UNITED STATES AIR FORCE
JOINT BASE ELMENDORF-RICHARDSON, ALASKA

ENVIRONMENTAL RESTORATION PROGRAM

TU091 ENGINEERING EVALUATION/COST ANALYSIS

FINAL

AUGUST 2025

This page intentionally left blank.

FINAL
TU091 ENGINEERING EVALUATION/COST ANALYSIS

JOINT BASE ELMENDORF-RICHARDSON, ALASKA

Prepared for
Air Force Civil Engineer Center

Contract No. W911KB20D0020

AUGUST 2025

This page intentionally left blank.

EXECUTIVE SUMMARY

This engineering evaluation/cost analysis (EE/CA) was prepared to support a Non-Time-Critical Removal Action (NTCRA) to address potential adverse health effects for current industrial workers due to short-term exposure to trichloroethylene (TCE) concentrations in indoor air at Buildings 8549 and 8574 at TU091 at Joint Base Elmendorf-Richardson (JBER) in Anchorage, Alaska.

TU091 is located between Sijan and Slammer Avenues, just south of Simpson Harbor Drive, southwest of the north-south runway at JBER. The site contains multiple buildings. Buildings 8549 and 8574, which are aircraft and aerospace-ground equipment maintenance shops and storage areas, include a garage/shop and offices. Building 8574 also houses a vehicle wash bay.

TU091 was the location of a 300-gallon single-walled steel underground storage tank (UST) that received waste oil and jet fuel from an oil/water separator at Building 8574. During tank removal, a sheen was noted on the soil near the vent line and shipping plug and visible staining and hydrocarbon odors were observed beneath the UST. Based on the presence of chlorinated solvents in soil and groundwater samples, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site was incorporated into the USAF Environmental Restoration Program for further investigation in accordance with the CERCLA process.

After several historical investigations, a remedial investigation (RI) was conducted at TU091 from February 2023 through January 2024. The center of the grassy courtyard between Buildings 8549 and 8574, not the area of the historical UST adjacent to Building 8574, was determined to be the area of highest contaminant concentrations (USAF 2025). This area of contamination is a separate source of contamination from the UST that was removed in 1998 and appears to have originated from surface spill(s). The TCE present in the subsurface soil within the courtyard has migrated into the soil vapor and then into indoor air within Buildings 8549 and 8574 through vapor intrusion (VI). The TU091 RI evaluated whether contamination in the soil or groundwater poses a potential for unacceptable risk from VI into overlying or nearby existing structures.

Based on the risk assessment in the TU091 RI report (USAF 2025), the noncancer hazard quotient for current industrial workers due to trichloroethylene (TCE) in indoor air in Buildings 8549 and 8574 equals the noncancer risk threshold of 1. This risk estimate is based on U.S. Environmental Protection Agency's (EPA's) standard chronic exposure parameters to include an exposure frequency of 250 days per year for 25 years. However, TCE also has a short-term exposure concern for a sensitive population (i.e., women of child-bearing age) due to the potential for developmental effects (fetal cardiac malformations) during a critical 21-day period. Various EPA Regions have identified TCE "action levels" for an industrial/commercial scenario ranging from 6 micrograms per cubic meter ($\mu g/m^3$) in EPA Region 6 to 8.4 $\mu g/m^3$ in EPA Region 10. Average concentrations of TCE in Buildings 8549 and 8574 exceed 8.4 $\mu g/m^3$. The lead agency (USAF) has made the determination that an NTCRA is warranted at TU091 in accordance with Title 40 *Code of Federal Regulations* (CFR) Part 300.415(a)(1) and that a removal action is appropriate, in accordance with 40 *Code of Federal Regulations* (CFR) 300.415(b)(1) and 300.415(b)(2)(i).

ES.1 REMOVAL ACTION OBJECTIVE

The scope of this removal action is to reduce the threat to human health posed by TCE in indoor air at Buildings 8549 and 8574 within TU091. This removal action does not include groundwater, stormwater, or soil. Alternatives for those media will be evaluated in a future feasibility study (FS) report. Based on the scope of the removal action, the following removal action objective was developed:

- Prevent exposure of industrial workers at Buildings 8549 and 8574 to indoor air containing TCE concentrations greater than 8.4 $\mu g/m^3$.

The action level is the short-term exposure concentration determined to be protective of human health in the 2012 U.S. Environmental Protection Agency (EPA) memorandum "OEA Recommendations Regarding Trichloroethylene Toxicity in Human Health Risk Assessment" (EPA 2012). This short-term action level assumes exposure over an 8-hour work day, 5 days per week, during any 21-day period.

This removal action involves soil gas, but only in the context of mitigating VI at Buildings 8549 and 8574. No cleanup goals are proposed for soil gas below or adjacent to the buildings.

ES.2 REMOVAL ACTION ALTERNATIVES

The removal action alternatives evaluated in this EE/CA include:

- **Alternative 1 – No Action**—The No Action alternative implies that no action will be taken to reduce TCE concentrations in indoor air below the EPA Region 10 short-term action level of 8.4 µg/m^3. This alternative is included as a basis of comparison for the other alternatives and to determine what would occur if a removal action were not undertaken at these buildings.
- **Alternative 2 – Subslab Depressurization (SSD) Systems** —This alternative includes SSD systems in Buildings 8549 and 8574 to maintain a negative pressure differential between the indoor air and the subslab soil gas and thereby reduce concentrations of TCE in indoor air below the EPA Region 10 short-term action level of 8.4 µg/m^3. System effectiveness would be evaluated through collection of vacuum, flow, and differential pressure measurements. Annual VI monitoring would be performed to:
  - Confirm whether concentrations of TCE in indoor air within Buildings 8549 and 8574 decrease below the EPA Region 10 short-term action level
  - Evaluate changes in concentrations of TCE in the subslab soil gas (if any) over time
- **Alternative 3 – Air Purifying Units (APUs)** —This alternative includes APUs in Buildings 8549 and 8574 to reduce concentrations of TCE in indoor air below the EPA Region 10 short-term action level of 8.4 µg/m^3. Annual indoor air monitoring would be performed to assess the following:
  - Confirm whether concentrations of TCE in indoor air within Buildings 8549 and 8574 decrease below the EPA Region 10 short-term action level
  - Provide information to determine the necessary carbon changeout frequency to maintain concentrations of TCE in indoor air below the EPA Region 10 short-term action level
- **Alternative 4 – Soil Vapor Extraction (SVE) Trenches** —This alternative includes SVE trenches adjacent to both buildings to cut off the source of TCE in subslab soil gas and thereby reduce concentrations of TCE in indoor air below the EPA Region 10 short-term action level of 8.4 µg/m^3. System effectiveness would be evaluated through collection of vacuum, flow, and differential pressure measurements. Annual VI monitoring would be performed to assess the following:
  - Confirm whether concentrations of TCE in indoor air within Buildings 8549 and 8574 decrease below the EPA Region 10 short-term action level
  - Evaluate changes in concentrations of TCE in the subslab soil gas over time

For cost estimation purposes, the systems in each alternative are assumed to be operated and maintained for 10 years until the NTCRA is replaced by a permanent remedy through the FS/Proposed Plan (PP)/Record of Decision (ROD) process.

ES.3 RECOMMENDED REMOVAL ACTION ALTERNATIVE

Alternative 2 (SSD Systems) is the recommended removal action alternative for TU091 at JBER. SSD systems are an established, effective remedy for addressing VI, and this alternative has the lowest present-value cost ($783,000) compared to Alternatives 3 and 4 ($978,000 and $1,492,000, respectively). SSD

systems would be applied to Buildings 8549 and 8574. Annual VI monitoring would confirm whether concentrations of TCE in indoor air within Buildings 8549 and 8574 decrease below the EPA Region 10 short-term action level and evaluate changes in concentrations of TCE in the subslab soil gas (if any) over time.

For cost estimation purposes, the SSD systems are assumed to be operated and maintained for 10 years, until the NTCRA is replaced by a permanent remedy through the FS/PP/ROD process.

Sections 300.415(n) and 300.820 of the National Oil and Hazardous Substances Pollution Contingency Plan specify community relations and Administrative Record activities as two forms of public participation necessary for the types of removal actions detailed in those sections. After this EE/CA is finalized, a notice of its availability will be provided in the *Anchorage Daily News* and in the *Mat-Su Valley Frontiersman*, which are newspapers of circulation in Anchorage and Palmer/Wasilla, respectively, and a 30-day public comment period will take place. The Action Memorandum will provide a summary of comments received during the comment period and written responses to significant comments.

This page intentionally left blank.

CONTENTS

SECTION PAGE

Acronyms and Abbreviations vii

1. Introduction 1-1
1.1 Purpose and Objective 1-1
1.2 Statutory Framework 1-2
1.3 Report Organization 1-2

2. Site Characterization 2-1
2.1 Site Description and Background 2-1
2.1.1 Installation Description and Background 2-1
2.1.2 Site Location and History 2-1
2.1.3 Previous Removal Action 2-1
2.1.4 Physical and Environmental Setting 2-1
2.1.5 Current and Future Land Use 2-2
2.2 Previous Investigations and Analytical Data 2-3
2.3 Source, Nature, and Extent of Contamination 2-3
2.4 Human Health Risk Assessment 2-4

3. Development of the Removal Action Objective 3-1
3.1 Statutory Framework 3-1
3.2 Scope of Removal Action 3-1
3.3 Removal Action Criteria 3-1
3.4 Removal Action Objective 3-1

4. Identification and Development of Removal Action Alternatives 4-1
4.1 Potential Removal Action Technologies 4-2
4.2 Development of Removal Action Alternatives 4-2

5. Evaluation of Removal Action Alternatives 5-1
5.1 Detailed Description of Removal Action Alternatives 5-1
5.1.1 Alternative 1: No Action 5-1
5.1.2 Alternative 2: SSD Systems 5-1
5.1.3 Alternative 3: APUs 5-10
5.1.4 Alternative 4: SVE Trenches 5-18
5.2 Individual Analysis of Alternatives 5-22
5.2.1 Alternative 1: No Action 5-22
5.2.2 Alternative 2: SSD Systems 5-23
5.2.3 Alternative 3: APUs 5-24
5.2.4 Alternative 4: SVE Trenches 5-25

6. Comparative Analysis of Removal Action Alternatives 6-1
6.1 Effectiveness 6-1
6.1.1 Overall Protection of Human Health and the Environment 6-1
6.1.2 Long-term Effectiveness and Permanence 6-1
6.1.3 Reduction of Toxicity, Mobility, or Volume through Treatment 6-2
6.1.4 Short-term Effectiveness 6-2
6.2 Implementability 6-2
6.3 Cost 6-2

7. Recommended Removal Action Alternative 7-1

8. References 8-1

EXHIBITS

2-1 North End of Building 8549, Looking South....2-2
2-2 Wash Bay in Building 8574, Looking West....2-3
5-1 Example of SSD Piping at a U.S. Department of Defense Facility....5-2
5-2 Photos of Ceiling-mounted Amaircare ES3X Tri-Carbon Heavy Duty Air Filtration Systems for Heavy VOCs....5-10

TABLES

4-1 Detailed Screening of VI Mitigation Technologies....4-5
6-1 Comparative Analysis of Removal Action Alternatives....6-3
6-2 Cost Summary of Removal Action Alternatives....6-4

FIGURES

1-1 TU091 Site Location....1-3
2-1 Building 8549 Summer and Winter Subslab Soil Gas and Indoor and Outdoor Air Sample Data....2-5
2-2 Building 8574 Summer and Winter Subslab Soil Gas and Indoor and Outdoor Air Sample Data....2-7
3-1 TCE in Indoor Air Summer 2023....3-3
3-2 TCE in Indoor Air Winter 2023 and 2024....3-5
3-3 Building 8549 Data for Indoor Air Samples....3-7
3-4 Building 8574 Data for Indoor Air Samples....3-9
5-1a Alternative 2 Proposed Subslab Depressurization Systems....5-3
5-1b Building 8549 – Alternative 2 Subslab Depressurization Systems....5-5
5-1c Building 8574 – Alternative 2 Subslab Depressurization Systems....5-7
5-2a Alternative 3 Proposed Air Purifying Units....5-11
5-2b Building 8549 – Alternative 3 Air Purifying Units....5-13
5-2c Building 8574 – Alternative 3 Air Purifying Units....5-15
5-3 Alternative 4 Proposed Soil Vapor Extraction Trenches for Vapor Intrusion Mitigation....5-19

