UNITED STATES AIR FORCE
JOINT BASE ELMENDORF-RICHARDSON, ALASKA

ENVIRONMENTAL RESTORATION PROGRAM

FEASIBILITY STUDY
SS109 - F-22 WEAPONS RELEASE SHOP

JOINT BASE ELMENDORF-RICHARDSON, ALASKA

FINAL

September 2019

FEASIBILITY STUDY
SS109 - F-22 WEAPONS RELEASE SHOP

JOINT BASE ELMENDORF-RICHARDSON, ALASKA

Prepared for
Air Force Civil Engineer Center

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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
µg/m^3	micrograms per cubic meter
µg/L	micrograms per liter
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
AFB	Air Force Base
ARAR	applicable or relevant and appropriate requirement
B	The analyte was detected in the method blank or the trip blank above the DL, and the concentration in the sample did not exceed the blank concentration by a factor of 5 (factor of 10 for common laboratory contaminants acetone and methylene chloride).
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	contaminant of concern
COPC	contaminant of potential concern
cy	cubic yard
DRO	diesel-range organics
EDB	1,2-dibromomethane (ethylene dibromide)
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
ERP	Environmental Restoration Program
FFA	Federal Facility Agreement
FRTR	Federal Remediation Technologies Roundtable
FS	feasibility study
GRA	general response action
GRO	gasoline-range organics
HHE	human health and the environment
HHRA	human health risk assessment
HI	hazard index
ILCR	incremental lifetime cancer risk
J	The analyte was positively identified; however, the associated result was less than the limit of quantitation but greater than or equal to the detection limit.
Jacobs	Jacobs Engineering Group Inc.

ACRONYMS AND ABBREVIATIONS (Continued)

JBER	Joint Base Elmendorf-Richardson
LOD	limit of detection
LUC	land use control
mg/kg	milligrams per kilogram
ND	nondetect
O&M	operations and maintenance
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCA	tetrachloroethane
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene
PCL	project cleanup level
PID	photoionization detector
POL	petroleum, oil, and lubricants
PSL	project screening level
RI	remedial investigation
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
RRO	residual-range organics
RSL	Regional Screening Level
SVE	soil vapor extraction
TCE	trichloroethylene
TMV	toxicity, mobility, and volume
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
UU/UE	unlimited use/unrestricted exposure
VI	vapor intrusion
VISL	Vapor Intrusion Screening Level
VOC	volatile organic compound
VSP	ventilated stockpile

EXECUTIVE SUMMARY

The purpose of this feasibility study (FS) is to provide an evaluation of remedial alternatives to address contamination related to the SS109 F-22 Weapons Release Shop that are appropriate to site-specific conditions and are protective of human health. As the lead agency under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the U.S. Air Force (USAF) will use the findings of this FS to develop a Proposed Plan and Record of Decision (ROD) for SS109. Regulatory support will be provided by the U.S. Environmental Protection Agency (EPA) and Alaska Department of Environmental Conservation (ADEC).

This FS summarizes previous environmental investigations and the human health risk assessment, including the results of the 2017 SS109 *Remedial Investigation* (RI) (U.S. Air Force [USAF] 2018b) and an update on treatment undertaken for contaminated soil that was previously removed. Upon completion of the RI and risk assessment, only trichloroethylene (TCE) in soil gas was retained as a contaminant of concern at SS109, and previously removed soil that has undergone four rounds of treatment in an offsite location still exceeded cleanup goals as of the most recent (2018) sampling event.

General response actions and associated remedial technologies were previously developed for SS109 soil and are evaluated in this FS for both soil and soil gas. Technologies and options were formulated into remedial alternatives that were initially screened against the EPA's criteria of effectiveness, implementability, and relative cost. Alternatives that passed the initial screening process were evaluated in detail against the CERCLA evaluation criteria (Table ES-1). These alternatives were evaluated individually and comparatively.

Table ES-1
Remedial Alternatives Evaluated

Alternative	Applicable Media	Applicable Contaminant
1. No Action	Soil Gas	TCE
2. LUCs and LTM	Soil Gas	TCE
3. Ex Situ Treatment of Excavated Soils	Soil	TCE
4. LUCs, LTM, and Ex Situ Treatment	Soil Gas & Soil	TCE

Note:
For definitions, refer to the Acronyms and Abbreviations section.

This FS recommends Alternative 4 to best protect human health and the environment. Following final approval of this FS, the USAF will issue a Proposed Plan for SS109. Comments on the Proposed Plan will be solicited from both the community and the regulatory agencies (EPA and ADEC) to be considered during the selection process of the appropriate remedies for the site. The selected remedy will then be presented in a ROD for the site.

1.0 INTRODUCTION

This feasibility study (FS) is the evaluation of remedial alternatives for the source area SS109 F-22 Weapons Release Shop located on Joint Base Elmendorf-Richardson (JBER), Alaska. This FS is part of a continuing effort by the U.S. Air Force (USAF) to address contamination at SS109. This FS was developed by Eagle Eye Electric, a subsidiary of Bering Straits Native Corporation, and Jacobs Engineering Group Inc. (Jacobs) for the Air Force Civil Engineer Center under the U.S. Army Corps of Engineers (USACE), Alaska District, Contract No. W911KB-15-C-0028.

Elmendorf Air Force Base (AFB) was proposed for placement on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List of contaminated sites in need of cleanup on 14 July 1989, and was listed on 30 August 1990. The Federal Facility Agreement (FFA) for Elmendorf AFB ensures that the environmental impacts at the site are thoroughly investigated and that appropriate removal and/or remedial actions are taken to protect human health and welfare as well as the environment (USAF 1991). Per the National Priorities List and the FFA, environmental assessment and remediation activities at JBER-Elmendorf are performed in compliance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 and subsequent amendments.

1.1 PURPOSE

The purpose of this FS is to develop and evaluate remedial alternatives to address contamination identified at SS109 in a manner that is both protective of human health and the environment (HHE) and in compliance with CERCLA, as outlined in the *National Oil and Hazardous Substances Pollution Contingency Plan* [Code of Federal Regulations (CFR) Title 40, Part 300.430(e)]. This FS was developed in accordance with *Guidance for Conducting Remedial Investigations* (RIs) *and Feasibility Studies Under CERCLA* (U.S. Environmental Protection Agency [EPA] 1988).

This FS provides information to support risk management decisions and the future selection of the most appropriate remedial alternative. The final selection and documentation of the selected remedy for SS109 will be presented in the Record of Decision (ROD).

1.2 FEASIBILITY STUDY ORGANIZATION

The content and format of this FS are structured according to EPA guidelines (EPA 1988). This document is organized into the following sections and appendices:

- **Section 1: Introduction.** Provides a summary of the FS process and the organization of this report.
- **Section 2: Background Information.** Provides historical background information for SS109, previous investigation results and removal actions, the nature and extent of contaminated media, and the potential risks to HHE.
- **Section 3: Contaminants of Concern (COCs) and Remedial Action Objectives (RAOs).** Presents the identified COCs, applicable or relevant and appropriate requirements (ARARs), project cleanup levels (PCLs), and RAOs.
- **Section 4: Identification of Remedial Technologies and Evaluation of Process Options.** Identifies the general response actions (GRAs), relevant remedial technologies, and process options and evaluates these based on effectiveness, implementability, and cost.
- **Section 5: Development and Screening of Remedial Alternatives.** Develops remedial alternatives by combining specific remedial technologies and process options to accomplish the RAOs. Assembled alternatives are initially screened based on effectiveness, implementability, and cost.
- **Section 6: Detailed Individual Analysis of Remedial Alternatives.** Provides a detailed analysis of each remedial alternative based on the seven CERCLA threshold and balancing evaluation criteria: overall protectiveness of HHE; compliance with ARARs; long-term effectiveness and permanence; reduction in toxicity, mobility, and volume (TMV) through treatment; short-term effectiveness; implementability; and cost. Compliance with the modifying criteria – community acceptance and state acceptance – will be determined following both the issuance of the final FS and a public comment period on the Proposed Plan.
- **Section 7: Comparative Analysis of Remedial Alternatives.** Provides a comparison of the relative performance of each alternative evaluated against the performance of the other alternatives for each of the nine CERCLA criteria described above. The comparative analysis identifies advantages and disadvantages of each alternative in order to assist in future decision making. It also points out the similarities and differences among alternatives.
- **Section 8: Recommendations.** Provides remedial alternative recommendations for contaminated media at SS109.
- **Section 9: References.** Lists the documents used to develop this FS.

- **Appendix A: Figures.** Presents figures relevant to this FS.
- **Appendix B: Analysis of Potential ARARs.** Presents a list of regulations applicable or relevant and appropriate to SS109 and the rationale for their consideration.
- **Appendix C: Cost Estimates for Alternatives.** Describes the assumptions used and calculations for the cost estimates.
- **Appendix D:** Responses to Comments. Documents regulatory comments received on the draft version of this FS and responses incorporated into the final document.

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2.0 BACKGROUND INFORMATION

This section provides a description and a brief history of SS109, including a summary of previous soil, groundwater, and air investigations and removal actions. The nature, extent, fate, and transport of contamination at SS109 are described and the completed human health risk assessment (HHRA) is summarized. A detailed background description of JBER, including regional geology, climate, and general hydrogeology is provided in the SS109 RI Report (USAF 2018b). Relevant soil and groundwater sampling locations are depicted on Figures A-4a and A-4b, respectively.

2.1 SITE DESCRIPTION

JBER-Elmendorf, formerly Elmendorf AFB, is located in Southcentral Alaska within the Municipality of Anchorage (Figure A-1) and to the west of Chugach State Park. JBER-Elmendorf encompasses 13,130 acres of land.

The F-22 Weapons Release Shop is located on the west side of Talley Avenue on JBER, globally positioned at coordinates 61° 15' 40.3266" N, 149° 46' 40.8684" W (Figure A-1). The F-22 Weapons Release Shop, or SS109, refers to Hangar 15 (Building 16716) and three connected buildings: Building 16718, Building 17720, and a building expansion, Building 17722, which was completed in 2011. Bordering the site on the north and west are runways and taxiways with associated cleared areas. On the south side are multiple buildings and paved areas. There is a partially cleared forest and gravel pit to the east. The area includes active hangars and associated buildings and infrastructure, runways, taxiways, and parking lots. The site is located in an industrial area designated as “Airfield Use Area” for aircraft operations and maintenance (O&M). The site area is located within Operable Unit (OU) 4, northeast of Hangar 15 (Building 16716). There are no nearby residential structures and groundwater use is restricted throughout JBER-Elmendorf.

SD029 is an adjacent site located southwest of Hangar 15 (Building 16716) that includes a previously delineated trichloroethylene (TCE) and tetrachloroethylene (PCE) plume. This solvent contamination at Hangar 15 is linked to its use for aircraft maintenance. SS109 RI results indicate no connectivity between this area and SD029, including nondetect TCE groundwater results for SB04 west of Hangar 15 and multiple temporary and monitoring well locations to the east (Figure A-4b).

CG519 (Building 16716 underground storage tank [STMP 445]) is another adjacent site that is located to the east of Hangar 15 (Building 16716) that was previously closed but is being reopened in light of new fuel-related results discovered as part of the SS109 RI work (Figures A-4a and A-4b).

2.1.1 Geology and Hydrology

In the area of Elmendorf AFB the Bootlegger Cove Formation extends as a continuous, clay-dominated unit beneath the Elmendorf Moraine, locally inter-fingering with ground moraines related to the Elmendorf Moraine toward the north (USAF 2018a). Late-Quaternary outwash deposits overlying the formation include fine-grained silt and clay, fine- to medium-grained sand, and thin diamicton beds (Hunter et al. 2000). The formation acts as a confining layer between the deep aquifer and a shallower aquifer in the surrounding area and influences groundwater flow.

Environmental investigations at SS109 have been conducted within the shallow aquifer to approximately 60 feet below ground surface (bgs). Based on nearby site data from Source Area SS022, located 1 mile south of SS109, the upper contact of the Bootlegger Cove Formation in this area could be expected at a depth of 100 to 105 feet bgs (USAF 2013).

Data collected from 2010 to 2016 indicate that groundwater at SS109 was encountered between 50 and 58 feet bgs. Previous records of groundwater depth at the site suggest a slight gradient to the southwest from the Chugach Mountains toward Knik Arm. Updated 2016 contours presented on Figure A-4b suggest a more northwesterly groundwater flow; however, a limited data set was used to generate these contours. Recharge for the confined aquifer system originates from the upper Ship Creek basin that flows from the Chugach Mountains into Knik Arm.

2.1.2 Land Use Controls

Soil and groundwater contamination were found at SS109 during previous investigations, which are described in Section 2.2. Although the exposure pathway for groundwater ingestion is technically complete, groundwater use at this site, for any reason, is prohibited, although the aquifer is considered a potential drinking water source. JBER administratively controls groundwater use through 673d Air Base Wing Instruction 32-7003 (30 June 2011).

Land use controls (LUCs), including restrictions on land use, excavation, and groundwater as well as annual groundwater monitoring are in place at adjacent source area SD029 as stipulated in the 1995 ROD (USAF 1995). The current groundwater sampling program at SD029 includes annual sampling for PCE and TCE at monitoring well IS6-01 with a cleanup goal of 5 micrograms per liter (µg/L). for both contaminants. Groundwater at SD029 was anticipated to reach cleanup goals through natural attenuation in 2009. However, TCE still remained above cleanup goals at IS6-01 in 2017 at a concentration of 7.29 micrograms per liter and groundwater conditions were aerobic (USAF 2018c). Groundwater exceedances for TCE from SS109 RI were located within the SD029 plume (USAF 2018b).

2.2 SITE HISTORY

Investigations have been ongoing at SS109 since contamination was first identified in 1993 during an RI for OU4 (USAF 1994). Prior site names include the USACE construction project ID ELM300 (10-012). In 2018, the USAF issued the *SS109 F-22 Weapons Release Shop RI Report* (USAF 2018b), which provided a comprehensive characterization of SS109 site conditions, the nature and extent of contamination, and a quantitative estimate of the risk to human health.

2.2.1 1993 RI/FS Report

In 1993, soil gas samples were collected from the north and south sides of the area surrounding Hangar 15 (Building 16716) as well as across Talley Avenue to the east in order to identify hot spots of contamination for further investigation (USAF 1994). Volatile contaminant concentrations were measured with a field gas chromatographer. Concentrations of volatiles exceeded the project threshold of 100 parts per billion south of Hangar 15. Groundwater screening in this area suggested the presence of a halogenated volatile organic compounds (VOCs) plume, described as the OU4 East SD029 TCE plume extent on Figure A-4b. This plume was at the time attributed to a dry well or a leach field located east of the building. Farther south, a benzene, toluene, ethylbenzene, and xylenes plume at Building 43-410 (now Building 16710) was attributed to a leak in one of the petroleum, oil, and lubricants (POL) valve pits or pipelines located southeast of Hangar 15, which would later be designated as Source Area SD029.

Two soil borings (SB-44 and SB-48) were advanced to 50 feet bgs north and northeast of Hangar 15, respectively, and analyzed for petroleum hydrocarbons, VOCs, semivolatile organic compounds, and metals. Chromium was prevalent and reached a maximum detection of 39.6 milligrams per kilogram (mg/kg) in SB-44; in 2010, the presence of the more harmful hexavalent chromium was later ruled out through speciation analysis of chromium, therefore all chromium exceedances at SS109 are attributed to naturally occurring concentrations. Groundwater well IS6-01 was sampled in June, July, and August 1993. IS6-01 contained PCE at 19.5 µg/L and TCE at 21.4 µg/L in June, with slightly lower sample concentrations in July (17.2 and 16.5 µg/L, respectively).

2.2.2 2010 Foundation Study Hazardous, Toxic, and Radioactive Waste Survey

In 2010, three soil sampling events were conducted at SS109 (USAF 2011). Geotechnical and chemical samples were collected mostly to the west of Building 17720. The area was described as "a grassy area and loading dock for Building 17720" and within the future construction footprint (USACE 2010). Forty-seven soil samples were collected from the borings and analyzed for VOCs (all samples); some of the samples were also analyzed for gasoline-range organics (GRO) (27 samples), diesel-range organics (DRO) and residual-range organics (RRO) (35 samples), polycyclic aromatic hydrocarbons (PAHs) (eight samples), Resource Conservation and Recovery Act (RCRA) metals (eight samples), polychlorinated biphenyls

(PCB) (eight samples), chlorinated pesticides (eight samples), and hexavalent chromium (eight samples). The three events are described as follows:

- In February, seven borings (AP-4723 through AP-4729) were advanced to collect geotechnical and chemical samples. Soil samples were generally collected near the surface, at 2.5 and 5 feet bgs, and at 5-foot intervals thereafter; maximum depths reached ranged from 30 to 32 feet.
- In July, eight additional borings (TB-1 through TB-8) were advanced up to 19 feet and sampled. All PID readings were below 20 parts per million and no visual evidence of chemical contamination was observed. Samples were collected from each boring and analyzed for GRO, DRO, RRO, and VOCs. Samples were not analyzed for PAHs since only benzo(a)pyrene was detected above its Alaska Department of Environmental Conservation (ADEC) cleanup level during the February 2010 sampling event.
- Because the vertical extent of PCE and TCE contamination was not defined, a third sampling effort was conducted in September. There were attempts to sample three of the previous borings advanced in July (TB-3, TB-6, and TB-7) at greater depths; however, refusal was encountered at 21.5 feet, 31.5 feet, and 47 feet, respectively. Groundwater was not encountered in the borings and no visual evidence of chemical contamination was observed. Samples were collected from 19 feet to 45 feet bgs and analyzed for VOCs. Three soil samples were collected from TB-3, one soil sample was collected from TB-6, and six soil samples were collected from TB-7.

Concentrations of DRO, RRO, TCE, PAHs, PCBs (one sample, Aroclor 1260 at 0.89 mg/kg), and arsenic exceeded the RI project screening levels (PSLs). Some of these locations were excavated in 2011 during a pre-construction removal effort that included 180 cubic yards (cy) of DRO-contaminated soil and 2,200 cy of PCE- and TCE-contaminated soil (USAF 2011). All arsenic concentrations identified at SS109 are consistent with naturally occurring levels and arsenic is not considered a COC.

Note that none of the concentrations of PCE that were reported as ADEC cleanup level exceedances in 2010 exceed the RI PSL, although several sample concentrations remaining on site exceed the current ADEC migration to groundwater cleanup level (ADEC 2018b) for PCE with a maximum detected concentration of 0.4 mg/kg at AP-4726 (this location also exceeds the RI PSL for DRO at the 4.5 to 6 feet bgs interval; it was only excavated to 3 feet bgs). The presence of PAHs in the top 4 feet of material may be attributed to the construction-driven migration of asphalt from the asphalt covered surfaces that surround the sample collection area.

2.2.3 2010 Fieldwork Summary Technical Memorandum

In November and December 2010; soil, groundwater, and soil gas samples were collected to characterize the nature and extent of environmental contamination and support the completion of an engineering evaluation/cost analysis (EE/CA) (USACE 2011b). Twenty soil borings were advanced in and around the Building 17720 expansion area at varying depths based on prior results and field screening values. A surface sample and five subsurface samples were collected from each borehole within the proposed building footprint; a surface sample and three subsurface samples were collected at boreholes outside the proposed building footprint. Soil was analyzed for POL, VOCs, PAHs, metals, PCBs, and pesticides.

- In surface soil, concentrations of DRO, RRO, PAHs, and arsenic were detected in concentrations that exceed the RI PSLs. The maximum result for arsenic, which is likely naturally occurring, was 28.5 mg/kg from 2010 surface sample location SS08. Concentrations of DRO, RRO and PAHs were likely the result of asphalt mixed in with the soil, which was excavated and treated during the removal of PCE- and TCE-contaminated soil in 2011.
- In subsurface soil, TCE, PAHs, arsenic, chromium, and mercury were identified above RI PSLs:
  - Concentrations of TCE exceed the RI PSL in four locations: SB13 (13 feet bgs), SB14 (14, 22, and 37 feet bgs), SB16 (12 feet bgs, duplicate sample only), and SB18 (14 feet bgs). The highest TCE result was 0.743 mg/kg at SB14 (22 feet bgs). Of the 20 borings sampled, 10 of them exceeded the migration to groundwater cleanup level for TCE.
  - PAHs are either fuel-related or the result of buried asphalt and asphalt paving material depending on location. Fuel contamination will be addressed as part of CG519.
  - Concentrations of arsenic and chromium are consistent with naturally occurring levels. Mercury reached a maximum concentration of 2.65 mg/kg in a sample from 32 feet bgs, which exceeds applicable criteria, as well as the background level for deep soil. As per the RI, mercury only occurs in one sample; no potential source of mercury has been identified.

Also in November and December 2010, temporary wells were installed and groundwater samples were collected at the following select locations:

- SB03, SB08Z, SB11, SB12, and SB18 within the proposed building footprint.
- SB01, SB02, SB14, SB15, and SB16 outside the proposed building footprint.

Groundwater grab samples were collected at each well and analyzed for GRO, DRO, and VOCs; PAHs and RCRA metals were analyzed at all wells except SB15. Concentrations of DRO exceed the RI PSL in samples collected from six of the ten wells. Concentrations of PAHs exceed the RI PSLs in samples collected in five locations. Arsenic, chromium, and lead were identified above RI PSLs and ADEC cleanup levels in all nine samples for which metals were analyzed. Barium and cadmium were collocated with arsenic, chromium, and lead in five of those locations and selenium exceeded the RI PSL at SB16. Although groundwater samples were collected in accordance with the bailer procedure approved in the *Fort Richardson Post Wide Work Plan* (USACE 2010), the method resulted in highly turbid samples causing the metals concentrations in groundwater to be biased high.

