRONMENTAL REMEDIATION SERVICES, LLC
Phone (907)563-0013
Fax (907)563-6713

| | | | |
|---|---|---|---|
| DATUM: WGS84 | | DATE | OCT 2017 |
| SYSTEM: UTM ZONE 6 N | | DWN. | CB |
| Project No. | | SCALE | AS SHOWN |
| 34150037 | | APPRVD. | JA |

**ACRONYMS AND ABBREVIATIONS:**

ANALYTES
DRO - Diesel Range Organics
GRO - Gasoline Range Organics
EBZ - Ethylbenzene
NAP - Naphthalene
1,2,4-TMB - 1,2,4 Trimethylbenzene
1,3,5-TMB - 1,3,5 Trimethylbenzene
1,1,2-TCA - 1,1,2-Trichloroethane
2-MNPT - 2-Methylnaphthalene
UNITS
MG/KG - Milligrams per Kilogram
OTHER
FES - Fairbanks Environmental Services
VOCs - Volatile Organic Compounds
PAHs - Polynuclear Aromatic Hydrocarbons
ND - Not Detected at LOD Shown in Parenthesis
LOD - Limit of Detection
Q - result considered an estimate (L-low; N-uncertain) due to a quality control failure
J - Result Qualified as Estimate because it is less than the LOQ
LOQ - Limit of Quantitation

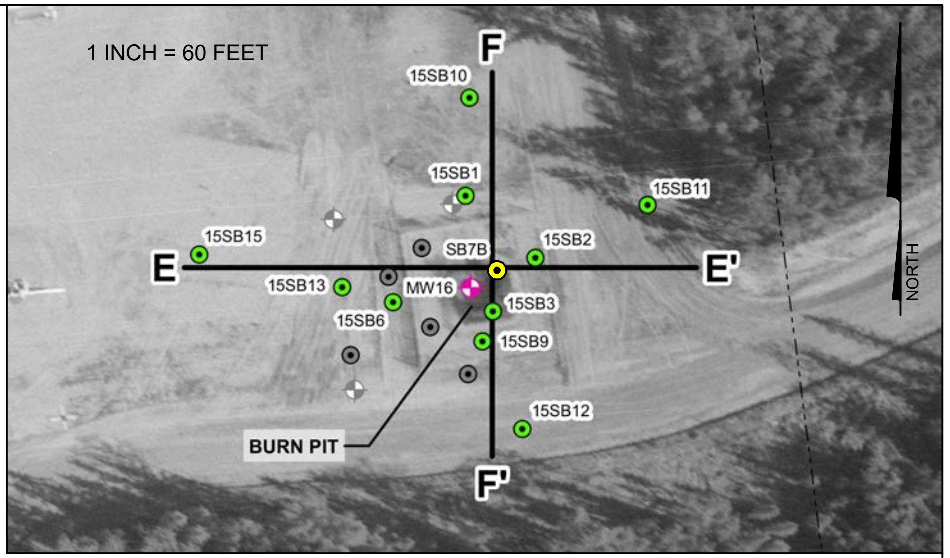
**ACRONYMS AND ABBREVIATIONS cont.:**

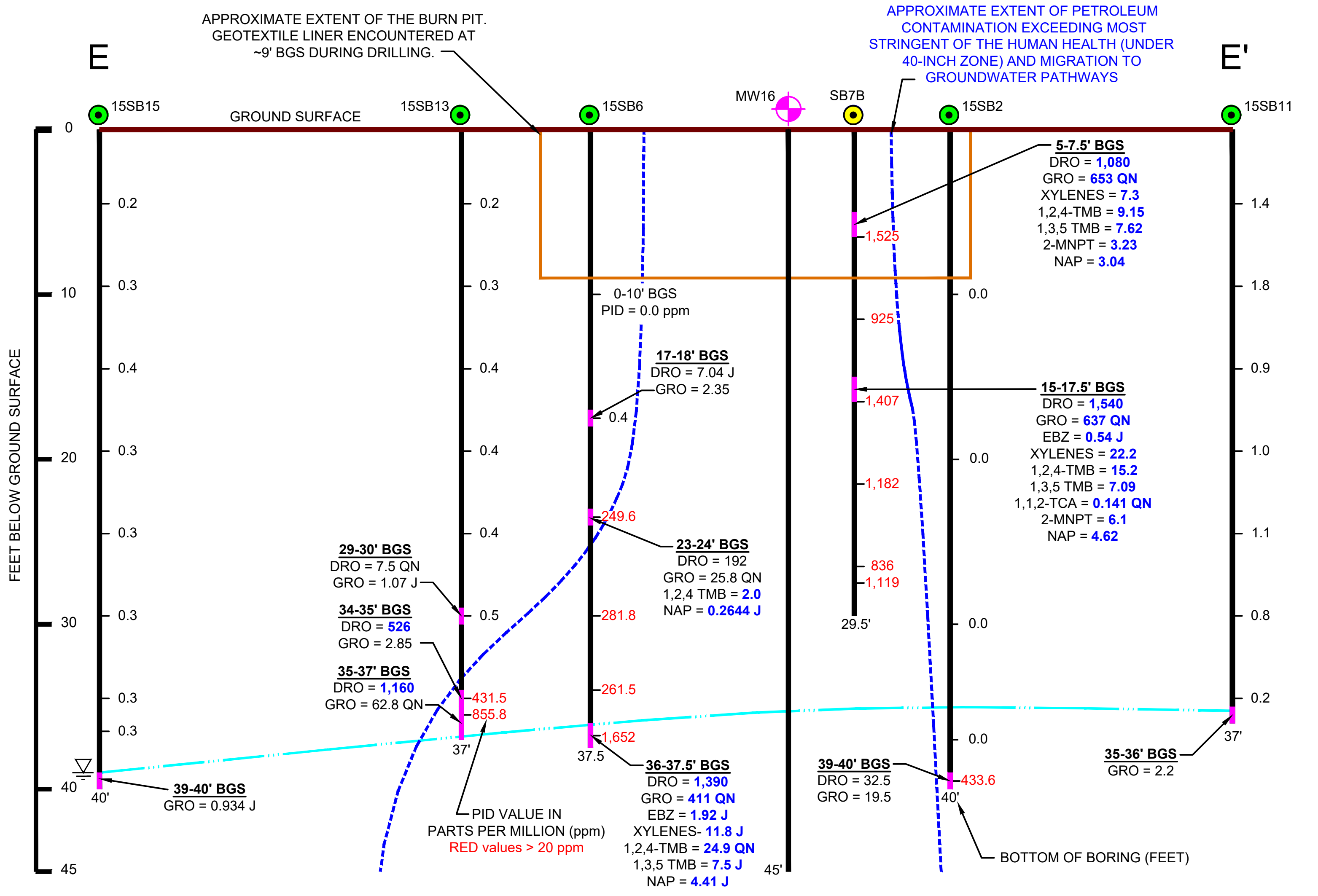
ppm - parts per million
BGS - Below Ground Surface
NAVD88 - North American Vertical Datum of 1988
ADEC - Alaska Department of Environmental Conservation

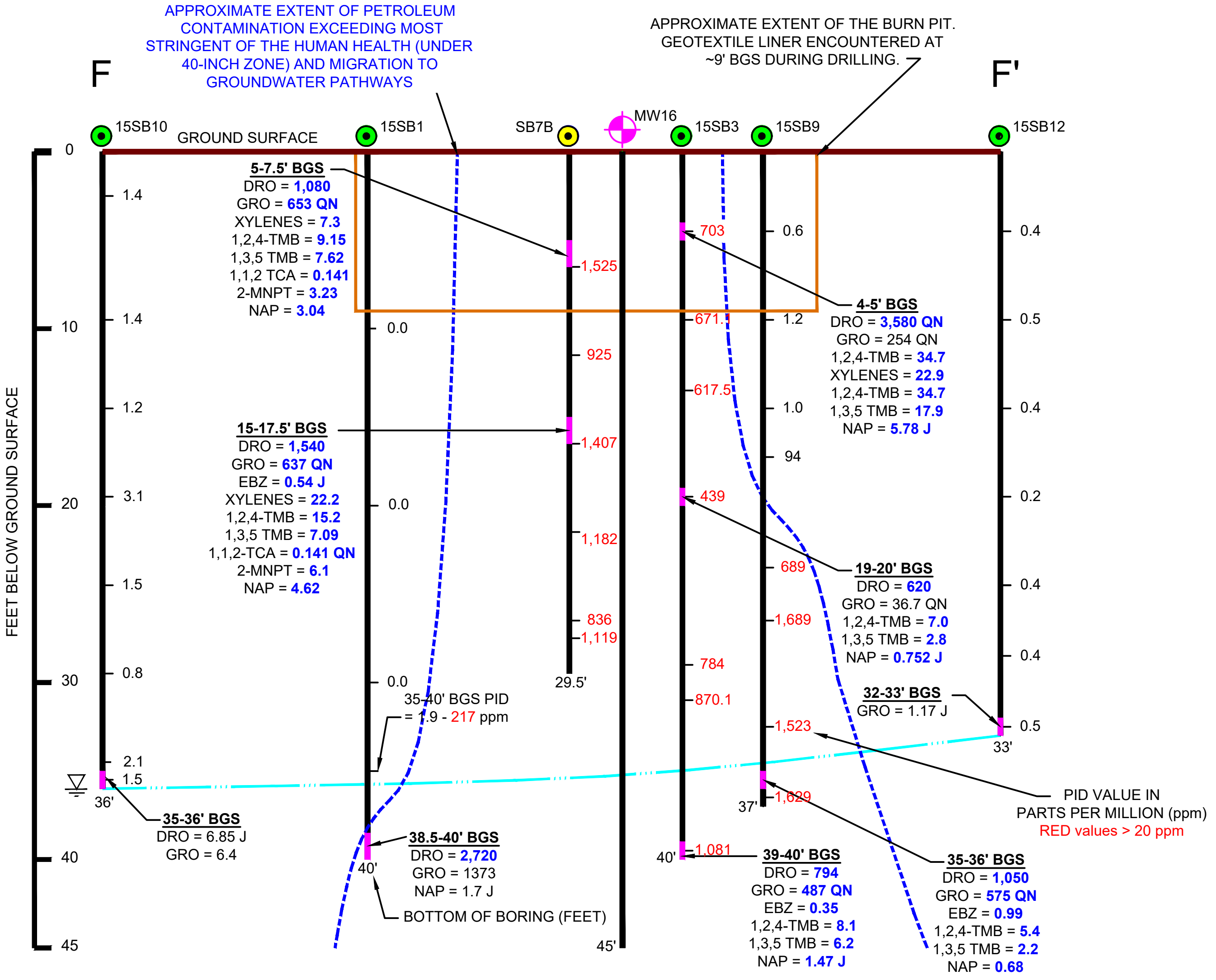
**ADEC SOIL CLEANUP LEVELS:**
18 AAC 75.341 TABLES B1/B2
UNITS = MG/KG

| | |
|---|---|
| **BULK FUEL HYDROCARBONS** | |
| DRO | 250 |
| GRO | 300 |
| **VOCs** | |
| ETHYLBENZENE | 0.13 |
| XYLENES (TOTAL) | 1.5 |
| 1,2,4-TMB | 0.16 |
| 1,3,5-TMB | 1.3 |
| 1,1,2-TCA | 0.0014 |
| **PAHs** | |
| 1-MNPT | 0.41 |
| 2-MNPT | 1.3 |
| NAPHTHALENE | 0.038 |

UNDER 40-INCH ZONE
MOST STRINGENT PATHWAY







**LEGEND:**

| | |
|---|---|
| ● 15SB15 | 2015 BURN PIT INVESTIGATION SOIL BORING - NORTH WIND |
| ● SB7B | OCTOBER 2007 SOIL BORING |
| ⊕ MW16 | GROUNDWATER MONITORING WELL |
| - - - | APPROXIMATE WATER LEVEL IS BASED ON OBSERVATIONS AT TIME OF DRILLING |
| \| | LAB SAMPLE INTERVAL |

**NOTES:**

1. Concentrations shown in Blue exceed ADEC cleanup levels
2. The highest concentration between primary and duplicate samples is shown where duplicate samples were collected
3. Non-detect values are not shown. Only values above the ADEC cleanup level are shown for all analytes except DRO and GRO
4. Concentrations are in MG/KG.
5. Vertical Scale only applies to boring depths.

HORIZONTAL (FEET)
0 20 40
0 10 20
VERTICAL (FEET)
(BORING DEPTHS)

## Figure 1-4

## Sears Creek Cross Sections E - E' and F - F' (Burn Pit)

Dry Well, Burn Pit, and Site Groundwater Feasibility Study
Sears Creek Station, Alaska

Bristol
Phone (907)563-0013
Fax (907)563-6713

| | |
|---|---|
| DATE | AUGUST 2017 |
| DWN | CB |
| SCALE | AS SHOWN |
| APPRVD. | JA |
| PROJECT NO. | 34150037 |

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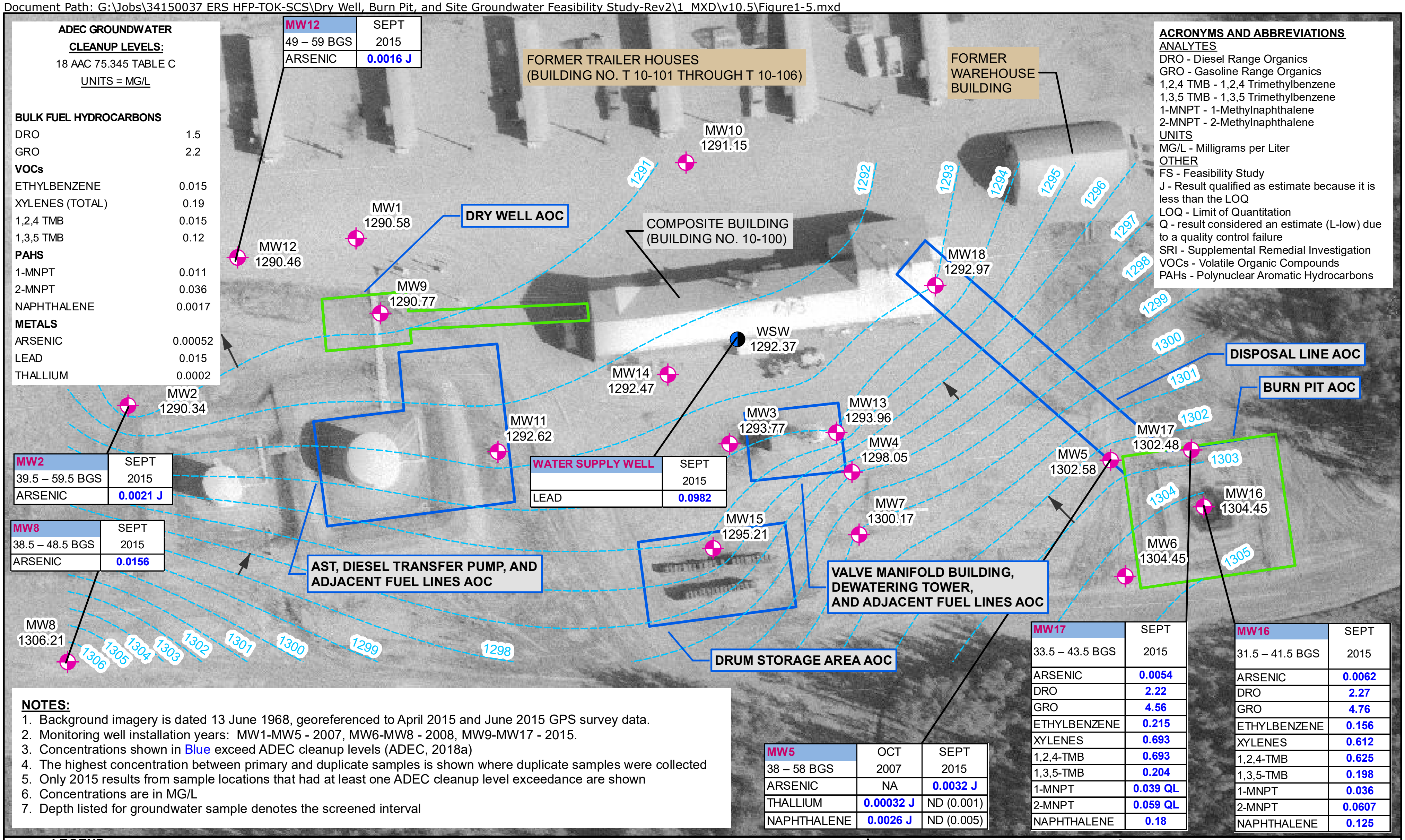

**ADEC GROUNDWATER CLEANUP LEVELS:**
18 AAC 75.345 TABLE C
UNITS = MG/L

| | |
|---|---|
| **BULK FUEL HYDROCARBONS** | |
| DRO | 1.5 |
| GRO | 2.2 |
| **VOCs** | |
| ETHYLBENZENE | 0.015 |
| XYLENES (TOTAL) | 0.19 |
| 1,2,4 TMB | 0.015 |
| 1,3,5 TMB | 0.12 |
| **PAHS** | |
| 1-MNPT | 0.011 |
| 2-MNPT | 0.036 |
| NAPHTHALENE | 0.0017 |
| **METALS** | |
| ARSENIC | 0.00052 |
| LEAD | 0.015 |
| THALLIUM | 0.0002 |

| **MW12** | SEPT |
|---|---|
| 49 – 59 BGS | 2015 |
| ARSENIC | **0.0016 J** |

| **MW2** | SEPT |
|---|---|
| 39.5 – 59.5 BGS | 2015 |
| ARSENIC | **0.0021 J** |

| **MW8** | SEPT |
|---|---|
| 38.5 – 48.5 BGS | 2015 |
| ARSENIC | **0.0156** |

| **WATER SUPPLY WELL** | SEPT |
|---|---|
| | 2015 |
| LEAD | **0.0982** |

| **MW5** | OCT | SEPT |
|---|---|---|
| 38 – 58 BGS | 2007 | 2015 |
| ARSENIC | NA | **0.0032 J** |
| THALLIUM | **0.00032 J** | ND (0.001) |
| NAPHTHALENE | **0.0026 J** | ND (0.005) |

| **MW17** | SEPT |
|---|---|
| 33.5 – 43.5 BGS | 2015 |
| ARSENIC | **0.0054** |
| DRO | **2.22** |
| GRO | **4.56** |
| ETHYLBENZENE | **0.215** |
| XYLENES | **0.693** |
| 1,2,4-TMB | **0.693** |
| 1,3,5-TMB | **0.204** |
| 1-MNPT | **0.039 QL** |
| 2-MNPT | **0.059 QL** |
| NAPHTHALENE | **0.18** |

| **MW16** | SEPT |
|---|---|
| 31.5 – 41.5 BGS | 2015 |
| ARSENIC | **0.0062** |
| DRO | **2.27** |
| GRO | **4.76** |
| ETHYLBENZENE | **0.156** |
| XYLENES | **0.612** |
| 1,2,4-TMB | **0.625** |
| 1,3,5-TMB | **0.198** |
| 1-MNPT | **0.036** |
| 2-MNPT | **0.0607** |
| NAPHTHALENE | **0.125** |

**ACRONYMS AND ABBREVIATIONS**

ANALYTES
DRO - Diesel Range Organics
GRO - Gasoline Range Organics
1,2,4 TMB - 1,2,4 Trimethylbenzene
1,3,5 TMB - 1,3,5 Trimethylbenzene
1-MNPT - 1-Methylnaphthalene
2-MNPT - 2-Methylnaphthalene