APPENDICES

A Air Discharge Calculations
B Cost Estimates

ACRONYMS AND ABBREVIATIONS

µg/m^3	microgram(s) per cubic meter
AAC	Alaska Administrative Code
ABW	Air Base Wing
ADEC	Alaska Department of Environmental Conservation
AFB	Air Force Base
AGE	aerospace-ground equipment
AM	Action Memorandum
APU	air purifying unit
ARAR	applicable or relevant and appropriate requirement
AS	Alaska Statute
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
DERP	Defense Environmental Restoration Program
DoD	U.S. Department of Defense
EE/CA	engineering evaluation/cost analysis
EIAP	Environmental Impact Analysis Process
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ERP	Environmental Restoration Program
FS	feasibility study
GAC	granular activated carbon
HAP	hazardous air pollutant
HHE	human health evaluation
HI	hazard index
HSP	health and safety plan
HVAC	heating, ventilation, and air conditioning
IDP	Installation Development Plan
JBER	Joint Base Elmendorf-Richardson
JBER-E	JBER-Elmendorf
LUC	land use control
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NTCRA	Non-Time-Critical Removal Action
O&M	operation and maintenance
OEA	Office of Environmental Assessment
OWS	oil/water separator
PCB	polychlorinated biphenyl
PP	Proposed Plan
RAO	removal action objective
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation

ROD	Record of Decision
ROI	radius of influence
SSD	subslab depressurization
SVE	soil vapor extraction
TCE	trichloroethylene
TSCA	Toxic Substances Control Act
U.S.C.	United States Code
USAF	U.S. Air Force
UST	underground storage tank
VI	vapor intrusion
VISL	vapor intrusion screening level
VOC	volatile organic compound

1. INTRODUCTION

This engineering evaluation/cost analysis (EE/CA) was prepared to support a Non-Time-Critical Removal Action (NTCRA) to address potential adverse health effects for current industrial workers due to TCE concentrations in indoor air that exceed the U.S. Environmental Protection Agency (EPA) Region 10 short-term action level within Buildings 8549 and 8574 at TU091 at Joint Base Elmendorf-Richardson (JBER) in Alaska (Figure 1-1). The lead agency for this NTCRA is the U.S. Air Force (USAF), with project oversight by the Air Force Civil Engineer Center. The regulatory agencies involved in this project are the Alaska Department of Environmental Conservation (ADEC) and EPA.

This EE/CA is being prepared to satisfy the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Title 40 *Code of Federal Regulations* (CFR) Part 300. The Defense Environmental Restoration Program (DERP) statute (Title 10 United States Code [U.S.C.] Section 2701 et seq.) authorizes the USAF to conduct CERCLA response actions and lead agency functions, as delegated by Executive Order (EO) 12580, and further redelegated by the Secretary of Defense.

1.1 Purpose and Objective

CERCLA and the NCP define removal actions to include "the cleanup or removal of released hazardous substances from the environment, such actions as may necessarily be taken in the event of the threat of release of hazardous substances into the environment; such actions as may be necessary to monitor, assess, and evaluate the release or threat of release of hazardous substances; the disposal of removed material; or the taking of other such actions as may be necessary to abate, prevent, minimize, stabilize, mitigate, or eliminate damage to the public health or welfare or to the environment, which may otherwise result from a release or threat of release" (EPA 1993). TCE, which is the subject of this NTCRA, is a hazardous substance under CERCLA.

Removal actions are usually interim measures that, to the extent practicable, must contribute to the efficient performance of any anticipated long-term remedial action. The three removal action categories are: emergency, time-critical, and non-time-critical. Selection of the type of removal action is based on the type of situation, urgency and threat of the release or potential release, and subsequent time frame in which the action must be initiated.

Based on a review of site conditions and available data collected from TU091, TCE has been released in the environment. The lead agency (USAF) has made the determination that a NTCRA is warranted at TU091 in accordance with 40 CFR 300.415(a)(1) and that a removal action is appropriate, in accordance with 40 CFR 300.415(b)(1) and 300.415(b)(2)(i). The evaluation of risk to a sensitive population (i.e., women of child-bearing age) due to short-term exposure to TCE in indoor air, as presented in the TU091 remedial investigation (RI) report (USAF 2025), forms the basis for the NTCRA.

This NTCRA will address potential adverse health effects for industrial receptors due to TCE concentrations in indoor air that exceed the EPA Region 10 short-term action level for an industrial/commercial scenario at Buildings 8549 and 8574 until the Feasibility Study (FS)/Proposed Plan (PP)/Record of Decision (ROD) process is complete.

Section 300.415(b)(4)(i) of the NCP requires an EE/CA for all NTCRAs. This EE/CA is intended to (1) satisfy environmental review requirements for removal actions, (2) satisfy Administrative Record requirements at NCP Section 300.820(a) for documentation of removal action selection, and (3) provide a framework for evaluating and selecting alternative technologies. Thus, this EE/CA identifies the objectives of the removal action and analyzes the effectiveness, implementability, and cost of various alternatives that may satisfy these objectives (EPA 1993). This EE/CA will also provide a recommended removal action alternative that will be presented to the public. Following public input, the final selection of the removal action alternative will be summarized in an Action Memorandum (AM).

1.2 Statutory Framework

CERCLA and the NCP provide authority for the lead federal agency (USAF) to take action to abate, prevent, minimize, stabilize, mitigate, or eliminate the release or threat of release of hazardous substances the agency determines poses an unacceptable risk to human health and the environment. The USAF may determine, based on the existence of one or more factors described at Section 300.415(b)(2) of the NCP, that such an action is appropriate to address potential and/or complete risk pathways.

1.3 Report Organization

The following summarizes the components of the report and lists the appendices:

- Section 2.0 provides a description of JBER and TU091.
- Section 3.0 presents the removal action objective (RAO).
- Section 4.0 identifies and develops removal action alternatives.
- Section 5.0 evaluates the removal action alternatives.
- Section 6.0 compares the removal action alternatives.
- Section 7.0 summarizes the recommended removal action alternative.
- Section 8.0 presents the references used in preparation of this document.
- Appendices
  - Appendix A: Air Discharge Calculations
  - Appendix B: Cost Estimates

Fence

Base Boundary

Sources
GIS Data:USAF GeoBase 2020
Imagery: GeoBase, JBER_19jun2023_wgs84_utm6_7.5cm_1of2.sid

1:1,200
0 30 60 90 120
Feet
WGS 1984 UTM Zone 6N

N

TU091 SITE LOCATION
TU091 EE/CA REPORT
JOINT BASE ELMENDORF-RICHARDSON, ALASKA

DATE:	PROJECT MANAGER:	FIGURE NO:
07 MAR 2025	K. MAHER	1-1

\\dc1vs01\GISProj\A\Airforce\AK_JBER_ORC\MapFiles\TU091\EECA\TU091_EECA.aprx JBER_ORC_TU091_EECA_Fig1-1_Site KMINO 3/7/2025

This page intentionally left blank.

2. SITE CHARACTERIZATION

2.1 Site Description and Background

The following subsections present characteristics of JBER and TU091.

2.1.1 Installation Description and Background

JBER encompasses approximately 73,157 acres in south-central Alaska and is within the Municipality of Anchorage. Historically, the base consisted of Elmendorf Air Force Base (AFB) and Fort Richardson. In 2005, the U.S. Department of Defense (DoD) recommended realignment of Fort Richardson and Elmendorf AFB under the base closure and realignment process, establishing JBER. JBER became fully functional in October 2010, combining installation management functions of Elmendorf AFB and Fort Richardson. JBER-Elmendorf (JBER-E) is located in the western portion of the installation, covering approximately 13,375 acres, and is bounded on the west and north by the Knik Arm of Cook Inlet and on the east by JBER-Richardson. Immediately to the south of JBER-E lies Ship Creek, the Alaska Railroad, and urban development within the Municipality of Anchorage.

CERCLA activities at JBER-E are conducted under the Federal Facilities Agreement for Elmendorf AFB (USAF 1991). JBER-E is identified as Facility Identification Number 1525.

2.1.2 Site Location and History

TU091 is located between Sijan and Slammer Avenues, just south of Simpson Harbor Drive, southwest of the north-south runway at JBER (Figure 1-1). The site contains multiple buildings. Buildings 8549 and 8574, which are aircraft and aerospace-ground equipment (AGE) maintenance shops and storage areas, include a garage/shop and offices. Building 8574 also houses a vehicle wash bay. Building 8554, a warm storage building, is also present at the site but is unoccupied. Historical aerial photographs indicate that in 1972, a historical north-south railroad line was located between Buildings 8549 and 8574 but was removed sometime between 1972 and 1984 (USAF 2025).

2.1.3 Previous Removal Action

TU091 was the location of a 300-gallon single-walled steel underground storage tank (UST) that received waste oil and jet fuel from an oil/water separator (OWS) at the northwest side of Building 8574. The UST, OWS, and associated piping were decommissioned and removed in September 1998, along with 70 cubic yards of soil. A sheen was noted on the soil near the vent line and shipping plug and visible staining and hydrocarbon odors were observed beneath the UST. Based on the presence of chlorinated solvents in soil and groundwater samples, the site is currently managed under the CERCLA process within the USAF Environmental Restoration Program (USAF 2025).

2.1.4 Physical and Environmental Setting

The source area at TU091, which is the subject of this NTCRA, is relatively flat, with roads, buildings, and a grassy courtyard between Buildings 8549 and 8574. TU091 is not located within an ecologically sensitive area. No known endangered or threatened species are known or suspected to exist at the site or in the immediate surrounding areas.

The subsurface at TU091 generally consists of well-graded sand and/or well-graded gravel with trace to minor silt. Isolated intervals of poorly graded sand or silty sand are also present. During the RI, depth to groundwater in the source area was approximately 25 to 26 feet below ground surface (bgs). Groundwater flow direction is to the southwest (USAF 2025). TU091 is approximately 0.54 mile northeast (upgradient) of Ship Creek and approximately 0.43 mile northeast of a cooling pond. Groundwater is not addressed in this NTCRA.

The frost-free growing season at JBER is approximately 100 days. The latitude of JBER makes for a short summer season with long daylight hours and a long winter with shortened days. The highest amount of rainfall occurs in August, and snowfall is largely between December and March, with the highest amount of snowfall in December (USAF 2025).

2.1.5 Current and Future Land Use

The current and reasonably anticipated future land use at TU091 is industrial. The site is located across the street to the west from the fence for the flight line area (Figure 1-1).

2.1.5.1 Building 8549

Building 8549 is used as an aircraft and AGE maintenance shop and is mostly open garage space (Exhibit 2-1) with a few offices, conference rooms, storage rooms, and a break room along the perimeter of the building. According to a November 2024 email from the AGE superintendent (USAF 2024), it is occupied by approximately 14 people, approximately 30 hours per week. These same people spend 10 hours per week in Building 8574. At that time, Building 8549 also had 1 occupant 40 hours per week.

Exhibit 2-1 North End of Building 8549, Looking South
Source: Paragon-Jacobs JV

2.1.5.2 Building 8574

Building 8574 is used as an aircraft and AGE maintenance shop and is mostly open garage space with a wash bay (Exhibit 2-2), one office, rest rooms, and a mechanical room along the perimeter of the building. According to a November 2024 email from the AGE superintendent (USAF 2024), it is occupied by approximately 14 people, approximately 10 hours per week. These same people spend 30 hours per week in Building 8549.