Three soil gas probes were placed within the excavation footprint and samples were collected at 4 and 15 feet bgs; all of the soil gas samples were analyzed for VOCs by EPA Method TO-15. In January 2011, six ambient air samples were collected from inside the F-22 Weapons Release Shop and one outdoor air sample was collected (USACE 2011a). The six ambient air samples were regularly spaced and collected from the breathing zone approximately 4 feet above the slab surface. Results are reported with the follow-on indoor and outdoor air samples collected as part of the EE/CA.

2.2.4 2011 EE/CA

The 2011 EE/CA (USACE 2011b) contains the complete analytical results for the 2010 sampling effort and provides an evaluation of six remedial alternatives for the site. The EE/CA concluded that DRO, PCE, and TCE in soil and DRO in groundwater posed an unacceptable risk.

Contamination identified during the EE/CA investigation as well as previous investigations indicated that approximately 250 cy of DRO-contaminated soil and 13,000 cy of PCE- and TCE-contaminated soil were present near the F-22 Weapons Release Shop. The EE/CA supported selection of Alternative 6, minimal excavation with in situ treatment of PCE- and TCE-contaminated soil, to mitigate direct contact exposure risks to construction workers and future site personnel. The treatment technology proposed under this remedy was soil vapor extraction (SVE). A vapor barrier was planned for installation beneath the building foundation.

2.2.5 2013 SVE System After-Action Report

To implement the remedy selected in the EE/CA, DRO-, PCE-, and TCE-contaminated soil was excavated from the F-22 Weapons Release Shop Area for treatment in a ventilated stockpile (VSP) and an SVE system was installed to treat the soil that remained in situ from August 2011 to August 2013 (USAF 2014). Not all subsurface exceedance locations were removed; where shallower than 10 feet, prior results were used in HHRA calculations.

- The SVE system was comprised of nine vacuum wells that were used to enhance volatilization to the atmosphere and three vapor monitoring point clusters that were used to monitor PCE and TCE concentrations and optimize the treatment process. Four wells were placed beneath the proposed building footprint; five wells were placed in nearby areas with known contamination. Following construction of the SVE system, the excavated areas were backfilled with clean material. These soil gas points can be seen on Figure A-2.
- The VSP comprises 2,200 cubic yards (cy) of PCE- and TCE-contaminated soil that was excavated from the Building 17720 expansion area (Figure A-3). The VSP is located within a lined and fenced area at the OU1 landfill about 1 mile west of SS109 (USAF 2012). The area is sloped for drainage into a 10-inch-diameter sump and surrounded by a 24-inch berm. Slotted PVC piping on 12-foot centers were placed across the bottom of the VSP and connected to a 1.5-horsepower vacuum blower housed within a small nearby structure. The completed height of soil at construction was 8 feet above the prepared base, and nine perforated, 4-inch-diameter pipes were placed across the top of the pile to capture volatiles followed by a top cover to contain them and prevent moisture infiltration.

Beneath the proposed building footprint, soil gas concentrations at VW1, VW2, VW3, and VW4 were reduced to acceptable levels (upon re-screening data to RI PSLs, VW4 exceeded for TCE). In several outlying areas (wells VW7, VW8, and VW9), soil gas concentrations were expected to rebound and were all above RI PSLs upon re-screening for TCE (as was VW6). Outlying vacuum well VW5 did not and does not exceed criteria. Figure A-2 depicts the final round of air sampling prior to SVE system decommissioning as well as 2016 soil gas results.

The VSP fell short of meeting its original objectives. While concentrations initially declined rapidly, post-operation soil samples exceeded the project action level (ADEC migration to groundwater cleanup level [0.02 mg/kg, from 2009]) in six of the seven confirmation samples with a maximum detection of 0.22 mg/kg TCE. Only one of the post-treatment samples contained PCE, at 0.042 J mg/kg, which exceeded the project action level (ADEC migration to groundwater cleanup level [0.024 mg/kg, from 2009]). Current results are discussed in Section 2.4.1.

2.2.6 2016 RI and HHRA

In 2016, soil, groundwater, and soil gas samples were collected at SS109 to further characterize the nature and extent of environmental contamination and support the completion of an HHRA (USAF 2018b). Investigation and data collection procedures are outlined in the SS109 RI/FS Work Plan (USAF 2016).

Twenty-three soil borings were advanced to depths between 57 and 62 feet bgs. A soil sample was collected every 5 feet, as practicable, from each boring and well location. Soil was field screened with a PID to document the potential presence of volatile contaminants in each soil boring interval. A total of 268 primary soil samples were collected and analyzed for GRO, DRO and VOCs (mid- and low-level). Six of the 23 soil borings were completed as groundwater monitoring wells. In the 17 boreholes where groundwater monitoring wells were not installed, groundwater grab samples were collected. A total of 23 groundwater samples were analyzed for DRO, GRO, and VOCs (including a low-level analysis for 1,4-dioxane). Five near-slab permanent soil gas probes were installed in the vicinity of the F-22 Weapons Release Shop (Building 16718) and Hangar 15 (Building 16716) above the SS109 plume.

In 2016, soil samples exceeded the ADEC (most stringent) migration to groundwater cleanup levels for DRO, TCE, and naphthalene as outlined below:

- DRO was present above the cleanup level of 250 mg/kg in SB10 (55 feet), SB12 (55 feet), SB15 (50 feet), MW02 (5 feet), and MW05 (55 feet). Results ranged from 330 mg/kg in the shallow subsurface at MW02 to 1,600 mg/kg in the smear zone at SB12.
- TCE exceeded the migration to groundwater cleanup level of 0.011 mg/kg in multiple soil boring locations at various depths ranging from 5 to 55 feet bgs. These soil boring locations include SB02, SB03, SB05, SB06, SB07, SB13, MW01, MW02, and MW03. Results ranged from 0.027 mg/kg at SB07 (50 feet, smear zone) to 0.47 mg/kg at MW02 (30 feet).
- Naphthalene was identified in SB10 (55 feet), SB12 (55 feet), and SB15 (25, 40, and 55 feet) above its migration to groundwater cleanup level of 0.038 mg/kg. These exceedances

were collocated with DRO at SB10 and SB12; DRO occurred in only one interval at SB15 (50 feet).

Groundwater monitoring well and groundwater grab samples in 2016 contained DRO, PCE, TCE, 1,1,2,2-tetrachloroethane (1,1,2,2-PCA), chloroform, and naphthalene above RI PSLs. DRO, 1,1,2,2-PCA, and naphthalene exceeded in only one well (MW05). PCE exceeded in two locations, MW01 at 10 µg/L and nearby SB03 at 11 µg/L. MW01 also contained the maximum detected result for TCE but this monitoring well is located within the SD029 plume, which is separate from the solvent plume associated with SS109. Several sample locations to the south of SS109 show a separation between SS109 and SD029 including SB04, SB08, SB10, SB11, SB12, SB14, SB16, and MW06 (Figure A-4b).

MW02 and MW03 to the northwest of Hangar 15 also exceeded the RI PSL for TCE. TCE was detected in soil from 10 to 55 feet at MW02 but occurred in only the surface and smear zone intervals at MW03. Groundwater samples exceeded the ADEC Table C cleanup level for TCE (MW01) and 1,1,2,2-PCA (MW05). TCE was also identified in a groundwater grab sample collected at SB03, which was also located within the SD029 plume. Other contaminants identified above Table C cleanup levels in grab samples include DRO (SB10 and SB12) and naphthalene (SB10, SB12, and SB15). These locations are suspected to be located within the groundwater plume associated with CG519.

2.2.7 2018 Ventilated Stockpile SVE System Summary Report

Because enhanced volatilization took place more slowly than expected in the initial two years of treatment, the remedy was continued in 2017 and 2018 (USAF 2018d) with the addition of monthly soil tilling using an excavator just above the SVE piping while the system was in operation (May to September). In the most recent sampling event, September 2018, PCE was reported as nondetect (ND) in all seven samples, and TCE exceeded the current ADEC migration to groundwater cleanup level (0.011 mg/kg) (ADEC 2018b) in all seven samples ranging from 0.0143 mg/kg to 0.0194 mg/kg. These concentrations are all below the original project action level of 0.02 mg/kg, the EPA Regional Screening Level (RSL) (TR = 1×10^{-6}, HQ = 0.1) of 0.412 mg/kg, and the ADEC human health cleanup level of 4.9 mg/kg. Soil gas concentrations had fallen below ADEC vapor intrusion (VI) guidance criteria in 2017; TCE/PCE analyses were not repeated for soil gas in 2018.

2.3 HHRA SUMMARY

An HHRA was completed in 2018 as part of the SS109 RI and HHRA report (USAF 2018b). The HHRA evaluated the current and potential future conditions at the site to quantify potential risk from any identified site contamination. The HHRA evaluation included the location and amount of contamination present, toxicity of each contaminant, current and potential use of SS109, and the potential pathways of human exposure. The evaluation results were used to determine RAOs and support the selection of remedial technologies.

An ecological risk assessment was not completed for SS109 due to the current and anticipated future industrial nature of the site and the absence of ecological receptors in the vicinity of the airfield. The lack of ecological receptors and associated habitat at the site was determined using the ADEC *Ecoscoping Guidance* (ADEC 2014). The completed ADEC Ecoscoping form is located in Appendix A of the SS109 RI and HHRA report (USAF 2018b). Both EPA and ADEC reviewed the ADEC ecoscoping form at the RI phase and agreed that no ecological risk assessment is warranted for SS109.

2.3.1 Exposure Scenarios

The exposure scenarios considered in the HHRA, based on the human health conceptual site model (Appendix A of the RI/RA Report [USAF 2018]), included the following site receptors and exposure pathways:

- **Current/Future Site Employee.** The site employee may be military or civilian personnel who work in buildings located within or near the site. The site employee spends a majority of the workday within the buildings but visits outdoor areas during limited times of the day. The site employee is potentially exposed to surface soil via ingestion, dermal contact, and inhalation of soil particulates/VOCs in ambient air. This receptor may also be exposed to contaminants in subsurface soil and groundwater via inhalation of VOCs in indoor or outdoor air. This receptor is assumed to be exposed to groundwater as a drinking water source via ingestion. Potential exposure to groundwater contamination via dermal contact (e.g., washing hands) and inhalation of volatiles (e.g., from cooking or showering) for office workers is considered to be negligible and was not evaluated.

- **Current/Future Industrial/Commercial Worker.** The industrial/commercial worker conducts typical base operational activities in an outdoor setting and is exposed to surface soil and subsurface soil via incidental ingestion, dermal contact, and inhalation of soil particulates/VOCs in ambient air. This receptor is assumed to use groundwater as a drinking water source where it is available for commercial or industrial purposes and could be exposed via ingestion. Potential exposure to groundwater contamination via dermal contact (e.g., washing hands) and inhalation of volatiles (e.g., from cooking or showering) for outdoor workers is considered negligible and was not evaluated.
- **Current/Future Construction Worker.** The construction worker may be involved in activities that include installation/maintenance of subsurface utilities and structures, excavation of building foundations, etc. Exposure may be to surface and subsurface soil via ingestion, dermal contact, and inhalation of soil particulates/VOCs in ambient air. This receptor may also be exposed to contaminants in subsurface soil via inhalation of VOCs in outdoor air. Due to the depth of groundwater, this receptor is not likely to be exposed to groundwater via dermal contact during excavation activities. Construction workers are not expected to use groundwater as a future drinking water source because they are short-term workers and not regular employees at the site.
- **Current/Future Site Visitor.** The site visitor may be military or civilian personnel. On- and off-base personnel may participate in indoor and/or outdoor activities across portions of the site. This receptor may be exposed to surface soil via incidental ingestion, dermal contact, and inhalation of soil particulates/VOCs in ambient air. This receptor (adult or child) may also be exposed to contaminants in subsurface soil and groundwater via inhalation of VOCs in indoor or outdoor air through VI into a building or volatilization into outdoor air. Due to the depth of groundwater, this receptor is not likely to be exposed to groundwater via dermal contact or to use groundwater as a future drinking water source because they are short-term site visitors.
- **Future Resident.** Military residents are present at JBER but there are no residential areas proximal to the F-22 Weapons Release Shop. Based on the proximity of the F-22 Weapons Release Shop to the airfield, future development could potentially occur, but would not be residential. ADEC and EPA guidance require the evaluation of residential receptors for all sites. The residential receptor serves as a baseline receptor for risk management decisions. For this reason, a resident scenario is included in the conceptual site model. This receptor (adult or child) may be exposed to the combined surface and subsurface soil (assuming future excavation and mixing of soil for construction of a dwelling) via incidental ingestion, dermal contact, and inhalation of soil particulates/VOCs. This receptor may also be exposed to contaminants in subsurface soil and groundwater via inhalation of VOCs in indoor or outdoor air. This receptor could be exposed to groundwater contaminants in drinking water via ingestion, dermal exposure, or inhalation of volatiles.

2.3.2 Health Hazards and Risks

The non-carcinogenic hazard risk of exposure to contaminants at SS109 was reported as a hazard index (HI), which is the ratio between the estimated intake of a chemical and the level at which no adverse health effects are expected to occur. An HI value greater than one indicates the potential for adverse noncancerous health effects associated with the evaluated exposure to the chemical(s). The carcinogenic health risk of exposure to contaminants at SS109 was reported as an incremental lifetime cancer risk (ILCR) value. ILCR is the added probability of developing cancer over a lifetime given exposure to contaminants. EPA and ADEC consider 1×10^{-6} to 1×10^{-4} and 1×10^{-6} to 1×10^{-5}, respectively, to be acceptable cancer risk ranges.

Contaminants of potential concern (COPCs) that were input into the HHRA are those chemicals which were identified as potentially capable of contributing significantly to human health risk. COPCs are those contaminants reported above RI PSLs that can potentially be attributed to site-related activities rather than naturally occurring conditions. The maximum detected concentration of each detected analyte per medium was screened against RI PSLs and used in risk calculations. Residual concentrations from the VSP were not included in the HHRA, as the soil treatment occurs offsite and is, therefore, not representative of current site conditions.

Compounds that are considered COCs in the HHRA are those that contribute significantly to an ILCR exceeding ADEC's risk goal of 1×10^{-5} or an HI exceeding 1. For this discussion, an individual chemical is considered to contribute significantly to the cancer risk estimate if its ILCR summed across all exposure routes exceeds EPA's most conservative risk goal of 1×10^{-6}. Similarly, an individual chemical is considered to contribute significantly to the noncancer hazard if its hazard quotient summed across all exposure routes exceeds 0.1.

Risk calculations using the VISL Calculator (ILCR = 1×10^{-6}, HQ = 0.1, @ 5 degrees Celsius [°C]), residential scenario, found unacceptable risk from TCE for the Groundwater to Indoor Air and the Soil Gas to Indoor air pathways. Although EDB contributed significantly to cancer risk for the Soil Gas to Indoor Air pathway, this analyte was not identified in groundwater and should have been qualified B based on an associated method blank detection within 5 times the reported concentration, indicating the presence of laboratory contamination.

In soil gas, only TCE exceeded acceptable thresholds on an individual basis. The ILCR for TCE in soil gas was 1.9×10^{-5}, and the HQ = 4.3. TCE also exceeded or met acceptable thresholds under a commercial scenario with risk values of 3×10^{-6} and 1, respectively.

Individually, none of the groundwater risk values exceeded the ADEC threshold for cancer risk. Although TCE exceeded the acceptable hazard quotient of 1, this value corresponds to a separate groundwater plume from adjacent site SD029. Table 2-1 presents the COPCs, initial COCs, and retained COCs for each medium at SS109. For further detail, refer to the SS109 HHRA (Appendix G of USAF 2018b).

Table 2-1
Contaminants of Concern

Medium	Preliminary Screening for COPCs[1]	Initial COCs based on Quantitative Analysis[2]	COCs Retained for Consideration in the FS
Surface Soil	Arsenic Benzo(a)pyrene Chromium DRO RRO	Arsenic	Arsenic is naturally occurring and therefore not considered a COC. PCE and TCE exceed ADEC migration to groundwater cleanup levels at the offsite VSP. Because this soil originated at SS109, the potential for continued soil treatment is being evaluated in this FS.
Subsurface Soil	Arsenic Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Chromium Chrysene Dibenzo(a,h)anthracene DRO Indeno(1,2,3-cd)pyrene RRO TCE	Arsenic Benzo(a)pyrene	None – arsenic is naturally occurring and benzo(a)pyrene is likely due to the presence of asphalt, not a contaminant release.
Combined Soil	Arsenic Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Chromium Chrysene Dibenzo(a,h)anthracene DRO Indeno(1,2,3-cd)pyrene RRO TCE	Arsenic Benzo(a)pyrene Benzo(b)fluoranthene Dibenzo(a,h)anthracene RRO	None – arsenic is naturally occurring and RRO and PAHs (not collocated with fuel) are likely due to the presence of asphalt, not a contaminant release.
Groundwater	1,1,2,2-PCA 2-Hexanone Benzene Chloroform DRO Naphthalene PCE TCE	1,1,2,2-PCA 2-Hexanone DRO Naphthalene PCE RRO TCE	None – fuels will be addressed as a separate source area, CG519, under State of Alaska regulations, and elevated VOCs driving risk are from nearby SD029 plume, not SS109.
Soil Gas[3]	1,2,4-TMB 1,2,4-Trichlorobenzene Chloroform EDB Naphthalene PCE TCE	EDB TCE	TCE only – EDB has been omitted because the concentration used as the exposure point concentration, the maximum detection, has been attributed to laboratory contamination

Notes:

[1] The maximum detected concentration of each detected analyte per medium was screened against RI PSLs.

[2] The quantitative portion of the HHRA showed potentially unacceptable cumulative risk levels for the industrial/commercial worker and the adult/child resident. For petroleum compounds, potentially unacceptable cumulative risk was attributed to the site employee and adult/child resident. These COCs contribute significantly to potentially unacceptable cumulative risk.

[3] EDB was detected in the laboratory method blank above the LOD, and the result is within 5 times the method blank detection.

For definitions, refer to the Acronyms and Abbreviations section.

2.4 NATURE AND EXTENT OF CONTAMINATION

The investigations discussed in Section 2.2 provide the basis for determining the nature and extent of contamination at SS109. This section describes the potential sources of contamination and summarizes the known soil, groundwater, and soil gas contamination at SS109, based on prior investigations.

2.4.1 Sources of Contamination

Operations at the F-22 Weapons Release Shop and Hangar 15 (Building 16716) are likely contributors to surface soil, subsurface soil, and groundwater contamination. Those contaminants contributing to unacceptable risk following quantitative analysis (individual risk of 1×10^{-6} and/or a hazard quotient of 0.1) include RRO, arsenic, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene in combined surface and subsurface soil; DRO, RRO, 1,1,2,2-PCA, 2-hexanone, naphthalene, PCE, and TCE in groundwater; and 1,2-dibromomethane (EDB) and TCE in soil gas. Analytes with unacceptable risk that were initially included as COCs based on quantitative analysis for soil and groundwater will not be carried forward as COCs in this FS, as described below. EDB in soil gas has not been retained as a COC because EDB was detected in the associated method blanks and was not detected in either soil or groundwater. The concentration was above the limit of detection (LOD) but below the limit of quantitation, and the results were within 5 times the blank concentration (0.093 micrograms per cubic meter [$\mu g/m^3$]), indicating laboratory contamination. The sample result was not qualified B even though, based on RI Management Plan criteria, it should have been. Table 2-2 is presented to correct the oversight.

Table 2-2
Results not Initially Qualified B due to RI Evaluation Error

Analyte	SDG	Sample ID	Lab Sample ID	Method	Result ($\mu g/m^3$)	DL ($\mu g/m^3$)	LOD ($\mu g/m^3$)	Qualifier
EDB	1607407	Method Blank	1607407-03B	TO-15 SIM	0.093	0.0086	0.046	J
EDB	1607407	16-WRS-SG04	1607407-01B	TO-15 SIM	0.16	0.014	0.076	J, B

Note:
For definitions and data qualifiers, refer to the Acronyms and Abbreviations section.

Fuels

An underground storage tank containing diesel, formerly located south of the Water Pump Station, is a potential source of DRO contamination but does not correspond to DRO exceedance locations. A more likely source area for DRO detected in 2016 is the heating oil underground storage tank formerly present on the east side of Building 16716. Leaks in fuel pipes and/or from vehicles both stationary (leaks) and during refueling operations (spills) are possible. Petroleum hydrocarbons in soil only exceed the ADEC migration to groundwater cleanup level and did not exceed either the ingestion or inhalation cleanup levels. DRO in groundwater exceeded the human health cleanup level at locations SB10, SB12 and SB15. The contamination at these locations is attributed to and will be managed as Source Area CG519 and, therefore, will not be examined as part of the SS109 FS. Source Area CG519 had been previous closed in 2012 after groundwater sampling did not identify DRO above unacceptable levels in two monitoring wells. ADEC reopened Source Area CG519 based on the groundwater sample results from the SS109 RI, which better defined the groundwater flow direction in this area.

VOCs

No PCE or TCE releases have been documented at SS109. Floor drains and a former dry well are likely transport mechanisms for subsurface soil and groundwater solvent contamination into the environment, including TCE contamination at depths greater than 20 feet bgs. TCE was detected in groundwater above the ADEC Table C cleanup level of 2.8 µg/L during the 2016 investigation at two locations, MW01 and SB03. However, these locations are within the TCE plume associated with Source Area SD029 (located to the south-southeast of the SS109 plume). The SD029 TCE plume and a separate area of TCE detections in groundwater attributed to SS109 both pass beneath Hangar 15 (Building 16716); therefore, all results were included in the HHRA. The highest concentration of TCE detected in groundwater that is attributed to SS109 is 1.5 µg/L, which is above the RI PSL of 0.26 µg/L but below the ADEC Table C cleanup level (ADEC 2018b) of 2.8 µg/L. When the results from within the SD029 plume are excluded, calculated risk of TCE in groundwater is below 1×10^{-5}. Similarly, PCE was only found above RI PSLs in the samples collected within the SD029 plume and a single much lower exceedance at SB04. PCE and TCE are not retained as COCs for groundwater in this FS because groundwater contamination (greater than the ADEC Table C cleanup level) is the result of the adjacent Source Area SD029.