UNITS
MG/L - Milligrams per Liter

OTHER
FS - Feasibility Study
J - Result qualified as estimate because it is less than the LOQ
LOQ - Limit of Quantitation
Q - result considered an estimate (L-low) due to a quality control failure
SRI - Supplemental Remedial Investigation
VOCs - Volatile Organic Compounds
PAHs - Polynuclear Aromatic Hydrocarbons

**NOTES:**

1. Background imagery is dated 13 June 1968, georeferenced to April 2015 and June 2015 GPS survey data.
2. Monitoring well installation years: MW1-MW5 - 2007, MW6-MW8 - 2008, MW9-MW17 - 2015.
3. Concentrations shown in Blue exceed ADEC cleanup levels (ADEC, 2018a)
4. The highest concentration between primary and duplicate samples is shown where duplicate samples were collected
5. Only 2015 results from sample locations that had at least one ADEC cleanup level exceedance are shown
6. Concentrations are in MG/L
7. Depth listed for groundwater sample denotes the screened interval

**LEGEND:**

| | |
|---|---|
| MW8 1306.21 ⊕ | MONITORING WELL<br>GROUNDWATER ELEVATION, 20 SEPT 2015<br>(ELEVATIONS ARE IN NAVD88, FEET) |
| ◐ | WATER SUPPLY WELL |
| - - - | GROUNDWATER TABLE CONTOUR - 20 SEPT 2015<br>CONTOUR INTERVAL - 1 FOOT |
| → | INFERRED GROUNDWATER FLOW DIRECTION |
| ▭ | FS AREA OF CONCERN |
| ▭ | SRI AREA OF CONCERN |
| 🟦 | GROUNDWATER SAMPLE FROM THE 2015 SUPPLEMENTAL REMEDIAL INVESTIGATION |

N
W E
S

0 30 60
Feet

# Figure 1-5
## Groundwater Elevations and Groundwater Sample Results Exceeding ADEC Cleanup Levels
Dry Well, Burn Pit, and Site Groundwater Feasibility Study
Sears Creek Station, Alaska

Bristol
ENVIRONMENTAL REMEDIATION SERVICES, LLC
Phone (907)563-0013
Fax (907)563-6713

| | |
|---|---|
| DATUM: WGS84 | DATE OCT 2017 |
| SYSTEM: UTM ZONE 6 N | DWN. CB |
| Project No. 34150037 | SCALE AS SHOWN |
| | APPRVD. JA |

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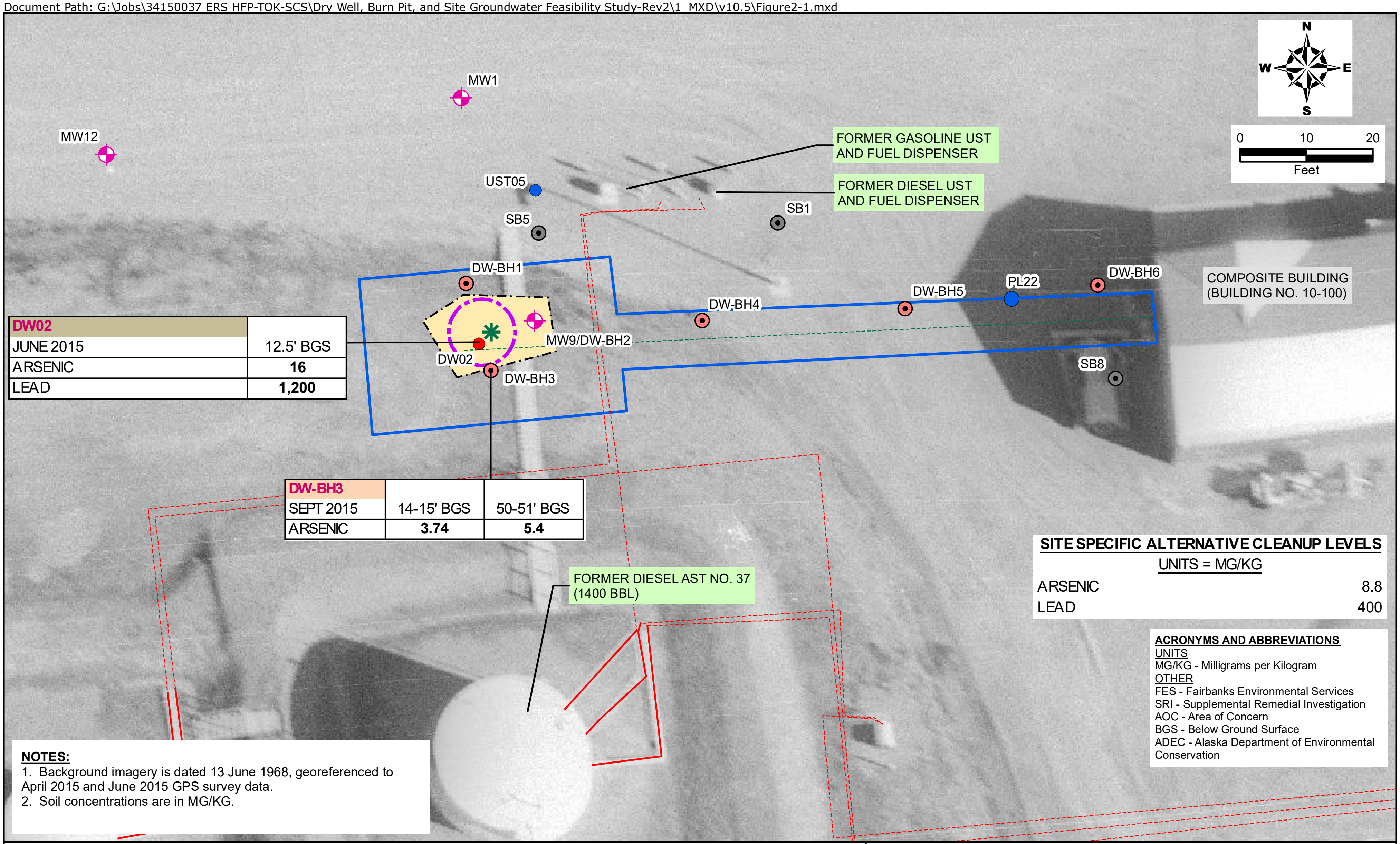


| DW02 | |
|---|---|
| JUNE 2015 | 12.5' BGS |
| ARSENIC | **16** |
| LEAD | **1,200** |

| DW-BH3 | | |
|---|---|---|
| SEPT 2015 | 14-15' BGS | 50-51' BGS |
| ARSENIC | **3.74** | **5.4** |

**SITE SPECIFIC ALTERNATIVE CLEANUP LEVELS**

UNITS = MG/KG

| | |
|---|---|
| ARSENIC | 8.8 |
| LEAD | 400 |

**ACRONYMS AND ABBREVIATIONS**

UNITS

MG/KG - Milligrams per Kilogram

OTHER

FES - Fairbanks Environmental Services

SRI - Supplemental Remedial Investigation

AOC - Area of Concern

BGS - Below Ground Surface

ADEC - Alaska Department of Environmental Conservation

**NOTES:**

1. Background imagery is dated 13 June 1968, georeferenced to April 2015 and June 2015 GPS survey data.
2. Soil concentrations are in MG/KG.

**LEGEND:**

| | |
|---|---|
| ⊕ | GROUNDWATER MONITORING WELL |
| ● | 2015 UIC EXCAVATION SOIL SAMPLE - BRISTOL |
| ● | REMOVAL ACTION SOIL SAMPLE (NO ADEC EXCEEDANCES) - BRISTOL |
| ⊙ | 2015 SRI SOIL BORING - FES |
| ⊙ | PRE-2015 SOIL BORING |
| ✱ | FORMER DRY WELL (REMOVED IN 2015) |
| ▭ | SOIL BORING SAMPLE FROM THE 2015 SUPPLEMENTAL REMEDIAL INVESTIGATION |
| ▭ | SOIL SAMPLE FROM THE 2015 UNDERGROUND INJECTION CONTROL (UIC) - BRISTOL |
| - - - - | FORMER DRY WELL PIPING (REMOVED IN 2015) |
| —— | FORMER ABOVEGROUND FUEL LINES (REMOVED IN 2015) |
| - - - - | FORMER UNDERGROUND FUEL LINES (REMOVED IN 2015) |
| ▭ | ESTIMATED EXTENT OF SOIL EXCEEDING ALTERNATIVE CLEANUP LEVELS |
| ▭ | DATA GAP AREA OF CONCERN |
| ▭ | DRY WELL EXCAVATION - BRISTOL 2015 |

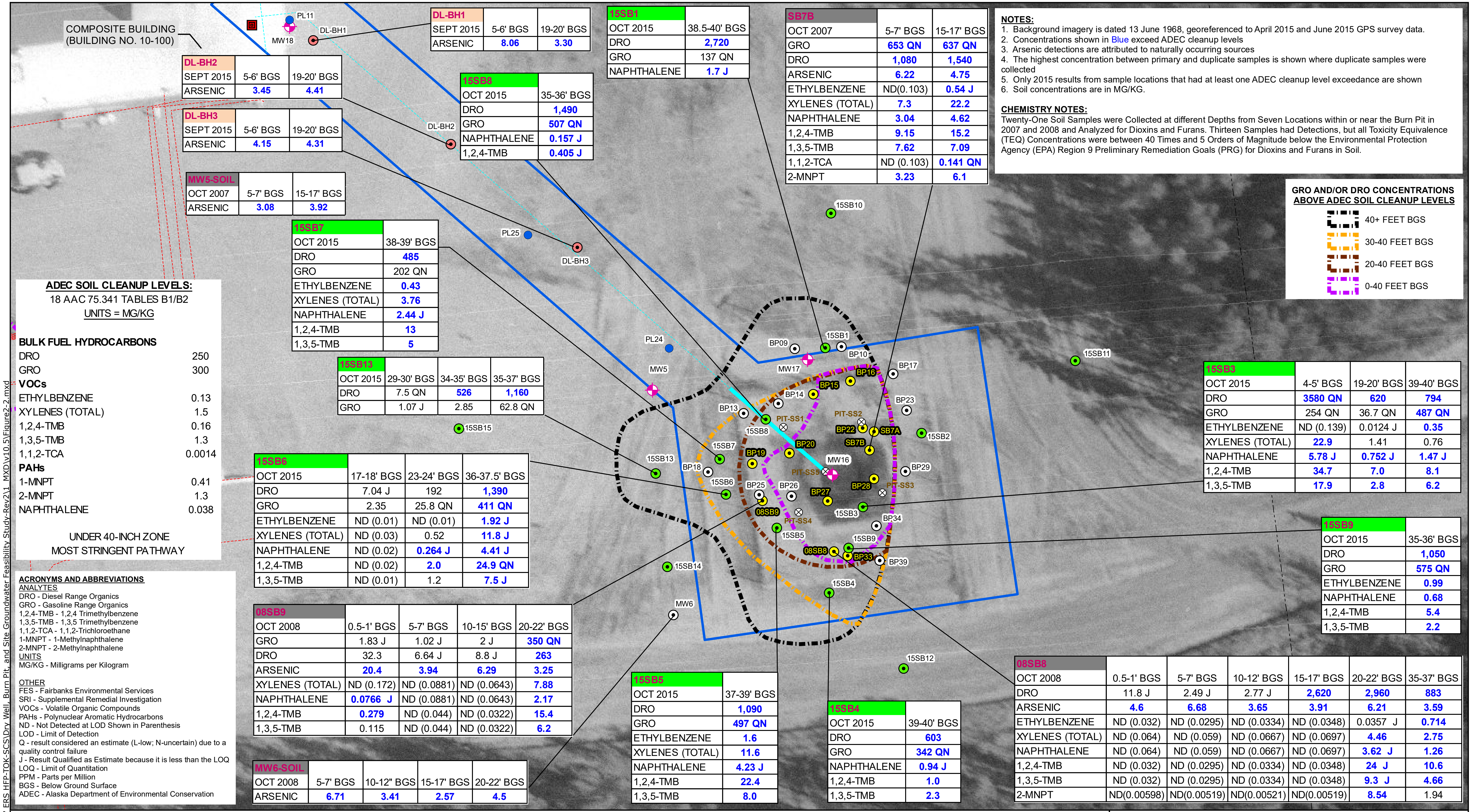
## Figure 2-1

## Estimated Extent of Soil Exceeding Alternative Cleanup Levels at Dry Well AOC

Dry Well, Burn Pit, and Site Groundwater Feasibility Study
Sears Creek Station, Alaska

Bristol
ENVIRONMENTAL REMEDIATION SERVICES, LLC
Phone (907)563-0013
Fax (907)563-6713

| | | | |
|---|---|---|---|
| DATUM: WGS84 | | DATE | OCT 2017 |
| SYSTEM: UTM ZONE 6 N | | DWN. | CB |
| Project No. | 34150037 | SCALE | AS SHOWN |
| | | APPRVD. | JA |



| DL-BH1 | | |
|---|---|---|
| SEPT 2015 | 5-6' BGS | 19-20' BGS |
| ARSENIC | 8.06 | 3.30 |

| DL-BH2 | | |
|---|---|---|
| SEPT 2015 | 5-6' BGS | 19-20' BGS |
| ARSENIC | 3.45 | 4.41 |

| DL-BH3 | | |
|---|---|---|
| SEPT 2015 | 5-6' BGS | 19-20' BGS |
| ARSENIC | 4.15 | 4.31 |

| MW5-SOIL | | |
|---|---|---|
| OCT 2007 | 5-7' BGS | 15-17' BGS |
| ARSENIC | 3.08 | 3.92 |

| 15SB8 | |
|---|---|
| OCT 2015 | 35-36' BGS |
| DRO | 1,490 |
| GRO | 507 QN |
| NAPHTHALENE | 0.157 J |
| 1,2,4-TMB | 0.405 J |

| 15SB1 | |
|---|---|
| OCT 2015 | 38.5-40' BGS |
| DRO | 2,720 |
| GRO | 137 QN |
| NAPHTHALENE | 1.7 J |

| SB7B | | |
|---|---|---|
| OCT 2007 | 5-7' BGS | 15-17' BGS |
| GRO | 653 QN | 637 QN |
| DRO | 1,080 | 1,540 |
| ARSENIC | 6.22 | 4.75 |
| ETHYLBENZENE | ND(0.103) | 0.54 J |
| XYLENES (TOTAL) | 7.3 | 22.2 |
| NAPHTHALENE | 3.04 | 4.62 |
| 1,2,4-TMB | 9.15 | 15.2 |
| 1,3,5-TMB | 7.62 | 7.09 |
| 1,1,2-TCA | ND (0.103) | 0.141 QN |
| 2-MNPT | 3.23 | 6.1 |

**NOTES:**

1. Background imagery is dated 13 June 1968, georeferenced to April 2015 and June 2015 GPS survey data.
2. Concentrations shown in Blue exceed ADEC cleanup levels
3. Arsenic detections are attributed to naturally occurring sources
4. The highest concentration between primary and duplicate samples is shown where duplicate samples were collected
5. Only 2015 results from sample locations that had at least one ADEC cleanup level exceedance are shown
6. Soil concentrations are in MG/KG.

**CHEMISTRY NOTES:**

Twenty-One Soil Samples were Collected at different Depths from Seven Locations within or near the Burn Pit in 2007 and 2008 and Analyzed for Dioxins and Furans. Thirteen Samples had Detections, but all Toxicity Equivalence (TEQ) Concentrations were between 40 Times and 5 Orders of Magnitude below the Environmental Protection Agency (EPA) Region 9 Preliminary Remediation Goals (PRG) for Dioxins and Furans in Soil.

**GRO AND/OR DRO CONCENTRATIONS ABOVE ADEC SOIL CLEANUP LEVELS**

- 40+ FEET BGS
- 30-40 FEET BGS
- 20-40 FEET BGS
- 0-40 FEET BGS

| 15SB7 | |
|---|---|
| OCT 2015 | 38-39' BGS |
| DRO | 485 |
| GRO | 202 QN |
| ETHYLBENZENE | 0.43 |
| XYLENES (TOTAL) | 3.76 |
| NAPHTHALENE | 2.44 J |
| 1,2,4-TMB | 13 |
| 1,3,5-TMB | 5 |

| 15SB13 | | | |
|---|---|---|---|
| OCT 2015 | 29-30' BGS | 34-35' BGS | 35-37' BGS |
| DRO | 7.5 QN | 526 | 1,160 |
| GRO | 1.07 J | 2.85 | 62.8 QN |

**ADEC SOIL CLEANUP LEVELS:**

18 AAC 75.341 TABLES B1/B2

UNITS = MG/KG

| BULK FUEL HYDROCARBONS | |
|---|---|
| DRO | 250 |
| GRO | 300 |
| **VOCs** | |
| ETHYLBENZENE | 0.13 |
| XYLENES (TOTAL) | 1.5 |
| 1,2,4-TMB | 0.16 |
| 1,3,5-TMB | 1.3 |
| 1,1,2-TCA | 0.0014 |
| **PAHs** | |
| 1-MNPT | 0.41 |
| 2-MNPT | 1.3 |
| NAPHTHALENE | 0.038 |

UNDER 40-INCH ZONE
MOST STRINGENT PATHWAY

| 15SB6 | | | |
|---|---|---|---|
| OCT 2015 | 17-18' BGS | 23-24' BGS | 36-37.5' BGS |
| DRO | 7.04 J | 192 | 1,390 |
| GRO | 2.35 | 25.8 QN | 411 QN |
| ETHYLBENZENE | ND (0.01) | ND (0.01) | 1.92 J |
| XYLENES (TOTAL) | ND (0.03) | 0.52 | 11.8 J |
| NAPHTHALENE | ND (0.02) | 0.264 J | 4.41 J |
| 1,2,4-TMB | ND (0.02) | 2.0 | 24.9 QN |
| 1,3,5-TMB | ND (0.01) | 1.2 | 7.5 J |

| 15SB3 | | | |
|---|---|---|---|
| OCT 2015 | 4-5' BGS | 19-20' BGS | 39-40' BGS |
| DRO | 3580 QN | 620 | 794 |
| GRO | 254 QN | 36.7 QN | 487 QN |
| ETHYLBENZENE | ND (0.139) | 0.0124 J | 0.35 |
| XYLENES (TOTAL) | 22.9 | 1.41 | 0.76 |
| NAPHTHALENE | 5.78 J | 0.752 J | 1.47 J |
| 1,2,4-TMB | 34.7 | 7.0 | 8.1 |
| 1,3,5-TMB | 17.9 | 2.8 | 6.2 |

| 15SB9 | |
|---|---|
| OCT 2015 | 35-36' BGS |
| DRO | 1,050 |
| GRO | 575 QN |
| ETHYLBENZENE | 0.99 |
| NAPHTHALENE | 0.68 |
| 1,2,4-TMB | 5.4 |
| 1,3,5-TMB | 2.2 |

**ACRONYMS AND ABBREVIATIONS**

ANALYTES
DRO - Diesel Range Organics
GRO - Gasoline Range Organics
1,2,4-TMB - 1,2,4 Trimethylbenzene
1,3,5-TMB - 1,3,5 Trimethylbenzene
1,1,2-TCA - 1,1,2-Trichloroethane
1-MNPT - 1-Methylnaphthalene
2-MNPT - 2-Methylnaphthalene
UNITS
MG/KG - Milligrams per Kilogram