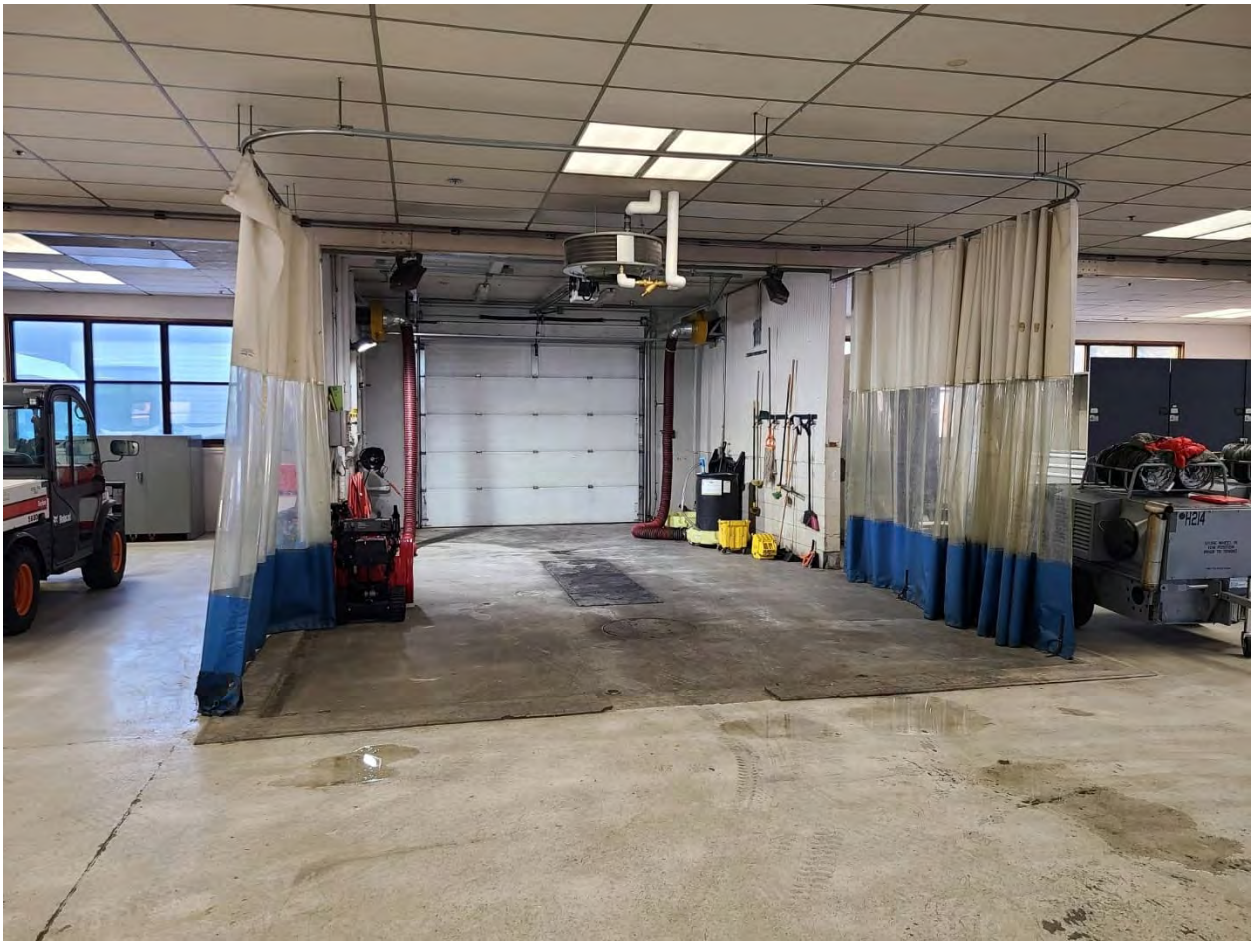


Exhibit 2-2 Wash Bay in Building 8574, Looking West
Source: Paragon-Jacobs JV

2.2 Previous Investigations and Analytical Data

Several historical investigations were conducted at TU091 between 2013 and 2018, followed by a RI from February 2023 through January 2024. Analytical data from the RI relevant to the NTCRA are summarized in this EE/CA. All relevant analytical data that supports this NTCRA are presented in the TU091 RI report (USAF 2025). The TU091 RI report contains additional details.

2.3 Source, Nature, and Extent of Contamination

The source area for TU091 lies in the northern courtyard between Buildings 8549 and 8574. The northern courtyard is the area north of the fence (Figure 1-1) that contains the asphalt driveway into the northwestern portion of Building 8574. As summarized in the TU091 RI report, the maximum concentrations of TCE in soil, soil gas, and groundwater were located in this area (USAF 2025). This area

of contamination is a separate source of contamination from the UST that was removed in 1998 and appears to have originated from surface spill(s). The RI report (USAF 2025) contains additional details.

As shown on Figures 2-1 and 2-2, TCE was detected above screening levels in indoor air samples and soil gas samples at Buildings 8549 and 8574. Note that the screening levels shown in these two figures (the EPA air Regional Screening Levels [RSLs] and soil gas vapor intrusion screening levels [VISLs]) apply only to the RI and are not action levels. Based on the elevated concentrations of TCE in subslab soil gas beneath these buildings (Figures 2-1 and 2-2) and the fact that TCE is no longer used in these buildings, the TCE in indoor air within Buildings 8549 and 8574 is believed to be the result of vapor intrusion (VI) from underlying and/or adjacent contaminated soils.

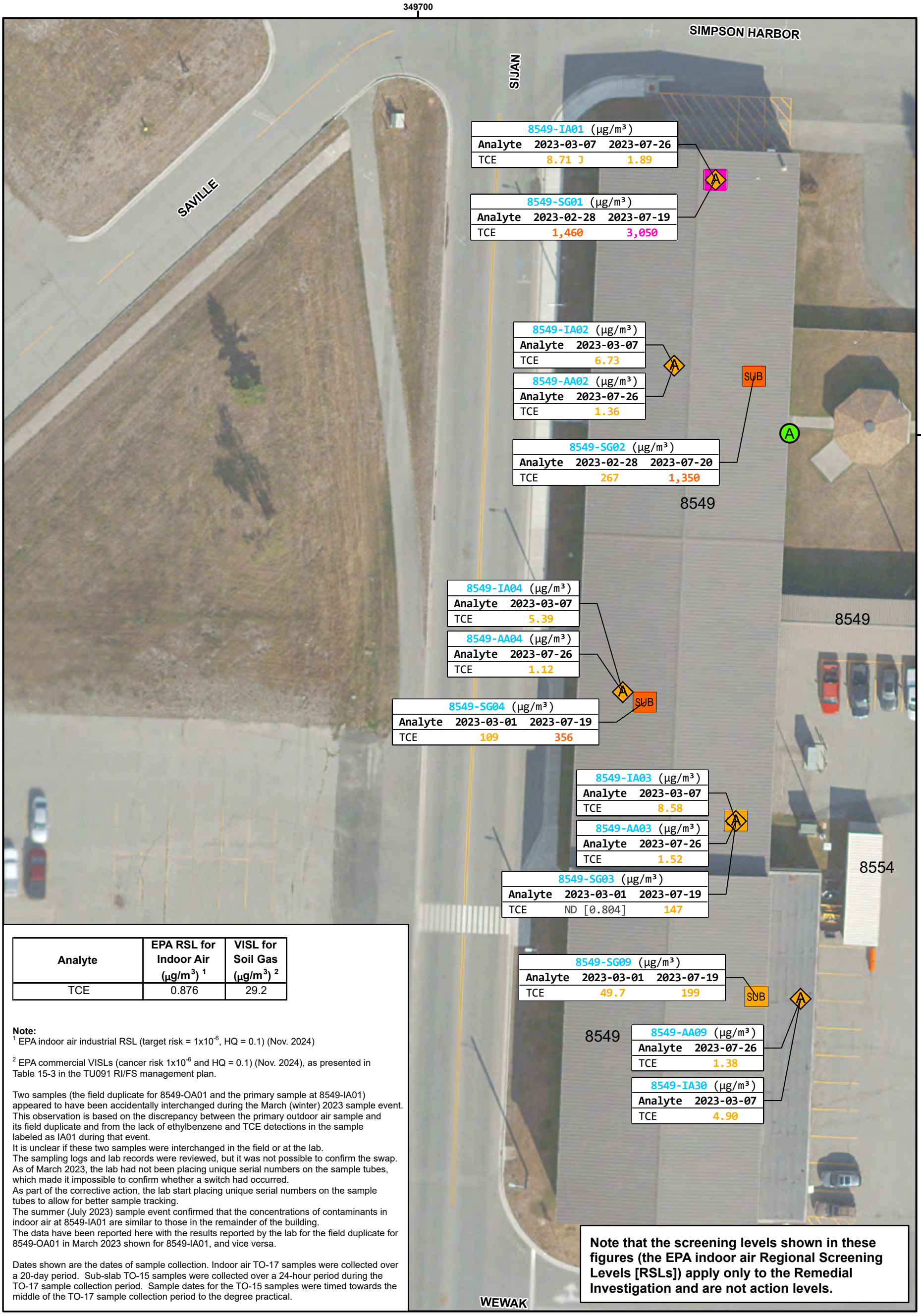
The extent of TCE contamination in indoor air at Buildings 8549 and 8574, which is the subject of this NTCRA, is discussed further in Section 3 in the context of the proposed action level.

2.4 Human Health Risk Assessment

The human health evaluation (HHE) in the RI report (USAF 2025) determined that the estimated cumulative carcinogenic risk is below the EPA target risk of 1×10^{-4}, and the target-organ-specific noncarcinogenic hazard index (HI) equals the EPA target HI of 1 for current industrial workers exposed to TCE in indoor air at Buildings 8549/8574. This evaluation addressed chronic exposure and was based on site-specific exposure times for current workers and "standard" exposure frequency (250 days per year, assuming a yearly 2-week absence). Buildings 8549 and 8574 were evaluated as a single exposure unit, since the workers split their time between the two buildings. The current workers were assumed to spend 30 hours per week within Building 8549 and 10 hours per week in Building 8574 based on a November 2024 email from the AGE superintendent at those buildings (USAF 2024).

The HHE (USAF 2025) further evaluated the potential for short-term adverse effects due to TCE exposure. In developing its 2012 EPA Region 10 short-term action level for TCE for an industrial/commercial scenario, EPA determined that to protect against potential developmental effects (i.e., cardiac malformations), it is appropriate to recommend average concentrations over any 21-day period of time not exceed the concentration in air that is determined to be protective for this exposure (EPA 2012). For the short-term exposure concern, when women of child-bearing age may be present at any time, the exposure frequency should be increased to 260 days per year, which eliminates the yearly 2-week absence, as any 21-day period should be protective. This results in EPA Region 10's short-term action level of 8.4 micrograms per cubic meter ($\mu g/m^3$) for an industrial scenario. Because TCE was detected in indoor air samples collected at currently occupied buildings at TU091, concentrations in indoor air were compared with the EPA Region 10 short-term action level. The HHE concluded that because TCE concentrations in indoor air exceeded the EPA Region 10 short-term action level, there are potential adverse health effects for sensitive populations (i.e., women of child-bearing age) in areas of Buildings 8549 and 8574 where an average concentration of TCE in indoor air exceeds the EPA Region 10 short-term action level.

Additional human health risk information pertaining to other contaminants and exposure scenarios is available in the RI (USAF 2025). Based on the potential adverse health effects for current industrial workers due to exposure to TCE concentrations in indoor air that exceed the EPA Region 10 short-term action level, the USAF made the determination that a NTCRA is warranted at TU091 in accordance with 40 CFR 300.415(a)(1) and that a removal action is appropriate, in accordance with 40 CFR 300.415(b)(1) and 300.415(b)(2)(i).



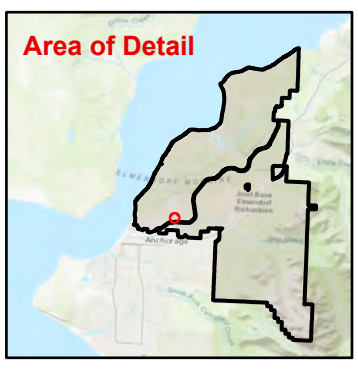
Analyte	EPA RSL for Indoor Air (µg/m³) [1]	VISL for Soil Gas (µg/m³) [2]
TCE	0.876	29.2

Note:
[1] EPA indoor air industrial RSL (target risk = 1x10^{-6}, HQ = 0.1) (Nov. 2024)

[2] EPA commercial VISLs (cancer risk 1x10^{-6} and HQ = 0.1) (Nov. 2024), as presented in Table 15-3 in the TU091 RI/FS management plan.

Two samples (the field duplicate for 8549-OA01 and the primary sample at 8549-IA01) appeared to have been accidentally interchanged during the March (winter) 2023 sample event. This observation is based on the discrepancy between the primary outdoor air sample and its field duplicate and from the lack of ethylbenzene and TCE detections in the sample labeled as IA01 during that event.
It is unclear if these two samples were interchanged in the field or at the lab.
The sampling logs and lab records were reviewed, but it was not possible to confirm the swap.
As of March 2023, the lab had not been placing unique serial numbers on the sample tubes, which made it impossible to confirm whether a switch had occurred.
As part of the corrective action, the lab start placing unique serial numbers on the sample tubes to allow for better sample tracking.
The summer (July 2023) sample event confirmed that the concentrations of contaminants in indoor air at 8549-IA01 are similar to those in the remainder of the building.
The data have been reported here with the results reported by the lab for the field duplicate for 8549-OA01 in March 2023 shown for 8549-IA01, and vice versa.