TCE exceeds the RI PSL and ADEC migration to groundwater cleanup level (ADEC 2018b) in surface and subsurface soil but not the ADEC human health cleanup level. TCE remains on site above RI PSLs in historical soil boring locations AP-4725 (4.5 feet), TB-7 (19.5 feet), SB13 (13 feet), SB14 (14, 22, and 37 feet), SB16 (12 feet), and SB18 (14 feet). TCE was identified in soil during the 2016 RI above PSLs at MW02 only (30 and 35 feet bgs). The inferred extent of TCE-contaminated soil following the 2018 RIRA can be seen on Figure A-4a. Although both PCE and TCE were detected in soil, the overall risk from soil contact is below 1×10^{-6}.

PCE and TCE in soil are considered for groundwater migration potential based on post-operational VSP sample concentrations; refer to Section 2.2.5 and 2.2.7 for additional details. The most current results for VSP soil sampling, all taken from 1 foot bgs, are provided in Table 2-3.

Table 2-3
Post-Operational Samples at the Ventilated Stockpile (2018)

Location ID	Cleanup Level[1]	3D	FD4 (3D)*	8D	10D	11D	12D	15D
PCE	0.19	ND	ND	ND	ND	ND	ND	ND
TCE	0.011	0.0171	0.0143	0.0194	0.0172	0.0166	0.0192	0.0147

Notes:
[1] ADEC 18 AAC 75 most stringent migration to groundwater cleanup level (under 40-inch zone)
* FD4 is a field duplicate sample of location 3D
Results shown in RED exceed current migration to groundwater criteria (ADEC 2018b).
Sample results are from the 2018 Monitoring Summary Report (USAF 2018d)
For definitions, refer to the Acronyms and Abbreviations section.

2-hexanone was detected below the RI PSL at SB12 and above the RI PSL at SB15; both of these locations also had DRO contamination, which will be addressed under a separate contract. The SB15 result for 2-hexanone was greater than the RI PSL (3.8 µg/L) at 4.5 µg/L and qualified J, indicating an estimated value.

1,1,2,2-PCA was also detected in groundwater in a single monitoring well (MW05) to the south-southeast of the SS109 inferred plume boundary. Risk from this analyte was calculated to contribute an ILCR of 2E-06 and an HI of 0.001. 1,1,2,2-PCA does not exceed the ADEC risk threshold of 1×10^{-5} and will not be retained as a COC for this FS. 1,1,2,2-PCA was not detected in any soil samples collected as part of the RI.

Naphthalene was only detected in groundwater collocated with the DRO plume and will therefore be managed under CG519. EDB was initially retained as a COC for soil gas based on the quantitative analysis; however, this compound was not detected in soil or groundwater and is commonly found in relation to fuels (leaded gasoline additive) and GRO was not detected above cleanup levels in either soil or groundwater. Therefore, it is unlikely that its detection in soil gas is related to contamination at SS109.

TCE has been detected in near-slab (USAF 2016), sub-slab and soil boring (USAF 2010), SVE system (USAF 2014), indoor air (USAF 2017) and outdoor air samples (USACE 2011b) in exceedance of the RI PSL and ADEC target levels. The 2016 exceedances show that soil gas contains unacceptable levels of TCE outside the former SVE treatment area. However, all 2010 and 2016 results that exceeded the TCE RI PSL (6.95 $\mu g/m^3$, Vapor Intrusion Screening Level [VISL] [EPA 2018] for a residential scenario) also exceed the VISL under a commercial scenario (29.2 $\mu g/m^3$). The winter soil gas results indicate an overall reduction in contaminant concentrations. An exception to this was EDB, which was detected at higher concentrations in four of the five winter sample locations. The basewide VI study concluded the VI pathway is considered complete for TCE with acceptable risk to the indoor worker and resident adult/child (USAF 2017). However, the risk assessment for the soil gas results collected as part of the 2016 RI demonstrated that cumulative risk for soil gas exposure exceeded acceptable thresholds. TCE is retained as a COC in soil gas for its potential to migrate to indoor air based on an ILCR 1.9×10^{-5} of and an HQ of 4.3.

PAHs

PAHs in surface and subsurface soil exceeded RI PSLs, ADEC human health cleanup levels, and ADEC migration to groundwater cleanup levels. At the surface, PAHs at SS109 may be indicative of emissions from jets and vehicles in this industrial and heavily trafficked area; however, they exceed cleanup levels by several orders of magnitude in localized areas. Asphalt and heater exhaust are also potential contributors to PAH-contamination; the presence of asphalt in soil was documented in the 2011 EE/CA (USACE 2011b). PAHs at SS109 are not related to the source area release and will not be carried forward in this FS. Further, RI PSLs were based on EPA regional screening levels from November 2016, which have been updated since the RI was published, and the screening levels for several PAHs – including SS109 COPCs benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(k)fluoranthene; chrysene; dibenzo(a,h)anthracene; indeno(1,2,3-cd)pyrene – have since increased by an order of magnitude or more.

Metals

Arsenic and chromium exceed risk-based cleanup levels in the State of Alaska but are not considered COPCs where there is no known or suspected anthropogenic source. Metals are attributed to background concentrations. Metals in temporary wellpoint samples likely reflect soil particulate in unfiltered samples.

2.5 FATE AND TRANSPORT CONSIDERATIONS

Fate and transport refers to how chemicals degrade and where chemicals are likely to migrate in the environment. Potential migration routes for TCE at the site include volatilization from soil to aboveground ambient or indoor air and volatilization from groundwater to aboveground ambient or indoor air. No surface water or sediments are present at or near the site.

2.5.1 Contaminant Persistence and Migration

Chlorinated solvents are volatile but do not readily degrade in aerobic conditions; anaerobic degradation is the more common pathway. TCE is highly volatile and soluble in water. Once released into the air TCE will break down within a week or less but will degrade more slowly in soil and groundwater. Due to its solubility, TCE will largely pass through soil to groundwater. These solvents have relatively low affinity to sorb to soil, which lends to mobility in the subsurface (Agency for Toxic Substances & Disease Registry 2014). The lack of daughter products from TCE degradation (cis-1,2-dichloroethene, trans-1,2-dichloroethene, and vinyl chloride) are evidence that TCE degradation at SS109 is minimal.

In groundwater, conditions are aerobic – concentrations have fluctuated due to seasonality, dispersion, adsorption, and dilution, not degradation, which occurs more readily in anaerobic environments.

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3.0 COCs

This section describes the COCs and the sources of PCLs for soil gas, and indoor air, and soil including ARARs and risk-based factors. This section also introduces the RAOs developed to protect HHE.

3.1 ARARs

Section 121(d) of CERCLA states that remedial actions on CERCLA sites must attain (or justify the waiver of) federal or more stringent state environmental standards, requirements, criteria, or limitations that are determined to be ARARs (Appendix B). Applicable requirements are those cleanup standards, criteria, or limitations promulgated under federal or state law that specifically address the situation at a CERCLA site. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not applicable, address problems or situations sufficiently similar to the circumstances of the proposed response action and are well suited to the conditions of the site. A third type of requirement, while not an ARAR, consists of non-promulgated advisories of guidance issued by the federal or state governments. These are "to be considered" requirements, which are not legally binding, but may be used to establish cleanup goals in the absence of ARARs.

Pursuant to EPA guidance, ARARs are generally classified into the following three categories:

- **Chemical-specific ARARs** include those laws and requirements that regulate the release to the environment of materials possessing certain chemical or physical characteristics or containing specified chemical compounds. These requirements generally set health- or risk-based concentration limits or discharge limitations for specific hazardous substances.
- **Location-specific ARARs** relate to the geographical or physical position of the site, rather than the nature of the contaminants or the proposed site remedial actions.
- **Action-specific ARARs** define acceptable handling, treatment, and disposal procedures for hazardous substances.

A complete discussion of chemical-, location-, and action-specific ARARs is presented in Appendix B.

3.2 PROJECT CLEANUP LEVELS

During the RI (USAF 2018b), both historical and more recent SS109 analytical results were compared to RI PSLs for risk characterization and ADEC cleanup levels for site delineation. RI PSLs for SS109 were EPA RSL values for soil and groundwater based on an ILCR of 1×10^{-6} and an HQ of 0.1 to account for cumulative risk, and the EPA VISLs (1×10^{-6}, HQ=1, @ 5°C) for soil gas and indoor air. Given that only TCE is retained for remedial action, PCLs based on an ILCR of 1×10^{-5} and HQ of 1 would be appropriate. However, due to specific human health risk considerations particular to this contaminant, the OEA Memorandum (EPA 2012) provides the basis for indoor air and soil gas PCLs to account for the most sensitive receptors (fetus in first trimester).

For the VSP, ADEC migration to groundwater cleanup levels will be retained as PCLs for PCE and TCE and updated to match regulations as most recently promulgated (ADEC 2018b). While not currently of concern due to the integrity of the lined, covered, bermed, and fenced offsite stockpile, TCE migrates readily through soil to and through groundwater, and this pathway is potentially complete under a future scenario.

3.2.1 Soil Gas PCL

The PCL for soil gas, 66.7 µg/m^3, which was calculated from the residential indoor air concentration in the OEA Memorandum (EPA 2012). As this document does not specify a soil gas concentration, one was calculated by applying an attenuation factor of 0.03 (VISL default value). The resulting soil gas value is slightly more stringent because the VISL uses toxicity values from 2011, which are superseded by those published in the OEA Memorandum. Although this area is currently used for commercial activities, this FS considers the more conservative short-term residential not-to-be exceeded concentration.

3.2.2 Indoor Air PCL

Current indoor air concentrations are below unacceptable risk levels. However, the only potentially complete pathway for human health exposure is inhalation of contaminated indoor air resulting from VI. Future changes to land use or building construction could cause an increased potential for VI; therefore, this FS considers PCLs for indoor air. The short-term noncancer not-to-be exceeded indoor air concentrations listed in the OEA Memorandum (EPA 2012) are 2.0 μg/m^3 for a residential scenario and 8.4 μg/m^3 for commercial/industrial scenario.

3.2.3 Soil (at the VSP) PCLs

The EE/CA evaluated alternatives based on previous ADEC migration to groundwater cleanup levels for PCE and TCE. This FS proposes to update those cleanup levels to those most recently promulgated, 0.011 mg/kg for TCE and 0.024 mg/kg for PCE.

3.3 CONTAMINANTS OF CONCERN

TCE the only COC retained following the RI, completion of the HHRA, and VSP treatment. TCE is retained for consideration in soil gas for its potential to migrate to indoor air at Hangar 15. TCE is retained in soil for its potential to migrate to groundwater at the VSP.

3.4 REMEDIAL ACTION OBJECTIVES

RAOs are site- and media-specific goals for remediation to protect HHE. In accordance with EPA guidance, RAOs are as specific as possible without unduly limiting the range of alternatives that can be developed (EPA 1988). RAOs specify the following:

- COCs
- Media (e.g., soil, groundwater, or air)
- Exposure routes and receptors
- Acceptable contaminant levels

The exposure routes and receptors for SS109 are described in Section 2.3.1 of this FS. The following RAOs were developed for SS109 based on regulatory guidance, the findings of recent investigations (refer to Section 2.2), and the results of the HHRA (USAF 2018b):

- Reduce or eliminate TCE migration from soil gas to indoor air, which would complete the inhalation pathway and escalate human health risk to potentially unacceptable levels (greater than 8.4 μg/m^3).

- Reduce or eliminate the groundwater migration potential of TCE in soils, which were previously removed as part of the VSP treatment system and still exist at concentrations greater than 0.011 mg/kg.

4.0 IDENTIFICATION OF REMEDIAL TECHNOLOGIES AND EVALUATION OF PROCESS OPTIONS

This section describes the potential general response actions (GRAs) that may be implemented to satisfy the RAOs defined for SS109, as addressed in this FS. Except for the No Action alternative, each GRA can be achieved by several remedial technologies. Presumptive remedies were developed to eliminate the need to identify and screen a variety of alternatives and to simplify the overall remedy selection process (EPA 1993, 1996). Presumptive remedies have been established for ex situ treatment of VOC-contaminated soil and are expected to be used for remediation except under unusual circumstances (significant advantages of alternate technologies or extraordinary community concerns).

4.1 GENERAL RESPONSE ACTIONS

GRAs are broad categories of action that can be undertaken to satisfy RAOs. An evaluation of general actions that may be effective in meeting RAOs has led to the selection of the following GRAs for contaminated media:

- No Action
- Limited action
- Containment
- Ex situ treatment
- In situ treatment
- Disposal/discharge

4.1.1 No Action

The No Action general response serves as a baseline against which other GRAs can be compared. Any ongoing remedial activities would cease under this response. Natural degradation, dispersion, adsorption, dilution, and volatilization are the only processes that would take place and will occur regardless of intervention.

4.1.2 Limited Action

Limited action includes LUCs, monitored natural attenuation, and long-term soil gas monitoring.

- LUCs are options that may consist of engineering controls or physical barriers such as fences and security guards, or institutional controls, which are legal or administrative measures taken to limit human exposure to contaminants by restricting access to and use of an area (e.g., zoning restrictions, excavation permits, and well drilling prohibitions).
- Monitored natural attenuation is a procedure used to document naturally occurring rates of contaminant degradation.
- Long-term soil gas monitoring can be employed to ensure that assumptions made during remedy selection remain valid.

When undertaken without other GRAs, limited actions attempt to protect HHE without reducing the volume or toxicity of contaminants present.

4.1.3 Containment

Containment actions reduce risk to human health and environmental receptors by limiting possible exposure to and controlling the migration or mobilization of contaminants. Containment can prevent either direct exposure (ingestion or inhalation) or indirect exposure (migration of soil gas). Containment technologies do not reduce the toxicity or volume of contaminants but can reduce contaminant mobility or eliminate exposure. The VSP soil is temporarily contained through the use of a liner, top cover, and dewatering sump to eliminate contaminant migration via subsurface percolation or aboveground surface water flow.

4.1.4 Ex Situ Treatment

This GRA entails the removal and treatment of contaminated media, which has been enacted at the VSP where a vacuum pump is used to extract vapors from stockpiled soil through a network of perforated pipes before the vapors are filtered and the air is released into the atmosphere. Treatment mechanisms may be physical, chemical, biological, or thermal processes. Removal and treatment of contaminated media can reduce long-term risks to HHE but require extra care to minimize short-term risks associated with handling the contaminated media.

4.1.5 In Situ Treatment

In situ treatment reduces long-term risks to HHE by destroying or immobilizing contaminants in place through physical, chemical, biological, or thermal processes. Short-term risks are generally minimized by in situ treatment because the contaminated media is treated in place rather than transported to an offsite location. Limited access to the contaminated media can reduce the effectiveness of in situ treatment options. Examples of in situ treatment for soil gas include techniques such as the placement of an additional venting system consisting of a vent pipe (or a series of vent pipes) installed through the slab and connected to a vacuum pump to extract the vapors from beneath the slab, a fan-powered vent that draws air from beneath a soil gas retarder membrane, or depressurizing the void network within a block wall foundation by drawing air from inside the wall and venting it to the outside.

4.1.6 Removal and Disposal or Discharge

Removal actions may include partial or total removal of contaminated media. Depending on the nature of the contaminants and the acceptance criteria of the landfill or facility, contaminated media can be removed and disposed of offsite at a publicly owned treatment works facility, an industrial waste landfill, a Toxic Substances Control Act landfill, or an RCRA landfill.

4.2 IDENTIFICATION OF APPLICABLE REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

Potentially applicable remedial technologies were identified based on previous experience in treating contamination at JBER, professional judgment, Federal Remediation Technologies Roundtable (FRTR) databases (FRTR 2017), EPA guidance documents, and input from the USAF, EPA and ADEC. The applicability of specific process options for each remedial technology was evaluated by considering the technical feasibility of the option to address the identified COC in the media of concern, with regard to the anticipated current and future use of SS109. This initial screening eliminated those technologies and process options that are clearly not applicable or feasible for the contaminants and/or site characteristics found at SS109.

For the purposes of this FS, the in situ, containment, and removal treatment methods have not been considered for two reasons. First, the basewide VI study included Hangar 15 and the TCE concentrations in indoor air were found to be within acceptable limits so there is currently no unacceptable risk at the site from inhalation of indoor air. Second, SS109 is not the only source for TCE in soil gas. If TCE in indoor air were to exceed the PCL, treatment options would need to evaluate both the SD029 and SS109 source areas. Evaluation of these more active treatment options may be necessary if damage occurs to the foundation of the buildings or preferential pathways are introduced via building improvements (e.g., remodels, drain installations) or major changes to the land use in this area.

4.2.1 Limited Actions

The two types of limited actions that are considered to address site contaminants in soil gas are LUCs (soil gas) and long-term soil gas monitoring. Both of these remedial technologies would require five-year reviews to evaluate the effectiveness of the selected remedy until the site becomes eligible for unlimited use/unrestricted exposure (UU/UE).

Land Use Controls

LUCs are legal or administrative measures designed to reduce or eliminate human or environmental exposure to contamination and to eliminate activities that may result in increased exposure to contamination or the spread of contamination. ADEC has provided informal guidance describing varying levels of LUCs likely to be required, based on the cleanup standard used at any given site (ADEC 2011). LUCs discussed and evaluated as part of this FS will only address access to and activities on SS109 and may be designed to limit access to the site and/or prohibit certain activities or uses of the site.

In general, physical measures may also be taken to prevent access to areas that may pose an unacceptable risk to human health. These controls can also be used to prevent actions that could cause the spread of contaminants or to prevent general access. Typical site controls include fencing, signage, and excavation restrictions. LUCs are currently in place at the OU1 landfill where the VSP is located.

Long-Term Monitoring

Soil gas and indoor air samples would be collected as part of an LTM program at SS109 as long as soil gas concentrations indicate that a potential threat to human health exists. Building surveys at the outset of each sampling event would assess any changes to site use, receptors, and exposure pathways as well as identify preferential pathways (i.e., cracks in foundation, utilities) and chemical storage or use that may be contributing to indoor air contamination, if present. Results and trends would be evaluated in the Five-Year Review.

4.2.2 Ex Situ Treatment

Ex situ treatment would consist of treating the existing VSP of contaminated soil previously excavated from SS109. Soil would continue to be treated by SVE, in which VOCs are extracted via a vacuum pump through a series of perforated pipes, filtered, and released into the atmosphere. Treatment will continue until results are below regulatory cleanup levels and the soil may be recycled.

4.3 FIVE-YEAR REVIEWS

Five-year reviews are required at sites where contaminants are left at levels that do not allow for UU/UE or when the selected remedy takes more than five years to complete. Statutory five-year reviews would be required with the LUC remedy at SS109 as soil gas contamination will remain onsite at levels that do not allow for UU/UE. If an active remedial action such as treatment or passive remediation through monitored natural attenuation is undertaken at SD029, a policy five-year review may be appropriate given that volatile contaminants will dissipate and degrade over time, but this would not be expected to happen within five years.

The five-year review process integrates information from the Decision Document or ROD and operational data. The components of the five-year review process include the following:

- Community involvement and notification
- Document review
- Data reviews and analysis
- Site inspection

- Interviews
- A protectiveness determination.

5.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES

This section describes the remedial alternatives that are proposed for implementation at SS109. A full set of alternatives for contamination present at SS109 were evaluated in the 2010 EE/CA. Since the EE/CA was published, the selected remedy components (including a TCRA and non-TCRA removal, SVE system, and ventilated stockpile) were implemented. USAF does not believe additional treatment technologies would benefit the decision process at this point, as no current threat to human health exists at SS109 and the preferred remedy could be re-visited via the five-year review process in the future should increase potential for human health exposure be identified. The ventilated stockpile currently in operation to treat previously removed soils appears effective; continued operation will bring contaminant levels below migration to groundwater criteria without the need for optimization.

5.1 ALTERNATIVE 1: NO ACTION

Under the No Action alternative, no activities would be undertaken to treat or remove the contamination present at SS109, or to reduce or eliminate exposure to this contamination.

5.2 ALTERNATIVE 2: LUCs AND LONG-TERM MONITORING AT SS109

This alternative would control potential exposure to soil gas and evaluate the effectiveness and protectiveness of the site remedy over time. Enforceable LUCs are included in this alternative because TCE at concentrations above the PCL of 66.7 $\mu g/m^3$ would remain in soil gas at SS109. While the basewide VI study (USAF 2017) demonstrated that contaminants are not present in the surrounding buildings above the PCL and, therefore, do not represent a current risk, LUCs would ensure that the current conditions that maintain acceptable indoor air quality are not compromised.

5.2.1 Implementation of LUCs

This alternative includes the implementation of LUCs to ensure that RAOs are met until the site has reached UU/UE conditions.

These LUCs would ensure the following:

- That no work is carried out on the foundations of the buildings that are within the LUC boundary that would increase the migration of TCE into the indoor air, such as poorly sealed floor drains. A vapor barrier is present underneath the F-22 Weapons Release Shop expansion but not Hangar 15; any new construction for an occupied facility would require this protective measure.
- That any land use change takes into account the soil gas contamination. Construction plans would need to include mitigation measures to prevent unacceptable migration of TCE into indoor air. Changes to land use in this area may need to evaluate the exposure risks from all of the contaminated sites (SD029, SS109, and CG519) rather than only SS109.
- That information regarding the soil gas contamination and associated LUCs are documented in the JBER Environmental Restoration Program (ERP) Atlas, Base General Plan, and GeoBase. The JBER ERP staff evaluate each Facility Siting and Work Clearance Request against the information in the ERP Atlas, Base General Plan, and GeoBase to determine if the proposed activities would increase exposure risk.