OTHER
FES - Fairbanks Environmental Services
SRI - Supplemental Remedial Investigation
VOCs - Volatile Organic Compounds
PAHs - Polynuclear Aromatic Hydrocarbons
ND - Not Detected at LOD Shown in Parenthesis
LOD - Limit of Detection
Q - result considered an estimate (L-low; N-uncertain) due to a quality control failure
J - Result Qualified as Estimate because it is less than the LOQ
LOQ - Limit of Quantitation
PPM - Parts per Million
BGS - Below Ground Surface
ADEC - Alaska Department of Environmental Conservation

| 08SB9 | | | | |
|---|---|---|---|---|
| OCT 2008 | 0.5-1' BGS | 5-7' BGS | 10-15' BGS | 20-22' BGS |
| GRO | 1.83 J | 1.02 J | 2 J | 350 QN |
| DRO | 32.3 | 6.64 J | 8.8 J | 263 |
| ARSENIC | 20.4 | 3.94 | 6.29 | 3.25 |
| XYLENES (TOTAL) | ND (0.172) | ND (0.0881) | ND (0.0643) | 7.88 |
| NAPHTHALENE | 0.0766 J | ND (0.0881) | ND (0.0643) | 2.17 |
| 1,2,4-TMB | 0.279 | ND (0.044) | ND (0.0322) | 15.4 |
| 1,3,5-TMB | 0.115 | ND (0.044) | ND (0.0322) | 6.2 |

| MW6-SOIL | | | | |
|---|---|---|---|---|
| OCT 2008 | 5-7' BGS | 10-12" BGS | 15-17' BGS | 20-22' BGS |
| ARSENIC | 6.71 | 3.41 | 2.57 | 4.5 |

| 15SB5 | |
|---|---|
| OCT 2015 | 37-39' BGS |
| DRO | 1,090 |
| GRO | 497 QN |
| ETHYLBENZENE | 1.6 |
| XYLENES (TOTAL) | 11.6 |
| NAPHTHALENE | 4.23 J |
| 1,2,4-TMB | 22.4 |
| 1,3,5-TMB | 8.0 |

| 15SB4 | |
|---|---|
| OCT 2015 | 39-40' BGS |
| DRO | 603 |
| GRO | 342 QN |
| NAPHTHALENE | 0.94 J |
| 1,2,4-TMB | 1.0 |
| 1,3,5-TMB | 2.3 |

| 08SB8 | | | | | | |
|---|---|---|---|---|---|---|
| OCT 2008 | 0.5-1' BGS | 5-7' BGS | 10-12' BGS | 15-17' BGS | 20-22' BGS | 35-37' BGS |
| DRO | 11.8 J | 2.49 J | 2.77 J | 2,620 | 2,960 | 883 |
| ARSENIC | 4.6 | 6.68 | 3.65 | 3.91 | 6.21 | 3.59 |
| ETHYLBENZENE | ND (0.032) | ND (0.0295) | ND (0.0334) | ND (0.0348) | 0.0357 J | 0.714 |
| XYLENES (TOTAL) | ND (0.064) | ND (0.059) | ND (0.0667) | ND (0.0697) | 4.46 | 2.75 |
| NAPHTHALENE | ND (0.064) | ND (0.059) | ND (0.0667) | ND (0.0697) | 3.62 J | 1.26 |
| 1,2,4-TMB | ND (0.032) | ND (0.0295) | ND (0.0334) | ND (0.0348) | 24 J | 10.6 |
| 1,3,5-TMB | ND (0.032) | ND (0.0295) | ND (0.0334) | ND (0.0348) | 9.3 J | 4.66 |
| 2-MNPT | ND(0.00598) | ND(0.00519) | ND(0.00521) | ND(0.00519) | 8.54 | 1.94 |

**LEGEND:**

- ⊕ GROUNDWATER MONITIORING WELL
- ● REMOVAL ACTION SOIL SAMPLE (NO ADEC EXCEEDANCES) - BRISTOL
- ⊗ 2015 SRI SURFACE SOIL SAMPLE
- ▣ SUMP
- ━ DISPOSAL LINE REMAINING IN PLACE
- ---- FORMER DISPOSAL LINE (REMOVED IN 2015)
- ---- FORMER UNDERGROUND FUEL LINES (REMOVED IN 2015)
- ⊙ 2015 SRI SOIL BORING - FES
- ⊙ 2015 BURN PIT INVESTIGATION SOIL BORING - NORTH WIND
- ⊙ 2007/2008 RI SOIL BORING WITH PID > 20 PPM - NORTH WIND
- ⊙ 2007/2008 RI SOIL BORING WITH PID < 20 PPM - NORTH WIND
- —·—·— FENCE
- ▭ SRI AREA OF CONCERN
- 🟦 GROUNDWATER SAMPLE FROM THE 2015 SUPPLEMENTAL REMEDIAL INVESTIGATION
- 🟧 SOIL BORING SAMPLE FROM THE 2015 SUPPLEMENTAL REMEDIAL INVESTIGATION
- 🟩 SOIL BORING FROM 2015 BURN PIT INVESTIGATION - NORTH WIND
- ⬛ SOIL BORING SAMPLE FROM PREVIOUS SITE INVESTIGATIONS

0 10 20
Feet

N
W E
S

**Figure 2-2**
**Burn Pit and Disposal Line AOC Soil**
**Sampling Results Exceeding ADEC Cleanup Levels**
Dry Well, Burn Pit, and Site Groundwater Feasibility Study
Sears Creek Station, Alaska

Bristol
ENVIRONMENTAL REMEDIATION SERVICES, LLC
Phone (907)563-0013
Fax (907)563-6713

| | | |
|---|---|---|
| DATUM: WGS84 | DATE | AUGUST 2017 |
| SYSTEM: UTM ZONE 6 N | DWN. | CB |
| Project No. | SCALE | AS SHOWN |
| 34150037 | APPRVD. | CM |

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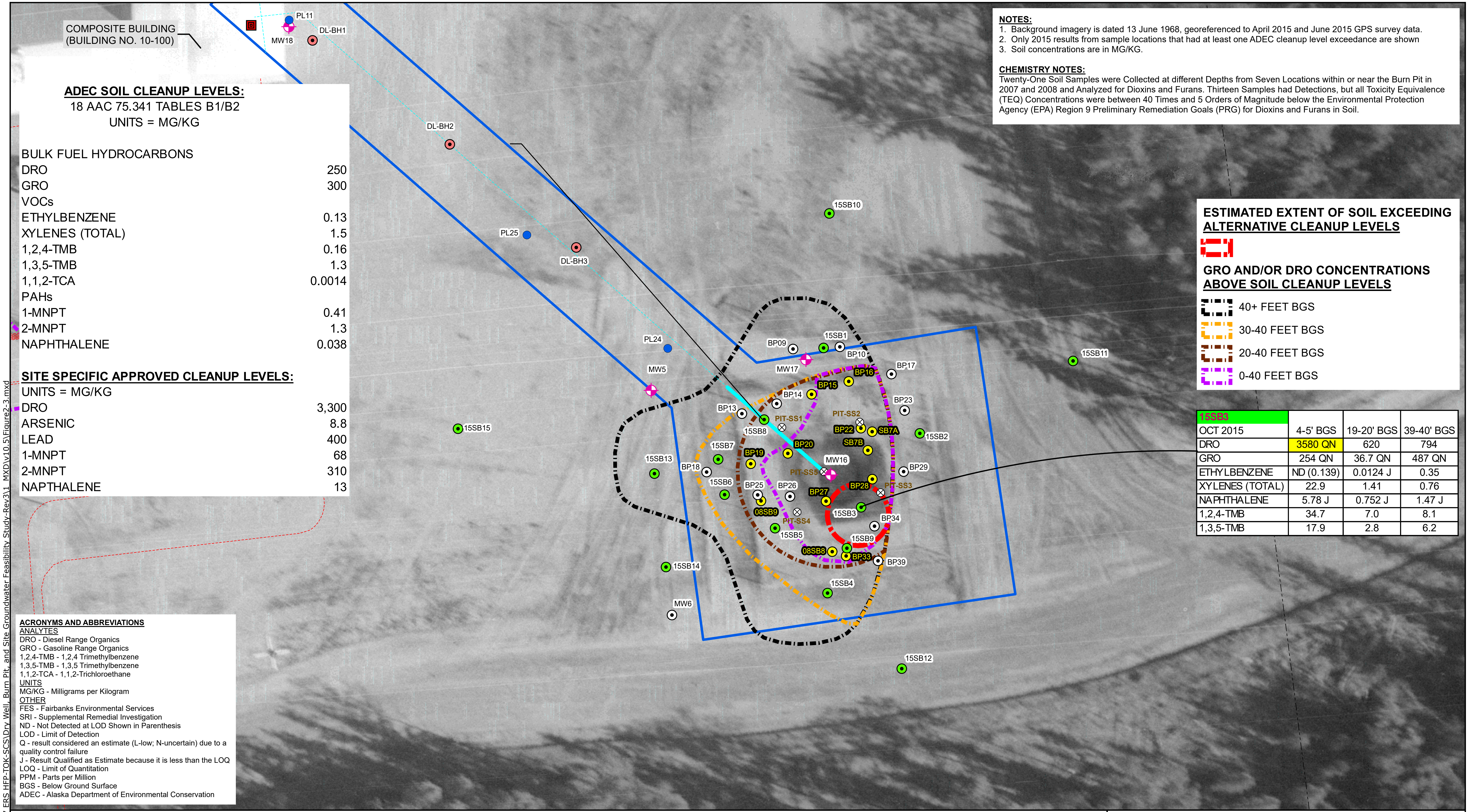


**NOTES:**
1. Background imagery is dated 13 June 1968, georeferenced to April 2015 and June 2015 GPS survey data.
2. Only 2015 results from sample locations that had at least one ADEC cleanup level exceedance are shown
3. Soil concentrations are in MG/KG.

**CHEMISTRY NOTES:**
Twenty-One Soil Samples were Collected at different Depths from Seven Locations within or near the Burn Pit in 2007 and 2008 and Analyzed for Dioxins and Furans. Thirteen Samples had Detections, but all Toxicity Equivalence (TEQ) Concentrations were between 40 Times and 5 Orders of Magnitude below the Environmental Protection Agency (EPA) Region 9 Preliminary Remediation Goals (PRG) for Dioxins and Furans in Soil.

**ADEC SOIL CLEANUP LEVELS:**
18 AAC 75.341 TABLES B1/B2
UNITS = MG/KG

| | |
|---|---|
| BULK FUEL HYDROCARBONS | |
| DRO | 250 |
| GRO | 300 |
| VOCs | |
| ETHYLBENZENE | 0.13 |
| XYLENES (TOTAL) | 1.5 |
| 1,2,4-TMB | 0.16 |
| 1,3,5-TMB | 1.3 |
| 1,1,2-TCA | 0.0014 |
| PAHs | |
| 1-MNPT | 0.41 |
| 2-MNPT | 1.3 |
| NAPHTHALENE | 0.038 |

**SITE SPECIFIC APPROVED CLEANUP LEVELS:**
UNITS = MG/KG

| | |
|---|---|
| DRO | 3,300 |
| ARSENIC | 8.8 |
| LEAD | 400 |
| 1-MNPT | 68 |
| 2-MNPT | 310 |
| NAPTHALENE | 13 |

**ESTIMATED EXTENT OF SOIL EXCEEDING ALTERNATIVE CLEANUP LEVELS**

| | |
|---|---|
| ▨ | |
| **GRO AND/OR DRO CONCENTRATIONS ABOVE SOIL CLEANUP LEVELS** | |
| ▨ | 40+ FEET BGS |
| ▨ | 30-40 FEET BGS |
| ▨ | 20-40 FEET BGS |
| ▨ | 0-40 FEET BGS |

| 15SB3 | | | |
|---|---|---|---|
| OCT 2015 | 4-5' BGS | 19-20' BGS | 39-40' BGS |
| DRO | 3580 QN | 620 | 794 |
| GRO | 254 QN | 36.7 QN | 487 QN |
| ETHYLBENZENE | ND (0.139) | 0.0124 J | 0.35 |
| XYLENES (TOTAL) | 22.9 | 1.41 | 0.76 |
| NAPHTHALENE | 5.78 J | 0.752 J | 1.47 J |
| 1,2,4-TMB | 34.7 | 7.0 | 8.1 |
| 1,3,5-TMB | 17.9 | 2.8 | 6.2 |

**ACRONYMS AND ABBREVIATIONS**
ANALYTES
DRO - Diesel Range Organics
GRO - Gasoline Range Organics
1,2,4-TMB - 1,2,4 Trimethylbenzene
1,3,5-TMB - 1,3,5 Trimethylbenzene
1,1,2-TCA - 1,1,2-Trichloroethane
UNITS
MG/KG - Milligrams per Kilogram
OTHER
FES - Fairbanks Environmental Services
SRI - Supplemental Remedial Investigation
ND - Not Detected at LOD Shown in Parenthesis
LOD - Limit of Detection
Q - result considered an estimate (L-low; N-uncertain) due to a quality control failure
J - Result Qualified as Estimate because it is less than the LOQ
LOQ - Limit of Quantitation
PPM - Parts per Million
BGS - Below Ground Surface
ADEC - Alaska Department of Environmental Conservation

**LEGEND:**

| | | | |
|---|---|---|---|
| ⌖ | GROUNDWATER MONITORING WELL | ● | 2015 SRI SOIL BORING - FES |
| ● | REMOVAL ACTION SOIL SAMPLE<br>(NO ADEC EXCEEDANCES) - BRISTOL | ● | 2015 BURN PIT INVESTIGATION SOIL BORING - NORTH WIND |
| ⊗ | 2015 SRI SURFACE SOIL SAMPLE | ● | 2007/2008 RI SOIL BORING WITH PID > 20 PPM - NORTH WIND |
| ▣ | SUMP | ⊙ | 2007/2008 RI SOIL BORING WITH PID < 20 PPM - NORTH WIND |
| ▬ | DISPOSAL LINE REMAINING IN PLACE | - · - | FENCE |
| - - - | FORMER DISPOSAL LINE (REMOVED IN 2015) | ▭ | SRI AREA OF CONCERN |
| - - - | FORMER UNDERGROUND FUEL LINES (REMOVED IN 2015) | | |

## Figure 2-3
## Estimated Extent of Soil Exceeding Approved Cleanup Levels at the Burn Pit AOC

Dry Well, Burn Pit, and Site Groundwater Feasibility Study
Sears Creek Station, Alaska

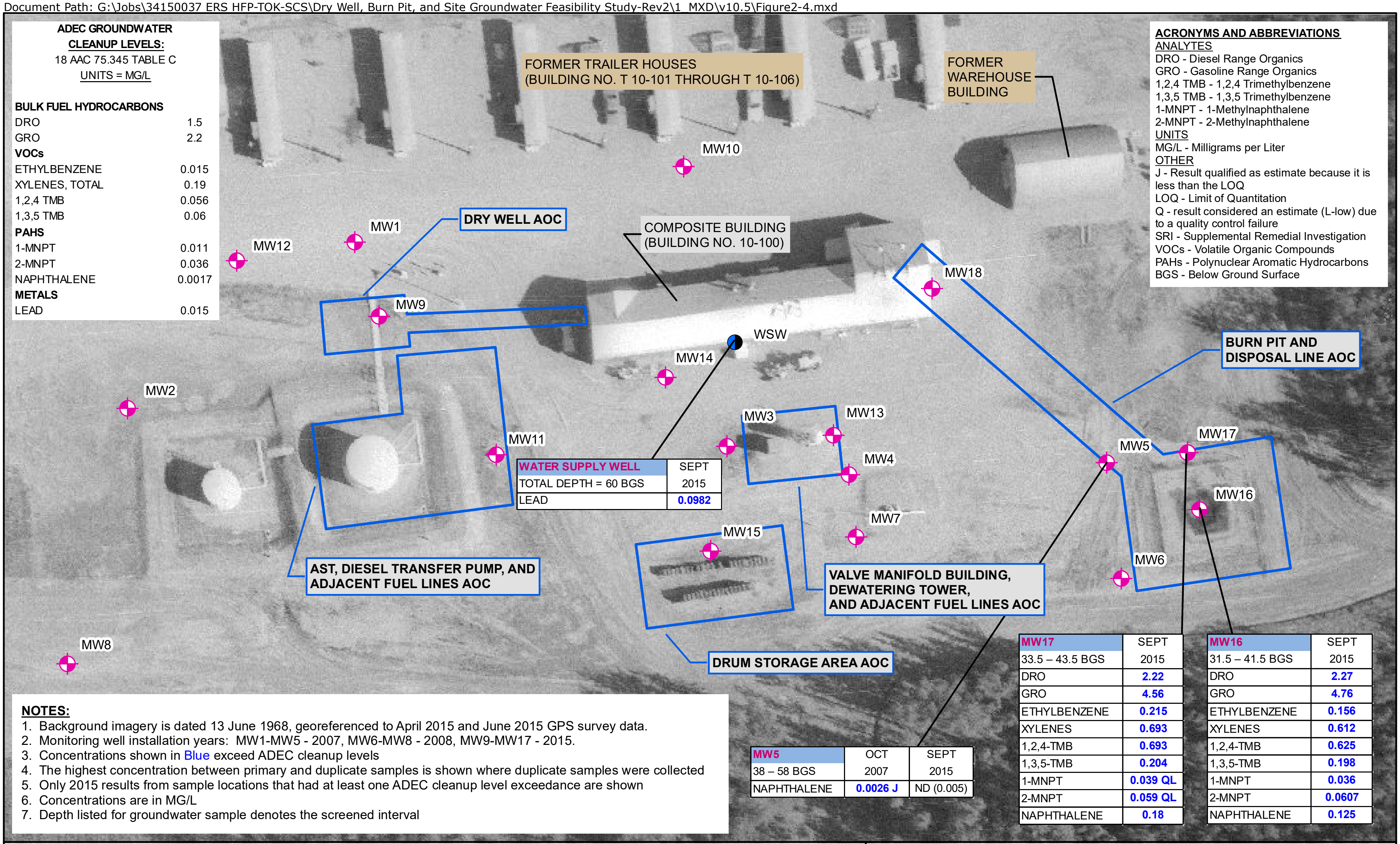
Bristol
ENVIRONMENTAL REMEDIATION SERVICES, LLC
Phone (907)563-0013
Fax (907)563-6713

DATUM: WGS84
SYSTEM: UTM ZONE 6 N
Project No. 34150037

DATE OCT 2017
DWN. CB
SCALE AS SHOWN
APPRVD. JA

Document Path: G:\Jobs\34150037 ERS HFP-TOK-SCS\Dry Well, Burn Pit, and Site Groundwater Feasibility Study-Rev3\1_MXD\v10.5\Figure2-3.mxd

Document Path: G:\Jobs\34150037 ERS HFP-TOK-SCS\Dry Well, Burn Pit, and Site Groundwater Feasibility Study-Rev2\1_MXD\v10.5\Figure2-4.mxd



**ADEC GROUNDWATER CLEANUP LEVELS:**
18 AAC 75.345 TABLE C
UNITS = MG/L

| | |
|---|---|
| **BULK FUEL HYDROCARBONS** | |
| DRO | 1.5 |
| GRO | 2.2 |
| **VOCs** | |
| ETHYLBENZENE | 0.015 |
| XYLENES, TOTAL | 0.19 |
| 1,2,4 TMB | 0.056 |
| 1,3,5 TMB | 0.06 |
| **PAHS** | |
| 1-MNPT | 0.011 |
| 2-MNPT | 0.036 |
| NAPHTHALENE | 0.0017 |
| **METALS** | |
| LEAD | 0.015 |