Dates shown are the dates of sample collection. Indoor air TO-17 samples were collected over a 20-day period. Sub-slab TO-15 samples were collected over a 24-hour period during the TO-17 sample collection period. Sample dates for the TO-15 samples were timed towards the middle of the TO-17 sample collection period to the degree practical.



A Indoor air exceedance up to 10x EPA VISL

A Outdoor air no exceedance

SUB Sub-slab air exceedance 100 to 1000x EPA VISL

SUB Sub-slab air exceedance 10 to 100x EPA VISL

SUB Sub-slab air exceedance up to 10x EPA VISL

Sources
GIS Data:USAF GeoBase 2020
Imagery: GeoBase, JBER_19jun2023_wgs84_utm6_7.5c

1:420
0 10 20 30 40 50 60
Feet

N

WGS 1984 UTM Zone 6N

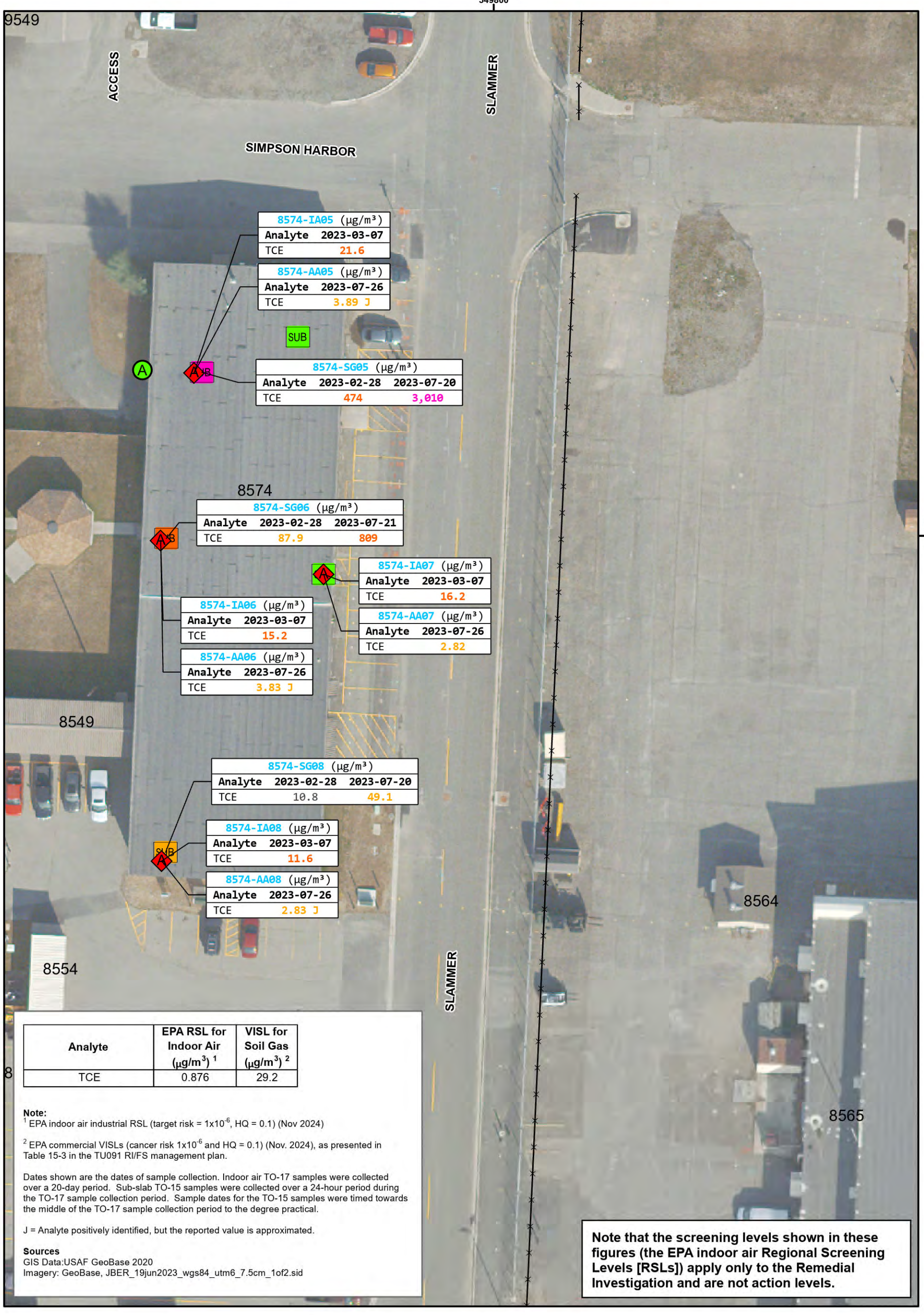
BLDG. 8549 SUMMER AND WINTER SUBSLAB SOIL GAS AND INDOOR AND OUTDOOR AIR SAMPLE DATA TU091 EE/CA REPORT

JOINT BASE ELMENDORF-RICHARDSON, ALASKA

DATE:	PROJECT MANAGER:	FIGURE NO:
22 APR 2025	K. MAHER	2-1

\\dc1vs01\GISProj\AA\Airforce\AK_JBER_ORC\MapFiles\TU091\EECA\TU091_EECA.aprx Layout: JBER_ORC_TU091_EECA_Fig2-1_TU091_VIExceedances_Bldg8549 dward 4/22/2025 12:45

This page intentionally left blank.



Analyte	EPA RSL for Indoor Air (µg/m³) [1]	VISL for Soil Gas (µg/m³) [2]
TCE	0.876	29.2

Note:
[1] EPA indoor air industrial RSL (target risk = $1x10^{-6}$, HQ = 0.1) (Nov 2024)

[2] EPA commercial VISLs (cancer risk $1x10^{-6}$ and HQ = 0.1) (Nov. 2024), as presented in Table 15-3 in the TU091 RI/FS management plan.

Dates shown are the dates of sample collection. Indoor air TO-17 samples were collected over a 20-day period. Sub-slab TO-15 samples were collected over a 24-hour period during the TO-17 sample collection period. Sample dates for the TO-15 samples were timed towards the middle of the TO-17 sample collection period to the degree practical.

J = Analyte positively identified, but the reported value is approximated.

Sources
GIS Data:USAF GeoBase 2020
Imagery: GeoBase, JBER_19jun2023_wgs84_utm6_7.5cm_1of2.sid

Note that the screening levels shown in these figures (the EPA indoor air Regional Screening Levels [RSLs]) apply only to the Remedial Investigation and are not action levels.

Area of Detail

- A — Indoor air exceedance 10 to 100x EPA VISL
- A — Indoor air exceedance up to 10x EPA VISL
- A — Outdoor air no exceedance
- SUB — Sub-slab air exceedance 100 to 1000x EPA VISL
- SUB — Sub-slab air exceedance 10 to 100x EPA VISL
- SUB — Sub-slab air exceedance up to 10x EPA VISL
- SUB — Sub-slab air no exceedance
- Fence

Sources
GIS Data:USAF GeoBase 2020
Imagery: GeoBase, JBER_19jun2023_wgs84_utm6_7.5cm_1of2.sid

1:420
0 10 20 30 40 50 60
Feet
WGS 1984 UTM Zone 6N

N

BLDG. 8574 SUMMER AND WINTER SUBSLAB SOIL GAS AND INDOOR AND OUTDOOR AIR SAMPLE DATA TU091 EE/CA REPORT

JOINT BASE ELMENDORF-RICHARDSON, ALASKA

DATE:	PROJECT MANAGER:	FIGURE NO:
24 APR 2025	K. MAHER	2-2

\\dc1vs01\GISProj\AVAirforce\AK_JBER_ORC\MapFiles\TU091\EECA\TU091_EECA aprx Layout: JBER_ORC_TU091_EECA_Fig2-2_TU091_VIExceedances_Bldg8574 KMINO 4/24/2025 9:52 AM

This page intentionally left blank.

3. DEVELOPMENT OF THE REMOVAL ACTION OBJECTIVE

This section identifies the statutory framework of removal actions, determines the removal scope, and specifies the removal action criteria.

3.1 Statutory Framework

This removal action will be performed pursuant to CERCLA and the NCP under the authority delegated to the Secretary of Defense by the Office of the President of the United States through EO 12580. This EO, as implemented through DoD Instruction 4715.07 and DoD Manual 4715.20, as amended, provides the USAF with authorization to conduct removal actions. DERP provides funding to the USAF for removal actions conducted under CERCLA. This removal action is non-time-critical because it was determined that a planning period at least 6 months was necessary prior to undertaking the removal action at this site.

This EE/CA provides an analysis of alternatives for the site and recommends a removal action alternative. This EE/CA is required by CERCLA, as amended by the Superfund Amendments and Reauthorization Act, the NCP, DERP, and EO 12580. This EE/CA is undertaken pursuant to 40 CFR 300.415(b)(4)(i). The requirements for this EE/CA and its mandated public comment period provide an opportunity for public input regarding the cleanup process.

3.2 Scope of Removal Action

This removal action applies to the potential adverse health effects due to TCE concentrations in indoor air that exceeded the EPA Region 10 short-term action level for industrial workers at TU091. This removal action does not address groundwater, stormwater, sediment, or soil. This removal action involves soil gas, but only in the context of mitigating exposure to TCE in indoor air in two buildings due to VI. No cleanup goals are proposed for soil gas below, or adjacent to, the buildings. Those media, along with indoor air, will be evaluated in the future FS/PP/ROD.

3.3 Removal Action Criteria

Section 121(d) of CERCLA (42 U.S.C. Section 9621(d)) requires that onsite remedial actions attain or waive federal environmental applicable or relevant and appropriate requirements (ARARs), or more stringent state environmental ARARs, upon completion of the remedial action. 40 CFR 300.415(j) specifies that certain types of removal actions must, to the extent practicable considering the exigencies of the situation, attain ARARs. The removal action contemplated by the USAF is not one of the types addressed in 40 CFR 300.415(j) (i.e., a removal action funded by Superfund or an abatement action taken under 42 U.S.C. 9606). Therefore, the USAF is not required to attain ARARs as part of this removal action.

The resulting removal action criteria for this EE/CA are the contaminant concentrations that the removal action alternative must achieve. The EPA Region 10 Office of Environmental Assessment (OEA) 2012 memorandum identified the short-term action level for TCE in indoor air as 8.4 $\mu g/m^3$ for industrial workers. The action level is the short-term exposure concentration determined to be protective of human health (EPA 2012).

3.4 Removal Action Objective

RAOs specify what the proposed removal action is expected to accomplish. In other words, they define the goals for the removal action. As such, RAOs are site-specific and are influenced by the nature and extent of chemical contamination, current and potentially threatened resources, and potential for human and environmental exposure.

Based on the scope of the removal action, the site description and the results of the human health risk assessment provided in Section 2, and the action level discussed in Section 3.3, the following RAO is proposed for the TU091 NTCRA:

- Prevent exposure by industrial workers at Buildings 8549 and 8574 to indoor air containing TCE concentrations greater than 8.4 µg/m^3.

This action level addresses exposure over an 8-hour work day, 5 days per week, during any 21-day period and is protective for sensitive populations (i.e., women of child-bearing age). The sample locations exceeding the proposed action level of 8.4 µg/m^3 of TCE in indoor air are illustrated in Figures 3-1 through 3-4.

Indoor Air Sample - no exceedance

Fence

1:780

0 30 60 90 120

Feet

WGS 1984 UTM Zone 6N

N

Acronyms and Abbreviations
TCE = Trichloroethylene

Notes
The proposed action level is **8.4 µg/m^3 of TCE** in indoor air.

Sources
GIS Data:USAF GeoBase 2020
Imagery: GeoBase, JBER_19jun2023_wgs84_utm6_7.5cm_1of2.sid

TCE IN INDOOR AIR
SUMMER 2023
TU091 EE/CA REPORT

JOINT BASE ELMENDORF-RICHARDSON, ALASKA

DATE:	PROJECT MANAGER:	FIGURE NO:
22 APR 2025	K. MAHER	3-1

\\dc1vs01\GISProj\AAirforce\AK_JBER_ORC\MapFiles\TU091\EECA\TU091_EECA.aprx Layout: JBER_ORC_TU091_EECA_Fig3-1_IA_Summer_8x11 dward 4/22/2025 12:46

This page intentionally left blank.

A Indoor air exceedance (TCE > 8.4 µg/m³)

A Indoor air no exceedance

Fence

1:780

0 30 60 90 120

Feet

WGS 1984 UTM Zone 6N

N

Acronyms and Abbreviations
TCE = Trichloroethylene

Notes
The proposed action level is **8.4 µg/m³ of TCE** in indoor air.