While no COCs are present in the soil at SS109, the soil contamination will still be listed in the JBER GeoBase to notify utility companies and other contractors of the potential for contaminated soil should intrusive activities be required in the future. This is due to the uncertainty inherent in RIs that contamination exists outside of those areas sampled. Although adequate coverage was achieved in the RI to inform site delineation as well as the human health risk assessment, low levels of contamination do exist and could be higher in other areas. Notification will prevent the unauthorized movement or use of potentially contaminated material in a manner that results in a violation of 1Alaska Administrative Code (AAC) Title 18, Chapter 70 (18 AAC 70) water quality standards or puts the soil in contact with groundwater (ADEC 2018a). Any potentially contaminated soil removed from the site will be characterized and handled according to standard environmental industry practice, including regulatory approval prior to transport of soil or groundwater offsite.

5.2.2 Long-Term Monitoring

Currently, the concrete floor of Hangar 15 is in good condition and cracks or other penetrations do not result in a preferential pathway. Future building inspections as part of long-term monitoring should re-evaluate preferential pathways and recommend repairs as needed.

Two VI monitoring rounds (to capture both summer and winter conditions) would be undertaken prior to each five-year review at all occupied buildings within the LUC boundary (see Figure A-4a). The monitoring at Hangar 15 would focus on the cluster of offices located in the northern section of the building. Three indoor air samples, three soil gas samples, and one outdoor sample would be collected. VI monitoring sampling may be conducted more frequently than every five years, for example, in the event of renovation projects, building upgrades, addition of new facilities, or events that may affect the structural integrity of the foundation. Building inspections should assess potential changes to the VI pathway, and include an inventory of chemicals stored/used in the facility.

5.2.3 CERCLA Five-Year Reviews

Long-term monitoring will be carried out in advance of each CERCLA Five-Year Review to evaluate the effectiveness of the remedy as it relates to continued protectiveness of human health; a statutory review will be required under CERCLA because contamination will be left in place at levels that do not allow for UU/UE. If combined with another remedy (e.g., groundwater treatment at SD029), a policy five-year review would be warranted, as regardless of method, attenuation is likely to take more than five years to complete. Five-year reviews would be initiated to include building inspections and a review of any new toxicity data as well as make recommendations based on new data that have been published about the site. The proposed extent of the LUCs and the buildings within that extent that would be subject to inspection as part of the five-year reviews can be seen on Figure A-4a (Appendix A).

5.3 ALTERNATIVE 3: EX SITU TREATMENT OF VSP SOIL

This alternative would focus on continued treatment of approximately 2,200 cy of contaminated soil previously excavated from the site (USACE 2011b). SVE is a presumptive remedy for treatment of halogenated VOC-contaminated soil (EPA 1993). Given the low concentrations present, exposing the contaminated soil to air through tilling, which was incorporated into the previously selected remedy for the past two years of operation, has resulted in rapid volatilization. An additional year of treatment is recommended to include the following components:

- Initiate the blower system according to the O&M manual once the ground thaws, circa April or May.
- Perform monthly tilling until freeze-up using an excavator to reach depths just short of the SVE piping along the base of the 8-foot stockpile.
- Continue collecting precipitation water from sump at the base of the sloped pile and transferring it via drums to the JBER-Richardson investigation-derived waste yard for treatment and disposal.
- Collect an interim round of analytical confirmation samples from varying depths and analyze for PCE and TCE after three months of treatment. A total of 14 analytical samples are anticipated based upon soil volume. Note that prior efforts collected samples at 1 foot bgs; deeper samples using a hand auger or other appropriate device should be sought to provide more representative indicators and assess the effectiveness of soil mixing.
- Repeat post-treatment confirmation sampling at six months, if needed.
- Shut down and decommission the system once clean confirmation sample results are received.
- Restore the stockpile footprint, as directed by USAF in coordination with the JBER Compliance Program and ADEC Solid Waste Management offices, as it occurs within the OU1 landfill. Treated soil will not be deposited along surface water or in any sensitive environments. It should not be used within 100 feet of surface water, a private water system, or a fresh water supply system that uses groundwater, or within 200 feet of a water source serving a community water system, a non-transient non-community water system, or a transient non-community water system.
- No five-year reviews or additional follow-up actions would be required.

5.4 ALTERNATIVE 4: LUCs, LTM, AND EX SITU TREATMENT

Alternative 4 would include all remedy components previously stated (refer to Sections 5.2 and 5.3) for both Alternatives 2 and 3 to concurrently address both contaminated soil and potential future risks associated with TCE in soil gas.

6.0 DETAILED INDIVIDUAL ANALYSIS OF REMEDIAL ALTERNATIVES

In this section, the remedial alternatives retained for further evaluation are individually analyzed to provide adequate information to compare the alternatives.

6.1 DESCRIPTION OF EVALUATION CRITERIA

The NCP [40 CFR 430(e)(2)] and CERCLA guidance (EPA 1988) specify nine evaluation criteria to address statutory considerations and provide the basis for selecting an appropriate remedial alternative. The criteria are categorized as threshold factors (each alternative must meet these), balancing factors (the primary criteria upon which the analysis is based), and modifying considerations (which come into play following the presentation of the FS and Proposed Plan).

6.1.1 Threshold Criteria

Threshold criteria represent the minimum requirements that each alternative must meet to be eligible for selection. The two threshold criteria are:

- Overall protection of HHE
- Compliance with ARARs

Overall Protection of HHE

This criterion assesses the overall effectiveness of an alternative and describes how it achieves and maintains the protection of HHE. This evaluation focuses on how risk reduction, elimination, or control are achieved, drawing on assessments conducted under other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

Compliance with ARARs

Each alternative is assessed to determine whether it complies with ARARs. Appendix B presents the ARARs for SS109.

6.1.2 Balancing Criteria

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

- Long-term effectiveness and permanence
- Reduction of TMV through treatment
- Short-term effectiveness
- Implementability
- Cost

Long-Term Effectiveness and Permanence

This criterion assesses the magnitude of residual risks remaining at the conclusion of remedial activities and the adequacy and reliability of controls that will be used in the management of residual risk.

Reduction of TMV through Treatment

CERCLA Section 9621 (Cleanup Standards) states that remedial action treatments that permanently and significantly reduce the TMV of contaminants are preferred over other remedial actions. This criterion addresses the capacity of the alternative to reduce principal risks through the destruction of contaminants, reduction in the total mass of contaminants, irreversible reduction in contaminant mobility, or reduction in the total volume of contaminated media.

Short-Term Effectiveness

Short-term effectiveness addresses the effects of the alternative during construction and operation until RAOs are met. Each alternative is evaluated with respect to its protectiveness of community health, worker safety, and environmental quality during the implementation of remedial actions. This criterion also addresses the time required until RAOs are achieved.

Implementability

This criterion is used to assess the technical and administrative feasibility of implementing an alternative. Technical issues include the reliability of the technology under consideration, potential construction difficulties, the ability to monitor effectiveness of the alternative, and the availability of services, materials, and equipment required for the implementation of the alternative. Administrative issues include permitting and access for construction as well as monitoring.

Cost

Cost estimates include both capital costs and O&M costs. Capital costs include costs for equipment, materials, construction-related labor, and site development. O&M costs include operating labor, maintenance, and repair materials, as well as associated labor, energy, process chemicals, disposal of treatment residues, operational sampling and analysis, data management, and administration. O&M costs have been included in life-cycle costs.

Cost estimates (Appendix C) were prepared using available data and are intended to provide an accuracy of between +50 and –30 percent. These cost estimates are preliminary and were developed in accordance with *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA 2000). More detailed and accurate cost estimates will be developed as the CERCLA process progresses. Cost estimates included in this document are intended for comparative purposes only. They intentionally emphasize comparability (a key factor in the decision-making process) versus accuracy. Costs provided in this FS assume that work will be performed in 2018.

The costs associated with implementing LUCs at the site are equivalent among the alternatives and were based on an estimated 30 years of site control for each alternative. A detailed cost analysis of LUCs is included in Appendix C. Long-term soil gas monitoring costs were based on an estimated 30 years of monitoring. Five-year review costs were based on an estimated 30 years of reviews occurring at five-year intervals.

6.1.3 Modifying Criteria

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

6.2 ALTERNATIVE 1: NO ACTION

Under the No Action alternative, no activities would be undertaken to treat or remove the contamination present at SS109 or to reduce or eliminate exposure to the contamination. No monitoring would be conducted. A No Action alternative is required for consideration to serve as a baseline against which other alternatives are compared.

6.2.1 Overall Protection of HHE

Alternative 1 does not meet this threshold criterion because it does not address potential exposure pathways to current or future onsite workers nor to the hypothetical future resident.

6.2.2 Compliance with ARARs

Alternative 1 does not meet this threshold criterion as ARARs established for cleanup and monitoring of contaminated soil gas would not be satisfied. Because LUCs would not be in place to prohibit excavation or creation of vapor pathways, and no monitoring would take place to confirm reduction of contamination, this alternative is associated with low to moderate remaining risk for site user exposure to contamination.

6.2.3 Long-Term Effectiveness and Permanence

All current and future risks would remain under Alternative 1, the No Action alternative. Some contamination may attenuate through natural processes, providing some degree of long-term reduction in risk at the site. No controls would be implemented to manage residual contamination and exposure pathways to current and future site users would remain.

6.2.4 Reduction of TMV through Treatment

Alternative 1 does not involve treatment and, therefore, does not reduce TMV through treatment, nor does it create treatment residuals.

6.2.5 Short-Term Effectiveness

The No Action alternative includes some short-term effectiveness provided that site conditions do not change. There are no risks to the community or workers associated with a remedial action because no remedial activities would be performed. Likewise, no environmental impacts are associated with the implementation of this alternative. RAOs are not expected to be achieved under this alternative as the characteristics of the contamination and site conditions indicate that natural attenuation would not appreciably reduce contamination.

6.2.6 Implementability

There are no technical and administrative feasibility considerations associated with the No Action alternative because no remedial actions would be taken; however, administrative approval is unlikely. Likewise, the No Action alternative would not impede any future remedial actions.

6.2.7 Cost

There is no cost associated with the No Action alternative.

6.3 ALTERNATIVE 2: LUCs AND LTM

This alternative would not include actions to treat or remove the potential for soil gas contamination at SS109 to migrate to indoor air, but would control potential exposure to contaminants via VI as well as monitor the site to ensure that any change in site conditions does not alter risks to HHE.

Under this alternative, LUCs would be used to eliminate the evolution of exposure pathways for the COC in soil gas to site users. LTM would be conducted and overall protectiveness would be assessed during Five-year reviews would assess any deficiencies noted during inspections, changes in land use or regulatory criteria, and VI sampling results to evaluate the continued protectiveness and effectiveness of the remedy.

6.3.1 Overall Protection of HHE

This alternative eliminates potential future exposure pathways to site users by implementing LUCs. This alternative effectively protects human health under the current and expected future industrial use of the site; should land use change at SS109, the effectiveness of this strategy should be reevaluated. Inspections conducted as part of the five-year reviews would assess the continued protectiveness of the alternative. LUCs may require future construction activities to take into account the soil gas contamination and design the buildings accordingly (vapor barrier).

6.3.2 Compliance with ARARs

This alternative complies with ARARs because site use at SS109 is anticipated to remain the same. Long-term monitoring will be conducted to ensure that TCE in soil gas does not migrate to indoor air and present an inhalation risk to site employees. Dig restrictions will prevent the transport of soil contamination above ADEC migration to groundwater criteria. Five-year reviews will include building inspections to verify that potential exposure pathways as evaluated in this FS remain the same.

6.3.3 Long-Term Effectiveness and Permanence

No threat to human health currently exists at SS109. Potential for future threats will be evaluated through building inspections and long-term VI monitoring. As a precautionary measure, LUCs will be implemented to restrict invasive activities and preclude any changes to infrastructure or site use that could complete human health exposure pathways.

Remedy protectiveness and permanence will be assessed through the Five-Year Review Process. At SS109, these reviews will include the long-term VI monitoring results, building inspections specifically designed to identify preferential pathways such as cracks in the foundation or evidence of LUC violation, and interviews with site personnel to ensure that current and recent activities at the time of review and in between reviews align with LUC restrictions. Five-Year Reviews will be submitted for EPA and ADEC review; final protectiveness determinations will depend upon regulatory concurrence and any proposed changes to the remedy discussed as they arise through the comment response process, and/or through an Amended ROD or Explanation of Significant Differences.

6.3.4 Reduction of TMV through Treatment

This alternative would not satisfy the statutory preference for treatment as a principal element. The goal of Alternative 2 would be to reduce or eliminate potential future exposure to contamination, as no complete pathway to human health currently exists. Alternative 2 does not include treatment and, therefore, does not reduce TMV through treatment, nor does it create treatment residuals.

6.3.5 Short-Term Effectiveness

Implementation of this alternative would not involve significant intrusive activities and would not have negative impacts on community or worker health and safety, or environmental quality. Natural processes would not be expected to reduce contaminant concentrations within a reasonable timeframe.

6.3.6 Implementability

There are no technical feasibility considerations associated with the implementation of Alternative 2; however, administrative approval may be challenging as this alternative requires administrative control to ensure protectiveness of site users.

6.3.7 Cost

The estimated present-worth cost for implementation of Alternative 2 is approximately \$227,095. This cost estimate includes planning, coordination, annual site inspections, VI monitoring, and documentation involved with implementing LUCs and conducting five-year reviews. Details regarding cost estimates can be found in Appendix C.

6.4 ALTERNATIVE 3: EX SITU TREATMENT

Continued treatment of approximately 2,200 cy of contaminated soil previously excavated from the site and placed into a VSP (USACE 2011b) is expected to successfully reach RAOs within one year.

6.4.1 Overall Protection of HHE

Alternative 3 achieves overall protection of HHE by reducing contaminant levels to below the most stringent ADEC migration to groundwater criteria for PCE and TCE (concentrations are already below EPA RSLs and ADEC human health cleanup levels). This alternative would allow for UU/UE to previously contaminated soils.

6.4.2 Compliance with ARARs

Chemical-, location-, and action-specific ARARs would be met under Alternative 3. PCE- and TCE-contaminated soil would be reduced to UU/UE concentrations through continued treatment.

6.4.3 Long-Term Effectiveness and Performance

All current and future risks associated with VSP soils would be removed through Alternative 3. Contaminated soil would be treated until PCE and TCE concentrations are below ADEC migration to groundwater cleanup levels.

6.4.4 Reduction of TMV through Treatment

Alternative 3 satisfies the CERCLA statutory preference for treatment. Contaminated VSP soils originating from SS109 would continue to be treated through SVE until PCE and TCE concentrations are below regulatory cleanup values.

6.4.5 Short-Term Effectiveness

Generally, ex situ options provide lower short-term effectiveness scores due to increased exposure potential during removal and remedy implementation. However, the SVE system and biopile are already in place and only need to be continued. Minimal exposure potential exists during tilling, but contaminant concentrations have already fallen below both EPA RSLs and ADEC human health cleanup levels and potential migration is controlled through a liner, top cover, berm, and sump for drainage. A six-month duration is anticipated.

6.4.6 Implementability

Given that Alternative 3 is a continuation of a remedy already in place, this remedy is highly implementable but only effective during summer months when the ground is thawed.

6.4.7 Cost

The estimated present-worth cost for implementation of Alternative 3 is approximately $253,538. This cost estimate includes planning, coordination, operation, and monitoring and sampling of the SVE system for six months. Details regarding cost estimates can be found in Appendix C.

6.5 ALTERNATIVE 4: LUCs, LTM, AND EX SITU TREATMENT

This alternative would control potential exposure to contaminants via VI as well as monitor the site to ensure that any change in site conditions does not alter risks to HHE, plus continue treatment of approximately 2,200 cy of contaminated soil previously excavated from the site and placed into a VSP (USACE 2011b). The soil gas remedy must continue until both soil gas and indoor air concentrations reach RAOs. The soil remedy is expected to successfully reach

RAOs within one year; the soil gas remedy would continue until Five-Year Reviews determine that the site is eligible for UU/UE.

6.5.1 Overall Protection of Human Health and the Environment

LUCs would effectively protect human health under the current and expected future industrial use of SS109; should land use change, the effectiveness of this strategy should be reevaluated. LTM and building inspections assessed through the five-year reviews would ensure protectiveness of the soil gas portion of this remedy. LUCs may require future construction activities to take into account the soil gas contamination and design the buildings accordingly (i.e., vapor barrier). For soil, as with Alternative 3, Alternative 4 would achieve overall protection of HHE by reducing contaminant levels to below the most stringent ADEC migration to groundwater criteria for PCE and TCE (concentrations are already below EPA RSLs and ADEC human health cleanup levels). This alternative would allow for UU/UE to previously contaminated soils.

6.5.2 Compliance with ARARs

Chemical-, location-, and action-specific ARARs would be met under Alternative 4 as long as site use remains the same. LUCs including dig restrictions to present the transport of soil contamination expected to remain in place above the ADEC migration to groundwater criterion for TCE at SS109, and continued ex situ treatment of TCE- and PCE-contaminated soil at the VSP.

6.5.3 Long-Term Effectiveness

No threat to human health currently exists at SS109 or the VSP. Potential for future threats will be evaluated through building inspections, long-term VI monitoring, and continued ex situ soil treatment. As a precautionary measure, LUCs will be implemented to restrict invasive activities and preclude any changes to infrastructure or site use that could complete human health exposure pathways (i.e. soil gas to indoor air).

Remedy protectiveness and permanence will be assessed for soil gas through the Five-Year Review Process at SS109; these reviews will include the long-term VI monitoring results, building inspections specifically designed to identify preferential pathways such as cracks in the foundation or evidence of LUC violation, and interviews with site personnel to ensure that current and recent activities at the time of review and in between reviews align with LUC restrictions. Five-Year Reviews will be submitted for EPA and ADEC review; final protectiveness determinations will depend upon regulatory concurrence and any proposed changes to the remedy discussed as they arise through the comment response process, and/or through an Amended ROD or Explanation of Significant Differences. All current and future risks associated with VSP soils would be removed through Alternative 4. Contaminated soil would be treated until PCE and TCE concentrations are below ADEC migration to groundwater cleanup levels.

6.5.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 4 satisfies the CERCLA statutory preference for treatment. Contaminated VSP soils originating from SS109 would continue to be treated through SVE until PCE and TCE concentrations are below regulatory cleanup values.

6.5.5 Short-Term Effectiveness

Implementation of LUCs and LTM would not involve significant intrusive activities and would not have negative impacts on community or worker health and safety, or environmental quality. For ex situ treatment, minimal exposure risk is anticipated because the VSP is already in place and only needs to be continued. Minimal exposure potential exists during tilling, but contaminant concentrations have already fallen below both EPA RSLs and ADEC human health cleanup levels and potential migration is controlled through a liner, top cover, berm, and sump for drainage. Natural processes would not be expected to reduce TCE in soil gas within a reasonable timeframe, but a six-month duration is anticipated for VSP soils.

6.5.6 Implementability

There are no technical feasibility considerations associated with the implementation of Alternative 4; however, administrative approval may be challenging as this alternative requires administrative control for the LUC component to ensure protectiveness of site users. As ex situ treatment is a continuation of a remedy already in place, this remedy is highly implementable but only effective during summer months when the ground is thawed.

6.5.7 Cost

The estimated present-worth cost for implementation of Alternative 4 is approximately $480,634. This cost estimate includes planning, coordination, annual site inspections, VI monitoring, and documentation involved with implementing LUCs, conducting five-year reviews, as well as operations and maintenance and sampling of the SVE system for 6 months. Details regarding cost estimates for the individual remedy components (under Alternatives 2 and 3) can be found in Appendix C.

7.0 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

This section compares the four alternatives that would address contaminated soil gas at SS109 and soil at the VSP according to their ability to comply with the National Oil and Hazardous Substances Pollution Contingency Plan criteria explained in Section 6.1.

7.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative 1 (No Action) would neither eliminate the creation of human health exposure pathways from contaminated soil gas nor bring VSP-treated soil concentrations down to the original project goals. Neither contaminant source constitutes a current threat to human health; however, both have the potential for future risk and, therefore, No Action would not be protective of human health long-term. Alternatives 2 and 3 would each reduce or eliminate exposure pathways to future site users to soil gas and soil, respectively. Alternative 4 would eliminate future exposure pathways to both soil gas and soil.

7.2 COMPLIANCE WITH ARARs

Alternative 1 would not comply with ARARs under a future use scenario. Alternatives 2, 3, and 4 would comply with the ARARs as explained in Appendix B.

7.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternative 1 would not provide long-term effectiveness. Alternative 2 would provide long-term effectiveness by reducing or eliminating the creation of exposure pathways to site users (via LUCs). Alternative 3 would provide long-term effectiveness by reducing contaminant concentrations to acceptable levels. Alternative 4 would combine the long-term effectiveness benefits of Alternatives 2 and 3.

7.4 REDUCTION OF TMV THROUGH TREATMENT

Alternatives 1 and 2 do not provide treatment of contamination. Alternatives 3 and 4 provide ex situ treatment via SVE.

7.5 SHORT-TERM EFFECTIVENESS

Alternative 1 does not present additional adverse risks to site users or workers as it involves no remedial action. Alternative 2 represents limited actions that present little to no risk in the implementation of the minimal actions involved, and Alternative 3 has already been implemented and only requires operations and maintenance. Current risks associated with Alternative 4 would not be substantially greater than either of the two alternatives taken alone.

7.6 IMPLEMENTABILITY

There are no actions associated with Alternative 1; therefore, there are no obstacles to implementation other than the likelihood that the No Action alternative would not be approved by the owner, community, or regulators. Alternative 2 is easily implemented, especially given the expected future use of SS109 and currently existing procedures used on JBER to manage LUCs. Alternative 3 is also easily implemented considering the contaminated soil has previously been removed from site and the infrastructure required for remediation activities is already in place. The implementability associated with Alternative 4 would not be substantially greater than either of the two alternatives taken alone.