**ACRONYMS AND ABBREVIATIONS**

ANALYTES
DRO - Diesel Range Organics
GRO - Gasoline Range Organics
1,2,4 TMB - 1,2,4 Trimethylbenzene
1,3,5 TMB - 1,3,5 Trimethylbenzene
1-MNPT - 1-Methylnaphthalene
2-MNPT - 2-Methylnaphthalene
UNITS
MG/L - Milligrams per Liter
OTHER
J - Result qualified as estimate because it is less than the LOQ
LOQ - Limit of Quantitation
Q - result considered an estimate (L-low) due to a quality control failure
SRI - Supplemental Remedial Investigation
VOCs - Volatile Organic Compounds
PAHs - Polynuclear Aromatic Hydrocarbons
BGS - Below Ground Surface

| WATER SUPPLY WELL | SEPT |
|---|---|
| TOTAL DEPTH = 60 BGS | 2015 |
| LEAD | 0.0982 |

| MW5 | OCT | SEPT |
|---|---|---|
| 38 – 58 BGS | 2007 | 2015 |
| NAPHTHALENE | 0.0026 J | ND (0.005) |

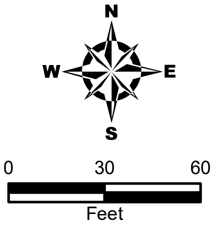
| MW17 | SEPT |
|---|---|
| 33.5 – 43.5 BGS | 2015 |
| DRO | 2.22 |
| GRO | 4.56 |
| ETHYLBENZENE | 0.215 |
| XYLENES | 0.693 |
| 1,2,4-TMB | 0.693 |
| 1,3,5-TMB | 0.204 |
| 1-MNPT | 0.039 QL |
| 2-MNPT | 0.059 QL |
| NAPHTHALENE | 0.18 |

| MW16 | SEPT |
|---|---|
| 31.5 – 41.5 BGS | 2015 |
| DRO | 2.27 |
| GRO | 4.76 |
| ETHYLBENZENE | 0.156 |
| XYLENES | 0.612 |
| 1,2,4-TMB | 0.625 |
| 1,3,5-TMB | 0.198 |
| 1-MNPT | 0.036 |
| 2-MNPT | 0.0607 |
| NAPHTHALENE | 0.125 |

**NOTES:**
1. Background imagery is dated 13 June 1968, georeferenced to April 2015 and June 2015 GPS survey data.
2. Monitoring well installation years: MW1-MW5 - 2007, MW6-MW8 - 2008, MW9-MW17 - 2015.
3. Concentrations shown in Blue exceed ADEC cleanup levels
4. The highest concentration between primary and duplicate samples is shown where duplicate samples were collected
5. Only 2015 results from sample locations that had at least one ADEC cleanup level exceedance are shown
6. Concentrations are in MG/L
7. Depth listed for groundwater sample denotes the screened interval

**LEGEND:**

MW8 ⊕ MONITORING WELL
GROUNDWATER ELEVATION, 20 SEPT 2015 (ELEVATIONS ARE IN NAVD88, FEET)
◐ WATER SUPPLY WELL
▭ SRI AREA OF CONCERN



## Figure 2-4
## Groundwater COCs Exceeding ADEC Cleanup Levels
Dry Well, Burn Pit, and Site Groundwater Feasibility Study
Sears Creek Station, Alaska

Bristol
ENVIRONMENTAL REMEDIATION SERVICES, LLC
Phone (907)563-0013
Fax (907)563-6713

DATUM: WGS84
SYSTEM: UTM ZONE 6 N
Project No. 34150037

DATE NOV 2018
DWN. CB
SCALE AS SHOWN
APPRVD. JA

# APPENDIX A

## Applicability of Relevant and Appropriate Requirements

# TABLE A.1 CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

## DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY

## SEARS CREEK STATION, ALASKA

| Item | Requirement | Citation | Synopsis | Evaluation / Action To Be Taken |
|---|---|---|---|---|
| 1 | Site cleanup rules: purpose, applicability, and general provisions. | 18 AAC 75.325(g) | After completing site cleanup, the risk from hazardous substances will be evaluated to ensure it does not exceed a cumulative carcinogenic risk standard of 1 in 100,000 or a cumulative noncarcinogenic HI of 1 across all exposure pathways. | Complete cumulative risk evaluation to determine the cumulative risks from constituents of interest (COIs) present at the site. |
| 2 | Soil Cleanup levels; site-specific alternative cleanup levels | 18 AAC 75.340(e) | Provides procedure for development and application of site-specific alternative soil cleanup levels under method three. | Develop site-specific alternative cleanup levels for the migration to groundwater pathway for COCs in soil (DRO, arsenic, and lead). |
| 3 | Soil cleanup levels; soil cleanup levels tables | 18 AAC 75.341(c) Tables B1 and B2 | Provides tabulated soil cleanup levels for human health and migration to groundwater pathways that are not site-specific | Select soil cleanup levels for the human health pathway for COCs in soil (DRO, arsenic, and lead) from the cleanup levels on Tables B1 and B2. |
| 4 | Soil cleanup levels; selection of soil cleanup levels | 18 AAC 75.340(d) | Provides for how and when alternative cleanup levels can be apply rather than tabulated Method One or Two soil cleanup levels | Compare tabulated human health cleanup levels for COCs in soil (DRO, arsenic, and lead) to site specific alternative cleanup levels calculated for migration to groundwater to select approved cleanup levels (ACLs). Lower of two is selected. Compare soil concentations to ACLs. |
| 5 | Groundwater and surface water cleanup levels | 18 AAC 75.345 | Groundwater must meet the cleanup levels listed in Table C of this Section. | Compare concentrations of COCs in groundwater (arsenic, DRO, GRO, ethylbenzene, xylenes, 1,2,3-trimethylbenzene, 1,3,5-trimethylbenzene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene, and lead) to Table C values. |

## TABLE A.2 LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
## DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
### SEARS CREEK STATION, ALASKA

| Item | Requirement | Citation | Synopsis | Evaluation / Action To Be Taken |
|---|---|---|---|---|
| 1 | Archaeological Resources Protection | 43 CFR 7.4(a) and 7.5(b)(1) (Archaeological Resources Protection Act of 1979 ; 16 United States Code (USC) 470ii) | May not excavate, remove, damage, or otherwise alter or deface archaeological resources unless by permit or exception. Must protect any such archaeological resources if discovered. | No historic or archaeological resources have been identified at the site. In the event that buried historic or archaeological resources are discovered, notification and mitigation measures to protect the area will be implemented. |
| 2 | Protection of Native American Graves | 43 CFR 10.4(c) and (d) (Native American Graves Protection and Repatriation Regulations) | Must stop activities in the area of discovery and make a reasonable effort to secure and protect the objects discovered. Must consult with Native organization likely to be affiliated with the objects to determine further disposition per 43 CFR 10.5(b). | No human remains, funerary objects, sacred objects, or objects of cultural patrimony have been identified at the site. In the event that these items are discovered, notification and mitigation measures to protect the area will be implemented. |
| 3 | Environmental Covenants | Uniform Environmental Covenants Act (UECA) | Ensures that environmental covenants are preserved and enforceable over time and transfer of property ownership. | If a remedy involving environmental covenants is selected for the site, the covenants will be preserved over time and any property ownership transfers in accordance with this regulation. |
| 4 | Institutional Controls | 18 AAC 75.375 | Provides procedures for how institutional controls (ICs) are implemented | If a remedy involving ICs is selected for the site, selection and design and implemention of ICs will occur in accordance with this regulation. |

# TABLE A.3 ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
## DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
### SEARS CREEK STATION, ALASKA

| Item | Medium / Action | Requirements | Prerequisite | Citation | Citation Title or Subject |
|---|---|---|---|---|---|
| 1 | Soil / Waste Disposal | Properly characterize, label, store, transport hazardous waste. Only dispose of hazardous waste in RCRA permitted treatment, storage, and disposal facilities (TSDF). | Waste characterization | 40 CFR 262.11(a)-(d) | Characteristics of Hazardous Waste |
| 2 | Groundwater / Underground Injections | Prohibits injections that allow movement of fluid into underground sources of drinking water that might cause endangerment and provides closure requirements. | Injection of chemical oxidants, substrates and/or amendments as part of in situ remedy may trigger UIC requirements. | 40 CFR 144.82 | What must I do to protect underground sources of drinking water? |
| 3 | Soil / Storage and Disposal | Prohibits blending contaminated soil with uncontaminated soil and provides requirements for storing of contaminated soil. | Excavation of Contaminated Soil | 18AAC75.370(a) | Soil storage and disposal |
| 4 | Soil / Storage | A persons may not store accumulated solid waste in a manner that causes polluted run-off water. | Waste accumulation on site | 18 AAC 60.010(a)(4) | Accumulation, storage, and treatment |

# APPENDIX B

## Cost Estimate Summaries

# APPENDIX B
# COST ESTIMATE TABLE OF CONTENTS
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

# TABLE B.1A
## REMEDIAL ALTERNATIVES COST SUMMARY
## DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
## SEARS CREEK STATION, ALASKA

| Remedial Alternative | Description | Capital Cost | Annual Operations and Maintenance Cost [a] | Periodic Cost [b] | Non-Discounted Constant Dollar Cost [c] | TPV at 0.6% Discount Rate [d] |
|---|---|---|---|---|---|---|
| **1** | **No Action** | **$0** | **$0** | **$0** | **$0** | **$0** |
| **2** | **LUCs (100 Years; SRA 2a) and<br>MNA (40 Years; SRA 4a)** | **$97,000** | **$8,300** | **$102,800** | **$1,980,000** | **$1,590,000** |
| **3** | **LUCs (20 years; SRA 2b)<br>Groundwater: MNA (20 years; SRA 4b)<br>Burn Pit: Excavation and Off-Site Treatment (SRA 12)<br>Dry Well: Excavation and Off-Site Disposal (SRA 13)** | **$641,000** | **$8,300** | **$95,000** | **$1,214,000** | **$1,185,000** |
| **4** | **LUCs (5 years; SRA 2c)<br>Groundwater: Biosparging (SRA 8)<br>Burn Pit: Excavation and Off-Site Treatment (SRA 12)<br>Dry Well: Excavation and Off-Site Disposal (SRA 13)** | **$1,100,000** | **$73,400** | **$39,400** | **$1,523,100** | **$1,516,000** |
| **5** | **LUCs (5 years; SRA 2c)<br>Groundwater: ISCO (SRA 6)<br>Burn Pit: Excavation and Off-Site Treatment (SRA 12)<br>Dry Well: Excavation and Off-Site Disposal (SRA 13)** | **$1,086,000** | **$8,300** | **$85,900** | **$1,356,100** | **$1,353,000** |

**NOTES**

[a] Highest annual operations and maintenance (O&M) costs for remedial alternatives shown. Some costs decrease after a period of operation.

[b] Highest annual periodic costs for remedial alternatives shown. Periodic costs may be less during a specific year.

[c] Non-discounted constant dollar cost provided to show impact of discount rate on total present value (TPV).

[d] TPV cost estimates are considered accurate to within -30% to +50% of actual costs. Discount rate and calculation is shown below.

**Other Notes/Assumptions**

1. Design and construction contingencies have been added to capital and O&M costs based on USEPA (2000) and professional judgment.
   USEPA. 2000. *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study.* USEPA 540-R-00-002. July.

| | **Source** |
|---|---|
| Discount Rate = 0.60% | 30-Year Real Discount Rate from Office of Management and Budget, Circular A-94 Appendix C, Revised February 2018. |

## TABLE B.1B
## SPECIFIC RESPONSE ACTIONS COST SUMMARY
## DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
## SEARS CREEK STATION, ALASKA

| Specific Response Action | Description | Capital Cost | Annual Operations and Maintenance Cost [a] | Periodic Cost [b] | Non-Discounted Constant Dollar Cost [c] | TPV at 0.6% Discount Rate [d] |
|---|---|---|---|---|---|---|
| **1** | **No Action** | $0 | $0 | $0 | $0 | $0 |
| **2a** | **Land Use Controls (100-Year Duration)** | $73,000 | $8,330 | $25,340 | $1,422,000 | $1,083,000 |
| **2b** | **Land Use Controls (20-Year Duration)** | $73,000 | $8,330 | $25,340 | $350,000 | $333,000 |
| **2c** | **Land Use Controls (5-Year Duration)** | $72,600 | $8,330 | $25,340 | $149,100 | $148,000 |
| **4a** | **MNA (40 Year Duration)** | $24,000 | $0 | $77,500 | $558,000 | $506,000 |
| **4b** | **MNA (20 Year Duration)** | $24,000 | $0 | $69,700 | $320,000 | $308,000 |
| **6** | ***In Situ* Chemical Oxidation** | $469,000 | $0 | $60,586 | $663,000 | $661,000 |
| **8** | **Biosparging** | $483,000 | $65,035 | $14,086 | $830,000 | $824,000 |
| **12** | **Excavation and Off-site Treatment** | $394,000 | $0 | $0 | $394,000 | $394,000 |
| **13** | **Excavation and Off-site Disposal** | $150,000 | $0 | $0 | $150,000 | $150,000 |

**NOTES**

[a] Highest annual operations and maintenance (O&M) costs for remedial alternatives shown. Some costs decrease after a period of operation.

[b] Highest annual periodic costs for remedial alternatives shown. Periodic costs may be less during a specific year.

[c] Non-discounted constant dollar cost provided to show impact of discount rate on total present value (TPV).

[d] TPV cost estimates are considered accurate to within -30% to +50% of actual costs.

**Other Notes/Assumptions**

1. Design and construction contingencies have been added to capital and O&M costs based on USEPA (2000) and professional judgment.

| | Source |
|---|---|
| Discount Rate = 0.60% | 30-Year Real Discount Rate from Office of Management and Budget, Circular A-94 Appendix C, Revised February 2018. |

# TABLE B.2
# SPECIFIC RESPONSE ACTION 1
# NO ACTION
# COST BREAKDOWN
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Item | Quantity | Unit | Unit Cost ($) | Quantity | Extended ($) |
|---|---|---|---|---|---|
| *Capital* | | | | | |
| None | | | | | $ - |
| | | | | *Capital Total* | **$ -** |

# TABLE B.3
# SPECIFIC RESPONSE ACTION 1
# NO ACTION
# PRESENT VALUE
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Year | Capital Cost ($) | Annual O&M ($) | Periodic Costs ($) | Total Cost ($) | Discount Factor at 0.6% | Present Value at 0.6% ($) |
|---|---|---|---|---|---|---|
| 0 | $ - | $ - | $ - | $ - | 1.000 | $ - |
| **TOTALS** | **$ -** | **$ -** | **$ -** | **$ -** | | **$ -** |

# TABLE B.4
# SPECIFIC RESPONSE ACTION 1
# NO ACTION
# PERIODIC COST BREAKDOWN
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Year | Annual O&M Cost Breakdown ($) | Periodic Cost Breakdown ($) |
|---|---|---|
| 0 | $ - | $ - |
| **TOTALS** | **$ -** | **$ -** |

# TABLE B.5
# SPECIFIC RESPONSE ACTION 2
# LAND USE CONTROLS
# COST BREAKDOWN
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Item | Units | | Unit Cost ($) | Extended ($) |
|---|---|---|---|---|
| ***Capital*** | | | | |
| Implementation of Land Use Controls (See Table B.17 Attachment 1) | 1 | Lump Sum | $ 24,950 | $ 24,950 |
| Monitoring Well Installation in Year 0 (Table B.17, Attachment 6) | 1 | 1 | $ 20,655 | $ 20,655 |
| Water Supply Well Decommissioning (see Table B.17 Attachment 9) | 1 | each | $ 12,522 | $ 12,522 |
| | | | *Sub-Total* | $ 58,127 |
| Contingency (design + construction) | 25% | | | $ 14,500 |
| | | | *Capital Total* | **$ 72,627** |
| ***Annual Operation and Maintenance*** | | | | |
| Annual Inspection and Reporting (See Table B.17 Attachment 2) | 1 | each | $ 6,630 | $ 6,630 |
| Contingency | 25% | | | $ 1,700 |
| | | | *Annual Total* | **$ 8,330** |
| ***Periodic*** | | | | |
| Quarterly GW sampling event, 1 wells in Year 0 (Table B.17, Attachment 3 | 1 | 4 | $ 1,900 | $ 7,600 |
| Contingency | 25% | | | $ 1,900 |
| | | | *Total* | **$ 9,500** |
| Five-Year Review (see Table B.17 Attachment 7) | 1 | each | $ 20,240 | $ 20,240 |
| Contingency | 25% | | | $ 5,100 |
| | | | *Total* | **$ 25,340** |

1) Assumes installation of one new well near Water Supply Well and quarterly sampling for one year.