Sources
GIS Data:USAF GeoBase 2020
Imagery: GeoBase, JBER_19jun2023_wgs84_utm6_7.5cm_1of2.sid

TCE IN INDOOR AIR
WINTER 2023 AND 2024
TU091 EE/CA REPORT

JOINT BASE ELMENDORF-RICHARDSON, ALASKA

DATE:	PROJECT MANAGER:	FIGURE NO:
07 JUL 2025	K. MAHER	3-2

\\dc1vs01\GISProj\AVAirforce\AK_JBER_ORC\MapFiles\TU091\EECA\TU091_EECA aprx Layout: JBER_ORC_TU091_EECA_Fig3-2_IA_Winter_8x11 KMINO 7/7/2025 2:19 PM

This page intentionally left blank.

First Floor, Building 8549

8549-AA01			
Date	**Analyte**	**Media**	**Result (µg/m³)**
2/14/2023 - 3/7/2023	TCE	Indoor Air	8.71
7/6/2023 - 7/26/2023	TCE	Indoor Air	1.89

IA01

Boiler/Electrical Room

8549-AA02			
Date	**Analyte**	**Media**	**Result (µg/m³)**
2/14/2023 - 3/7/2023	TCE	Indoor Air	6.73
7/6/2023 - 7/26/2023	TCE	Indoor Air	1.36

IA02

8549-AA04			
Date	**Analyte**	**Media**	**Result (µg/m³)**
2/14/2023 - 3/7/2023	TCE	Indoor Air	5.39
7/6/2023 - 7/26/2023	TCE	Indoor Air	1.12

IA04

Corridor to Building 8574

Breakroom

Mechanical Room

8549-AA03			
Date	**Analyte**	**Media**	**Result (µg/m³)**
2/14/2023 - 3/7/2023	TCE	Indoor Air	8.58
7/6/2023 - 7/26/2023	TCE	Indoor Air	1.52

IA03

Closet

Occupied Office

8549-AA09			
Date	**Analyte**	**Media**	**Result (µg/m³)**
2/14/2023 - 3/7/2023	TCE	Indoor Air	4.9
7/6/2023 - 7/26/2023	TCE	Indoor Air	1.38

IA30

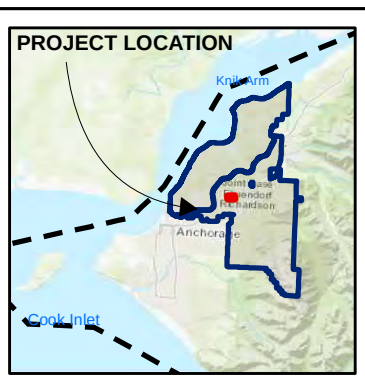
Conference Room

Garage Door

N

0 20 40
FEET

PROJECT LOCATION



Legend

- Indoor Air Sample Containing TCE Less than 8.4 µg/m³
- Indoor Air Sample Containing TCE More than 8.4 µg/m³

BUILDING 8549
DATA FOR INDOOR AIR SAMPLES
TU091 EE/CA REPORT
JOINT BASE ELMENDORF-RICHARDSON, ALASKA

DATE:	PROJECT MANAGER:	FIGURE NO:
17 APR 2025	K. MAHER	3-3

ES062612224557SAC TU091_B9549_Figure3-3_V3.ai tdaus 04.17.2025

This page intentionally left blank.

First Floor, Building 8574

Mechanical Room

8574-AA05			
Date	**Analyte**	**Media**	**Result (µg/m³)**
2/14/2023 - 3/7/2023	TCE	Indoor Air	**21.6**
7/6/2023 - 7/26/2023	TCE	Indoor Air	3.89

IA05

Garage Door

Wash Bay

IA06

Shop Area

8574-AA06			
Date	**Analyte**	**Media**	**Result (µg/m³)**
2/14/2023 - 3/7/2023	TCE	Indoor Air	**15.2**
7/6/2023 - 7/26/2023	TCE	Indoor Air	3.83

8574-AA07			
Date	**Analyte**	**Media**	**Result (µg/m³)**
2/14/2023 - 3/7/2023	TCE	Indoor Air	**16.2**
7/6/2023 - 7/26/2023	TCE	Indoor Air	2.82

IA07

Bathroom

Office

Corridor to Building 8549

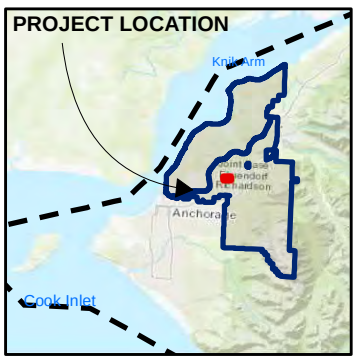
8574-AA08			
Date	**Analyte**	**Media**	**Result (µg/m³)**
2/14/2023 - 3/7/2023	TCE	Indoor Air	**11.6**
7/6/2023 - 7/26/2023	TCE	Indoor Air	2.83

IA08

N

0 15 30
FEET

PROJECT LOCATION



Legend

- Indoor Air Sample Containing TCE Less than 8.4 µg/m³
- Indoor Air Sample Containing TCE More than 8.4 µg/m³

BUILDING 8574
DATA FOR INDOOR AIR SAMPLES
TU091 EE/CA REPORT
JOINT BASE ELMENDORF-RICHARDSON, ALASKA

DATE:	PROJECT MANAGER:	FIGURE NO:
17 APR 2025	K. MAHER	3-4

ES062612224557SAC TU091_B9549_Figure3-4_V4.ai tdaus 04.17.2025

This page intentionally left blank.

4. IDENTIFICATION AND DEVELOPMENT OF REMOVAL ACTION ALTERNATIVES

This section identifies, develops, and screens potentially applicable technologies for assembling removal action alternatives. All technology processes considered are presented in Table 4-1. Technology processes considered to be developmentally sound and implementable were assessed in greater detail using three primary criteria: effectiveness, implementability, and cost. Based on the review of technology processes, potential removal action alternatives have been developed to achieve the RAO.

EPA guidance on conducting NTCRAs provides the following descriptions about effectiveness, implementability, and cost (EPA 1993):

- **Effectiveness**—The effectiveness of an alternative refers to its ability to meet the RAO within the scope of the removal action. This criterion considers protection of public health, the community, workers during implementation, and the environment; and attainment of the removal action criteria. The following factors are also considered:
  - Long-term effectiveness and permanence, which is the extent and effectiveness of controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes
  - Reduction of toxicity, mobility, or volume through treatment
  - Short-term effectiveness, which addresses the effects of the alternative during implementation and before the RAO has been met.
- **Implementability**—This criterion evaluates the technical and administrative feasibility of each alternative and the availability of the services and materials needed to implement the alternative. This criterion also considers state and community acceptance. The acceptance of an alternative will be evaluated during the public comment period and preparation of the AM. The final version of this EE/CA will be made available for a 30-day public comment period, and all comments received will be summarized and addressed in the responsiveness summary section of the AM. The following factors are considered:
  - Technical feasibility, which is the ability of the technology to implement the remedy and the technology's reliability. Technical feasibility is evaluated from construction through operation and maintenance (O&M) of the removal action.
  - Administrative feasibility, which evaluates those activities needed to coordinate with other offices and agencies and the need for permits, adherence to applicable non-environmental laws, and concerns of other regulatory agencies.
  - Availability of services and materials, which considers whether the requisite personnel, equipment, and materials will be available during the removal action schedule; the adequacy of offsite treatment capacity if the alternative includes offsite removal and treatment of waste; and whether the technology has been sufficiently developed for full-scale application.

  Cost—The total estimated cost of each alternative is calculated by considering the initial capital cost of planning and construction, followed by O&M and monitoring. These estimates can be based on costing tools (such as RSMeans or HeavyBid), engineering estimates, vendor quotes, and information from similar projects. The cost of each alternative is evaluated as to whether costs are high, medium, or low relative to the other options.

4.1 Potential Removal Action Technologies

As described in Section 2.6 of the EPA guidance on conducting NTCRAs:

> *Based on the available information, only the most qualified technologies that apply to the media or source of contamination should be discussed in the EE/CA. The use of presumptive remedy guidance can in many cases provide an immediate focus to the discussion and selection of alternatives, speeding the process by limiting the universe of effective alternatives for the non-time-critical removal action. Presumptive remedies involve the use of remedial technologies that have been selected in the past at similar sites or for similar contaminants* (EPA 1993).

Removal action technologies and removal mechanisms potentially capable of addressing TCE contamination in indoor air underwent a preliminary screening process presented in Table 4-1. Technologies determined to be inefficient, not implementable, or not developmentally sound were eliminated from further consideration. As summarized in Table 4-1, technologies and removal mechanisms initially retained as potentially viable treatment options were evaluated for effectiveness, implementability, and cost. Retained technologies will undergo a more detailed evaluation, as described in Section 5.

4.2 Development of Removal Action Alternatives

For purposes of the NTCRA, Buildings 8549 and 8574 will be addressed together. Most workers at these buildings split their time between both buildings and the buildings are connected via an enclosed walkway, thus indoor air within the two buildings constitutes a single exposure area.

Based on the initial evaluation in Table 4-1, the following removal action alternatives were developed for addressing TCE in indoor air at Buildings 8549 and 8574 at TU091:

- **Alternative 1 – No Action—**The No Action alternative implies that no action will be taken to reduce TCE concentrations in indoor air below the EPA Region 10 short-term action level of 8.4 µg/m^3. This alternative is included as a basis of comparison for the other alternatives and to determine what would occur if a removal action were not undertaken at this site.
- **Alternative 2 – Subslab Depressurization (SSD) Systems —**This alternative includes SSD systems in Buildings 8549 and 8574 to maintain a negative pressure differential between the indoor air and the subslab soil gas and thereby reduce concentrations of TCE in indoor air below the EPA Region 10 short-term action level of 8.4 µg/m^3. Annual VI monitoring would be performed to assess the following:
  - Confirm whether concentrations of TCE in indoor air within Buildings 8549 and 8574 decrease below the EPA Region 10 short-term action level
  - Evaluate changes in concentrations of TCE in the subslab soil gas (if any) over time
- **Alternative 3 – Air Purifying Units (APUs) —**This alternative includes APUs in Buildings 8549 and 8574 to reduce concentrations of TCE in indoor air below the EPA Region 10 short-term action level of 8.4 µg/m^3. Annual indoor air monitoring would be performed to assess the following:
  - Confirm whether concentrations of TCE in indoor air within Buildings 8549 and 8574 decrease below the EPA Region 10 short-term action level
  - Provide information to determine the necessary carbon changeout frequency to maintain concentrations of TCE in indoor air below the EPA Region 10 short-term action level.
- **Alternative 4 – Soil Vapor Extraction (SVE) Trenches** —This alternative includes SVE trenches adjacent to Buildings 8549 and 8574 to cut off the source of TCE in subslab soil gas and thereby

reduce concentrations of TCE in indoor air below the EPA Region 10 short-term action level of 8.4 $\mu g/m^3$. Annual VI monitoring would be performed to assess the following:

- Confirm whether concentrations of TCE in indoor air within Buildings 8549 and 8574 decrease below the EPA Region 10 short-term action level
- Evaluate changes in concentrations of TCE in the subslab soil gas over time

This page intentionally left blank.

Table 4-1 Detailed Screening of VI Mitigation Technologies

Technology Removal Mechanism	Screening Criteria			Screening Comments
	Effectiveness	Implementability	Cost	
No Action	Not effective	Easy to implement	Low	Retained for baseline comparison as required under CERCLA.
Land Use Control (LUC)	Effective in limited situations	Easy to implement	Low	Not retained for further evaluation. A LUC would not be feasible for reducing exposures to current workers at Buildings 8549 and 8574, because they need to access those areas
SSD	Highly effective	Well-demonstrated, proven technology. Moderately easy to implement	Medium low	Retained for further evaluation. SSD maintains a negative pressure differential between the indoor air and the subslab soil gas (applies a vacuum to the subslab soil gas) and thereby reduces concentrations of VI-related contaminants in indoor air. SDD is the most common technology used to mitigate VI of VOCs.
APUs	Highly effective	Well-demonstrated, proven technology. Moderately easy to implement	Medium	Retained for further evaluation. APUs recirculate air within the affected space and sorb the contaminants in GAC. APUs are commonly used to address indoor air contaminants.
SVE	Highly effective	Well-demonstrated, proven technology; implementable	High	Retained for further evaluation. SVE would involve shallow wells or trenches adjacent to the buildings, located between the buildings and the TCE source area to cut off the source of the TCE in subslab soil gas and indoor air.