7.7 COST

There would be no cost to implement Alternative 1. Alternative 2 would cost approximately $227,095. Alternative 3 would cost approximately $253,538. Alternative 4 would cost approximately $480,634. Detailed cost calculations are presented in Appendix C.

7.8 SUMMARY AND RANKING OF REMEDIAL ALTERNATIVES

Table 7-1 provides a comparative analysis based on the the previous subsections (Sections 7.1 to 7.7). Each alternative will either pass or fail each threshold criterion and is assigned a numerical score between 0 and 5 for each of the balancing criteria except for cost.

The balancing criteria score values are defined as follows:

- 5 – Criterion is fulfilled
- 1 to 4 – Criterion is partially fulfilled (depends on the degree to which the criterion is satisfied)
- 0 – Criterion is not fulfilled

Table 7-1
Summary Comparison of Remedial Alternatives for SS109

Criteria	Alternative 1 No Action	Alternative 2 LUCs and LTM	Alternative 3 Ex Situ Treatment	Alternative 4 LUCs, LTM, and Ex Situ Treatment
Overall Protection of HHE	Fail	Pass	Pass	Pass
Compliance with ARARs	Fail	Pass	Pass	Pass
Long-Term Effectiveness and Permanence	0	3	5	4
Reduction of TMV through Treatment	0	0	5	4
Short-Term Effectiveness	2	5	4	4
Implementability	5	4	4	4
Cost	$0	$227,095	$253,538	$480,634
State Acceptance	-	-	-	-
Community Acceptance	-	-	-	-

Notes:
- = State and community acceptance will be evaluated following public comment on the Proposed Plan and addressed when the ROD is prepared.
For definitions, refer to the Acronyms and Abbreviations section.

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8.0 RECOMMENDATIONS

Based on the evaluation presented in this FS, Alternative 4, which involves both the implementation of LUCs and five-year reviews to address the potential for future exposure risks at SS109 and continued ex situ treatment of VSP soils, is recommended to complete previously selected remedy implementation and restore previously contaminated soils to UU/UE.

8.1 SS109 − HANGAR 15

Long-term monitoring will include building inspections and VI sampling to determine remedy protectiveness prior to Five-Year Reviews. VI evaluation and evaluating the effectiveness of LUCs such as restrictions on invasive activities administered through the JBER work clearance request process and recorded in GeoBase, construction/repair requirements to alleviate VI pathway potential, and continued industrial land use are sufficient to keep exposures below acceptable thresholds. Changes to land use in this area should also take into account contaminated media associated with the adjacent contaminated sites, Source Areas SD029 and CG519. Five-year reviews should be undertaken, including community involvement and notification, document review, data reviews and analysis, interviews, site and building inspections, and two rounds of VI monitoring to determine if a risk to human health has developed and to monitor any natural attenuation of soil gas levels. Additional building inspections and VI monitoring may occur if any major construction activity happens at or near the sites or if there is a significant natural disaster such as an earthquake that may have affected buildings foundations.

8.2 VENTILATED STOCKPILE SVE SYSTEM

Continued treatment of previously excavated and stockpiled soil from SS109 by SVE will likely bring the VOC levels below regulatory cleanup levels. Duration of treatment is expected to last six months through the spring and summer with sampling taking place at three and six months.

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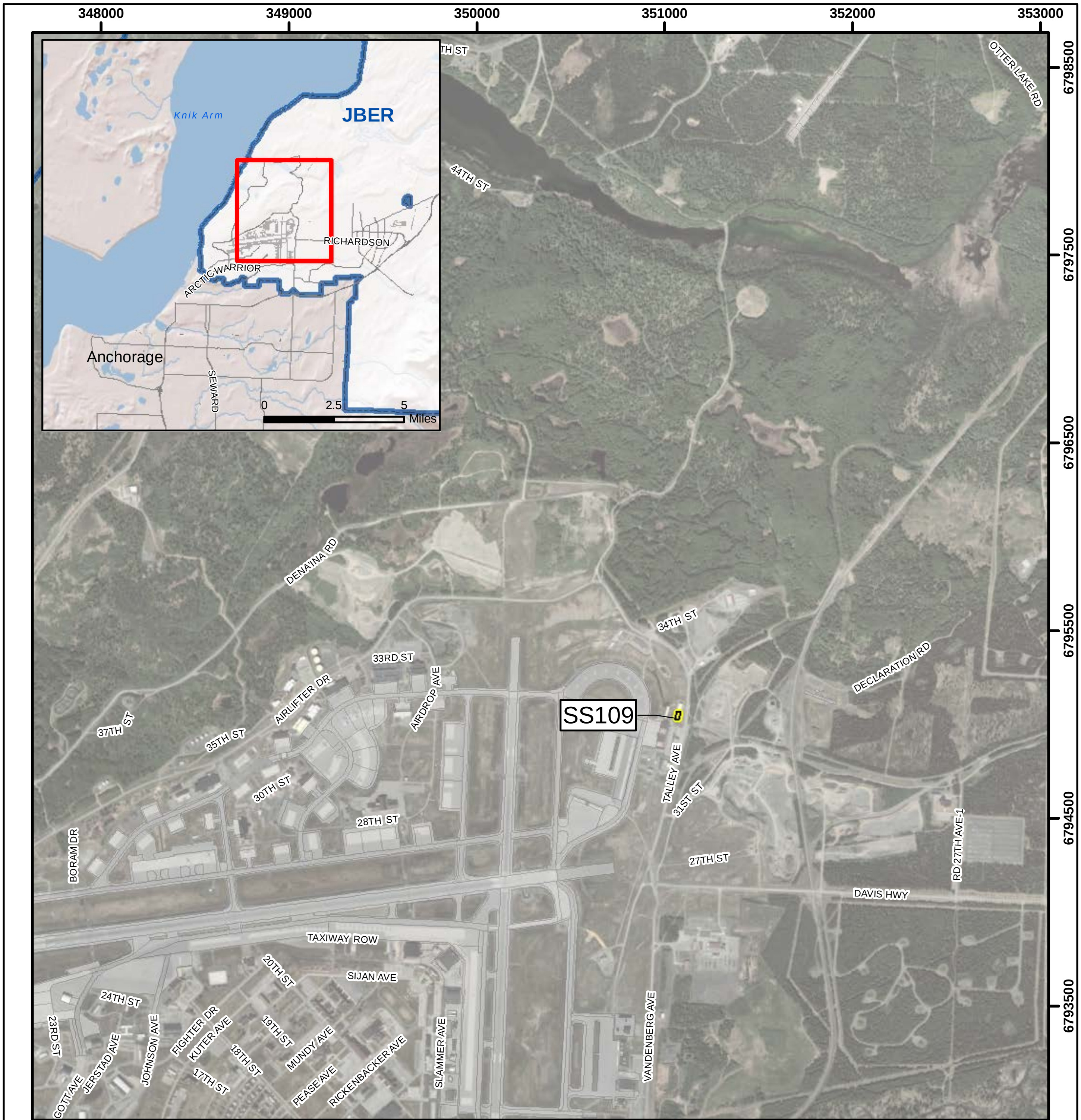
APPENDIX A
Figures



Imagery: ESRI World Imagery Service Layer, Anchorage 2015

Environmental Remediation Site

JBER Boundary

0 0.25 0.5 0.75 1

Miles

WGS 1984 UTM Zone 6N Transverse Mercator

N

SS109 (F-22 WEAPONS RELEASE SHOP)
LOCATION VICINITY

JOINT BASE ELMENDORF-RICHARDSON (JBER), ALASKA

JACOBS	DATE: 26 DEC 2018	PROJECT MANAGER: G. RUTKOWSKI	FIGURE NO: A-1

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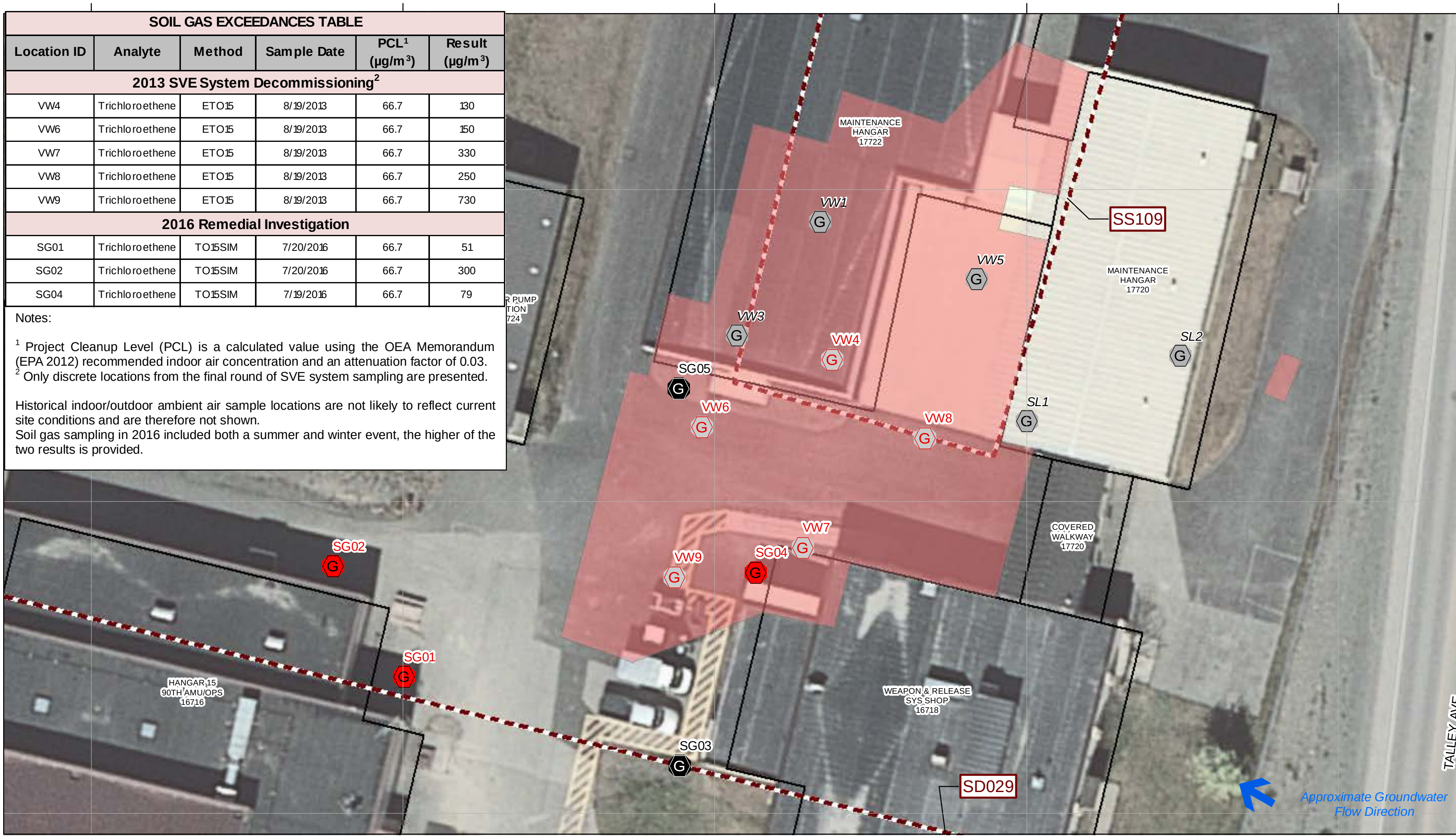
SOIL GAS EXCEEDANCES TABLE

Location ID	Analyte	Method	Sample Date	PCL[1] (µg/m³)	Result (µg/m³)
2013 SVE System Decommissioning[2]					
VW4	Trichloroethene	ETO15	8/19/2013	66.7	130
VW6	Trichloroethene	ETO15	8/19/2013	66.7	150
VW7	Trichloroethene	ETO15	8/19/2013	66.7	330
VW8	Trichloroethene	ETO15	8/19/2013	66.7	250
VW9	Trichloroethene	ETO15	8/19/2013	66.7	730
2016 Remedial Investigation					
SG01	Trichloroethene	TO15SIM	7/20/2016	66.7	51
SG02	Trichloroethene	TO15SIM	7/20/2016	66.7	300
SG04	Trichloroethene	TO15SIM	7/19/2016	66.7	79

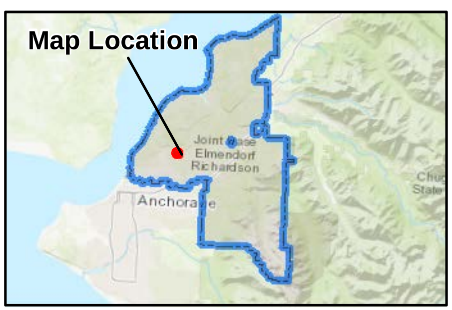
Notes:

[1] Project Cleanup Level (PCL) is a calculated value using the OEA Memorandum (EPA 2012) recommended indoor air concentration and an attenuation factor of 0.03.
[2] Only discrete locations from the final round of SVE system sampling are presented.

Historical indoor/outdoor ambient air sample locations are not likely to reflect current site conditions and are therefore not shown.
Soil gas sampling in 2016 included both a summer and winter event, the higher of the two results is provided.



Imagery: ESRI World Imagery Service Layer, Anchorage 2015



- 2016 Soil Gas Sample with Exceedance
- 2016 Soil Gas Sample with No Exceedance
- Soil Gas Sample with Historical Exceedance
- Soil Gas Sample with No Historical Exceedance
- Excavated Area
- Environmental Remediation Site
- Building
- JBER Boundary

N

0 25 50 75 100
Feet

WGS 1984 UTM Zone 6N

SS109 (F-22 WEAPONS RELEASE SHOP)
TCE SOIL GAS SAMPLE LOCATIONS AND EXCEEDANCES

JOINT BASE ELMENDORF-RICHARDSON, ALASKA

	DATE:	PROJECT MANAGER:	FIGURE NO:
JACOBS	26 DEC 2018	G. RUTKOWSKI	A-2

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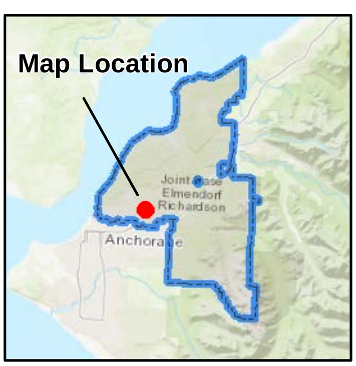
Imagery: ESRI World Imagery Service Layer, Anchorage 2015



Structures
Landfill Fence
Stockpile Fence
Vacuum Piping
Vent Piping
Stockpile Footprint
Improved Gravel Road
Unimproved Dirt Road
JBER Boundary

1 inch = 30 feet

0 10 20 30 40

Feet

WGS 1984 UTM Zone 6N

N

SS109 (F-22 WEAPONS RELEASE SHOP)
VENTILATED STOCKPILE LAYOUT

JOINT BASE ELMENDORF-RICHARDSON

JACOBS	DATE: 26 DEC 2018	PROJECT MANAGER: G. RUTKOWSKI	FIGURE NO: A-3

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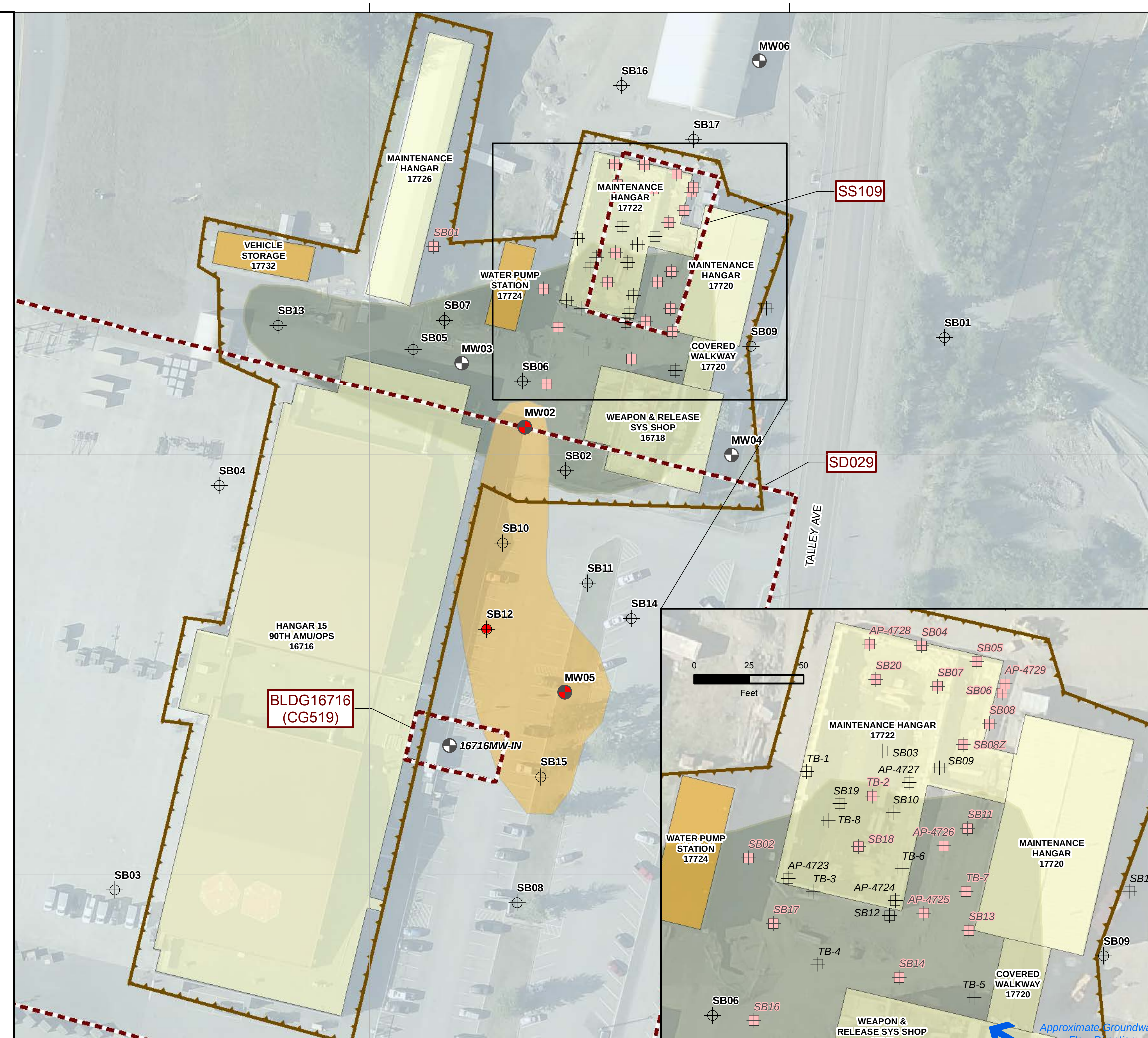
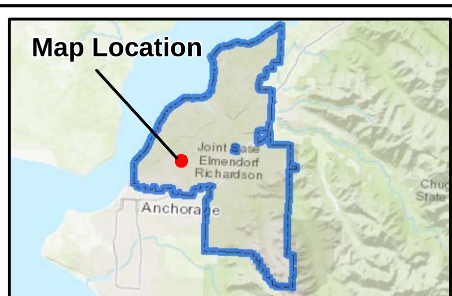
PSL EXCEEDANCES TABLE - SOIL