# TABLE B.6
# SPECIFIC RESPONSE ACTION 2a
# LAND USE CONTROLS - 100 YEARS
# PRESENT VALUE
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Year | Capital Cost ($) | Annual O&M ($) | Periodic Costs ($) | Total Cost ($) | Discount Factor at 0.6% | Present Value at 0.6% ($) |
|---|---|---|---|---|---|---|
| 0 | $ 72,600 | $ - | $ 9,500 | $ 82,100 | 1.000 | $ 82,100 |
| 1 | $ - | $ 8,330 | $ - | $ 8,330 | 0.994 | $ 8,281 |
| 2 | $ - | $ 8,330 | $ - | $ 8,330 | 0.988 | $ 8,231 |
| 3 | $ - | $ 8,330 | $ - | $ 8,330 | 0.982 | $ 8,182 |
| 4 | $ - | $ 8,330 | $ - | $ 8,330 | 0.976 | $ 8,134 |
| 5 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.971 | $ 32,678 |
| 6 | $ - | $ 8,330 | $ - | $ 8,330 | 0.965 | $ 8,037 |
| 7 | $ - | $ 8,330 | $ - | $ 8,330 | 0.959 | $ 7,989 |
| 8 | $ - | $ 8,330 | $ - | $ 8,330 | 0.953 | $ 7,941 |
| 9 | $ - | $ 8,330 | $ - | $ 8,330 | 0.948 | $ 7,894 |
| 10 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.942 | $ 31,715 |
| 11 | $ - | $ 8,330 | $ - | $ 8,330 | 0.936 | $ 7,800 |
| 12 | $ - | $ 8,330 | $ - | $ 8,330 | 0.931 | $ 7,753 |
| 13 | $ - | $ 8,330 | $ - | $ 8,330 | 0.925 | $ 7,707 |
| 14 | $ - | $ 8,330 | $ - | $ 8,330 | 0.920 | $ 7,661 |
| 15 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.914 | $ 30,781 |
| 16 | $ - | $ 8,330 | $ - | $ 8,330 | 0.909 | $ 7,570 |
| 17 | $ - | $ 8,330 | $ - | $ 8,330 | 0.903 | $ 7,525 |
| 18 | $ - | $ 8,330 | $ - | $ 8,330 | 0.898 | $ 7,480 |
| 19 | $ - | $ 8,330 | $ - | $ 8,330 | 0.893 | $ 7,436 |
| 20 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.887 | $ 29,874 |
| 21 | $ - | $ 8,330 | $ - | $ 8,330 | 0.882 | $ 7,347 |
| 22 | $ - | $ 8,330 | $ - | $ 8,330 | 0.877 | $ 7,303 |
| 23 | $ - | $ 8,330 | $ - | $ 8,330 | 0.871 | $ 7,260 |
| 24 | $ - | $ 8,330 | $ - | $ 8,330 | 0.866 | $ 7,216 |
| 25 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.861 | $ 28,994 |
| 26 | $ - | $ 8,330 | $ - | $ 8,330 | 0.856 | $ 7,131 |
| 27 | $ - | $ 8,330 | $ - | $ 8,330 | 0.851 | $ 7,088 |
| 28 | $ - | $ 8,330 | $ - | $ 8,330 | 0.846 | $ 7,046 |
| 29 | $ - | $ 8,330 | $ - | $ 8,330 | 0.841 | $ 7,004 |
| 30 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.836 | $ 28,139 |
| 31 | $ - | $ 8,330 | $ - | $ 8,330 | 0.831 | $ 6,921 |
| 32 | $ - | $ 8,330 | $ - | $ 8,330 | 0.826 | $ 6,879 |
| 33 | $ - | $ 8,330 | $ - | $ 8,330 | 0.821 | $ 6,838 |
| 34 | $ - | $ 8,330 | $ - | $ 8,330 | 0.816 | $ 6,797 |
| 35 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.811 | $ 27,310 |
| 36 | $ - | $ 8,330 | $ - | $ 8,330 | 0.806 | $ 6,717 |
| 37 | $ - | $ 8,330 | $ - | $ 8,330 | 0.801 | $ 6,677 |
| 38 | $ - | $ 8,330 | $ - | $ 8,330 | 0.797 | $ 6,637 |
| 39 | $ - | $ 8,330 | $ - | $ 8,330 | 0.792 | $ 6,597 |
| 40 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.787 | $ 26,505 |
| 41 | $ - | $ 8,330 | $ - | $ 8,330 | 0.782 | $ 6,519 |
| 42 | $ - | $ 8,330 | $ - | $ 8,330 | 0.778 | $ 6,480 |
| 43 | $ - | $ 8,330 | $ - | $ 8,330 | 0.773 | $ 6,441 |
| 44 | $ - | $ 8,330 | $ - | $ 8,330 | 0.769 | $ 6,403 |
| 45 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.764 | $ 25,724 |
| 46 | $ - | $ 8,330 | $ - | $ 8,330 | 0.759 | $ 6,327 |
| 47 | $ - | $ 8,330 | $ - | $ 8,330 | 0.755 | $ 6,289 |
| 48 | $ - | $ 8,330 | $ - | $ 8,330 | 0.750 | $ 6,251 |
| 49 | $ - | $ 8,330 | $ - | $ 8,330 | 0.746 | $ 6,214 |
| 50 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.741 | $ 24,966 |

# TABLE B.6
# SPECIFIC RESPONSE ACTION 2
# LAND USE CONTROLS - 100 YEARS
# PRESENT VALUE
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Year | Capital Cost ($) | Annual O&M ($) (LUCs) | Periodic Costs ($) | Total Cost ($) | Discount Factor at 0.6% | Present Value at 0.6% ($) |
|---|---|---|---|---|---|---|
| 51 | $ - | $ 8,330 | $ - | $ 8,330 | 0.737 | $ 6,140 |
| 52 | $ - | $ 8,330 | $ - | $ 8,330 | 0.733 | $ 6,104 |
| 53 | $ - | $ 8,330 | $ - | $ 8,330 | 0.728 | $ 6,067 |
| 54 | $ - | $ 8,330 | $ - | $ 8,330 | 0.724 | $ 6,031 |
| 55 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.720 | $ 24,231 |
| 56 | $ - | $ 8,330 | $ - | $ 8,330 | 0.715 | $ 5,959 |
| 57 | $ - | $ 8,330 | $ - | $ 8,330 | 0.711 | $ 5,924 |
| 58 | $ - | $ 8,330 | $ - | $ 8,330 | 0.707 | $ 5,888 |
| 59 | $ - | $ 8,330 | $ - | $ 8,330 | 0.703 | $ 5,853 |
| 60 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.698 | $ 23,517 |
| 61 | $ - | $ 8,330 | $ - | $ 8,330 | 0.694 | $ 5,784 |
| 62 | $ - | $ 8,330 | $ - | $ 8,330 | 0.690 | $ 5,749 |
| 63 | $ - | $ 8,330 | $ - | $ 8,330 | 0.686 | $ 5,715 |
| 64 | $ - | $ 8,330 | $ - | $ 8,330 | 0.682 | $ 5,681 |
| 65 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.678 | $ 22,824 |
| 66 | $ - | $ 8,330 | $ - | $ 8,330 | 0.674 | $ 5,613 |
| 67 | $ - | $ 8,330 | $ - | $ 8,330 | 0.670 | $ 5,580 |
| 68 | $ - | $ 8,330 | $ - | $ 8,330 | 0.666 | $ 5,547 |
| 69 | $ - | $ 8,330 | $ - | $ 8,330 | 0.662 | $ 5,513 |
| 70 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.658 | $ 22,151 |
| 71 | $ - | $ 8,330 | $ - | $ 8,330 | 0.654 | $ 5,448 |
| 72 | $ - | $ 8,330 | $ - | $ 8,330 | 0.650 | $ 5,415 |
| 73 | $ - | $ 8,330 | $ - | $ 8,330 | 0.646 | $ 5,383 |
| 74 | $ - | $ 8,330 | $ - | $ 8,330 | 0.642 | $ 5,351 |
| 75 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.638 | $ 21,498 |
| 76 | $ - | $ 8,330 | $ - | $ 8,330 | 0.635 | $ 5,287 |
| 77 | $ - | $ 8,330 | $ - | $ 8,330 | 0.631 | $ 5,256 |
| 78 | $ - | $ 8,330 | $ - | $ 8,330 | 0.627 | $ 5,224 |
| 79 | $ - | $ 8,330 | $ - | $ 8,330 | 0.623 | $ 5,193 |
| 80 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.620 | $ 20,865 |
| 81 | $ - | $ 8,330 | $ - | $ 8,330 | 0.616 | $ 5,132 |
| 82 | $ - | $ 8,330 | $ - | $ 8,330 | 0.612 | $ 5,101 |
| 83 | $ - | $ 8,330 | $ - | $ 8,330 | 0.609 | $ 5,071 |
| 84 | $ - | $ 8,330 | $ - | $ 8,330 | 0.605 | $ 5,040 |
| 85 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.601 | $ 20,250 |
| 86 | $ - | $ 8,330 | $ - | $ 8,330 | 0.598 | $ 4,980 |
| 87 | $ - | $ 8,330 | $ - | $ 8,330 | 0.594 | $ 4,951 |
| 88 | $ - | $ 8,330 | $ - | $ 8,330 | 0.591 | $ 4,921 |
| 89 | $ - | $ 8,330 | $ - | $ 8,330 | 0.587 | $ 4,892 |
| 90 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.584 | $ 19,653 |
| 91 | $ - | $ 8,330 | $ - | $ 8,330 | 0.580 | $ 4,834 |
| 92 | $ - | $ 8,330 | $ - | $ 8,330 | 0.577 | $ 4,805 |
| 93 | $ - | $ 8,330 | $ - | $ 8,330 | 0.573 | $ 4,776 |
| 94 | $ - | $ 8,330 | $ - | $ 8,330 | 0.570 | $ 4,748 |
| 95 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.566 | $ 19,074 |
| 96 | $ - | $ 8,330 | $ - | $ 8,330 | 0.563 | $ 4,691 |
| 97 | $ - | $ 8,330 | $ - | $ 8,330 | 0.560 | $ 4,663 |
| 98 | $ - | $ 8,330 | $ - | $ 8,330 | 0.556 | $ 4,635 |
| 99 | $ - | $ 8,330 | $ - | $ 8,330 | 0.553 | $ 4,608 |
| 100 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.550 | $ 18,512 |
| **TOTALS** | **$ 72,600** | **$ 833,000** | **$ 516,300** | **$ 1,421,900** |  | **$ 1,082,917** |

# TABLE B.7
# SPECIFIC RESPONSE ACTION 2a
# LAND USE CONTROLS - 100 YEARS
# PERIODIC COST BREAKDOWN
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Year | Annual O&M Cost Breakdown ($) | Periodic Cost Breakdown ($) (5-Year Review) |
|---|---|---|
| 0 | $ - | $ 9,500 |
| 1 | $ 8,330 | $ - |
| 2 | $ 8,330 | $ - |
| 3 | $ 8,330 | $ - |
| 4 | $ 8,330 | $ - |
| 5 | $ 8,330 | $ 25,340 |
| 6 | $ 8,330 | $ - |
| 7 | $ 8,330 | $ - |
| 8 | $ 8,330 | $ - |
| 9 | $ 8,330 | $ - |
| 10 | $ 8,330 | $ 25,340 |
| 11 | $ 8,330 | $ - |
| 12 | $ 8,330 | $ - |
| 13 | $ 8,330 | $ - |
| 14 | $ 8,330 | $ - |
| 15 | $ 8,330 | $ 25,340 |
| 16 | $ 8,330 | $ - |
| 17 | $ 8,330 | $ - |
| 18 | $ 8,330 | $ - |
| 19 | $ 8,330 | $ - |
| 20 | $ 8,330 | $ 25,340 |
| 21 | $ 8,330 | $ - |
| 22 | $ 8,330 | $ - |
| 23 | $ 8,330 | $ - |
| 24 | $ 8,330 | $ - |
| 25 | $ 8,330 | $ 25,340 |
| 26 | $ 8,330 | $ - |
| 27 | $ 8,330 | $ - |
| 28 | $ 8,330 | $ - |
| 29 | $ 8,330 | $ - |
| 30 | $ 8,330 | $ 25,340 |
| 31 | $ 8,330 | $ - |
| 32 | $ 8,330 | $ - |
| 33 | $ 8,330 | $ - |
| 34 | $ 8,330 | $ - |
| 35 | $ 8,330 | $ 25,340 |
| 36 | $ 8,330 | $ - |
| 37 | $ 8,330 | $ - |
| 38 | $ 8,330 | $ - |
| 39 | $ 8,330 | $ - |
| 40 | $ 8,330 | $ 25,340 |
| 41 | $ 8,330 | $ - |
| 42 | $ 8,330 | $ - |
| 43 | $ 8,330 | $ - |
| 44 | $ 8,330 | $ - |
| 45 | $ 8,330 | $ 25,340 |
| 46 | $ 8,330 | $ - |
| 47 | $ 8,330 | $ - |
| 48 | $ 8,330 | $ - |
| 49 | $ 8,330 | $ - |
| 50 | $ 8,330 | $ 25,340 |

### TABLE B.7
### SPECIFIC RESPONSE ACTION 2
### LAND USE CONTROLS - 100 YEARS
### PERIODIC COST BREAKDOWN
### DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
### SEARS CREEK STATION, ALASKA

| Year | Annual O&M Cost Breakdown ($) (LUCs) | Periodic Cost Breakdown ($) (5-Year Review) |
|---|---|---|
| 51 | $ 8,330 | $ - |
| 52 | $ 8,330 | $ - |
| 53 | $ 8,330 | $ - |
| 54 | $ 8,330 | $ - |
| 55 | $ 8,330 | $ 25,340 |
| 56 | $ 8,330 | $ - |
| 57 | $ 8,330 | $ - |
| 58 | $ 8,330 | $ - |
| 59 | $ 8,330 | $ - |
| 60 | $ 8,330 | $ 25,340 |
| 61 | $ 8,330 | $ - |
| 62 | $ 8,330 | $ - |
| 63 | $ 8,330 | $ - |
| 64 | $ 8,330 | $ - |
| 65 | $ 8,330 | $ 25,340 |
| 66 | $ 8,330 | $ - |
| 67 | $ 8,330 | $ - |
| 68 | $ 8,330 | $ - |
| 69 | $ 8,330 | $ - |
| 70 | $ 8,330 | $ 25,340 |
| 71 | $ 8,330 | $ - |
| 72 | $ 8,330 | $ - |
| 73 | $ 8,330 | $ - |
| 74 | $ 8,330 | $ - |
| 75 | $ 8,330 | $ 25,340 |
| 76 | $ 8,330 | $ - |
| 77 | $ 8,330 | $ - |
| 78 | $ 8,330 | $ - |
| 79 | $ 8,330 | $ - |
| 80 | $ 8,330 | $ 25,340 |
| 81 | $ 8,330 | $ - |
| 82 | $ 8,330 | $ - |
| 83 | $ 8,330 | $ - |
| 84 | $ 8,330 | $ - |
| 85 | $ 8,330 | $ 25,340 |
| 86 | $ 8,330 | $ - |
| 87 | $ 8,330 | $ - |
| 88 | $ 8,330 | $ - |
| 89 | $ 8,330 | $ - |
| 90 | $ 8,330 | $ 25,340 |
| 91 | $ 8,330 | $ - |
| 92 | $ 8,330 | $ - |
| 93 | $ 8,330 | $ - |
| 94 | $ 8,330 | $ - |
| 95 | $ 8,330 | $ 25,340 |
| 96 | $ 8,330 | $ - |
| 97 | $ 8,330 | $ - |
| 98 | $ 8,330 | $ - |
| 99 | $ 8,330 | $ - |
| 100 | $ 8,330 | $ 25,340 |
| **TOTALS** | **$ 833,000** | **$ 516,300** |

### TABLE B.8
### SPECIFIC RESPONSE ACTION 2b
### LAND USE CONTROLS - 20 YEARS
### PRESENT VALUE
### DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
### SEARS CREEK STATION, ALASKA

| Year | Capital Cost ($) | Annual O&M ($) | Periodic Costs ($) | Total Cost ($) | Discount Factor at 0.6% | Present Value at 0.6% ($) |
|---|---|---|---|---|---|---|
| 0 | $ 72,600 | $ - | $ 9,500 | $ 82,100 | 1.000 | $ 82,100 |
| 1 | $ - | $ 8,330 | $ - | $ 8,330 | 0.994 | $ 8,281 |
| 2 | $ - | $ 8,330 | $ - | $ 8,330 | 0.988 | $ 8,231 |
| 3 | $ - | $ 8,330 | $ - | $ 8,330 | 0.982 | $ 8,182 |
| 4 | $ - | $ 8,330 | $ - | $ 8,330 | 0.976 | $ 8,134 |
| 5 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.971 | $ 32,678 |
| 6 | $ - | $ 8,330 | $ - | $ 8,330 | 0.965 | $ 8,037 |
| 7 | $ - | $ 8,330 | $ - | $ 8,330 | 0.959 | $ 7,989 |
| 8 | $ - | $ 8,330 | $ - | $ 8,330 | 0.953 | $ 7,941 |
| 9 | $ - | $ 8,330 | $ - | $ 8,330 | 0.948 | $ 7,894 |
| 10 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.942 | $ 31,715 |
| 11 | $ - | $ 8,330 | $ - | $ 8,330 | 0.936 | $ 7,800 |
| 12 | $ - | $ 8,330 | $ - | $ 8,330 | 0.931 | $ 7,753 |
| 13 | $ - | $ 8,330 | $ - | $ 8,330 | 0.925 | $ 7,707 |
| 14 | $ - | $ 8,330 | $ - | $ 8,330 | 0.920 | $ 7,661 |
| 15 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.914 | $ 30,781 |
| 16 | $ - | $ 8,330 | $ - | $ 8,330 | 0.909 | $ 7,570 |
| 17 | $ - | $ 8,330 | $ - | $ 8,330 | 0.903 | $ 7,525 |
| 18 | $ - | $ 8,330 | $ - | $ 8,330 | 0.898 | $ 7,480 |
| 19 | $ - | $ 8,330 | $ - | $ 8,330 | 0.893 | $ 7,436 |
| 20 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.887 | $ 29,874 |
| **TOTALS** | **$ 72,600** | **$ 166,600** | **$ 110,860** | **$ 350,100** |  | **$ 332,800** |

# TABLE B.9
# SPECIFIC RESPONSE ACTION 2b
# LAND USE CONTROLS - 20 YEARS
# PERIODIC COST BREAKDOWN
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Year | Annual O&M Cost Breakdown ($) | Periodic Cost Breakdown ($) (5-Year Review) |
|---|---|---|
| 0 | $ - | $ 9,500 |
| 1 | $ 8,330 | $ - |
| 2 | $ 8,330 | $ - |
| 3 | $ 8,330 | $ - |
| 4 | $ 8,330 | $ - |
| 5 | $ 8,330 | $ 25,340 |
| 6 | $ 8,330 | $ - |
| 7 | $ 8,330 | $ - |
| 8 | $ 8,330 | $ - |
| 9 | $ 8,330 | $ - |
| 10 | $ 8,330 | $ 25,340 |
| 11 | $ 8,330 | $ - |
| 12 | $ 8,330 | $ - |
| 13 | $ 8,330 | $ - |
| 14 | $ 8,330 | $ - |
| 15 | $ 8,330 | $ 25,340 |
| 16 | $ 8,330 | $ - |
| 17 | $ 8,330 | $ - |
| 18 | $ 8,330 | $ - |
| 19 | $ 8,330 | $ - |
| 20 | $ 8,330 | $ 25,340 |
| **TOTALS** | **$ 166,600** | **$ 110,860** |

# TABLE B.10
# SPECIFIC RESPONSE ACTION 2c
# LAND USE CONTROLS - 5 YEARS
# PRESENT VALUE
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Year | Capital Cost ($) | Annual O&M ($) | Periodic Costs ($) | Total Cost ($) | Discount Factor at 0.6% | Present Value at 0.6% ($) |
|---|---|---|---|---|---|---|
| 0 | $ 72,600 | $ - | $ 9,500 | $ 82,100 | 1.000 | $ 82,100 |
| 1 | $ - | $ 8,330 | $ - | $ 8,330 | 0.994 | $ 8,281 |
| 2 | $ - | $ 8,330 | $ - | $ 8,330 | 0.988 | $ 8,231 |
| 3 | $ - | $ 8,330 | $ - | $ 8,330 | 0.982 | $ 8,182 |
| 4 | $ - | $ 8,330 | $ - | $ 8,330 | 0.976 | $ 8,134 |
| 5 | $ - | $ 8,330 | $ 25,340 | $ 33,670 | 0.971 | $ 32,678 |
| **TOTALS** | **$ 72,600** | **$ 41,700** | **$ 34,840** | **$ 149,100** | | **$ 147,700** |

### TABLE B.11
### SPECIFIC RESPONSE ACTION 2c
### LAND USE CONTROLS - 5 YEARS
### PERIODIC COST BREAKDOWN
### DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
### SEARS CREEK STATION, ALASKA

| Year | Annual O&M Cost Breakdown ($) | Periodic Cost Breakdown ($) (5-Year Review) |
|---|---|---|
| 0 | $ - | $ 9,500 |
| 1 | $ 8,330 | $ - |
| 2 | $ 8,330 | $ - |
| 3 | $ 8,330 | $ - |
| 4 | $ 8,330 | $ - |
| 5 | $ 8,330 | $ 25,340 |
| **TOTALS** | **$ 41,650** | **$ 34,840** |

# TABLE B.12
# SPECIFIC RESPONSE ACTION 4
# MNA
# COST BREAKDOWN
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Item | Units | Number Events | Unit Cost ($) | Extended ($) |
|---|---|---|---|---|
| ***Capital Costs*** | | | | |
| MNA Work Plan Preparation (Table B.17, Attachment 5) | 1 | 1 | $ 19,000 | $ 19,000 |
| Contingency (design + construction) | 25% | | | $ 4,800 |
| | | | *MNA Workplan Total* | **$ 23,800** |
| ***Periodic Costs*** | | | | |
| Monitoring Well Installation in Year 0 (Table B.17, Attachment 6) | 1 | 1 | $ 20,655 | $ 20,655 |
| Contingency (design + construction) | 25% | | | $ 5,200 |
| | | | *MW Installation Total* | **$ 25,855** |
| Monitoring Well Replacement in Year 20 (Table B.17, Attachment 6) | 3 | 1 | $ 20,655 | $ 61,965 |
| Contingency (design + construction) | 25% | | | $ 15,500 |
| | | | *MW Replacement Total* | **$ 77,465** |
| Quarterly GW sampling event, 3 wells in Years 0-1 (Table B.17, Attachment 3) | 3 | 4 | $ 1,900 | $ 22,800 |
| Contingency (design + construction) | 25% | | | $ 5,700 |
| | | | *GW Sampling Total* | **$ 28,500** |
| Annual GW sampling event, 3 wells Years 2 on (Table B.17, Attachment 3) | 3 | 1 | $ 1,900 | $ 5,700 |
| Contingency (design + construction) | 25% | | | $ 1,400 |
| | | | *GW Sampling Total* | **$ 7,100** |
| Annual Reporting (Table B.17, Attachment 4) | 1 | 1 | $ 12,228 | $ 12,228 |
| Contingency (design + construction) | 25% | | | $ 3,100 |
| | | | *Annual Reporting Total* | **$ 15,328** |
| Monitoring Well Abandonment (Table B.17, Attachment 8) | 1 | 1 | $ 27,580 | $ 27,580 |
| Contingency (design + construction) | 25% | | | $ 6,900 |
| | | | *Abandonment Total* | **$ 34,480** |
| Periodic Soil Sampling, Years 19 and 39 for MNA only (Table B.17, Attachment 10) | | 1 | $ 27,680 | $ 27,680 |
| Contingency (design + construction) | 25% | | | $ 6,900 |
| | | | *Soil Sampling Total* | **$ 34,580** |

**Assumptions:**

1) Assume groundwater will be monitored for 40 years for Alternative 2, 20 years for Alternatives 3, 4, and 5.
2) Wells will be replaced in Year 20 for Alternative 2.
3) Wells will be sampled quarterly for first 2 years, annually for the next 3 years, then every 5 years thereafter.
4) Monitoring wells will be abandoned in the final year. Assumes abandonment of 4 wells.
5) Total vertical feet of wells to abandon is assumed to be 40 feet per well or 160 feet total.
6) Assumes installation of one new well at Burn Pit.