Technology Removal Mechanism	Screening Criteria			Screening Comments
	Effectiveness	Implementability	Cost	
Passive Subslab Soil Gas Venting	Possibly effective	Moderately easy to implement for new construction; difficult to implement for existing construction	High (for existing buildings)	Not retained. Passive subslab soil gas venting is relatively easy to implement for new construction but not for existing buildings. Due to the age of these buildings (constructed prior to World War Two), it is uncertain if the available drawings would be sufficiently accurate to design a passive subslab removal alternative. Horizontal directional drilling below the building could potentially address those concerns, but would be highly expensive compared to other alternatives that have been proven effective.
Passive In-Floor Venting	Effective	Moderately easy to implement for new construction; difficult to implement for existing construction	High (for existing buildings)	Not retained. Passive in-floor venting provides a continuous void space below concrete floor slabs, which then can be passively vented with/to outdoor air for VI mitigation (Cupolex Engineering Solutions 2024). However, this technology is typically used for new construction. To modify the flooring at these existing buildings without a complete building demolition, the new flooring would likely be added on top of the existing flooring. All active operations would need to temporarily cease, and all equipment would need to be removed until the floors were replaced. Existing offices and restrooms would also be removed and replaced. The remaining vertical space after adding the additional flooring might be insufficient for the equipment that need to be used at Buildings 8549 and 8574. These constraints could adversely affect the JBER mission. The cost of this technology is also expected to be much higher to retrofit existing buildings than other technologies that have been proven effective.

Note:

GAC = granular activated carbon

5. EVALUATION OF REMOVAL ACTION ALTERNATIVES

Four removal action alternatives were developed to address the potential threat to human health posed by TCE in indoor air at Buildings 8549 and 8574 at TU091.

The alternatives were developed based on the following assumptions:

- The EPA Region 10 short-term action level identified in the RAO is intended to be protective of workers spending 8-hour work days within the affected space (EPA 2012).
- JBER personnel can provide sufficient electrical power for any applicable, proposed alternative.
- Access to Buildings 8549 and 8574 is not limited, such that contractors can access areas within the buildings with prior coordination for system installation, VI sampling, or system O&M.
- A future FS/PP/ROD will further evaluate and select a permanent remedy for Buildings 8549 and 8574.
- The removal action alternative selected in the NTCRA will operate for approximately 10 years until the permanent remedy is implemented.

As discussed in Section 4.2, indoor air within Buildings 8549 and 8574 constitutes a single exposure area, thus Buildings 8549 and 8574 will be addressed together. Four removal action alternatives were developed to address the potential threat to human health posed by TCE in indoor air at Buildings 8549 and 8574 at TU091. Interior systems at Buildings 8549 and 8574 are included in Alternatives 2 and 3, whereas an exterior SVE system is addressed by Alternative 4.

Each developed alternative is described in detail within the following subsections and individually assessed for effectiveness, implementability, and cost.

5.1 Detailed Description of Removal Action Alternatives

The following subsections provide a detailed description of potential removal action alternatives for Buildings 8549 and 8574 at TU091.

5.1.1 Alternative 1: No Action

Alternative 1 assumes that no removal action would be employed at these buildings at TU091 to address TCE in indoor air. The No Action alternative is evaluated to establish a baseline comparison regarding the future performance for the other alternatives, even though this alternative is not a viable option itself.

Under this alternative, no removal actions would be conducted to meet the RAO. Environmental monitoring would also not be performed to confirm whether TCE concentrations within indoor air increase or decrease over time.

5.1.2 Alternative 2: SSD Systems

The conceptual design presented in this subsection is intended to inform cost estimation. The conceptual design will be updated during the NTCRA implementation work plan.

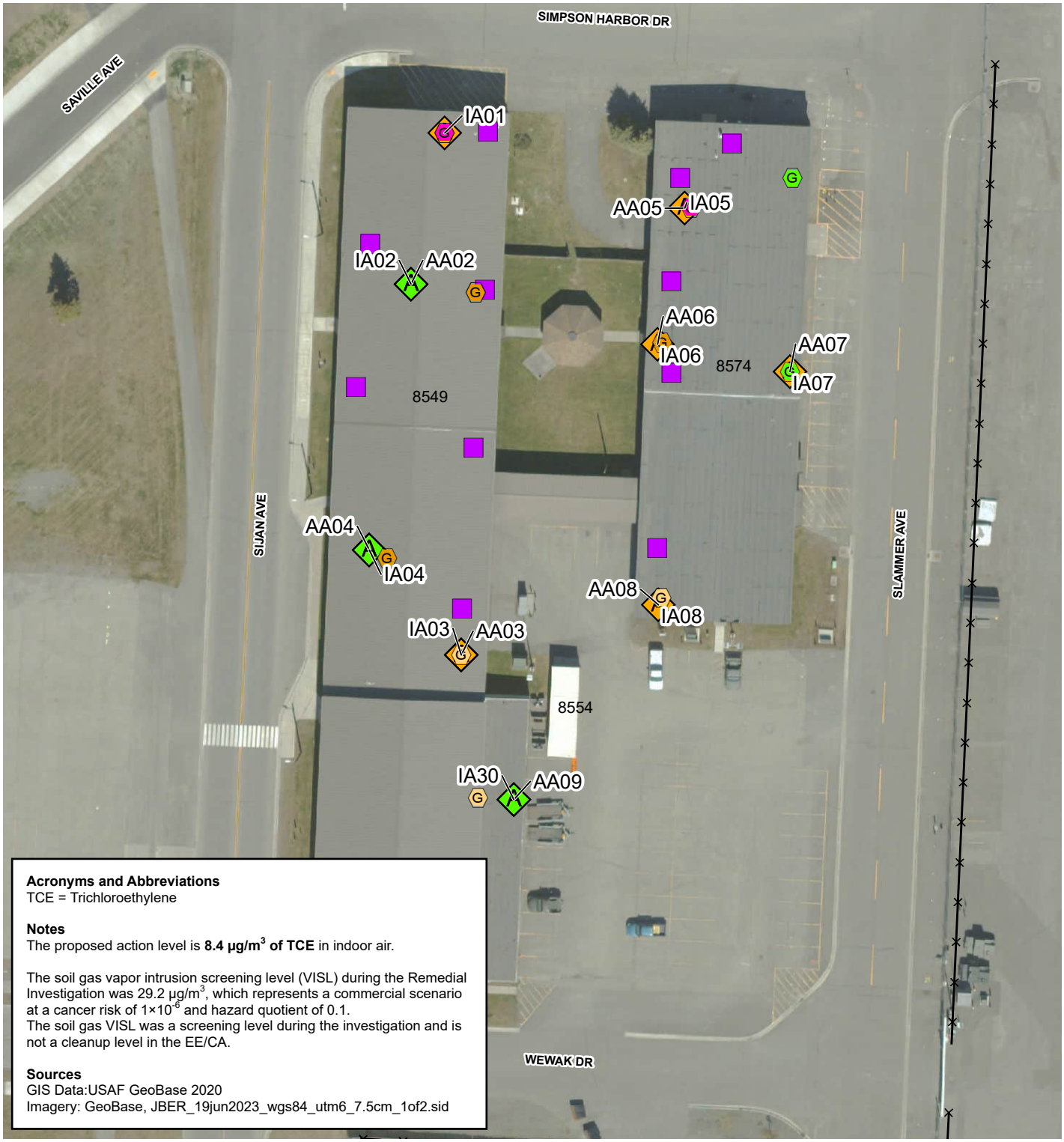
5.1.2.1 Conceptual Design

Figures 5-1a through 5-1c show the conceptual design for Alternative 2. Under Alternative 2, SSD systems would be installed at Buildings 8549 and 8574 to maintain a negative pressure differential between the indoor air and the subslab soil gas and thereby reduce concentrations of TCE in indoor air below the EPA Region 10 short-term action level of 8.4 $\mu g/m^3$. Suction points (nodes) would be installed through the concrete slab as shown in the figures. An example of a suction node and piping extending through a building wall to the blower on the exterior wall of the building is provided in Exhibit 5-1.

Exhibit 5-1 Example of SSD Piping at a U.S. Department of Defense Facility

Prior to system installation, cracks in the floor slab and floor penetrations would be sealed. Sealing could be performed using elastomeric compounds and insulating foam sealants to reduce or prevent TCE from being transported through these vapor entry points. Sealing would result in active subslab depressurization being more effective because it reduces short-circuiting between the subslab environment and the occupied space (resulting in a loss of applied vacuum). Attempting to identify and seal every potential entry point can be impractical. However, this approach would address the most obvious and potentially largest points of vapor entry/short circuiting.

Suction nodes would consist of a subslab void space below the slab, which would be backfilled with crushed stone to promote uniform and effective subslab vapor withdrawal. The piping intrusion through the slab would then be sealed with mortar or non-shrink grout. A RadonAway HS5500 blower or equivalent would be connected to up to two suction nodes; the extracted subslab soil gas would be vented to outdoor air through exhaust ports venting near or through the roof, away from fresh air intake locations. For purposes of cost estimation, a total of six blowers were assumed to be installed at Buildings 8549 and 8574. Appendix A1 provides an estimate of the potential quantity of TCE and total volatile organic compounds (VOCs) discharged through the vents. The potential discharges from any removal action at TU091 would fall under the category of “insignificant emissions” in 18 AAC 50.326(d), therefore, no treatment of the vented gas would be required.



Acronyms and Abbreviations
TCE = Trichloroethylene

Notes
The proposed action level is **8.4 µg/m^3 of TCE** in indoor air.

The soil gas vapor intrusion screening level (VISL) during the Remedial Investigation was 29.2 µg/m^3, which represents a commercial scenario at a cancer risk of 1×10^{-6} and hazard quotient of 0.1.
The soil gas VISL was a screening level during the investigation and is not a cleanup level in the EE/CA.

Sources
GIS Data:USAF GeoBase 2020
Imagery: GeoBase, JBER_19jun2023_wgs84_utm6_7.5cm_1of2.sid

- Proposed Subslab Depressurization Node (Approximate)
- Indoor Air Sample - No Exceedance
- Indoor Air Sample - Exceedance
- Subslab Soil gas concentration less than VISL
- Subslab Soil gas concentation up to 10x VISL
- Subslab Soil gas concentration between 10 to 100x VISL
- Subslab Soil gas concentration between 100 to 1000x VISL
- Fence