Location ID	Depth (ft)	Analyte	Method	Sample Date	PSL (mg/kg)	Result (mg/kg)
2010 Foundation Study						
AP-4725	4.5-6.5	Trichloroethene (TCE)	SW8260B	2/24/2010	0.41	0.54
AP-4726	4.5-6.5	DRO	AK102	2/22/2010	1025	3800 CN
AP-4728	2.5-4.5	Benzo(a)anthracene	8270SIM	2/23/2010	0.16	0.42
		Benzo(a)pyrene	8270SIM	2/23/2010	0.016	0.45
		Benzo(b)fluoranthene	8270SIM	2/23/2010	0.16	0.58
		Dibenzo(a,h)anthracene	8270SIM	2/23/2010	0.016	0.074
AP-4729	0-2	Benzo(a)anthracene	8270SIM	2/22/2010	0.16	1.9
		Benzo(a)pyrene	8270SIM	2/22/2010	0.016	1.8
		Benzo(b)fluoranthene	8270SIM	2/22/2010	0.16	2.9
		Dibenzo(a,h)anthracene	8270SIM	2/22/2010	0.016	0.33
		PCB-1260 (Aroclor 1260)	SW8082	2/22/2010	0.24	0.89
	2.5-4.5	Benzo(a)anthracene	8270SIM	2/22/2010	0.16	0.34
		Benzo(a)pyrene	8270SIM	2/22/2010	0.016	0.5
		Benzo(b)fluoranthene	8270SIM	2/22/2010	0.16	0.76
		Dibenzo(a,h)anthracene	8270SIM	2/22/2010	0.016	0.13
		Indeno(1,2,3-cd)pyrene	8270SIM	2/22/2010	0.16	0.21
		RRO	AK103	2/22/2010	1000	2700
TB-2	0-4	DRO	AK102	7/19/2010	1025	1120
		RRO	AK103	7/19/2010	1000	8760
TB-7	19.5	Trichloroethene (TCE)	SW8260B	9/2010	0.41	0.444
2010 Fieldwork Summary						
SS01	0-2	Benzo(a)pyrene	8270SIM	13-Nov-10	0.016	0.0246
SS02	0-2	Benzo(a)pyrene	8270SIM	13-Nov-10	0.016	0.0167
SS04	0-2	Benzo(a)anthracene	8270SIM	13-Nov-10	0.16	103
		Benzo(a)pyrene	8270SIM	13-Nov-10	0.016	131
		Benzo(b)fluoranthene	8270SIM	13-Nov-10	0.16	207
		Chrysene	8270SIM	13-Nov-10	16	98.7
		Dibenzo(a,h)anthracene	8270SIM	13-Nov-10	0.016	22.9
		DRO	AK102	13-Nov-10	1025	1510
		Indeno(1,2,3-cd)pyrene	8270SIM	13-Nov-10	0.16	74.5
		RRO	AK103	13-Nov-10	1000	9860
		Benzo(a)pyrene	8270SIM	30-Nov-10	0.016	0.116
		Dibenzo(a,h)anthracene	8270SIM	30-Nov-10	0.016	0.0178
SS05	0-2	Benzo(a)anthracene	8270SIM	13-Nov-10	0.16	75
		Benzo(a)pyrene	8270SIM	13-Nov-10	0.016	101
		Benzo(b)fluoranthene	8270SIM	13-Nov-10	0.16	156
		Chrysene	8270SIM	13-Nov-10	16	81.2
		Dibenzo(a,h)anthracene	8270SIM	13-Nov-10	0.016	10.5 J
		DRO	AK102	13-Nov-10	1025	1430
		Indeno(1,2,3-cd)pyrene	8270SIM	13-Nov-10	0.16	52.4
		RRO	AK103	13-Nov-10	1000	11600
SS06	0-2	Benzo(a)anthracene	8270SIM	13-Nov-10	0.16	32.8
		Benzo(a)pyrene	8270SIM	13-Nov-10	0.016	39.8
		Benzo(b)fluoranthene	8270SIM	13-Nov-10	0.16	40.4
		Chrysene	8270SIM	13-Nov-10	16	30.3
		Dibenzo(a,h)anthracene	8270SIM	13-Nov-10	0.016	4.5
		Indeno(1,2,3-cd)pyrene	8270SIM	13-Nov-10	0.16	21
		RRO	AK103	13-Nov-10	1000	2920
SS07	0-2	Benzo(a)anthracene	8270SIM	13-Nov-10	0.16	12.4
		Benzo(a)pyrene	8270SIM	13-Nov-10	0.016	14.2
		Benzo(b)fluoranthene	8270SIM	13-Nov-10	0.16	22.6
		Dibenzo(a,h)anthracene	8270SIM	13-Nov-10	0.016	2.23
		Indeno(1,2,3-cd)pyrene	8270SIM	13-Nov-10	0.16	8.7
		RRO	AK103	13-Nov-10	1000	1880

PSL EXCEEDANCES TABLE - SOIL (CONTINUED)

Location ID	Depth (ft)	Analyte	Method	Sample Date	PSL (mg/kg)	Result (mg/kg)
2010 Fieldwork Summary (Continued)						
SB07	5	Benzo(a)anthracene	8270SIM	30-Nov-10	0.16	0.811
		Benzo(a)pyrene	8270SIM	30-Nov-10	0.016	0.881
		Benzo(b)fluoranthene	8270SIM	30-Nov-10	0.16	1.36
		Dibenzo(a,h)anthracene	8270SIM	30-Nov-10	0.016	0.136
		Indeno(1,2,3-cd)pyrene	8270SIM	30-Nov-10	0.16	0.447
SB08	4	Benzo(a)anthracene	8270SIM	30-Nov-10	0.16	10.3
		Benzo(a)pyrene	8270SIM	30-Nov-10	0.016	11.1
		Benzo(b)fluoranthene	8270SIM	30-Nov-10	0.16	13.1
		Benzo(k)fluoranthene	8270SIM	30-Nov-10	1.6	3.37
		Dibenzo(a,h)anthracene	8270SIM	30-Nov-10	0.016	1.67
		Indeno(1,2,3-cd)pyrene	8270SIM	30-Nov-10	0.16	5.3
	12	Benzo(a)pyrene	8270SIM	30-Nov-10	0.016	0.0238
SB08Z	7.5	Benzo(a)pyrene	8270SIM	07-Dec-10	0.016	0.0292
SB11	4	Benzo(a)anthracene	8270SIM	02-Dec-10	0.16	39.2
		Benzo(a)pyrene	8270SIM	02-Dec-10	0.016	39.7
		Benzo(b)fluoranthene	8270SIM	02-Dec-10	0.16	48.1
		Benzo(k)fluoranthene	8270SIM	02-Dec-10	1.6	13.2
		Chrysene	8270SIM	02-Dec-10	16	37.8
		Dibenzo(a,h)anthracene	8270SIM	02-Dec-10	0.016	6.29
		Indeno(1,2,3-cd)pyrene	8270SIM	02-Dec-10	0.16	20.6
SB13	4	Benzo(a)anthracene	8270SIM	09-Dec-10	0.16	0.412
		Benzo(a)pyrene	8270SIM	09-Dec-10	0.016	0.48
		Benzo(b)fluoranthene	8270SIM	09-Dec-10	0.16	0.54
		Dibenzo(a,h)anthracene	8270SIM	09-Dec-10	0.016	0.0802
		Indeno(1,2,3-cd)pyrene	8270SIM	09-Dec-10	0.16	0.286
	13	Trichloroethene (TCE)	SW8260B	09-Dec-10	0.41	0.452
SB14	4	Benzo(a)anthracene	8270SIM	06-Dec-10	0.16	0.647
		Benzo(a)pyrene	8270SIM	06-Dec-10	0.016	0.859
		Benzo(b)fluoranthene	8270SIM	06-Dec-10	0.16	1.03
		Dibenzo(a,h)anthracene	8270SIM	06-Dec-10	0.016	0.166
		Indeno(1,2,3-cd)pyrene	8270SIM	06-Dec-10	0.16	0.516
	14	Trichloroethene (TCE)	SW8260B	06-Dec-10	0.41	0.42
	22	Trichloroethene (TCE)	SW8260B	06-Dec-10	0.41	0.743
	37	Trichloroethene (TCE)	SW8260B	06-Dec-10	0.41	0.528
SB16	12	Trichloroethene (TCE)	SW8260B	08-Dec-10	0.41	0.412
SB17	32	Mercury	SW7471B	06-Dec-10	1.1	2.65
SB18	14	Trichloroethene (TCE)	SW8260B	03-Dec-10	0.41	0.532
SB20	16	Benzo(a)pyrene	8270SIM	01-Dec-10	0.016	0.0703
	27	Benzo(a)pyrene	8270SIM	01-Dec-10	0.016	0.0681
	37	Benzo(a)pyrene	8270SIM	01-Dec-10	0.016	0.0782
		Dibenzo(a,h)anthracene	8270SIM	01-Dec-10	0.016	0.0186
2016 Remedial Investigation						
MW02	30-32	TRICHLOROETHENE (TCE)	8260B	3/30/2016	0.41	0.47
	35-37	TRICHLOROETHENE (TCE)	8260B	3/30/2016	0.41	0.44
MW05	55-57	DRO	AK102	4/6/2016	1025	1500
SB12	55-57	DRO	AK102	3/22/2016	1025	1600
		GRO	AK101	3/22/2016	140	160





- 2016 Monitoring Well with Soil Exceedance
- 2016 Monitoring Well with No Soil Exceedance
- 2016 Soil Boring with Exceedance
- 2016 Soil Boring with No Exceedance
- Historical Soil Boring with Exceedance (2010)
- Historical Soil Boring with No Exceedance (2010)
- LUC Boundary
- Environmental Remediation Site
- Occupied Building
- Unoccupied Building
- Inferred Soil Extent (DRO)
- Inferred Soil Extent (TCE)
- JBER Boundary

Notes:
Location IDs for 2010 surface soil samples ('SS') correspond numerically to the associated ('SB') soil boring locations.
PSLs are EPA 2016 (November) RSLs (THQ = 0.1) for residential soil or 1/10 ADEC human health (2017 [November]) where no RSL exists.
PSLs are 1/10 the ADEC 18 AAC 75 most stringent of ingestion/inhalation for fuels (2017 [November]).
CN = Hydrocarbon response in diesel range but does not resemble diesel.
J = The result is an estimated value because it is between the DL and the LOQ.
Arsenic and chromium results are presumed naturally occurring and have been omitted.

The vertical extent of 2011 excavation activities ranged from 3 feet to 15 feet bgs. Only those soil results representative of current site conditions have been retained for evaluation as part of the RI and Risk Assessment.
In 2016, soil samples were collected every 5 feet at each boring and monitoring well locations down to the groundwater interface.
Cleanup levels used to measure approximate extents are ADEC 18 AAC 75 (2017 [November]) Tables B1 and B2, migration to groundwater for the under 40-inch zone..
Geobase Imagery: AKANCH12-ELMENDORF-SID-6INCH.sid

0 50 100 150 200
Feet
N
WGS 1984 UTM Zone 6N

SS109 (F-22 WEAPONS RELEASE SHOP) RI SOIL SAMPLE LOCATIONS AND EXCEEDANCES, AND PROPOSED LAND USE CONTROL BOUNDARY

JOINT BASE ELMENDORF-RICHARDSON, ALASKA

JACOBS	DATE: 24 JUL 2019	PROJECT MANAGER: G. RUTKOWSKI	FIGURE NO: A-4a

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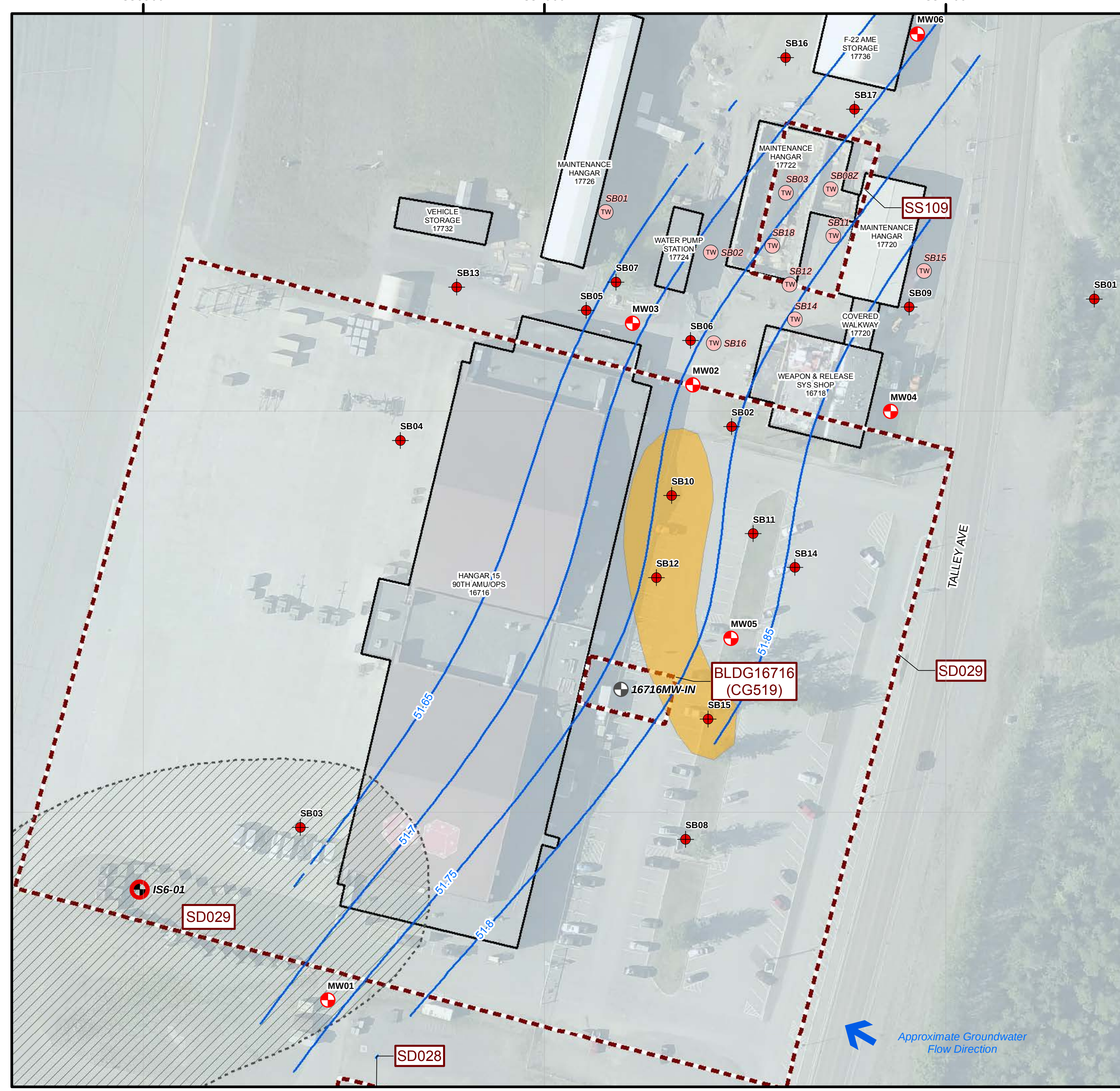
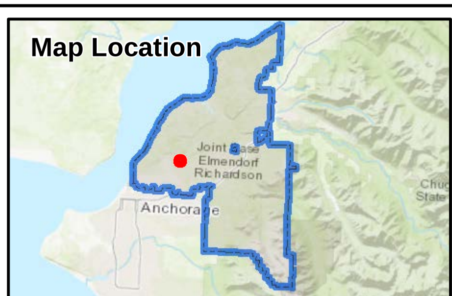
PSL EXCEEDANCES TABLE - GROUNDWATER					
Location ID	Analyte	Method	Sample Date	PSL (mg/L)	Result (mg/L)
2010 Fieldwork Summary Temporary Wellpoints					
SB01	Barium	SW6020	09-Dec-10	0.38	2.68
	Cadmium	SW6020	09-Dec-10	0.00092	0.00531
	Chloroform	SW8260B	09-Dec-10	0.00022	0.00278
	Diesel Range Organics	AK102	09-Dec-10	0.15	0.744 J
	Lead	SW6020	09-Dec-10	0.015	0.224
SB02	Barium	SW6020	10-Dec-10	0.38	1.18
	Cadmium	SW6020	10-Dec-10	0.00092	0.00136 J
	Chloroform	SW8260B	10-Dec-10	0.00022	0.00277
	Diesel Range Organics	AK102	09-Dec-10	0.15	3.19
	Lead	SW6020	10-Dec-10	0.015	0.0674
	Trichloroethene (TCE)	SW8260B	10-Dec-10	0.00026	0.00038 J
SB03	Barium	SW6020	10-Dec-10	0.38	2.71
	Benzo(a)anthracene	8270SIM	09-Dec-10	0.000012	0.0000346 J
	Benzo(a)pyrene	8270SIM	09-Dec-10	0.0000034	0.0000275 J
	Benzo(b)fluoranthene	8270SIM	09-Dec-10	0.000034	0.0000521
	Cadmium	SW6020	09-Dec-10	0.00092	0.006
	Chloroform	SW8260B	09-Dec-10	0.00022	0.00152
	Diesel Range Organics	AK102	09-Dec-10	0.15	0.666 J
	Lead	SW6020	10-Dec-10	0.015	0.207
SB08Z	Barium	SW6020	09-Dec-10	0.38	1.34
	Cadmium	SW6020	09-Dec-10	0.00092	0.00415
	Chloroform	SW8260B	09-Dec-10	0.00022	0.00119
	Lead	SW6020	09-Dec-10	0.015	0.132
SB11	Barium	SW6020	10-Dec-10	0.38	1.41
	Benzo(a)anthracene	8270SIM	10-Dec-10	0.000012	0.00105
	Benzo(a)pyrene	8270SIM	10-Dec-10	0.0000034	0.00101
	Benzo(b)fluoranthene	8270SIM	10-Dec-10	0.000034	0.00157
	Benzo(g,h,i)perylene	8270SIM	10-Dec-10	0.000026	0.000516
	Cadmium	SW6020	10-Dec-10	0.00092	0.00254
	Chloroform	SW8260B	10-Dec-10	0.00022	0.00135
	Dibenzo(a,h)anthracene	8270SIM	10-Dec-10	0.0000034	0.00014
	Diesel Range Organics	AK102	10-Dec-10	0.15	0.472 J
	Indeno(1,2,3-cd)pyrene	8270SIM	10-Dec-10	0.000034	0.000512
	Lead	SW6020	10-Dec-10	0.015	0.117
	Naphthalene	8270SIM	10-Dec-10	0.00017	0.00023
SB12	1-Methylnaphthalene	8270SIM	09-Dec-10	0.0011	0.108
	2-Methylnaphthalene	8270SIM	09-Dec-10	0.0036	0.127
	Barium	SW6020	10-Dec-10	0.38	0.693
	Cadmium	SW6020	10-Dec-10	0.00092	0.00163 J
	Chloroform	SW8260B	09-Dec-10	0.00022	0.00268
	Lead	SW6020	10-Dec-10	0.015	0.0691
	Naphthalene	8270SIM	09-Dec-10	0.00017	0.225
	Naphthalene	8270SIM	10-Dec-10	0.00017	0.000665
SB14	Barium	SW6020	10-Dec-10	0.38	2.98
	Benzo(a)anthracene	8270SIM	10-Dec-10	0.000012	0.0000365 J
	Benzo(a)pyrene	8270SIM	10-Dec-10	0.0000034	0.000048 J
	Benzo(b)fluoranthene	8270SIM	10-Dec-10	0.000034	0.0000784
	Benzo(g,h,i)perylene	8270SIM	10-Dec-10	0.000026	0.0000284 J
	Cadmium	SW6020	10-Dec-10	0.00092	0.0058
	Chloroform	SW8260B	10-Dec-10	0.00022	0.00314
	Diesel Range Organics	AK102	10-Dec-10	0.15	0.458 J
	Lead	SW6020	10-Dec-10	0.015	0.268
	Naphthalene	8270SIM	10-Dec-10	0.00017	0.000579
	Trichloroethene (TCE)	SW8260B	10-Dec-10	0.00026	0.00054 J
SB15	Chloroform	SW8260B	10-Dec-10	0.00022	0.00147
	Diesel Range Organics	AK102	10-Dec-10	0.15	0.34 J

PSL EXCEEDANCES TABLE - GROUNDWATER (CONTINUED)					
Location ID	Analyte	Method	Sample Date	PSL (mg/L)	Result (mg/L)
2010 Fieldwork Summary Temporary Wellpoints (Continued)					
SB16	Barium	SW6020	10-Dec-10	0.38	4.74
	Cadmium	SW6020	10-Dec-10	0.00092	0.013
	Chloroform	SW8260B	10-Dec-10	0.00022	0.00408
	Lead	SW6020	10-Dec-10	0.015	0.5
	Naphthalene	8270SIM	10-Dec-10	0.00017	0.000425 J,JM-
	Selenium	SW6020	10-Dec-10	0.01	0.0102
	Trichloroethene (TCE)	SW8260B	10-Dec-10	0.00026	0.00102
SB18	Barium	SW6020	9-Dec-10	0.38	2.53
	Cadmium	SW6020	09-Dec-10	0.00092	0.00547
	Chloroform	SW8260B	09-Dec-10	0.00022	0.00194
	Lead	SW6020	09-Dec-10	0.015	0.195
2016 Remedial Investigation - Temporary Wellpoints					
SB01	CHLOROFORM	8260B	31-May-16	0.00022	0.001
SB02	CHLOROFORM	8260B	7-Apr-16	0.00022	0.0016
SB03	CHLOROFORM	8260B	17-May-16	0.00022	0.0011
	TETRACHLOROETHENE (PCE)	8260B	17-May-16	0.0041	0.011
	TRICHLOROETHENE (TCE)	8260B	17-May-16	0.00026	0.003
SB04	BENZENE	8260B	17-May-16	0.00046	0.00066 J
	TETRACHLOROETHENE (PCE)	8260B	17-May-16	0.0041	0.0048
SB05	CHLOROFORM	8260B	31-Mar-16	0.00022	0.0018
	TRICHLOROETHENE (TCE)	8260B	31-Mar-16	0.00026	0.0015
SB06	CHLOROFORM	8260B	2-Apr-16	0.00022	0.0021
SB07	CHLOROFORM	8260B	1-Apr-16	0.00022	0.0021
SB08	CHLOROFORM	8260B	1-Jun-16	0.00022	0.0013
SB09	CHLOROFORM	8260B	29-Mar-16	0.00022	0.0011
SB10	CHLOROFORM	8260B	23-Mar-16	0.00022	0.00037 J
	NAPHTHALENE	8260B	23-Mar-16	0.00017	0.0024
	DRO	AK102	23-Mar-16	0.15	2.4
SB11	CHLOROFORM	8260B	25-Mar-16	0.00022	0.0012
SB12	NAPHTHALENE	8260B	22-Mar-16	0.00017	0.0036
	DRO	AK102	22-Mar-16	0.15	24
SB13	CHLOROFORM	8260B	1-Jun-16	0.00022	0.0013
	TRICHLOROETHENE (TCE)	8260B	1-Jun-16	0.00026	0.0009 J
SB14	CHLOROFORM	8260B	22-Mar-16	0.00022	0.0015
SB15	2-HEXANONE	8260B	25-Mar-16	0.0038	0.0045 J
	CHLOROFORM	8260B	25-Mar-16	0.00022	0.00033 J
	NAPHTHALENE	8260B	25-Mar-16	0.00017	0.0029
	DRO	AK102	25-Mar-16	0.15	3.4
SB16	CHLOROFORM	8260B	28-Mar-16	0.00022	0.00097 J
SB17	CHLOROFORM	8260B	26-Mar-16	0.00022	0.00069 J
2016 Remedial Investigation - Monitoring Wells					
MW01	CHLOROFORM	8260B	26-Apr-16	0.00022	0.0021
	TETRACHLOROETHENE (PCE)	8260B	26-Apr-16	0.0041	0.01
	TRICHLOROETHENE (TCE)	8260B	26-Apr-16	0.00026	0.0087
MW02	CHLOROFORM	8260B	25-Apr-16	0.00022	0.002
	TRICHLOROETHENE (TCE)	8260B	25-Apr-16	0.00026	0.00064 J
MW03	CHLOROFORM	8260B	25-Apr-16	0.00022	0.0019
	TRICHLOROETHENE (TCE)	8260B	25-Apr-16	0.00026	0.0013
MW04	CHLOROFORM	8260B	25-Apr-16	0.00022	0.0021
MW05	1,1,2,2-TETRACHLOROETHANE	8260B	26-Apr-16	0.000076	0.00081J
	CHLOROFORM	8260B	26-Apr-16	0.00022	0.00068 J
	NAPHTHALENE	8260B	26-Apr-16	0.00017	0.00089 J
	DRO	AK102	26-Apr-16	0.15	0.3
MW06	CHLOROFORM	8260B	25-Apr-16	0.00022	0.00083 J





Historic Well with No Groundwater Exceedance

Historic Well with Groundwater Exceedance

2016 Temporary Well with Groundwater Exceedance

2016 Monitoring Well with Groundwater Exceedance

Historical Temporary Well with Groundwater Exceedance

Ground Water Contours (ft)

OU4 EAST SD029 TCE Plume

Groundwater Plume (DRO)

Environmental Remediation Site

Building

JBER Boundary

Notes:
PSLs are the EPA 2016 (November) RSLs (THQ = 0.1) for tapwater or 1/10 ADEC Table C (2017 [November]) where no RSL exists.
The PSL for TCE is from the OEA Region 10 Memorandum (EPA 2012).
J = The result is an estimated value because it is between the DL and the LOQ.
JM-=The result was an estimated value because the analyte failed recovery criteria (low) in the matrix spike (MS) or matrix spike duplicate (MSD) sample, or both.
Arsenic and chromium results are presumed naturally occurring and have been omitted.