# TABLE B.13
# SPECIFIC RESPONSE ACTION 4a
# MNA - 40 YEARS
# PRESENT VALUE
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Year | Capital Cost ($) | Annual O&M ($) | Periodic Costs ($) | Total Cost ($) | Discount Factor at 0.6% | Present Value at 0.6% ($) |
|---|---|---|---|---|---|---|
| 0 | $ 23,800 | $ - | $ 69,700 | $ 93,500 | 1.000 | $ 93,500 |
| 1 | $ - | $ - | $ 43,800 | $ 43,800 | 0.994 | $ 43,600 |
| 2 | $ - | $ - | $ 22,400 | $ 22,400 | 0.988 | $ 22,200 |
| 3 | $ - | $ - | $ 22,400 | $ 22,400 | 0.982 | $ 22,002 |
| 4 | $ - | $ - | $ 22,400 | $ 22,400 | 0.976 | $ 21,871 |
| 5 | $ - | $ - | $ - | $ - | 0.971 | $ - |
| 6 | $ - | $ - | $ - | $ - | 0.965 | $ - |
| 7 | $ - | $ - | $ - | $ - | 0.959 | $ - |
| 8 | $ - | $ - | $ - | $ - | 0.953 | $ - |
| 9 | $ - | $ - | $ 22,400 | $ 22,400 | 0.948 | $ 21,226 |
| 10 | $ - | $ - | $ - | $ - | 0.942 | $ - |
| 11 | $ - | $ - | $ - | $ - | 0.936 | $ - |
| 12 | $ - | $ - | $ - | $ - | 0.931 | $ - |
| 13 | $ - | $ - | $ - | $ - | 0.925 | $ - |
| 14 | $ - | $ - | $ 22,400 | $ 22,400 | 0.920 | $ 20,601 |
| 15 | $ - | $ - | $ - | $ - | 0.914 | $ - |
| 16 | $ - | $ - | $ - | $ - | 0.909 | $ - |
| 17 | $ - | $ - | $ - | $ - | 0.903 | $ - |
| 18 | $ - | $ - | $ - | $ - | 0.898 | $ - |
| 19 | $ - | $ - | $ 57,000 | $ 57,000 | 0.893 | $ 50,877 |
| 20 | $ - | $ - | $ 77,500 | $ 77,500 | 0.887 | $ 68,761 |
| 21 | $ - | $ - | $ - | $ - | 0.882 | $ - |
| 22 | $ - | $ - | $ - | $ - | 0.877 | $ - |
| 23 | $ - | $ - | $ - | $ - | 0.871 | $ - |
| 24 | $ - | $ - | $ 22,400 | $ 22,400 | 0.866 | $ 19,405 |
| 25 | $ - | $ - | $ - | $ - | 0.861 | $ - |
| 26 | $ - | $ - | $ - | $ - | 0.856 | $ - |
| 27 | $ - | $ - | $ - | $ - | 0.851 | $ - |
| 28 | $ - | $ - | $ - | $ - | 0.846 | $ - |
| 29 | $ - | $ - | $ 22,400 | $ 22,400 | 0.841 | $ 18,833 |
| 30 | $ - | $ - | $ - | $ - | 0.836 | $ - |
| 31 | $ - | $ - | $ - | $ - | 0.831 | $ - |
| 32 | $ - | $ - | $ - | $ - | 0.826 | $ - |
| 33 | $ - | $ - | $ - | $ - | 0.821 | $ - |
| 34 | $ - | $ - | $ 22,400 | $ 22,400 | 0.816 | $ 18,278 |
| 35 | $ - | $ - | $ - | $ - | 0.811 | $ - |
| 36 | $ - | $ - | $ - | $ - | 0.806 | $ - |
| 37 | $ - | $ - | $ - | $ - | 0.801 | $ - |
| 38 | $ - | $ - | $ - | $ - | 0.797 | $ - |
| 39 | $ - | $ - | $ 57,000 | $ 57,000 | 0.792 | $ 45,140 |
| 40 | $ - | $ - | $ 49,800 | $ 49,800 | 0.787 | $ 39,203 |
| **TOTALS** | **$ 23,800** | **$ -** | **$ 534,000** | **$ 557,800** | | **$ 505,500** |

## TABLE B.14
## SPECIFIC RESPONSE ACTION 4a
## MNA - 40 YEARS
## PERIODIC COST BREAKDOWN
## DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
## SEARS CREEK STATION, ALASKA

| | | Periodic Cost Breakdown ($) | | |
|---|---|---|---|---|
| Year | Annual O&M Cost Breakdown ($) | Groundwater Monitoring/ Periodic Soil Sampling | Monitoring Well Installation/ Replacement/ Abandonment | Planning / Reporting |
| 0 | $ - | $ 28,500 | $ 25,855 | $ 15,328 |
| 1 | $ - | $ 28,500 | $ - | $ 15,328 |
| 2 | $ - | $ 7,100 | $ - | $ 15,328 |
| 3 | $ - | $ 7,100 | $ - | $ 15,328 |
| 4 | $ - | $ 7,100 | $ - | $ 15,328 |
| 5 | $ - | $ - | $ - | $ - |
| 6 | $ - | $ - | $ - | $ - |
| 7 | $ - | $ - | $ - | $ - |
| 8 | $ - | $ - | $ - | $ - |
| 9 | $ - | $ 7,100 | $ - | $ 15,328 |
| 10 | $ - | $ - | $ - | $ - |
| 11 | $ - | $ - | $ - | $ - |
| 12 | $ - | $ - | $ - | $ - |
| 13 | $ - | $ - | $ - | $ - |
| 14 | $ - | $ 7,100 | $ - | $ 15,328 |
| 15 | $ - | $ - | $ - | $ - |
| 16 | $ - | $ - | $ - | $ - |
| 17 | $ - | $ - | $ - | $ - |
| 18 | $ - | $ - | $ - | $ - |
| 19 | $ - | $ 41,680 | $ - | $ 15,328 |
| 20 | $ - | $ - | $ 77,465 | $ - |
| 21 | $ - | $ - | $ - | $ - |
| 22 | $ - | $ - | $ - | $ - |
| 23 | $ - | $ - | $ - | $ - |
| 24 | $ - | $ 7,100 | $ - | $ 15,328 |
| 25 | $ - | $ - | $ - | $ - |
| 26 | $ - | $ - | $ - | $ - |
| 27 | $ - | $ - | $ - | $ - |
| 28 | $ - | $ - | $ - | $ - |
| 29 | $ - | $ 7,100 | $ - | $ 15,328 |
| 30 | $ - | $ - | $ - | $ - |
| 31 | $ - | $ - | $ - | $ - |
| 32 | $ - | $ - | $ - | $ - |
| 33 | $ - | $ - | $ - | $ - |
| 34 | $ - | $ 7,100 | $ - | $ 15,328 |
| 35 | $ - | $ - | $ - | $ - |
| 36 | $ - | $ - | $ - | $ - |
| 37 | $ - | $ - | $ - | $ - |
| 38 | $ - | $ - | $ - | $ - |
| 39 | $ - | $ 41,680 | $ - | $ 15,328 |
| 40 | $ - | $ - | $ 34,480 | $ 15,328 |
| **TOTALS** | **$ -** | **$ 197,160** | **$ 137,800** | **$ 199,264** |

# TABLE B.15
# SPECIFIC RESPONSE ACTION 4b
# MNA - 20 YEARS
# PRESENT VALUE
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Year | Capital Cost ($) | Annual O&M ($) | Periodic Costs ($) | Total Cost ($) | Discount Factor at 0.6% | Present Value at 0.6% ($) |
|---|---|---|---|---|---|---|
| 0 | $ 23,800 | $ - | $ 69,700 | $ 93,500 | 1.000 | $ 93,500 |
| 1 | $ - | $ - | $ 43,800 | $ 43,800 | 0.994 | $ 43,600 |
| 2 | $ - | $ - | $ 22,400 | $ 22,400 | 0.988 | $ 22,200 |
| 3 | $ - | $ - | $ 22,400 | $ 22,400 | 0.982 | $ 22,002 |
| 4 | $ - | $ - | $ 22,400 | $ 22,400 | 0.976 | $ 21,871 |
| 5 | $ - | $ - | $ - | $ - | 0.971 | $ - |
| 6 | $ - | $ - | $ - | $ - | 0.965 | $ - |
| 7 | $ - | $ - | $ - | $ - | 0.959 | $ - |
| 8 | $ - | $ - | $ - | $ - | 0.953 | $ - |
| 9 | $ - | $ - | $ 22,400 | $ 22,400 | 0.948 | $ 21,226 |
| 10 | $ - | $ - | $ - | $ - | 0.942 | $ - |
| 11 | $ - | $ - | $ - | $ - | 0.936 | $ - |
| 12 | $ - | $ - | $ - | $ - | 0.931 | $ - |
| 13 | $ - | $ - | $ - | $ - | 0.925 | $ - |
| 14 | $ - | $ - | $ 21,000 | $ 21,000 | 0.920 | $ 19,313 |
| 15 | $ - | $ - | $ - | $ - | 0.914 | $ - |
| 16 | $ - | $ - | $ - | $ - | 0.909 | $ - |
| 17 | $ - | $ - | $ - | $ - | 0.903 | $ - |
| 18 | $ - | $ - | $ - | $ - | 0.898 | $ - |
| 19 | $ - | $ - | $ 22,400 | $ 22,400 | 0.893 | $ 19,994 |
| 20 | $ - | $ - | $ 49,800 | $ 49,800 | 0.887 | $ 44,185 |
| **TOTALS** | **$ 23,800** | **$ -** | **$ 296,300** | **$ 320,100** | | **$ 307,900** |

# TABLE B.16
# SPECIFIC RESPONSE ACTION 4b
# MNA - 20 YEARS
# PERIODIC COST BREAKDOWN
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Year | Annual O&M Cost Breakdown ($) | Periodic Cost Breakdown ($) | | |
|---|---|---|---|---|
| | | Groundwater Monitoring | Monitoring Well Installation/ Replacement/ Abandonment | Planning / Reporting |
| 0 | $ - | $ 28,500 | $ 25,855 | $ 15,328 |
| 1 | $ - | $ 28,500 | $ - | $ 15,328 |
| 2 | $ - | $ 7,100 | $ - | $ 15,328 |
| 3 | $ - | $ 7,100 | $ - | $ 15,328 |
| 4 | $ - | $ 7,100 | $ - | $ 15,328 |
| 5 | $ - | $ - | $ - | $ - |
| 6 | $ - | $ - | $ - | $ - |
| 7 | $ - | $ - | $ - | $ - |
| 8 | $ - | $ - | $ - | $ - |
| 9 | $ - | $ 7,100 | $ - | $ 15,328 |
| 10 | $ - | $ - | $ - | $ - |
| 11 | $ - | $ - | $ - | $ - |
| 12 | $ - | $ - | $ - | $ - |
| 13 | $ - | $ - | $ - | $ - |
| 14 | $ - | $ 5,700 | $ - | $ 15,328 |
| 15 | $ - | $ - | $ - | $ - |
| 16 | $ - | $ - | $ - | $ - |
| 17 | $ - | $ - | $ - | $ - |
| 18 | $ - | $ - | $ - | $ - |
| 19 | $ - | $ 7,100 | $ - | $ 15,328 |
| 20 | $ - | $ - | $ 34,480 | $ 15,328 |
| **TOTALS** | **$ -** | **$ 98,200** | **$ 60,335** | **$ 137,952** |

## TABLE B.17
## ATTACHMENTS FOR SPECIFIC RESPONSE ACTION 2 AND 4
## LUCs and MNA
## DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
## SEARS CREEK STATION, ALASKA

**Attachment 1 - Implementation of Land Use Controls**

| **Subtask Description, Labor** | **Quantity** | **Unit** | **Unit Cost** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Project Manager | 30 | Hour | $ 190 | $ 5,700 | Estimated |
| Engineer/Geologist-Sen | 40 | Hour | $ 150 | $ 6,000 | Estimated |
| Engineer/Geologist-Mid | 75 | Hour | $ 120 | $ 9,000 | Estimated |
| CADD/GIS | 50 | Hour | $ 85 | $ 4,250 | Estimated |
| | | | **Total** | **$ 24,950** | |

**Attachment 2 - Annual Land Use Controls Inspection and Reporting**

| **Subtask Description, Labor** | **Quantity** | **Unit** | **Unit Cost** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Project Manager | 12 | Hour | $ 190 | $ 2,280 | Estimated |
| Engineer/Geologist-Mid | 32 | Hour | $ 120 | $ 3,840 | Estimated |
| CADD/GIS | 6 | Hour | $ 85 | $ 510 | Estimated |
| | | | **Total** | **$ 6,630** | |

**Attachment 3 - Groundwater Monitoring, Sample Collection, and Analysis (per well)**

| **Equipment / Laboratory / Rentals** | **Quantity** | **Unit** | **Unit Cost** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Sample Suite (VOC, GRO, DRO, RRO, PAH, MNA) | 1 | per sample | $ 850 | $ 850 | Includes min 10% FD, MS MSD samples |
| Sample Shipping | 1 | per sample | $ 25 | $ 25 | |
| Sample Equipment | 1 | per sample | $ 93 | $ 93 | 1/3 of TTT day rate |
| Sample Crew Labor | 1 | per sample | $ 750 | $ 750 | Includes travel, prep and sample handling |
| Misc Expenses | 1 | per sample | $ 50 | $ 50 | |
| Per Diem | 1 | per sample | $ 65 | $ 65 | Fairbanks, 2 persons/ 3 samples |
| Mileage | 1 | per sample | $ 48 | $ 48 | 250 mi. RT/ 3 samples |
| | | | **Total** | **$ 1,881** | |

**Attachment 4 - Reporting - Annual (MNA)**

| **Labor** | **Quantity** | **Unit** | **Unit Cost** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Project Manager | 12 | Hour | $ 190 | $ 2,280 | Estimated |
| Engineer/Geologist-Mid | 60 | Hour | $ 120 | $ 7,200 | Estimated |
| CADD/GIS | 12 | Hour | $ 85 | $ 1,020 | Estimated |
| Chemist, Mid | 16 | Hour | $ 108 | $ 1,728 | Estimated |
| | | | **Total** | **$ 12,228** | |

**Attachment 5 - Work Plan Preparation (MNA)**

| **Labor** | **Quantity** | **Unit** | **Unit Cost** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Project Manager | 12 | Hour | $ 190 | $ 2,280 | Estimated |
| Engineer/Geologist-Sen | 80 | Hour | $ 150 | $ 12,000 | Estimated |
| CADD/GIS | 16 | Hour | $ 85 | $ 1,360 | Estimated |
| Chemist, Sen | 24 | Hour | $ 140 | $ 3,360 | Estimated |
| | | | **Total** | **$ 19,000** | |

**Attachment 6 - Monitoring Well Installation/Replacement (MNA)**

| **Labor** | **Quantity** | **Unit** | **Unit Cost** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Mobilization/Demobilization | 1 | each | $ 5,180.00 | $ 5,180 | SC quote |
| Day rate for direct push drill rig, crew, per diem, and supporting equipment (assume 10 hour shifts). | 1 | day | $ 4,000.00 | $ 4,000 | SC quote, GP8040, 2 man crew |
| Well Materials | 45 | ft | $ 35.00 | $ 1,575 | SC quote; recent project |
| Bollards | 1 | well | $ 600.00 | $ 600 | SC quote |
| Survey | 1 | day | $ 3,300.00 | $ 3,300 | Professional judgment; with travel time; data analysis |
| Engineer/Geologist-mid | 50 | Hour | $ 120 | $ 6,000 | includes subcontracting, preparation, mobilization, drilling oversight, and development |
| | | | **Total** | **$ 20,655** | |

**Attachment 7 - Five Year Review (LUCs)**

| **Labor** | **Quantity** | **Unit** | **Unit Cost** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Project Manager | 20 | Hour | $ 190 | $ 3,800 | Estimated |
| Engineer/Geologist-mid | 120 | Hour | $ 120 | $ 14,400 | Estimated |
| CADD/GIS | 24 | Hour | $ 85 | $ 2,040 | Estimated |
| | | | **Total** | **$ 20,240** | |