1:780
0 30 60 90 120
Feet

WGS 1984 UTM Zone 6N

N

ALTERNATIVE 2
PROPOSED SUBSLAB DEPRESSURIZATION SYSTEMS
TU091 EE/CA REPORT

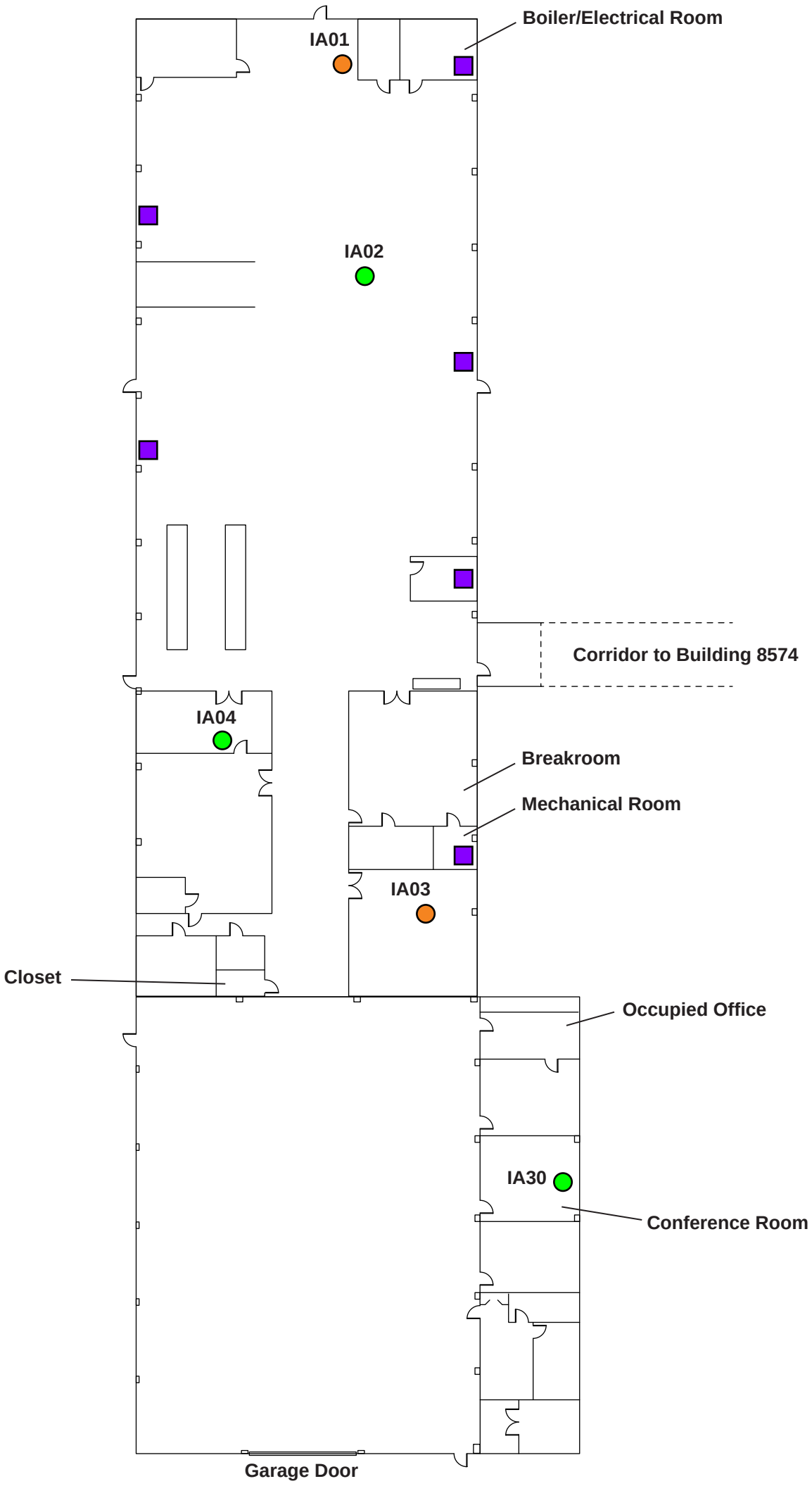
JOINT BASE ELMENDORF-RICHARDSON, ALASKA

DATE:	PROJECT MANAGER:	FIGURE NO:
01 JUL 2025	K. MAHER	5-1a

\\dc1vs01\vispro\AAirforce\AK_JBER_ORC\MapFiles\TU091\EECA\TU091_EECA.aprx Layout: JBER_ORC_TU091_EECA_Fig5-1a_All2_8x11 JCAIN4 7/1/2025 3:07 PM

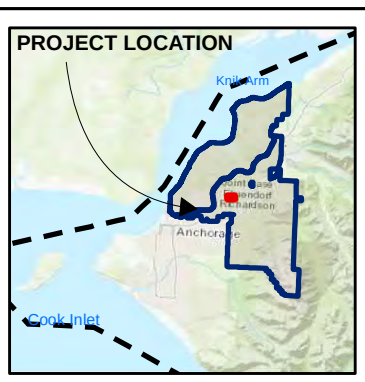
This page intentionally left blank.

First Floor, Building 8549



0 20 40
FEET

N



Legend

- Indoor Air Sample Containing TCE Less than 8.4 µg/m³
- Indoor Air Sample Containing TCE More than 8.4 µg/m³
- Subslab Depressurization Node (Approximate)

BUILDING 8549 - ALTERNATIVE 2
SUBSLAB DEPRESSURIZATION SYSTEMS
TU091 EE/CA REPORT
JOINT BASE ELMENDORF-RICHARDSON, ALASKA

DATE:	PROJECT MANAGER:	FIGURE NO:
17 APR 2025	K. MAHER	5-1b

ES062612224557SAC TU091_B9549_Figure5-1b_V1.ai tdaus 04.17.2025

This page intentionally left blank.

First Floor, Building 8574

Mechanical Room

IA05

Garage Door

Wash Bay

IA06

Shop Area

IA07

Bathroom

Office

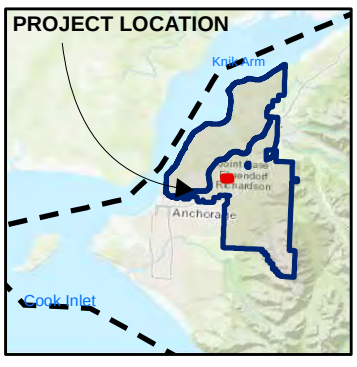
Corridor to Building 8549

IA08

0 15 30
FEET

N

PROJECT LOCATION



Legend

- Indoor Air Sample Containing TCE Less than 8.4 µg/m³
- Indoor Air Sample Containing TCE More than 8.4 µg/m³
- Subslab Depressurization Node (Approximate)

BUILDING 8574 - ALTERNATIVE 2
SUBSLAB DEPRESSURIZATION SYSTEMS
TU091 EE/CA REPORT
JOINT BASE ELMENDORF-RICHARDSON, ALASKA

DATE:	PROJECT MANAGER:	FIGURE NO:
17 APR 2025	K. MAHER	5-1c

ES062612224557SAC TU091_B9549_Figure5-1c_V1.ai tdaus 04.17.2025

This page intentionally left blank.

The proposed spacing for the SSD suction points (approximately 40 feet at Building 8549 and 25 feet at Building 8574) is based on the radius of influence of 25 to 40 feet observed in subslab soil gas during similar projects. As part of the design process, pilot testing is assumed to be conducted to determine the radius of influence of the negative pressure field at a given applied negative pressure and corresponding flow rate and to determine the TCE concentration in the exhaust gas. The negative pressure and flow rate data would then be used to select the number of extraction points and blower specifications. Pilot testing would be used to optimize the mitigation system design, potentially reducing both capital and long-term O&M costs.

No SSD systems are proposed for the southern third of Building 8549 because TCE concentrations in indoor air within that area were below the action level (Figures 5-1a and 5-1b). This section of Building 8549 is a separate portion of the building, added after the original building was constructed, and is likely serviced by a separate heating, ventilation, and air conditioning (HVAC) system.

No SSD systems are proposed for the east side of Building 8574 because subslab soil gas under the east side of Building 8574 contained TCE concentrations less than the VI screening level (Figures 5-1a and 5-1c). The presence of TCE above the action level in all sample locations throughout the building is believed to be the result of the building consisting of a single large bay. The TCE in indoor air within this building could have originated from VI in the northwestern portion of the building where TCE concentrations in indoor air were highest, as shown on Figure 2-2.

For cost estimation purposes, one RadonAway HS5500 blower was assumed to be connected to up to two suction nodes. Differential pressure monitoring locations would be installed where needed to assess the effectiveness of the systems.

5.1.2.2 Operations, Maintenance, and Monitoring

For cost estimation purposes, the SSD systems are assumed to be monitored through collection of field parameters (vacuum, flow, and differential pressure measurements) on a quarterly basis. Active SSD will provide some subsurface mass removal but will not address the source of the TCE in soil gas, which originates in the northern courtyard between Buildings 8549 and 8574.

VI monitoring would be performed to assess the following:

- Confirm whether concentrations of TCE in indoor air within Buildings 8549 and 8574 decrease below the EPA Region 10 short-term action level
- Evaluate changes in concentrations of TCE in the subslab soil gas (if any) over time

Indoor air and subslab soil gas sampling would be conducted at the same locations sampled during the RI within Building 8549 and Building 8574, for a total of nine locations. VI monitoring is assumed to occur annually in winter months because the concentrations of TCE in all locations were less than the action level during the summer RI sampling.

The results of the system inspections and VI monitoring would be documented in an annual report for ADEC/EPA review. For cost estimation purposes, the systems are assumed to operate for 10 years until the NTCRA is replaced by a permanent remedy through the FS/PP/ROD process.

If the operation of the initial systems does not achieve the EPA Region 10 short-term action level of 8.4 $\mu g/m^3$ at all indoor air sampling locations within Buildings 8549 and 8574, the analytical data and system operation data would be reviewed to assess modifications or enhancements to the system to ensure that TCE concentrations at all indoor air sampling locations would decrease below the EPA Region 10 short-term action level. Because SSD systems are a well-demonstrated, proven technology, modifications/enhancements of the systems are considered unlikely to be needed and have not been included in the cost estimate for this reason.

5.1.3 Alternative 3: APUs

The conceptual design presented in this subsection is intended to inform cost estimation. The conceptual design will be updated during the NTCRA implementation work plan.

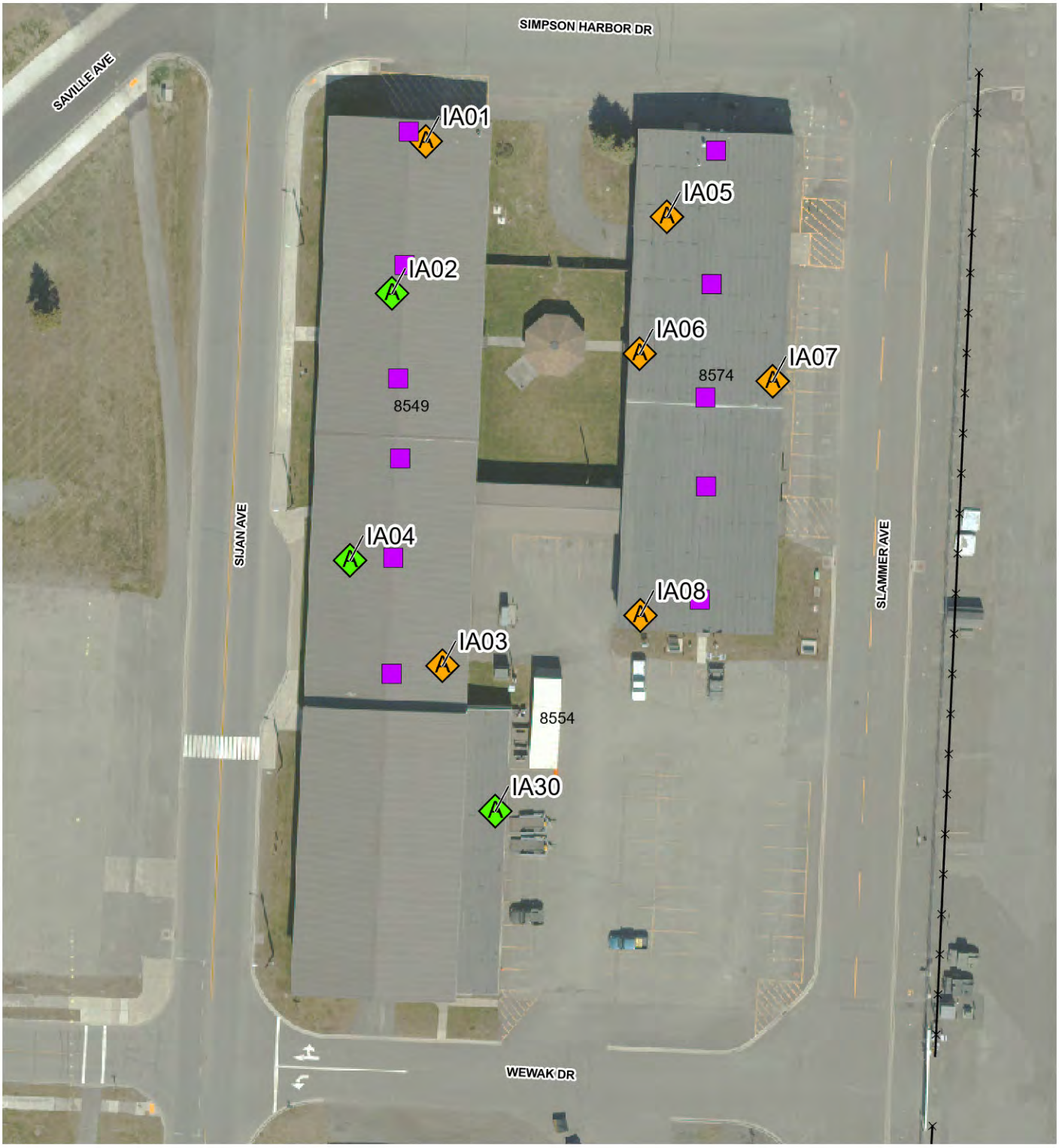
5.1.3.1 Conceptual Design

The conceptual design for Alternative 3 is shown on Figures 5-2a through 5-2c. Under Alternative 3, APU systems would be installed at Buildings 8549 and 8574 to reduce concentrations of TCE in indoor air below the EPA Region 10 short-term action level of 8.4 µg/m^3.