Elevated concentrations of metals found in 2010 temporary wells are likely due to the presence of particulate; groundwater samples from these locations were not filtered. Neither groundwater well nor soil boring groundwater grab samples were analyzed for metals in 2016.
Groundwater flow direction is based on monitoring well data collected for the 2016 RI.
• OU4 East SD029 TCE plume extent is sourced from 2016 JBER Geobase and was expanded to include MW01, which exceeded the ADEC Table C cleanup level for TCE in 2018.
Geobase Imagery: AKANCH12-ELMENDORF-SID-6INCH.sid

0 100 200 300
Feet

WGS 1984 UTM Zone 6N

N

SS109 (F-22 WEAPONS RELEASE SHOP) RI GROUNDWATER SAMPLE LOCATIONS AND EXCEEDANCES AND ADJACENT SITE PLUMES

JOINT BASE ELMENDORF-RICHARDSON, ALASKA

JACOBS	DATE: 24 JUL 2019	PROJECT MANAGER: G. RUTKOWSKI	FIGURE NO: A-4b

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APPENDIX B
Applicable or Relevant and Appropriate Requirements

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

This appendix reviews potential Applicable or Relevant and Appropriate Requirements (ARARs) for the SS109 F-22 Weapons Release Shop site (SS109) on Joint Base Elmendorf-Richardson (JBER). Under the Comprehensive Environmental Response, Compensation, and Liability Act, three types of ARARs are considered:

- Chemical-specific: This FS considers several regulations and guidance documents that pertain to TCE, the only contaminant of concern under consideration at this time. Refer to Table B-1.
- Location-specific: The site is a developed area. No endangered or threatened species are known to inhabit the area. It is not part of a wildlife refuge. Although the Migratory Bird Treaty Act applies to all of JBER, no tree-cutting or other disturbances are proposed, and SS109 is located on the flight line, which would not constitute appropriate habitat. No surface water is present at SS109 and groundwater is deeper than would be encountered by site visitors, construction workers, or wildlife. No drinking water wells exist; however, groundwater use restrictions currently in place for all of JBER apply to SS109. Refer to Table B-2.
- Action-specific: Regulations that address waste characterization and management have been retained for consideration should unacceptable levels of soil contamination be identified in the future, as dig restrictions are proposed for this reason as part of Alternatives 2 and 4. Refer to Table B-3.

Each ARAR has been assessed based on its applicability to the site, and categorized as applicable, potentially applicable, or to be considered (TBC) as guidance.

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ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ARAR	Applicable or Relevant and Appropriate Requirement
AS	Alaska Statute
CFR	Code of Federal Regulations
EPA	U.S. Environmental Protection Agency
JBER	Joint Base Elmendorf-Richardson
LUC	land-use control
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
TBC	to be considered (as guidance)
TCE	trichloroethylene
TSCA	Toxic Substances Control Act
U.S.C.	U.S. Code
VSP	ventilated stockpile

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

ARARs	Citation or Reference	Requirements	Applicability	Comments and Analysis / Rationale for Decision
Oil and Hazardous Substances Pollution Control Regulations	Table B1 (18 AAC 75.341) Table C (18 AAC 75.345) Institutional Controls (18 AAC 75.375).	Regulations establishing discharge reporting, cleanup, and disposal requirements for oil and other hazardous substances. Provides cleanup standards for soil and groundwater.	Applicable	• Under Alternative 1, no measures are in place to prevent human health exposures or contaminant migration. • Under Alternatives 2 and 4, LUCs preclude soil excavation. TCE concentrations at SS109 exceed the ADEC migration to groundwater cleanup level but not human health criterion. • Under Alternative 3, soil treatment will continue at the VSP until concentrations fall below ADEC migration to groundwater cleanup levels.
National Primary Drinking Water Standards	20 CFR 141.61	Defines health-based standards, monitoring requirements, and treatment techniques for public water systems.	Applicable	• Considered for maximum beneficial use of groundwater. Current TCE concentrations attributed to SS109 do not exceed the maximum contaminant level for TCE (5 µg/L); only the result from MW01, which is part of SD029, exceeded this value.
Not-to-be exceeded TCE concentrations	OEA Memorandum (EPA 2012)	Sets more conservative target levels for soil, groundwater, and air to account for more sensitive receptors.	Applicable	• Used to develop RAOs for soil gas and indoor air.
RCRA	40 CFR 268.35, 263	Standards for generation of hazardous waste and land disposal restrictions for waste with specific prohibitions.	Potentially applicable	• Hazardous waste is not anticipated, and removal actions are not being considered in this FS. LUCs will preclude excavation under Alternatives 2 and 4.

Table B-1
Chemical-Specific Applicable or Relevant and Appropriate Requirements (Continued)

ARARs	Citation or Reference	Requirements	Applicability	Comments and Analysis / Rationale for Decision
TSCA	15 U.S.C. §2601 et seq. (1976)	TSCA regulations consist of chemical control measures including information gathering, chemical testing, labeling, inspection, storage, and disposal requirements.	Potentially applicable	• Contamination at SS109 is not anticipated to be TSCA-regulated; however, any TSCA-level soil identified onsite would need to be handled and disposed of in accordance with TSCA.

Note:
For definitions, refer to the Acronyms and Abbreviations section.

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

ARARs	Citation or Reference	Requirements	Applicability	Comments and Analysis / Rationale for Decision
ADEC Solid Waste Regulations	18 AAC 60	Solid waste management including authorizations, inspections, compliance monitoring, and disposal regulations.	Applicable	The VSP proposed for continued treatment under Alternatives 3 and 4 is currently located within Class I landfill boundaries. Treated soils will remain onsite.

Note:
For definitions, refer to the Acronyms and Abbreviations section.

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

ARARs	Citation or Reference	Requirements	Applicability	Comments and Analysis/Rationale for Decision
Uniform Environmental Covenants Act	AS 46.04.300-390	An environmental covenant is a servitude arising under an environmental response project that imposes activity and use limitations. A notice of activity and use limitation is a restriction on or obligation concerning an activity on or use of real property that is filed into the appropriate public land records.	Applicable	A legal impediment precludes USAF from creating an environmental covenant on JBER; a notice of activity and use limitation per AS 46.04.340 that ensures the protection of human health, safety, welfare, and the environment will be applied to SS109.
Institutional Controls	18 AAC 75.375	ADEC specifies institutional controls for residual contamination left in excess of cleanup levels resulting from a discharge of oil or a hazardous substance.	Applicable	LUCs are specified for soil gas under Alternatives 2 and 4. Both EPA and ADEC guidance will be consulted in the development of LUCs.
Identification and Listing of Hazardous Waste	40 CFR 261	Defines solid waste that are subject to regulation as hazardous waste under 40 CFR Parts 124, 262-265, 270, and 271.	Applicable	Under Alternatives 2 and 4, LUCs preclude soil excavation. Under Alternatives 1 and 3, no such controls are in place. If soil is excavated, it may be necessary to make a waste determination.
Land Disposal Restrictions	40 CFR 268	Requires treatment to diminish toxicity of waste and/or minimize contaminant migration for any land disposal of hazardous wastes.	To Be Considered	Does not currently apply; soil undergoing treatment is non-hazardous. May apply in the future if additional soil is excavated.
RCRA	40 CFR 268.35, 263	Standards for generation of hazardous waste and land disposal restrictions for waste with specific prohibitions.	Potentially applicable	No hazardous waste will be generated under any of the alternatives developed for SS109. Soil undergoing treatment at the VSP is non-hazardous.

Note:
For definitions, refer to the Acronyms and Abbreviations section.

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APPENDIX C
Cost Estimates

JBER SS109 F-22 Weapons Release Shop Feasibility Study
Cost Analysis Summary Table

Alternative	Alternative Description	Estimated Contaminated Soil Quantity To Be Treated (CY)	Estimated Present Worth Cost for Alternative (+50% / -30%)
Alternative 1	No Action.	0	$0
Alternative 2	Institutional Controls (ICs) would be implemented to restrict tampering with or in any way harming the vapor barrier. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Five-Year Reviews would be required to inspect drains and other outfalls for degredation and other site conditions and to evaluate the long-term protectiveness of the remedy. As part of the 5 year reveiw two rounds of VI monitoring would take place ahead of the reveiw.	0	$227,095
Alternative 3	Alternative 3 Includes six months of continued operation and maintenance plus soil sampling and eventual decommisssioning at a ventilated stockpile currently in place to treat SS109 soils.	2,200	$253,538
Alternative 4	Components of both Alternative 2 and Alternative 4 are combined to comprehensively address both soil gas and soil.	2,200	$480,634

Notes:

Costs are based on subcontractor quotes, remedial investigation figures, and engineering estimates

Note that no separate cost tab was generated for Alternative 4, as few efficiencies could be realized by concurrently implementing Alternatives 2 and 4. The cost reflected in the FS for Alternative 4 is the sum of Alternatives 2 and 3.

For definitions, refer to the Acronyms and Abbreviations section in the SS109 FS.

JBER SS109 F-22 Weapons Release Shop Feasibility Study
Cost Analysis for Alternative 2

Institutional Controls (ICs) would be implemented to restrict tampering with or in any way harming the vapor barrier. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Five-Year Reviews would be required to inspect drains and other outfalls for degredation and other site conditions and to evaluate the long-term protectiveness of the remedy. As part of the 5 year reveiw two rounds of VI monitoring would take place ahead of the reveiw.

Task	Category	Item	Unit	Unit Cost	QTY	Cost
CAPITAL COSTS						
All Tasks						
Land Use Control Implementation and Maintenance						
Site Inspection						
	Planning		HR	$ 108	60	$ 6,479
	Procurements (camera, documentation supplies, cost tracking)		LS	$ 2,400	1	$ 2,400
	Site Inspection (inspect drains and other out falls, etc)					
	Mobilization (assumes out-of-state employees)		TRIP	$ 1,000	2	$ 2,000
	Labor (for further assessment/repairs as needed)		HR	$ 150	20	$ 3,000
	Site Manager/Site Safety and Health Officer		HR	$ 145	12	$ 1,737
	Project Engineer		HR	$ 145	12	$ 1,737
	Documentation		HR	$ 108	40	$ 4,319
	Project Manager		HR	$ 158	15	$ 2,375
				Subtotal		$ 24,046
Planning, Permitting, Design, Work Plans, Project Management			%	30%		$ 7,214
SUBTOTAL, CAPITAL COSTS						$ 31,260
				10% Estimating Contingency		$ 3,126
TOTAL ESTIMATED CAPITAL COSTS						**$ 34,386**
ANNUAL COSTS						
Five-Year Reviews (Conducted once every five years)						
	Community Involvment and Notification		HR	$ 107.98	10	$ 1,080
	Planning		TRIP	$ 107.98	40	$ 4,319
	Procurements - rentals, replacement of a sample train, consumables, etc		LS	$ 2,400.00	1	$ 2,400
	Mobilization Costs (assumes out of state employees)		TRIP	$ 1,000.00	2	$ 2,000
	Site Visit (Changes to site-re-check drains, out falls, erosion, etc)		HR	$ 144.73	24	$ 3,474
	Sampling plus canisters and sampling consumables -See Analyical tab for pricing.		LS	$ 5,643.36	2	$ 11,287
	Interviews		HR	$ 107.98	10	$ 1,080
	Document Review		HR	$ 107.98	20	$ 2,160
	Data Review and Analysis		HR	$ 107.98	40	$ 4,319
TOTAL ESTIMATED ANNUAL COSTS						**$32,118**

Alternative 2 Cost Summary (+50% / - 30%)	
Total Estimated Capital Costs	$ 34,386
Total Estimated Annual Costs	$32,118
Present Worth of Annual Costs	$192,708.79
Total Capital Cost with Present Worth Annual Costs	**$ 227,095**

JBER SS109 F-22 Weapons Release Shop Feasibility Study
Cost Analysis for Alternative 3

Alternative 3 Includes six months of continued operation and maintenance plus soil sampling and eventual decommisssioning at a ventilated stockpile currently in place to treat SS109 soils.

Task	Category	Item	Unit	Unit Cost	QTY	Cost
CAPITAL COSTS						
All Tasks						
	Office/Offsite Labor	Administrator	HR	$ 93.86	5	$ 469
	Field Labor	Project Manager	HR	$ 158.31	20	$ 3,166
		Site Manager / SSHO	HR	$ 144.73	36	$ 5,210
		Project Engineer / CQC	HR	$ 139.84	36	$ 5,034
		Lead Sampler	HR	$ 107.34	20	$ 2,147
		Field Sampler	HR	$ 93.86	20	$ 1,877
Tilling						
	Subcontractor	Mobilization	LS	$ 5,000.00	1	$ 5,000
		Site Superintendent	ST	$ 120.06	16	$ 1,921
			OT	$ 155.25	4	$ 621
		Operator (1 ea)	ST	$ 115.92	16	$ 1,855
			OT	$ 150.08	4	$ 600
		Laborer 1 (2 ea)	ST	$ 103.50	16	$ 1,656
			OT	$ 129.38	4	$ 518
	Equipment	Excavator	HR	$ 450.00	20	$ 9,000
		Tarp	LS	$ 658.00	2	$ 1,316
Operation and Maintenance						
System maintenance			LS	$ 6,820.00	2	$ 13,640
	Removal of ponded water			$ 500.00	6	$ 3,000
	Top venting		LS	$ 500.00	6	$ 3,000
Sampling	Soil			$ 136.62	40	$ 5,465
	Soil-low level			$ 157.11	40	$ 6,284
Operational Costs						
	Fuel/Power		Month	$ 3,720.00	6	$ 22,320
Decomissioning - Assume you can dispose of material onsite						
	Subcontractor	Mobilization	LS	$ 5,000.00	$ 1.00	$ 5,000
		Site Superintendent	ST	$ 1,956.15	16	$ 31,298
			OT	$ 136.62	4	$ 546
		Operator (1 ea)	ST	$ 115.92	16	$ 1,855
			OT	$ 6.99	4	$ 28
		Laborer 1 (2 ea)	ST	$ 26.52	16	$ 424
			OT	$ 393.30	4	$ 1,573
	Equipment	Excavator	HR	$ 5,175.00	20	$ 103,500
	Other Direct Costs	Waste disposal and small purchases	LS	$ 5,000.00	1	$ 5,000.00
		Fuel	GAL	$ 24.76	20.0	$ 495
	Document Review		HR	$ 107.98	20	$ 2,160
	Data Review and Analysis		HR	$ 107.98	40	$ 4,319
	Regulatory Coordination/Reporting		HR	$ 107.98	30	$ 3,239
TOTAL ESTIMATED CAPITAL COSTS						**$253,538**
TOTAL ESTIMATED ANNUAL COSTS						$ -

Alternative 3 Cost Summary (+50% / - 30%)	
Total Estimated Capital Costs	$253,538
Total Estimated Annual Costs	$0
Present Worth of Annual Costs	$0.00
Total Capital Cost with Present Worth Annual Costs	**$ 253,538**

JBER SS109 F-22 Weapons Release Shop Feasibility Study
Cost Estimates for Sampling and Analysis

Alternative	Soil	Soil - Low Level	Air	Total Esitmated Cost
Alternative 1: No Action	0	0	0	$0
Alternative 2: Institutional Controls	0	0	$4,827.36	$4,827.36
Alternative 3: VSP System	$5,464.80	$6,284.40	$0.00	$11,749

Laboratory Pricing

Method	TAT	Price	Total
SW8260 - Soil	14	$136.62	$136.62
SW8260 Low level- Soil	14	$157.11	$157.11
SW8260 - Air	30	$301.71	$301.71
Total			$595.44

Samples	Soil	Air
Quantity per Event	20	8

Notes:
For definitions, see the Acronyms and Abbreviations section in the SS109 Feasibility Study
Analytical sampling in coordination with Five-Year Reviews (Alternative 2) assumes 2 events, 8 each for air (7 primary, 1 duplicate)
VSP sampling (Alternative 3) includes two events total (14 primary, 2 duplicate, 1 MS/MSD pair, plus trip blanks).

APPENDIX D
Responses to Comments

EPA Comments: SS109 F22 Weapons Release Shop Draft Feasibility Study, JBER-Elmendorf, December 2018.

Number	Page	Section	Comment	Response
EPA received the SS109 F22 Weapons Release Shop Draft Feasibility Study, JBER-Elmendorf, December 2018 for review after the partial government shutdown ended on 1/28/2019. Other priorities in the queue so comments not sent until 5/7/2019.				
1.	Risk to SS109 attributed to adjacent site SD029		The SS109 Remedial Investigation Report (June 2018) attributes all of the human health risk at SS109 to the groundwater plume associated with adjacent site SD029. Until additional characterization is completed at SD029 and the groundwater plume better defined, it appears premature to proceed with a FS for SS109. EPA prefers to delay finalization of the SS109 FS until additional characterization and delineation of the contributing SD029 groundwater plume has concluded.	Disagree. The source area for SD029 is not known and remains to be investigated, but RI results and groundwater flow indicate that both the plumes and source areas are distinct and therefore subject to separate decision processes. The groundwater "solvent plume" at SS109 (areas where TCE is detected but at concentrations below PCLs) encompasses RI locations MW02, MW03, SB02, SB05, SB07, and SB13, all north of Hangar 15. This plume corresponds to soil contamination above migration to groundwater, but not human health, cleanup levels indicative of the prior release that comprises SS109. The following text will be added to Section 2.1: "SS109 RI results indicate no connectivity between this area and SD029, including nondetect TCE groundwater results for SB04 west of Hangar 15 and multiple temporary and monitoring well locations to the east (Figure A-4b)."
2.	Alternative 2		Alternative 3: Ex-Situ Treatment of Soil is a current interim remedy and should be combined with Alternative 2.	Agree. Alternatives 2 and 3 will be combined into a new Alternative 4. Alternative 4 will be recommended. (See also the response to ADEC Comment #1.)

EPA Comments: SS109 F22 Weapons Release Shop Draft Feasibility Study, JBER-Elmendorf, December 2018.

Number	Page	Section	Comment	Response
			As Five Year Reviews are not a remedy, Alternative 2 should include the Long Term Monitoring (air is described here, if kept generic could include additional groundwater monitoring as the SD029 supplemental investigation proceeds).	Agree. Five-Year Reviews will be dropped from the title of Proposed Alternative 2, but retained as a remedy component. Long-term monitoring for soil gas and ambient air address the only risk-driver at SS109, which is inhalation via a hypothetical future exposure pathway. This component will be added to the title of Alternative 2. Groundwater monitoring at SD029 is currently ongoing and could be expanded to include MW01; however, decision-making at SD029 will be more effective once a source area and plume boundaries have been established, which, given the lack of connectivity between the two sites, is outside the scope of the SS109 CERCLA process.
			The FS provides really only two alternatives in the analysis: Alternative 1 No Action and Alternative 2: Land Use Controls with Long Term Monitoring and Ex-Situ Treatment of Soils. Are there additional alternatives that should be evaluated? (ie.. building vapor mitigation, groundwater treatment, etc…)	Agree. The following text will be added to Section 5.0: "A full set of alternatives for contamination present at SS109 were evaluated in the 2010 EE/CA. Since the EE/CA was published, the selected remedy components (including a TCRA and non-TCRA removal, SVE system, and ventilated stockpile) were implemented. USAF does not believe additional technologies would benefit the decision process at this point, as no current threat to human health exists at SS109 and the preferred remedy could be re-visited via the five-year review process in the future should increase potential for human health exposure be identified. The ventilated stockpile currently in operation to treat previously removed soils appears effective; continued operation will bring contaminant levels below migration to groundwater criteria without the need for optimization."