# TABLE B.17
# ATTACHMENTS FOR SPECIFIC RESPONSE ACTION 2 AND 4
# LUCs and MNA
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Attachment 8 - Monitoring Well Abandonment (MNA) | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Quant.** | **Unit** | **Unit Cost** | **Cost** | **Notes** |
| Well Abandonment Work Plan / Health & Safety Plan | 1 | Lump Sum | $ 6,000 | $ 6,000 | |
| Mobilization/Demobilization | 1 | each | $ 5,180.00 | $ 5,180 | SC quote |
| Day rate for direct push drill rig, crew, per diem, and supporting equipment (assume 10 hour shifts). | 1 | day | $ 4,000.00 | $ 4,000 | SC quote, GP8040, 2 man crew |
| Engineer/Geologist-Mid | 40 | Hour | $ 120 | $ 4,800 | includes subcontracting, preparation, mobilization, oversight |
| Well Abandonment Reports | 1 | Lump Sum | $ 7,600 | $ 7,600 | |
| | | | **Total** | **$ 27,580** | |

| Attachment 9 - Water Supply Well Decommissioning (LUCs) | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Quant.** | **Unit** | **Unit Cost** | **Cost** | **Notes** |
| Mobilization/Demobilization | 1 | each | $ 2,000.00 | $ 2,000 | |
| Filling well with bentonite, cutting well head off 2' minimum below ground surface, capping well head, and burying | 1 | day | $ 3,322.00 | $ 3,322 | Aurora Drilling quote |
| Engineer/Geologist-Mid | 40 | Hour | $ 120 | $ 4,800 | includes subcontracting, preparation, mobilization, oversight |
| Well Abandonment Report | 1 | Lump Sum | $ 2,400 | $ 2,400 | |
| | | | **Total** | **$ 12,522** | |

| Attachment 10 - Soil Sample Collection and Analysis (MNA without an Active Soil Remedy) | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Quant.** | **Unit** | **Unit Cost** | **Cost** | **Notes** |
| Mobilization/Demobilization | 1 | each | $ 5,180.00 | $ 5,180 | SC quote |
| Day rate for direct push drill rig, crew, per diem, and supporting equipment (assume 10 hour shifts). | 1 | day | $ 4,000.00 | $ 4,000 | SC quote, GP8040, 2 man crew |
| Engineer/Geologist | 40 | Hour | $ 110 | $ 4,400 | includes subcontracting, preparation, mobilization, oversight |
| Sample Suite (VOC, GRO, DRO, RRO, PAH) | 20 | Sample | $ 385 | $ 7,700 | Includes 10% for MS MSD |
| Sample Shipping | 2 | Cooler | $ 200 | $ 400 | 10 samples per cooler |
| Reporting | 60 | Hour | $ 100 | $ 6,000 | |
| | | | **Total** | **$ 27,680** | |

# TABLE B.18
# SPECIFIC RESPONSE ACTION 6
# IN SITU CHEMICAL OXIDATION
# COST BREAKDOWN
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Item | Units | | Unit Cost ($) | Extended ($) |
|---|---|---|---|---|
| ***Capital*** | | | | |
| Implementation of ISCO | | | | |
| Work Plan Preparation (see Table B.21 Attachment 1) | 1 | Lump Sum | $ 35,200 | $ 35,200 |
| Field Effort Preparation (see Table B.21 Attachment 2) | 1 | Lump Sum | $ 16,750 | $ 16,750 |
| ISCO Products (see Table B.21 Attachment 3A) | 1 | Lump Sum | $ 192,680 | $ 192,680 |
| Injection Well Installation (see Table B.21 Attachment 3B) | 1 | Lump Sum | $ 92,180 | $ 92,180 |
| Construction Completion Reporting (see Table B.21 Attachment 5) | 1 | Lump Sum | $ 38,200 | $ 38,200 |
| | | | *Sub-Total* | $ 375,010 |
| Contingency (design + construction) | 25% | | | $ 93,800 |
| | | | *Capital Total* | **$ 468,811** |
| ***Periodic Costs*** | | | | |
| Injection Field Work (see Table B.21 Attachment 3C) | 1 | Event | $ 37,200 | $ 37,200 |
| Contingency (design + construction) | 25% | | | $ 9,300 |
| | | | *Injection Total* | **$ 46,500** |
| Confirmation Groundwater Sampling, 3 wells, 2 events per year (see Table B.21 Attachment 4) | 6 | Wells | $ 1,881 | $ 11,286 |
| Contingency (design + construction) | 25% | | | $ 2,800 |
| | | | *GW Confirmation Total* | **$ 14,086** |
| Monitoring & Injection Well Abandonment (Table B.21 Attachment 6) | 1 | Event | $ 35,980 | $ 35,980 |
| Contingency (design + construction) | 25% | | | $ 9,000 |
| | | | *Abandonment Total* | **$ 44,980** |

# TABLE B.19
# SPECIFIC RESPONSE ACTION 6
# IN SITU CHEMICAL OXIDATION
# PRESENT VALUE
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Year | Capital Cost ($) | Annual O&M ($) | Periodic Costs ($) | Total Cost ($) | Discount Factor at 0.6% | Present Value at 0.6% ($) |
|---|---|---|---|---|---|---|
| 0 | $ 468,800 | $ - | $ 60,586 | $ 529,386 | 1.000 | $ 529,386 |
| 1 | $ - | $ - | $ 60,586 | $ 60,586 | 0.994 | $ 60,225 |
| 2 | $ - | $ - | $ 14,086 | $ 14,086 | 0.988 | $ 13,919 |
| 3 | $ - | $ - | $ 14,086 | $ 14,086 | 0.982 | $ 13,836 |
| 4 | $ - | $ - | $ 44,980 | $ 44,980 | 0.976 | $ 43,917 |
| **TOTALS** | **$ 468,800** | **$ -** | **$ 194,400** | **$ 663,200** | | **$ 661,300** |

## TABLE B.20
## SPECIFIC RESPONSE ACTION 6
## IN SITU CHEMICAL OXIDATION
## PERIODIC COST BREAKDOWN
## DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
## SEARS CREEK STATION, ALASKA

| Year | Annual O&M Cost Breakdown ($) | Periodic Cost Breakdown ($) | | |
|---|---|---|---|---|
| | | ISCO Injections | Confirmation Sampling | Monitoring Well Abandonment |
| | | | | |
| 0 | $ - | $ 46,500 | $ 14,086 | $ - |
| 1 | $ - | $ 46,500 | $ 14,086 | $ - |
| 2 | $ - | $ - | $ 14,086 | $ - |
| 3 | $ - | $ - | $ 14,086 | $ - |
| 4 | $ - | $ - | $ - | $ 44,980 |
| **TOTALS** | **$ -** | **$ 93,000** | **$ 56,400** | **$ 45,000** |

# TABLE B.21
# ATTACHMENT FOR SPECIFIC RESPONSE ACTION 6
# IN SITU CHEMICAL OXIDATION
# COST BREAKDOWN
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

### Attachment 1 - Work Plan Preparation

| Item | Quantity | Unit | Unit Cost | Cost | Notes |
|---|---|---|---|---|---|
| Project Manager | 30 | Hour | $ 190 | $ 5,700 | Estimated |
| Engineer/Geologist-Sen | 100 | Hour | $ 150 | $ 15,000 | Estimated |
| Engineer/Geologist-Mid | 60 | Hour | $ 120 | $ 7,200 | Estimated |
| CADD/GIS | 20 | Hour | $ 85 | $ 1,700 | Estimated |
| Chemist, Sen | 40 | Hour | $ 140 | $ 5,600 | Estimated |
| | | | **Total** | **$ 35,200** | |

### Attachment 2 - Preparation Prior to ISCO

| Item | Quantity | Unit | Unit Cost | Cost | Notes |
|---|---|---|---|---|---|
| Project Manager, Senior | 15 | Hour | $ 190 | $ 2,850 | |
| Engineering Tech, Senior | 20 | Hour | $ 95 | $ 1,900 | Estimated |
| Engineer/Geologist-Sen | 60 | Hour | $ 150 | $ 9,000 | Estimated |
| Engineer/Geologist-Mid | 25 | Hour | $ 120 | $ 3,000 | Estimated |
| | | | **Total** | **$ 16,750** | |

### Attachment 3A - ISCO Application - Materials

| Item | Quantity | Unit | Unit Cost | Cost | Notes |
|---|---|---|---|---|---|
| Length | 45 | ft | | | Input |
| Width | 40 | ft | | | Input |
| Area | 1,800 | sq ft | | | Calculated |
| Thickness | 10 | ft | | | Input |
| Treatment Volume | 18,000 | cu ft | | | Calculated |
| Treatment Volume | 700 | CY | | | Calculated |
| Bulk Density | 100 | lbs/cu ft | | | Estimated |
| Soil Mass | 1,800,000 | lbs | | | Calculated |
| Soil Mass | 816,327 | kg | | | Calculated |
| Porosity | 0.35 | | | | |
| Groundwater Volume | 47,124 | gal | | | |
| GRO - soil | 35 | mg/kg | | | Estimated Average Starting Concentration |
| DRO - soil | 1,167 | mg/kg | | | Estimated Average Starting Concentration |
| GRO - GW | 2.3 | mg/L | | | Estimated Average Starting Concentration |
| DRO - GW | 4.8 | mg/L | | | Estimated Average Starting Concentration |
| Mass GRO | 63.9 | lbs | | | Calculated |
| Mass DRO | 2,102.5 | lbs | | | Calculated |
| Persulfate Needed for Soil Oxidant Demand | 2,700 | lbs | $ 1.43 | $ 3,860 | PerOxyChem qnty estimate and pricing FOB origin |
| Persulfate Needed for COCs | 47,889 | lbs | $ 1.43 | $ 68,481 | PerOxyChem qnty estimate and pricing FOB origin |
| Shipping (persulfate) | 50,600 | per lb | $ 0.91 | $ 46,046 | Estimated based on shipping similar materials from lower 48 |
| NaOH for Activation | 73,557 | lbs | $ 0.76 | $ 55,903 | Univar pricing, FOB Anchorage |
| Shipping (NaOH) | 73,557 | per lb | $ 0.25 | $ 18,389 | Estimated |
| | | | **Total** | **$ 192,680** | |

### Attachment 3B - ISCO Application - Injection Well Installation

| Item | Quantity | Unit | Unit Cost | Cost | Notes |
|---|---|---|---|---|---|
| Mobilization/Demobilization | 1 | each | $ 5,180.00 | $ 5,180 | SC pricing |
| Day rate for direct push drill rig, crew, and supporting equipment (assume 10 hour shifts). Includes crew per diem. | 10 | day | $ 4,000.00 | $ 40,000 | SC pricing; assume 20 well, 2 wells/day |
| Well materials | 1000 | ft | $ 35.00 | $ 35,000 | assume 20 wells to 50 feet |
| **Labor** | | | | | |
| Engineer/Geologist - Mid | 100 | Hour | $ 120 | $ 12,000 | 10 hrs/d for duration of drilling |
| | | | **Total** | **$ 92,180** | |

### Attachment 3C - ISCO Application - Injection

| Item | Quantity | Unit | Unit Cost | Cost | Notes |
|---|---|---|---|---|---|
| Mobilization/Demobilization | 1 | each | $ 3,500.00 | $ 3,500 | SC for injection equipment |
| ISCO mixing system, injection pumps, hoses, water transport tanks, supporting equipment. | 12 | day | $ 300.00 | $ 3,600 | SC pricing |
| **Labor** | | | | | |
| Engineer/Geologist - Mid | 140 | Hour | $ 120 | $ 16,800 | 10 hrs/d for duration of injection + day setup & breakdown |
| Engineering Tech., Senior | 140 | Hour | $ 95 | $ 13,300 | 10 hrs/d for duration of injection + day setup & breakdown |
| | | | **Total** | **$ 37,200** | |

# TABLE B.21
# ATTACHMENT FOR SPECIFIC RESPONSE ACTION 6
# IN SITU CHEMICAL OXIDATION
# COST BREAKDOWN
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

## Attachment 4 - Confirmation Groundwater Monitoring, Sample Collection, and Analysis (per well)

| Equipment / Laboratory / Rentals | Quantity | Unit | Unit Cost | Cost | Notes |
|---|---|---|---|---|---|
| Sample Suite (VOC, GRO, DRO, RRO, PAH, MN | 1 | per sample | $ 850 | $ 850 | Includes min 10% FD, MS MSD samples |
| Sample Shipping | 1 | per sample | $ 25 | $ 25 | |
| Sample Equipment | 1 | per sample | $ 93 | $ 93 | 1/3 of TTT day rate |
| Sample Crew Labor | 1 | per sample | $ 750 | $ 750 | Includes travel, prep and sample handling |
| Misc Expenses | 1 | per sample | $ 50 | $ 50 | |
| Per Diem | 1 | per sample | $ 65 | $ 65 | Fairbanks, 2 persons/ 3 samples |
| Mileage | 1 | per sample | $ 48 | $ 48 | 250 mi. RT/ 3 samples |
| | | | **Total** | **$ 1,881** | |

## Attachment 5 - Completion Reporting

| Item | Quantity | Unit | Unit Cost | Cost | Notes |
|---|---|---|---|---|---|
| Project Manager | 30 | Hour | $ 190 | $ 5,700 | Estimated |
| Engineer/Geologist-Sen | 120 | Hour | $ 150 | $ 18,000 | Estimated |
| Engineer/Geologist-Mid | 60 | Hour | $ 120 | $ 7,200 | Estimated |
| CADD/GIS | 20 | Hour | $ 85 | $ 1,700 | Estimated |
| Chemist, Sen | 40 | Hour | $ 140 | $ 5,600 | Estimated |
| | | | **Total** | **$ 38,200** | |

## Attachment 6- Monitoring and Injection Well Abandonment

| Equipment | Quant. | Unit | Unit Cost | Cost | Notes |
|---|---|---|---|---|---|
| Mobilization/Demobilization | 1 | each | $ 5,180.00 | $ 5,180 | SC quote |
| Day rate for direct push drill rig, crew, per diem, and supporting equipment (assume 10 hour shifts). | 4 | day | $ 4,000.00 | $ 16,000 | SC quote, GP8040, 2 man crew, assume 6 wells/day |
| Engineer/Geologist-Mid | 60 | Hour | $ 120 | $ 7,200 | includes subcontracting, preparation, mobilization, oversight |
| Well Abandonment Reports | 1 | Lump Sum | $ 7,600 | $ 7,600 | |
| | | | **Total** | **$ 35,980** | |

# TABLE B.22
# SPECIFIC RESPONSE ACTION 8
# BIOSPARGING
# COST BREAKDOWN
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Item | | Units | Unit Cost ($) | Extended ($) |
|---|---|---|---|---|
| *Capital* | | | | |
| Implementation of Biosparging | | | | |
| Work Plan Preparation (See Table B.25, Attachment 1) | 1 | Lump Sum | $ 41,620 | $ 41,620 |
| Field Effort Preparation (See Table B.25, Attachment 2) | 1 | Lump Sum | $ 12,900 | $ 12,900 |
| Biosparging System Installation (See Table B.25, Attachment 3) | 1 | Lump Sum | $ 286,642 | $ 286,642 |
| Survey New Wells (See Table B.25, Attachment 4) | 1 | Lump Sum | $ 9,900 | $ 9,900 |
| Construction Completion Reporting (See Table B.25, Attachment 5) | 1 | Lump Sum | $ 29,440 | $ 29,440 |
| Baseline Sampling Event | | | | |
| Groundwater Sampling (See Table B.25, Attachment 6) | 3 | Wells | $ 1,881 | $ 5,643 |
| | | | *Sub-Total* | $ 386,145 |
| Contingency (design + construction) | 25% | | | $ 96,500 |
| | | | *Capital Total* | **$ 482,645** |
| *Annual Operation and Maintenance* | | | | |
| Biosparging System Operation & Monitoring (Years 1 to 3) | | | | |
| Power (annual fuel usage, See Table B.25, Attachment 10) | 1 | Lump Sum | $ 20,988 | $ 20,988 |
| Annual O&M Labor (See Table B.25, Attachment 7) | 1 | Lump Sum | $ 14,340 | $ 14,340 |
| Progress Results Letter Report (See Table B.25, Attachment 8) | 1 | Lump Sum | $ 16,700 | $ 16,700 |
| | | | *Sub-Total* | $ 52,028 |
| Contingency (design + construction) | 25% | | | $ 13,007 |
| | | | *Annual Total* | **$ 65,035** |
| *Periodic* | | | | |
| Groundwater Sampling, 3 wells, 2 times/year (See Table B.25, Attachment 6) | 6 | Wells | $ 1,881 | $ 11,286 |
| Contingency (design + construction) | 25% | | | $ 2,800 |
| | | | *GW Sampling Total* | **$ 14,086** |
| Abandonment Activities (See Table B.17, Attachment 9) | 1 | Lump Sum | $ 54,230 | $ 54,230 |
| Contingency (design + construction) | 25% | | | $ 13,600 |
| | | | *Abandonment Total* | **$ 67,830** |

**Assumptions:**

1) Four air sparge wells and one additional monitoring well to total depth of 50 feet each. Two multi-interval vapor monitoring points in vadose zone to 35 feet bgs each.

2) Three years sparging operation followed by two years groundwater monitoring.

# TABLE B.23
# SPECIFIC RESPONSE ACTION 8
# BIOSPARGING
# PRESENT VALUE
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Year | Capital Cost ($) | Annual O&M ($) | Periodic Costs ($) | Total Cost ($) | Discount Factor at 0.6% | Present Value at 0.6% ($) |
|---|---|---|---|---|---|---|
| 0 | $ 482,645 | $ - | $ - | $ 482,645 | 1.000 | $ 482,645 |
| 1 | $ - | $ 65,035 | $ 14,086 | $ 79,121 | 0.994 | $ 78,650 |
| 2 | $ - | $ 65,035 | $ 14,086 | $ 79,121 | 0.988 | $ 78,181 |
| 3 | $ - | $ 65,035 | $ 14,086 | $ 79,121 | 0.982 | $ 77,714 |
| 4 | $ - | $ - | $ 14,086 | $ 14,086 | 0.976 | $ 13,753 |
| 5 | $ - | $ - | $ 14,086 | $ 14,086 | 0.971 | $ 13,671 |
| 6 | $ - | $ - | $ 81,916 | $ 81,916 | 0.965 | $ 79,028 |
| **TOTALS** | **$ 482,700** | **$ 195,200** | **$ 152,400** | **$ 830,100** | **$100** | **$ 823,700** |

# TABLE B.24
# SPECIFIC RESPONSE ACTION 8
# BIOSPARGING
# PERIODIC COST BREAKDOWN
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Year | O&M and Monitoring ($) | Periodic Cost Breakdown ($) | |
|---|---|---|---|
| | | Groundwater Sampling | System Abandonment |
| 0 | $ - | $ - | $ - |
| 1 | $ 65,035 | $ 14,086 | $ - |
| 2 | $ 65,035 | $ 14,086 | $ - |
| 3 | $ 65,035 | $ 14,086 | $ - |
| 4 | $ - | $ 14,086 | $ - |
| 5 | $ - | $ 14,086 | $ - |
| 6 | $ - | $ 14,086 | $ 67,830 |
| **TOTALS** | **$ 195,105** | **$ 84,516** | **$ 67,830** |

# TABLE B.25
# ATTACHMENTS FOR SPECIFIC RESPONSE ACTION 8
# BIOSPARGING
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

### Attachment 1 - Work Plan Preparation

| **Labor** | **Quant.** | **Unit** | **Unit Cost** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Project Manager, Senior | 30 | Hour | $ 190 | $ 5,700 | Estimated |
| Engineer/Geologist-Sen | 120 | Hour | $ 150 | $ 18,000 | Professional judgment |
| Engineer/Geologist-Mid | 60 | Hour | $ 190 | $ 11,400 | Professional judgment |
| CAD/GIS | 32 | Hour | $ 85 | $ 2,720 | Professional judgment |
| Environmental Tech-Sen | 40 | Hour | $ 95 | $ 3,800 | Professional judgment |
| | | | **Total** | **$ 41,620** | |

### Attachment 2 - Preparation Prior to Field Effort

| **Labor** | **Quant.** | **Unit** | **Unit Cost** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Engineer/Geologist-Mid | 60 | Hour | $ 120 | $ 7,200 | |
| Environmental Tech-Sen | 60 | Hour | $ 95 | $ 5,700 | Procurement of Subcontractors (lab, surveyor, etc.) |
| | | | **Total** | **$ 12,900** | |