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3.		2.2.6	A figure to present the groundwater results detailed in Section 2.2.6 would be very illustrative.	Agree. Figures showing prior investigation locations for soil and groundwater and PSL exceedances will be added to illustrate the discussion as Figures A-4a and A-4b, respectively. The figure note referencing the RI report will be removed. The soil figure (Figure A-4a) will include the LUC boundary. Note that soil results did not exceed PSLs and no groundwater exceedances are associated with SS109. The following text will be added to the last paragraph in Section 2.2.6: "… separate from the solvent plume associated with SS109. Several sample locations to the south of SS109 show a separation between SS109 and SD029 including SB04, SB08, SB10, SB11, SB12, SB14, SB16, and MW06 (Figure A-4b)."
4.	2-16	2.4.1	The statement "The SD029 plume and the SS109 plume both pass beneath Hangar 15 (Building 16716); therefore, all results were included in the HHRA" contradicts the sentence later in the paragraph "PCE and TCE are not retained as COCs for groundwater in this FS because groundwater contamination (greater than the ADEC Table C cleanup level) is the result of the adjacent Source Area SD029".	Agree. The sentence will be clarified: "The SD029 TCE plume and a separate area of TCE detections in groundwater attributed to SS109 both pass beneath Hangar 15 (Building 16716); therefore, all results were included in the HHRA. The highest concentration of TCE detected in groundwater that is attributed to SS109 is 1.5 µg/L, which is above the PSL of 0.26 µg/L but below the ADEC Table C cleanup level of 2.8 µg/L."
			Provide a figure to support this conclusion. If there were no releases at SS109, how is there a groundwater plume for SS109?	The groundwater plume for SS109 contains low-level detections of TCE, none of which exceed the PCL. Human health risk is attributed only to the SD029 plume, which underlies Hangar 15.

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			This needs to be substantiated better. Fig A-4 displays the SD029 Groundwater plume 400 feet from the inferred soil contamination area associated with SS109. No groundwater contours are provided on Fig A-4; a small blue arrow (in the trees on the SE corner of the map, very hard to see) suggests groundwater flows to the N-NE at this site.	Agree. A figure showing groundwater contours generated using the groundwater elevations measured during the 2016 sampling event will be added to the FS. The purpose of Figure A-4 is to display proposed LUC boundaries that preclude soil excavation relative to contaminated areas and site features.
5.	4-5	4.2.2	It seems odd to reference only SD029 here. The soil gas contamination at SS109 is not solely attributed to contaminated groundwater, is it?	Agree. The first sentence in the final paragraph of Section 4.2.2 will be clarified: “Statutory five-year reviews would be required with the LUC remedy at SS109 as soil gas contamination will remain onsite at levels that do not allow for UU/UE (refer to Section 5.1.2).” (*Note that this text has been moved to Section 5.3 Five-Year Reviews*). The EPA VISL Target Groundwater Concentration (TCR=1E-05 or THQ=1) is 13.4 µg/L; none of the groundwater concentrations within the SS109 plume exceed this value, and therefore soil contamination is likely to contribute.
6.		5.2	Alternative 2 should be renamed as “Land Use Controls and Long-Term Monitoring”. Five Year Reviews are not a remedy, and this section states that air monitoring (indoor/outdoor, soil gas) would be conducted periodically ahead of each five-year review to evaluate the effectiveness of the remedy.	Agree. See also EPA Response #2.
			Potentially groundwater monitoring could also be a component of the remedy.	Disagree. Groundwater concentrations at SS109 do not exceed PSLs. Exceedances at SD029 are unconnected as evidenced by the expanded

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				discussion of groundwater contamination in Section 2.2.6 (see EPA Response #1 above).
7.	5-2	5.2.2	This section states "Five-year reviews would be initiated to include building inspections". This is not a standard practice as part of the Five-Year Review site inspection and would need to be included as a specific component of the Long-Term Monitoring remedy.	Agree. Section 5.2 will be re-titled: Alternative 2: LUCs and Long-Term Monitoring. Section 5.2.2 will be re-titled: Long-Term Monitoring. The first sentence of Section 5.2.2 will read: "Long-term monitoring will be carried out in advance of each CERCLA Five-Year Review to evaluate the effectiveness …" A sentence will also be added to the end of the first paragraph in Section 5.2.2: "Building inspections should assess potential changes to the VI pathway, and include an inventory of chemicals stored/used in the facility."
8.		5.2.2	2nd paragraph: Drop the specificity of the sampling - save that for the RD or RA workplan.	USAF prefers that frequency and schedule be included as it pertains to the remedy cost comparison, and agreed upon for future programming and scoping purposes. Per EPA FS Guidance (1985) Section 9.7, the recommended remedial action should include "operation, maintenance, and monitoring requirements." Table 6-1 in RI/FS Guidance (1988) specifies the type, degree, and requirements for long-term monitoring be included as part of the analysis of 'Adequacy and Reliability of Controls."
9.		5.3	Describe how the 'clean soil' will be disposed.	The ultimate fate of the treated soil has yet to be determined. The second-to-last bullet in Section 5.3 currently states:

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				"Restore the stockpile footprint, as directed by USAF in coordination with the JBER Compliance Program and ADEC Solid Waste Management offices, as it occurs within the OU1 landfill." To acknowledge EPA's concern, the following best practices will be added at the end of the second to last bullet in Section 5.3: "Treated soil will not be deposited along surface water or in any sensitive environments. It should not be used within 100 feet of surface water, a private water system, or a fresh water supply system that uses groundwater, or within 200 feet of a water source serving a community water system, a non-transient non-community water system, or a transient non-community water system." Note that final soil disposition was not specified in the 2011 EE/CA, the 2012 SVE Installation and Stockpile Construction Technical Memorandum, or the 2012 O&M Manual. The 2012 Technical Memorandum states: Final disposal location of the ventilated stockpile soil after completion of remediation activities will be determined at a later time by the USAF. No regulatory comments were received.
10.		6.3.2	Be specific on how Alternative 2: Land Use Controls and Long Term Monitoring, Ex-Situ Treatment of Soils will meet chemical, location, and/or action specific ARARs	Agree. Section 6.3.2 will be revised to state: "This alternative complies with ARARs because site use at SS109 is anticipated to remain the same. Long-term monitoring will be conducted to ensure that TCE in soil gas does not migrate to indoor air and present an inhalation risk to site employees. Dig restrictions will prevent the transport and re-use of contaminated soil with concentrations

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				above ADEC migration to groundwater criteria. Five-year reviews will include the results of building inspections to verify that potential exposure pathways as evaluated in this FS remain the same.”
11.		6.3.3	Provide additional details on how Alt 2: LUCs and Long-Term Monitoring satisfies the Long-Term Effectiveness and Permanence. The US government in general has a relatively poor track record for long term stewardship/maintenance.	Section 6.3.3 will be revised to more explicitly address the Long-Term Effectiveness and Permanence criterion: “No threat to human health currently exists at SS109. Potential for future threats will be evaluated through building inspections and long-term VI monitoring. As a precautionary measure, LUCs will be implemented to restrict invasive activities and preclude any changes to infrastructure or site use that could complete human health exposure pathways. Remedy protectiveness and permanence will be assessed through the Five-Year Review Process. At SS109, these reviews will include the long-term VI monitoring results, building inspections specifically designed to identify preferential pathways such as cracks in the foundation or evidence of LUC violation, and interviews with site personnel to ensure that current and recent activities at the time of review and in between reviews align with LUC restrictions. Five-Year Reviews will be submitted for EPA and ADEC review; final protectiveness determinations will depend upon regulatory concurrence and any proposed changes to the remedy discussed as they arise through the comment response process, and/or through an Amended ROD or Explanation of Significant Differences.”

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12.		8.1	Describe the current barriers that prevent exposure. "LUCs would protect the current barriers in place that are sufficient to keep risk at an acceptable Level". Are these physical barriers like a VI impermeable membrane? Or administrative barriers like dig permits?	Agree. The first sentence in Section 8.1 will be re-written: "Long-term monitoring for VI and LUCs such as restrictions on invasive activities administered through the JBER work clearance request process and recorded in GeoBase, construction/repair requirements to alleviate VI pathway potential, and continued industrial land use are sufficient to keep exposures below acceptable thresholds." The first bullet in Section 5.2.1 will be revised to include the following text: A vapor barrier is present underneath the F-22 Weapons Release Shop expansion but not Hangar 15; any new construction for an occupied facility would require this protective measure. Section 5.2.2 Long-Term Monitoring will be added (CERCLA Five-Year Reviews will become Section 5.2.3). The text about VI sampling will be moved to the LTM section from the FYR section. The text will state: "Currently the concrete floor of Hangar 15 is in good condition and cracks or other penetrations do not result in a preferential pathway. Future building inspections as part of long-term monitoring should re-evaluate preferential pathways and recommend repairs as needed. Two VI monitoring rounds (to capture both summer and winter conditions) would be undertaken prior to each five-year review …" Section 8.1, the existing language will be revised to segregate long-term monitoring from five-year review tasks:

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				"Long-term monitoring will include building inspections and VI sampling to determine …" Five-year reviews should be undertaken …" *Note: The first and last parts of this response don't align exactly, although they have similar intent. The text specified here was merged into a single, cohesive paragraph as the document was finalized.*
13.		Appendix B	Drop Potential from the first column of the tables. The Applicability column seems to cover the uncertainty.	Agree. 'Potential' will be dropped from the first column heading on Tables B-1, B-2, and B-3.
14.		Appendix B	Chemical and Action specific ARARs should include RCRA regs to determine hazardous waste status, possible disposal options, and transport for the ex-situ soils once 'clean'. Table B-3 cites 40 CFR Part 261 but doesn not identify the ARAR as RCRA.	Agree. RCRA will be added to Table B-1 and more clearly identified along with its applicability to the ventilated stockpile soil in Table B-3. Note: The soil in the VSP has already been determined to be non-hazardous because otherwise it would have been ineligible for onsite treatment (hazardous waste cannot be treated without a permit).
			If the TCE waste is F-listed, it is unlikely the 'clean' soils can remain on-site within the OU 1 landfill boundary. 'Clean' soil disposal should be discussed.	As no definitive source was identified for TCE contamination in soil at SS109, D-List toxicity-based RCRA regulations apply. The soil in the SS109 ventilated stockpile has been determined to be non-hazardous and therefore eligible for onsite treatment. See also response above and EPA Response #9.
			National Ambient Air Quality Standards should be ARARs for the ex-situ soils alternative, both chemical and action ARARs.	Disagree. NAAQS was included in the EE/CA relative to the SVE system. The ventilated stockpile system utilizes an electric blower; no exhaust emissions are generated.

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15.		Table B1	Move the TSCA ARAR from Table B-3 to B-1.	Agree. TSCA will be moved from Table B-3 to Table B-1.
16.		Table B1	The list of 18 AAC 75.300-75.396 is overly broad. Narrowing down the portions of the Oil and Hazardous Substances Pollution Control Regulations to those that are substantive would be preferred (example 18 AAC 75.431 Soil Cleanup Table B-1; 18 AAC 75.345 Table C for Groundwater; 18 AAC 75.375 Institutional Controls, etc.)	Agree. On Table B-1, 18 AAC 75 will be narrowed down to specifically call out Table B1 (18 AAC 75.341), Table C (18 AAC 75.345), and Institutional Controls (18 AAC 75.375).
17.		Appendix B	Consider reviewing the ARARs in the EECA (May 2011) for additional regulations that are applicable or relevant and appropriate requirements.	Agree. The following ARARs will be included in addition to those specifically requested in the above comments. Chemical-Specific (Table B-1) • EPA Maximum Contaminant Levels (20 CFR 141.61) • EPA Region 10 OEA recommendations regarding not-to-be exceeded TCE concentrations in soil, water, and air No location-specific ARARs were included in the EECA. Action-specific ARARs in the EECA mostly pertained to SVE system installation and operation and soil excavation, which are not components of currently proposed remedies. Only one ARAR will be carried forward (as to be considered) from the EECA to the FS: Land Disposal Restrictions (40 CFR 268) With a note stating:

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				"Does not currently apply; soil undergoing treatment is non-hazardous. May apply in the future if additional soil is excavated." Note: One Action-Specific ARAR (Notice of Activity and Use Limitation per AS 46.04.340) will be added to Table B-3 per ADEC Response #6.
Minor Comments				
18.		2.2.1	Last sentence; try to keep units consistent. Section 2.1.2 reports concentrations at IS6-01 in ug/L and Section 2.2.1 in mg/L. The preferred unit for GW is typically ug/L.	Agree. The units will be converted in the last sentence of Section 2.2.1: "IS6-01 contained PCE at 19.5 µg/L and TCE at 21.4 µg/L in June, with slightly lower sample concentrations in July (17.2 and 16.5 µg/L, respectively)." Similarly, in the last paragraph of Section 2.2.6, the third sentence will be revised: "PCE exceeded in two locations, MW01 at 10 µg/L and nearby SB03 at 11 µg/L." In Section 2.4.1 under the subheading for VOCs: "TCE was detected in groundwater above the ADEC Table C cleanup level of 2.8 µg/L during …" In Section 2.4.1, under the subheading for VOCs, the paragraph about 2-hexanone will be re-written. Note correction from soil to groundwater and unit change from mg/L to ug/L as well as additional detail: "2-hexanone was detected in groundwater below the PSL at SB12 and above the PSL at SB15; both of these locations also had DRO contamination, which will be addressed under a separate contract.

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				The SB15 result for 2-hexanone was greater than the PSL (3.8 µg/L) at 4.5 µg/L and qualified J, indicating an estimated value.”
19.		6.4.4	Strike this sentence “~~A six-month duration beginning next spring is anticipated~~.”	Agree. The final sentence in Section 6.4.4 will be removed. To satisfy RI/FS Guidance, Section 6.2.3.5, which states. “This factor includes an estimate of time required to achieve protection for either the entire site or individual elements associated with specific site areas or threats,” an amended version of the sentence will be added to Section 6.4.5 Short-Term effectiveness: “A six-month duration is anticipated.”

From: Halstead, Sandra <Halstead.Sandra@epa.gov>
Sent: Thursday, June 27, 2019 4:13 PM
To: AIDE, DONALD R GS-12 USAF AFCEC 673 CES/CZOP <donald.aide.2@us.af.mil>; Howard, Louis R (DEC) (louis.howard@alaska.gov) <louis.howard@alaska.gov>; LUFKIN, STEVEN P GS-14 USAF AFLOA JACE <steven.lufkin@us.af.mil>
Subject: [Non-DoD Source] RE: EPA comments on the SS109 F22 Weapons Release Shop Draft Feasibility Study, December 2018

RTCs to EPA comments on the JBER SS109 F22 Weapons Release Shop Draft Feasibility Study, December 2018 are accepted.
Please finalize the document if/when ADEC has agreed to the draft final redline. I won't be able to review it.

Sandra Halstead
Superfund Site Manager

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From: AIDE, DONALD R GS-12 USAF AFCEC 673 CES/CZOP <donald.aide.2@us.af.mil>
Sent: Monday, June 24, 2019 8:31 AM
To: Halstead, Sandra <Halstead.Sandra@epa.gov>; Howard, Louis R (DEC) (louis.howard@alaska.gov) <louis.howard@alaska.gov>; LUFKIN, STEVEN P GS-14 USAF AFLOA JACE <steven.lufkin@us.af.mil>
Subject: FW: EPA comments on the SS109 F22 Weapons Release Shop Draft Feasibility Study, December 2018

Attached are the responses to both ADEC's and EPA's comments on the SS109 Draft Feasibility Study. Also attached are the revised ARARs and the ARAR list from the SS109 EECA (May 2011) that were referenced in the comments.

Have a great day!!

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Alaska Department of Environmental Conservation
SS109 F-22 Weapons Release Shop FS dated December 2018
Commenter: Louis Howard (ADEC), Comments Developed: February 6, 2019

Cmt. No.	Pg. & Line	Sec.	Comment/Recommendation	Response
1.	ES-1	Table ES-1	**Remedial Alternatives Evaluated** ADEC requests an alternative called "Alternative 4" be developed for LUCs, Five-Year Reviews (Soil Gas: TCE) and Ex Situ Treatment of Excavated Soils (Soil: TCE). ADEC recommends an alternative called "Alternative 4" be developed which combines Alternatives 2 and 3 together in one alternative which can be done during the Feasibility Study (FS) process[1]. Typically, Proposed Plans have a preferred alternative, not preferred alternatives. Record of Decisions have a selected remedy based on the preferred alternative, not preferred alternatives.	Agree. Alternative 4 will be added to provide a single alternative that combines the proposed actions of Alternatives 2 and 3.
2.	ES-2		The text states: "This FS recommends a combination of Alternatives 2 and 3 to best protect human health and the environment. Following final approval of this FS, the USAF will issue a Proposed Plan for SS109." ADEC recommends an alternative called "Alternative 4" be developed which combines Alternatives 2 and 3 together in one alternative which can be done during the FS process[2]. Comment applies throughout the FS.	Agree. The first sentence in the final paragraph of the Executive Summary will be revised to state: "This FS recommends <u>Alternative 4</u> to best protect …" Alternative 4 will be added throughout the document per Response #1.
3.	8-1	8.0	**Recommendations** The text states: "Based on the evaluation presented in this FS, a combination of Alternative 2, which involves the implementation of LUCs and five-year reviews to address the potential for future exposure risks at SS109, and Alternative 3, continued ex situ treatment of VSP soils, is recommended to complete previously selected remedy implementation and restore previously contaminated soils to UU/UE."	Agree. The first sentence in Section 8.0 will be revised: "Based on the evaluation presented in this FS, <u>Alternative 4, which involves both the implementation of LUCs and five-year reviews to address the potential for future exposure risks at SS109 and continued ex situ treatment of VSP soils</u>, is recommended

[1] 1.4.3 Alternatives for specific media and site areas either can be carried through the FS process separately or combined into comprehensive alternatives for the entire site. The approach is flexible to allow alternatives to be combined at various points in the process. (EPA OSWER Directive 9355.3-01)

[2] 6.2.1 Therefore, if separate alternatives have been developed for different areas or media of the site, it is recommended that they be combined during the detailed analysis phase to present comprehensive options addressing all potential threats posed by the site or that area being addressed by the operable unit. (EPA OSWER Directive 9355.3-01)

Cmt. No.	Pg. & Line	Sec.	Comment/Recommendation	Response
			ADEC recommends an alternative called "Alternative 4" be developed which combines Alternatives 2 and 3 together in one alternative which can be done during the FS process to satisfy the remedial action objectives[3].	to complete previously selected remedy implementation and restore previously contaminated soils to UU/UE." Alternative 4 will be added throughout the document per Response #1.
4.	**Appendix B Applicable or Relevant and Appropriate Requirements**			
5.			**General Comment** ADEC requests inclusion of the ADEC "Vapor Intrusion Guidance for Contaminated Sites" (November 2017) as to-be-considered as guidance. According to EPA guidance[4]: "To-be-Considered Material (TBCs) are non-promulgated advisories or guidance issued by Federal or State government that are not legally binding and do not have the status of potential ARARs. However, as described below, in many circumstances TBCs will be considered along with ARARs as part of the site risk assessment and may be used in determining the necessary level of cleanup for protection of health or the environment."	Disagree. The PCLs included in this FS are based on the EPA OEA memorandum. Refer to Sections 3.2.1 and 3.2.2. The ADEC *Vapor Intrusion Guidance* will be removed from Section 9.0 References as it was not utilized in the preparation of this FS.
6.	B-9	Table B-3	**Potential ARARs** List our Uniform Environmental Covenants Act (UECA). *Citation or Reference* AS 46.04.300-390 *Requirements* Relating to environmental real property covenants [5]and notices of activity and use limitation at contaminated sites to ensure the	Agree. Since there exists a legal impediment to the USAF creating an environmental covenant on JBER, we will instead file a Notice of Activity and Use Limitation per AS 46.04.340. This will be added as an action-specific ARAR to Appendix B, Table B-3 with the following comment:

[3] 4.1.2.1 Develop general response actions for each medium of interest defining containment, treatment, excavation, pumping, or other actions, singly or in combination that may be taken to satisfy the remedial action objectives for the site. (EPA OSWER Directive 9355.3-01)

[4] EPA. CERCLA Compliance with Other Laws Manual. Interim Final. August 1988 EPA/540/G-89/006

[5] For Department of Defense properties, rather than a covenant being applied under UECA, it will require a Notice of Activity and Use Limitation.

Cmt. No.	Pg. & Line	Sec.	Comment/Recommendation	Response
			protection of human health, safety, and welfare, and the environment; and providing for an effective date. *Applicability* Applicable	"A legal impediment precludes USAF from creating an environmental covenant on JBER; a notice of activity and use limitation per AS 46.04.340 that ensures the protection of human health, safety, welfare, and the environment will be applied to SS109."

From: Howard, Louis R (DEC) <louis.howard@alaska.gov>
Sent: Monday, July 8, 2019 1:55 PM
To: AIDE, DONALD R GS-12 USAF AFCEC 673 CES/CZOP <donald.aide.2@us.af.mil>; Halstead, Sandra <Halstead.Sandra@epa.gov>; LUFKIN, STEVEN P GS-14 USAF AFLOA JACE <steven.lufkin@us.af.mil>
Subject: [Non-DoD Source] RE: EPA comments on the SS109 F22 Weapons Release Shop Draft Feasibility Study, December 2018

ADEC has reviewed the responses to its comments and finds them satisfactory. ADEC will approve ADEC's RTCs for incorporation into the final version.

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From: AIDE, DONALD R GS-12 USAF AFCEC 673 CES/CZOP [mailto:donald.aide.2@us.af.mil]
Sent: Monday, June 24, 2019 8:31 AM
To: Halstead, Sandra <Halstead.Sandra@epa.gov>; Howard, Louis R (DEC) <louis.howard@alaska.gov>; LUFKIN, STEVEN P GS-14 USAF AFLOA JACE <steven.lufkin@us.af.mil>
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Attached are the responses to both ADEC's and EPA's comments on the SS109 Draft Feasibility Study. Also attached are the revised ARARs and the ARAR list from the SS109 EECA (May 2011) that were referenced in the comments.

Have a great day!!

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