### Attachment 3 - Biosparging System Capital Costs

| **Construction** | **Quant.** | **Unit** | **Unit Cost** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Biosparging System | 1 | Each | $ 35,000 | $ 35,000 | Vendor estimate. Motor, compressor, condensate separator, inlet filter, silencers, guages, and controls. Pre-assembled in shed with control panel and disconnect. |
| Biosparging System Delivery | 1 | Lump Sum | $ 14,800.00 | $ 14,800 | Fogel pricing |
| Generator (12 KVA, 3 phase, 80-gal fuel tank, arctic enclosure, long-run oil tank [300 hr]) | 1 | Lump Sum | $ 125,000.00 | $ 125,000 | Tier 4 Compliant - Cummings Estimates |
| Fuel Storage Tank (2,500-gallon double wall) | 1 | Lump Sum | $ 19,250.00 | $ 19,250 | Greer Tank |
| Spill Containment for Generator and fuel tank | 2 | Each | $ 1,996.00 | $ 3,992 | Interstate Products 16'x20'x12" |
| Electrician | 1 | Lump Sum | $ 3,500.00 | $ 3,500 | Subcontractor pricing. Connect generator to blower. |
| Drill Crew Mobilization/Demobilization | 1 | each | $ 5,180.00 | $ 5,180 | Subcontractor pricing |
| Day rate for HSA rig, crew, and supporting equipment (assume 10 hour shifts). Includes crew per diem. | 3 | day | $ 4,000.00 | $ 12,000 | Subcontractor pricing - GP8040, 2 man crew.<br>2 days to install of 4 sparge wells, 1 monitoring well, and 2 VMPs |
| Sparge well installation (materials, casing, cap) | 200 | feet | $ 35.00 | $ 7,000 | Materials and completion; 4 wells to 50 ft |
| VMP installation (material, probe tubing) | 70 | feet | $ 30.00 | $ 2,100 | Materials and completion; 2 VMPs to 35 ft |
| Trenching Crew (includes all equipment, fuel, tooling, vehicles, lodging, meals for three) | 4 | day | $ 8,130 | $ 32,520 | Contractor pricing. |
| Biosparging pipe materials | 1 | Lump Sum | $ 500 | $ 500 | Estimated |
| **Labor** | | | | | |
| Engineer/Geologist-Mid | 120 | Hour | $ 120 | $ 14,400 | |
| Environmental Tech-Sen | 120 | Hour | $ 95 | $ 11,400 | Installation Oversight; system startup |
| | | | **Total** | **$ 286,642** | |

### Attachment 4 - Survey

| Construction | Quant. | Unit | **Unit Cost** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Crew, vehicle and per diem | 3 | Day | $ 3,300 | $ 9,900 | Professional judgment; with travel time; data analysis |
| | | | **Total** | **$ 9,900** | |

### Attachment 5 - Construction Completion Reporting

| **Labor** | **Quant.** | **Unit** | **Unit Cost** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Project Manager, Senior | 16 | Hour | $ 190 | $ 3,040 | Estimated |
| Env. Engineer, Sen | 80 | Hour | $ 150 | $ 12,000 | Estimated |
| Geologist - Mid | 60 | Hour | $ 120 | $ 7,200 | Estimated |
| CAD/GIS | 40 | Hour | $ 85 | $ 3,400 | Estimated |
| Environmental Tech-Sen | 40 | Hour | $ 95 | $ 3,800 | Estimated |
| | | | **Total** | **$ 29,440** | |

### Attachment 6 - Groundwater Monitoring, Sample Collection, and Analysis (per well)

| **Equipment / Laboratory / Rentals** | **Quantity** | **Unit** | **Unit Cost** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Sample Suite (VOC, GRO, DRO, RRO, PAH, MNA) | 1 | per sample | $ 850 | $ 850 | Includes min 10% FD, MS MSD samples |
| Sample Shipping | 1 | per sample | $ 25 | $ 25 | |
| Sample Equipment | 1 | per sample | $ 93 | $ 93 | 1/3 of TTT day rate |
| Sample Crew Labor | 1 | per sample | $ 750 | $ 750 | Includes travel, prep and sample handling |
| Misc Expenses | 1 | per sample | $ 50 | $ 50 | |
| Per Diem | 1 | per sample | $ 65 | $ 65 | Fairbanks, 2 persons/ 3 samples |
| Mileage | 1 | per sample | $ 48 | $ 48 | 250 mi. RT/ 3 samples |
| | | | **Total** | **$ 1,881** | |

### Attachment 7 - Annual O&M Labor - Monthly System O&M

| **Labor** | **Quant.** | **Unit** | **Unit Cost** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Engineering Tech, Sen | 120 | Hour | $ 95 | $ 11,400 | 10 hrs/month for 12 months including travel |
| Misc Expenses | 12 | Event | $ 100 | $ 1,200 | oil, filters, etc. |
| Mileage | 12 | Event | $ 145 | $ 1,740 | 250 mi. RT, once per month |
| | | | **Total:** | **$ 14,340** | |

# TABLE B.25
# ATTACHMENTS FOR SPECIFIC RESPONSE ACTION 8
# BIOSPARGING
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

**Attachment 8 - Progress Results Letter Reporting**

| Labor | Quant. | Unit | Unit Cost | Cost | Notes |
|---|---|---|---|---|---|
| Project Manager, Senior | 16 | Hour | $ 190 | $ 3,040 | Estimated |
| Env. Engineer, Senior | 24 | Hour | $ 150 | $ 3,600 | Estimated |
| Geologist, Mid | 40 | Hour | $ 120 | $ 4,800 | Estimated |
| Engineering Tech., Senior | 20 | Hour | $ 95 | $ 1,900 | Estimated |
| Chemist, Senior | 24 | Hour | $ 140 | $ 3,360 | Estimated |
| | | | **Total:** | **$ 16,700** | |

**Attachment 9 - Abandonment Activities**

| Construction | Quant. | Unit | Unit Cost | Cost | Notes |
|---|---|---|---|---|---|
| Mobilization/Demobilization | 1 | each | $ 5,180.00 | $ 5,180 | SC quote |
| Day rate for direct push drill rig, crew, and supporting equipment (assume 10 hour shifts). Includes crew per diem. | 2 | day | $ 4,000.00 | $ 8,000 | SC quote, GP8040, 2 man crew |
| Biosparging system abandonment | 1 | Lump Sum | $ 18,000 | $ 18,000 | Professional judgment |
| Remove and Dispose of Abandonment Material | 30 | CY | $ 35 | $ 1,050 | Professional judgment |
| **Labor** | | | | | |
| Engineering Tech., Senior | 80 | Hour | $ 95 | $ 7,600 | Including procurement, preparation, ~ 5 days field |
| Env. Engineer, Mid | 120 | Hour | $ 120 | $ 14,400 | Including procurement, preparation, ~ 5 days field |
| | | | **Total:** | **$ 54,230** | |

**Attachment 10 - Fuel Unit Cost - Annual**

| Description | Quant. | Unit | Unit Cost | Cost | Notes |
|---|---|---|---|---|---|
| Fuel for Generator; delivered incld tax | 6,600 | Gallon | $ 3.18 | $ 20,988 | AK Fuel Deliveries; generator uses 1.5 gal/hr at full load, assumed 0.75 gph load for normal operations; 365 day/yr |
| | | | **Total** | **$ 20,988** | |

# TABLE B.26
# SPECIFIC RESPONSE ACTION 12
# EXCAVATION AND OFF-SITE TREATMENT
# COST BREAKDOWN
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Item | Units | | Unit Cost ($) | Extended ($) |
|---|---|---|---|---|
| ***Capital*** | | | | |
| Work Plan (see Table B.29 Attachment 1) | 1 | Lump Sum | $ 23,200 | $ 23,200 |
| Preparation (see Table B.29 Attachment 2) | 1 | Lump Sum | $ 14,980 | $ 14,980 |
| Excavation and Off-Site Treatment (see Table B.29 Attachment 3) | 1 | Lump Sum | $ 254,479 | $ 254,479 |
| Characterization and Confirmation Sampling (see Table B.29 Attachment 4) | 1 | Lump Sum | $ 22,160 | $ 22,160 |
| | | | *Sub-Total* | $ 314,819 |
| Contingency (design + construction) | 25% | | | $ 78,700 |
| | | | *Capital Total* | **$ 393,519** |
| ***Periodic Costs*** | | | | |
| | | | *Annual Total* | **$ -** |

# TABLE B.27
# SPECIFIC RESPONSE ACTION 12
# EXCAVATION AND OFF-SITE TREATMENT
# PRESENT VALUE
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Year | Capital Cost ($) | Annual O&M ($) | Periodic Costs ($) | Total Cost ($) | Discount Factor at 0.6% | Present Value at 0.6% ($) |
|---|---|---|---|---|---|---|
| | | | | | | |
| 0 | $ 393,500 | $ - | $ - | $ 393,500 | 1.000 | $ 393,500 |
| **TOTALS** | **$ 393,500** | **$ -** | **$ -** | **$ 393,500** | | **$ 393,500** |

# TABLE B.28
# SPECIFIC RESPONSE ACTION 13
# EXCAVATION AND OFF-SITE TREATMENT
# PERIODIC COST BREAKDOWN
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Year | Annual O&M Cost Breakdown ($) | Periodic Cost Breakdown ($) | |
|---|---|---|---|
| | | | |
| 0 | $ - | $ - | $ - |
| **TOTALS** | **$ -** | **$ -** | $ - |

# TABLE B.29
# ATTACHMENT FOR SPECIFIC RESPONSE ACTION 12
# EXCAVATION AND OFF-SITE TREATMENT
# COST BREAKDOWN
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

### Attachment 1 - Work Plan Preparation

| **Labor** | **Quant.** | **Unit** | **Unit Cost** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Engineering Tech, Senior | 40 | Hour | $ 95 | $ 3,800 | Professional judgment |
| Engineer/Geologist-Mid | 80 | Hour | $ 120 | $ 9,600 | Professional judgment |
| Engineer/Geologist-Sen | 40 | Hour | $ 150 | $ 6,000 | Professional judgment |
| Project Manager, Senior | 20 | Hour | $ 190 | $ 3,800 | Professional judgment |
| | | | **Total** | **$ 23,200** | |

### Attachment 2 - Preparation Prior to Field Effort

| **Labor** | **Quant.** | **Unit** | **Unit Cost** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Project Manager, Senior | 12 | Hour | $ 190 | $ 2,280 | Professional judgment; Coordination, Procurement of Subcontractors (GC, lab, surveyor, etc.) |
| Env. Engineer, Senior | 24 | Hour | $ 150 | $ 3,600 | |
| Engineer/Geologist-Mid | 60 | Hour | $ 120 | $ 7,200 | |
| Environmental Tech-Sen | 20 | Hour | $ 95 | $ 1,900 | |
| | | | **Total** | **$ 14,980** | |

### Attachment 3 - Excavation and Off-Site Treatment and Disposal of Impacted Soil

| **Item** | **Quantity** | **Unit** | **Unit Cost** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| ***Subcontractor Costs*** | | | | | |
| Mobilization/Demobilization | 1 | each | $ 19,800 | $ 19,800 | Contractor Pricing |
| Excavation; segregate clean soil; side sloping as needed (rate includes all equipment, fuel, tooling, vehicles, lodging, and meals for 3 operators. | 5.0 | Day | $ 8,130 | $ 40,650 | Contractor Pricing; 400-500 CY/day production 2100 CY total excavated, 650 CY contaminated |
| Backfill and restoration (crew rate with equipment and per diem) | 2.0 | Day | $ 8,130 | $ 16,260 | Contractor Pricing; ~1000 CY/day production |
| Backfill Material | 700 | CY | $ - | $ - | Free from OIT |
| Erosion and dust control | 1 | week | $ 1,750 | $ 1,750 | R.S. Means |
| Transport impacted soil to OIT in Moose Creek, AK | 945 | Tons | $ 47 | $ 44,415 | Contractor Pricing, single side-dump @ 24 ton/load Assume 1.35 tons per CY |
| Off-Site Thermal treatment of soil | 945 | Tons | $ 118 | $ 111,104 | OIT pricing; Assume 1.35 tons per CY |
| Survey Crew, vehicle and per diem | 1 | Day | $ 3,300 | $ 3,300 | Professional judgment; with travel time; data analysis; will be combined with other on-site work |
| ***Professional Labor - Oversight*** | | | | | |
| Env. Engineer, Mid | 80 | Hour | $ 120 | $ 9,600 | Professional judgment |
| Engineering Tech, Senior | 80 | Hour | $ 95 | $ 7,600 | Professional judgment |
| | | | **Total** | **$ 254,479** | |

### Attachment 4 - Confirmation/Characterization Soil Sample Collection and Analysis

| **Item** | **Quantity** | **Unit** | **Unit Cost** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Confirmation: Sample Suite (VOC, GRO, RRO, DRO, PAH) | 20 | Sample | $ 385 | $ 7,700 | lab pricing plus 10% for QA QC |
| Characterization: Sample Suite (VOC, GRO, RRO, DRO, PAH) | 20 | Sample | $ 385 | $ 7,700 | lab pricing plus 10% for QA QC |
| Sample Shipping | 8 | Cooler | $ 200 | $ 1,600 | 10 samples per cooler |
| ***Labor*** | | | | | |
| Env. Engineer, Mid | 24 | Hour | $ 120 | $ 2,880 | Professional judgment |
| Engineering Tech, Senior | 24 | Hour | $ 95 | $ 2,280 | Professional judgment |
| | | | **Total** | **$ 22,160** | |

# TABLE B.30
# SPECIFIC RESPONSE ACTION 13
# EXCAVATION AND OFF-SITE DISPOSAL
# COST BREAKDOWN
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Item | Units | | Unit Cost ($) | Extended ($) |
|---|---|---|---|---|
| ***Capital*** | | | | |
| Work Planning (see Table C.33 Attachment 1) | 1 | Lump Sum | $ 23,200 | $ 23,200 |
| Preparation (see Table C.33 Attachment 2) | 1 | Lump Sum | $ 14,980 | $ 14,980 |
| Excavation and Off-Site Disposal (see Table C.33 Attachment 3) | 1 | Lump Sum | $ 77,810 | $ 77,810 |
| Characterization and Confirmation Sampling (see Table C.33 Attachment 4) | 1 | Lump Sum | $ 4,345 | $ 4,345 |
| | | | *Sub-Total* | $ 120,335 |
| Contingency (design + construction) | 25% | | | $ 30,100 |
| | | | *Capital Total* | **$ 150,435** |
| ***Periodic Costs*** | | | | |
| | | | *Annual Total* | **$ -** |

# TABLE B.31
# SPECIFIC RESPONSE ACTION 13
# EXCAVATION AND OFF-SITE DISPOSAL
# PRESENT VALUE
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Year | Capital Cost ($) | Annual O&M ($) | Periodic Costs ($) | Total Cost ($) | Discount Factor at 0.6% | Present Value at 0.6% ($) |
|---|---|---|---|---|---|---|
| | | | | | | |
| 0 | $ 150,400 | $ - | $ - | $ 150,400 | 1.000 | $ 150,400 |
| **TOTALS** | **$ 150,400** | **$ -** | **$ -** | **$ 150,400** | | **$ 150,400** |

# TABLE B.32
# SPECIFIC RESPONSE ACTION 13
# EXCAVATION AND OFF-SITE DISPOSAL
# PERIODIC COST BREAKDOWN
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

| Year | Annual O&M Cost Breakdown ($) | Periodic Cost Breakdown ($) | |
|---|---|---|---|
| | | | |
| 0 | $ - | $ - | $ - |
| **TOTALS** | **$ -** | **$ -** | $ - |

# TABLE B.33
# ATTACHMENT FOR SPECIFIC RESPONSE ACTION 13
# EXCAVATION AND OFF-SITE DISPOSAL
# COST BREAKDOWN
# DRY WELL, BURN PIT, AND SITE GROUNDWATER FEASIBILITY STUDY
# SEARS CREEK STATION, ALASKA

### Attachment 1 - Work Plan Preparation

| Labor | Quant. | Unit | Unit Cost | Cost | Notes |
|---|---|---|---|---|---|
| Engineering Tech, Senior | 40 | Hour | $ 95 | $ 3,800 | Professional judgment |
| Engineer/Geologist-Mid | 80 | Hour | $ 120 | $ 9,600 | Professional judgment |
| Engineer/Geologist-Sen | 40 | Hour | $ 150 | $ 6,000 | Professional judgment |
| Project Manager, Senior | 20 | Hour | $ 190 | $ 3,800 | Professional judgment |
| | | | **Total** | **$ 23,200** | |

### Attachment 2 - Preparation Prior to Field Effort

| Labor | Quant. | Unit | Unit Cost | Cost | Notes |
|---|---|---|---|---|---|
| Project Manager, Senior | 12 | Hour | $ 190 | $ 2,280 | Professional judgment; Coordination, Procurement of Subcontractors (GC, lab, surveyor, etc.) |
| Engineer/Geologist-Mid | 24 | Hour | $ 150 | $ 3,600 | |
| Engineer/Geologist-Sen | 60 | Hour | $ 120 | $ 7,200 | |
| Engineering Tech, Senior | 20 | Hour | $ 95 | $ 1,900 | |
| | | | **Total** | **$ 14,980** | |

### Attachment 3 - Excavation Off-Site Disposal of Impacted Soil

| Item | Quantity | Unit | Unit Cost | Cost | Notes |
|---|---|---|---|---|---|
| ***Subcontractor Costs*** | | | | | |
| Mobilization/Demobilization | 1 | each | $ 19,800 | $ 19,800 | Contractor Pricing |
| Excavation; segregate clean soil; side sloping as needed (rate includes all equipment, fuel, tooling, vehicles, lodging, and meals for 3 operators. | 1.0 | Day | $ 8,130 | $ 8,130 | Contractor Pricing; 400-500 CY/day production Remove overburden to 12.5 feet bgs then lead impacted soil to 15 ft bgs; ~500 CY total excavated with 1vert:1.5hor sideslope, ~20 CY |
| Backfill and restoration (crew rate with equipment and per diem) | 1.0 | Day | $ 8,130 | $ 8,130 | Contractor Pricing; |
| Backfill Material | 20 | CY | $ - | $ - | Free from OIT; haul with Burn Pit backhaul |
| Erosion and dust control | 1 | week | $ 1,750 | $ 1,750 | R.S. Means |
| Transport and disposal of soil to lower 48 | 27 | Tons | $ 1,200 | $ 32,400 | Assume 1.35 tons per CY, NRC pricing |
| Survey Crew, vehicle and per diem | 1 | Day | $ 3,300 | $ 3,300 | Professional judgment; with travel time; data analysis; will be combined with other on-site work |
| ***Professional Labor - Oversight*** | | | | | |
| Env. Engineer, Mid | 20 | Hour | $ 120 | $ 2,400 | Professional judgment |
| Engineering Tech, Senior | 20 | Hour | $ 95 | $ 1,900 | Professional judgment |
| | | | **Total** | **$ 77,810** | |

### Attachment 4 - Confirmation/Characterization Soil Sample Collection and Analysis

| Item | Quantity | Unit | Unit Cost | Cost | Notes |
|---|---|---|---|---|---|
| Sample Suite (VOC, GRO, RRO, DRO, arsenic, lead) | 9 | Sample | $ 380 | $ 3,420 | Lab pricing; 6 for overburden, 2 bottom samples plus 10% for QA QC |
| TCLP Metals | 3 | Sample | $ 175 | $ 525 | Lab pricing |
| Labor | 0 | Hours | $ - | $ - | Included in Excavation Supervision |
| Sample Shipping | 2 | Cooler | $ 200 | $ 400 | 10 samples per cooler |
| | | | **Total** | **$ 4,345** | |