For the conceptual design, the units were assumed to be overhead (ceiling-mounted) Amaircare ES3X Tri-Carbon Heavy Duty Air Filtration Systems for Heavy VOCs (Exhibit 5-2), which would reduce the impact of the units on operations within the building. A variation of this alternative would be wheeled units on the floor, but the floor units would take up space otherwise needed for operations, and would be more likely to be moved by building personnel such that the units might not remain evenly spaced throughout the buildings.

Exhibit 5-2 Photos of Ceiling-mounted Amaircare ES3X Tri-Carbon Heavy Duty Air Filtration Systems for Heavy VOCs
Source: U.S. Air Purifiers 2024 (images used with permission; not to be reproduced elsewhere without written permission)

Prior to system installation, cracks in the floor slab and floor penetrations would be sealed to reduce the flux of TCE into the indoor air. Sealing could be performed using elastomeric compounds and insulating foam sealants to reduce or prevent TCE from being transported through these vapor entry points. Attempting to identify and seal every potential entry point can be impractical. However, this approach would address the most obvious and potentially largest points of vapor entry. The proposed units have a capacity to filter 2,000 cubic feet of air per minute.



Proposed Overhead Air Purifying Unit (Approximate)

Indoor Air Sample - No Exceedance

Indoor Air Sample - Exceedance

Fence

1:780

0 30 60 90 120

Feet

WGS 1984 UTM Zone 6N

N

Acronyms and Abbreviations
TCE = Trichloroethylene

Notes
The proposed action level is **8.4 µg/m^3 of TCE** in indoor air.

Sources
GIS Data:USAF GeoBase 2020
Imagery: GeoBase, JBER_19jun2023_wgs84_utm6_7.5cm_1of2.sid

ALTERNATIVE 3
PROPOSED AIR PURIFYING UNITS
TU091 EE/CA REPORT

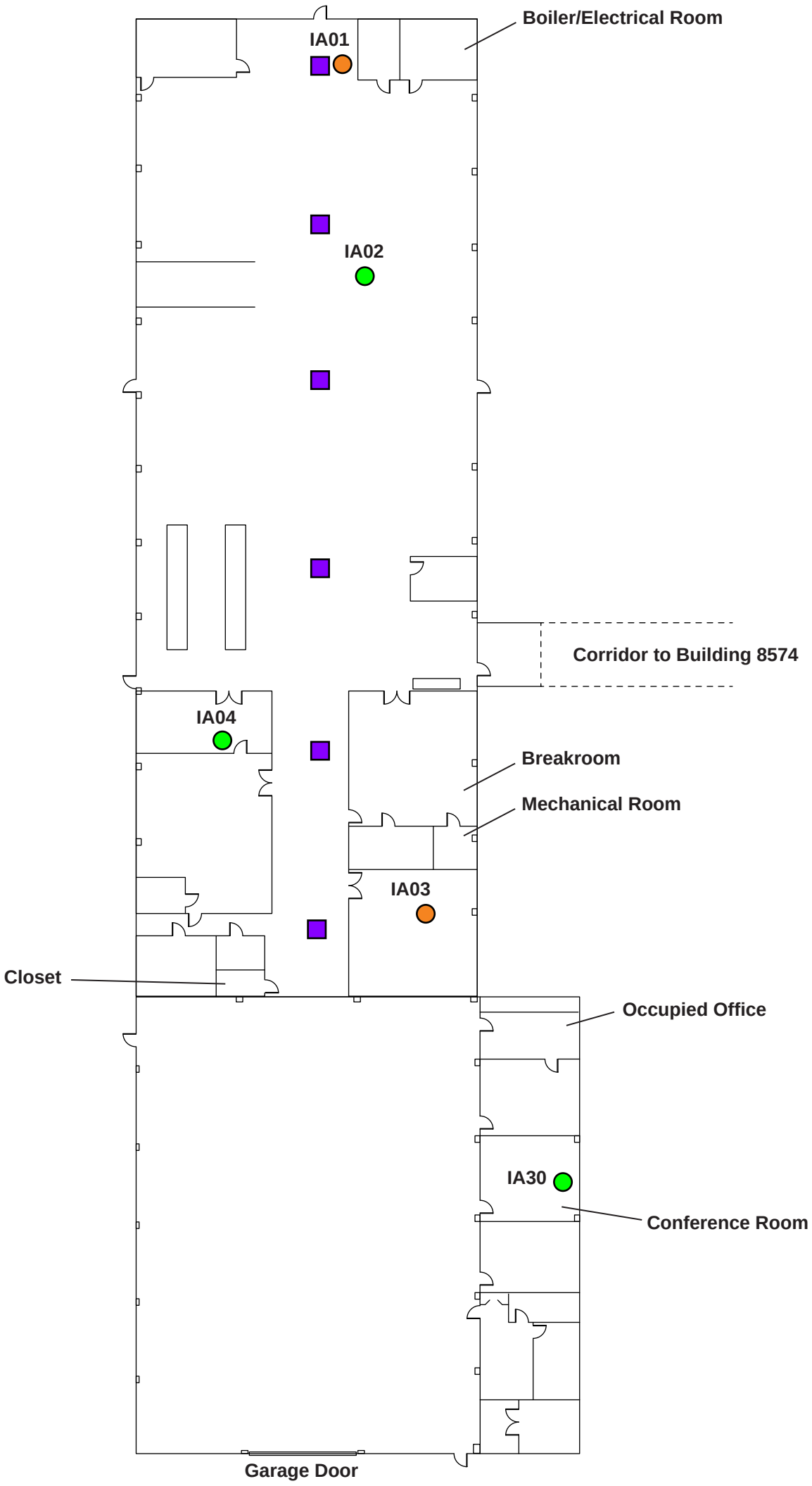
JOINT BASE ELMENDORF-RICHARDSON, ALASKA

DATE:	PROJECT MANAGER:	FIGURE NO:
17 APR 2025	K. MAHER	5-2a

\\dc1vs01\GISProj\AAirforce\AK_JBER_ORC\MapFiles\TU091\EECA\TU091_EECA aprx Layout: JBER_ORC_TU091_EECA_Fig5-2a_Alt3_8x11 KMINO 4/17/2025 11:24 AM

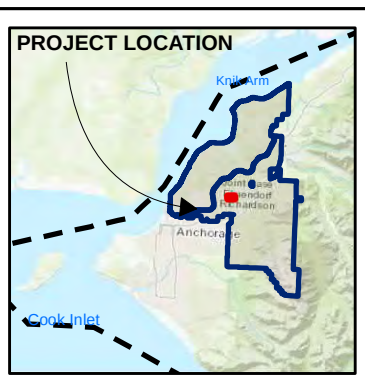
This page intentionally left blank.

First Floor, Building 8549



0 20 40
FEET

N



Legend

- Indoor Air Sample Containing TCE Less than 8.4 µg/m³
- Indoor Air Sample Containing TCE More than 8.4 µg/m³
- Air Purifying Unit (Approximate)

BUILDING 8549 - ALTERNATIVE 3
AIR PURIFYING UNITS
TU091 EE/CA REPORT
JOINT BASE ELMENDORF-RICHARDSON, ALASKA

DATE:	PROJECT MANAGER:	FIGURE NO:
17 APR 2025	K. MAHER	5-2b

ES062612224557SAC TU091_B9549_Figure5-2b_V1.ai tdaus 04.17.2025

This page intentionally left blank.

First Floor, Building 8574

Mechanical Room

IA05

Garage Door

Wash Bay

IA06

Shop Area

IA07

Bathroom

Office

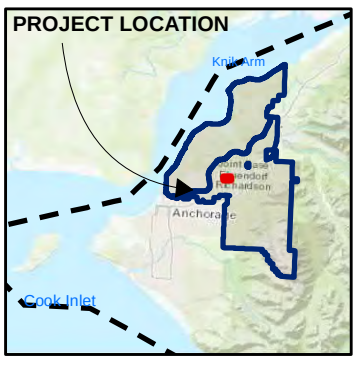
Corridor to Building 8549

IA08

0 15 30
FEET

N

PROJECT LOCATION



Legend

- Indoor Air Sample Containing TCE Less than 8.4 µg/m³
- Indoor Air Sample Containing TCE More than 8.4 µg/m³
- Air Purifying Unit (Approximate)

BUILDING 8574 - ALTERNATIVE 3
AIR PURIFYING UNITS
TU091 EE/CA REPORT
JOINT BASE ELMENDORF-RICHARDSON, ALASKA

DATE:	PROJECT MANAGER:	FIGURE NO:
17 APR 2025	K. MAHER	5-2c

ES062612224557SAC TU091_B9549_Figure5-2c_V1.ai tdaus 04.17.2025

This page intentionally left blank.

The following values are assumed to derive the number of APUs per building:

- Two air exchanges per hour
- 80 percent air-flow efficiency
- Areas of 15,600 square feet for Building 8574 and 18,600 square feet for the area of Building 8549 to be addressed
- A ceiling height of 15 feet

These assumptions result in six overhead APUs in Building 8549 and five overhead APUs at Building 8574. No APU systems are proposed for the south end of Building 8549 because TCE concentrations in indoor air within that area were below the action level (Figures 5-2a and 5-2b). The southern section of Building 8549 is a separate portion of the building, added after the original building was constructed, and is likely serviced by a separate HVAC system. No pilot testing is assumed in the cost estimate because (1) the buildings consist of large bays, thus no smaller areas can be segregated for pilot testing, and (2) the APU technology is sufficiently simple that rules of thumb can be used to design the system.

5.1.3.2 Operations, Maintenance, and Monitoring

For cost estimation purposes, the APU systems are assumed to operate 6 months per year because TCE concentrations in indoor air within these buildings did not exceed the EPA Region 10 short-term action level of 8.4 µg/m^3 during the summer sampling event. The systems would be inspected and the granular activated carbon (GAC) within the units replaced once per year. Based on the estimate in Appendix A2, the mass of GAC within the units (90 pounds per unit) is sufficient to sorb the solvents and petroleum hydrocarbons observed in the indoor air samples during the RI, based on the following conservative assumptions:

- Although the target of the indoor air treatment is TCE, the GAC lifespan will be determined by the concentrations of gasoline-range organics and diesel-range organics, which were detected in indoor air at much higher concentrations than TCE during the RI.
- The GAC will sorb at least 20 percent of its weight in petroleum-related VOCs (worst-case scenario, as shown by the GAC sorption ratings in Appendix A2).
- The APUs are 95 percent efficient in reducing indoor air concentrations of TCE (in other words, the maximum pre-operation concentration of 21.6 µg/m^3 of TCE in indoor air would be reduced to 1.1 µg/m^3 of TCE during APU operation).
- A corresponding decrease is seen in the concentration of petroleum contaminants, which have the same GAC sorption rating as TCE (Appendix A2).
- The resulting GAC lifespan is based on the steady-state concentration of petroleum contaminants in indoor air during APU operation.

As a result of these assumptions and the calculation in Appendix A2, the GAC is assumed to be replaced annually between the operational periods and sent offsite for regeneration or incineration.

Indoor air monitoring would be performed to assess the following:

- Confirm whether concentrations of TCE in indoor air within Buildings 8549 and 8574 decrease below the EPA Region 10 short-term action level
- Provide information to determine the necessary carbon changeout frequency to maintain concentrations of TCE in indoor air below the EPA Region 10 short-term action level

For cost estimation purposes, this sampling is assumed to consist of indoor air sampling at the same locations sampled during the RI within Buildings 8549 and 8574, for a total of nine locations. Subslab

soil gas sampling is not included in this alternative because the APUs would only affect indoor air concentrations. VI monitoring is assumed to occur annually in winter months because the concentrations of TCE in all locations were less than the action level during the summer RI sampling.

The results of the system inspections, GAC replacement/disposal, and indoor air monitoring would be documented in an annual report for ADEC/EPA review. For cost estimation purposes, the systems are assumed to operate for 10 years until the NTCRA is replaced by a permanent remedy through the FS/PP/ROD process.

If the operation of the initial systems does not achieve the EPA Region 10 short-term action level of 8.4 $\mu g/m^3$ at all indoor air sampling locations, the analytical data and system operation data would be reviewed to assess modifications or enhancements to the system to ensure that TCE concentrations at all indoor air sampling locations would decrease below the EPA Region 10 short-term action level. Based on the fact that APU systems are a well-demonstrated, proven technology, modifications/enhancements of the systems are considered unlikely to be needed and have not been included in the cost estimate for this reason.

5.1.4 Alternative 4: SVE Trenches

The conceptual design presented in this subsection is intended to inform cost estimation. The conceptual design will be updated during the NTCRA implementation work plan.

5.1.4.1 Conceptual Design

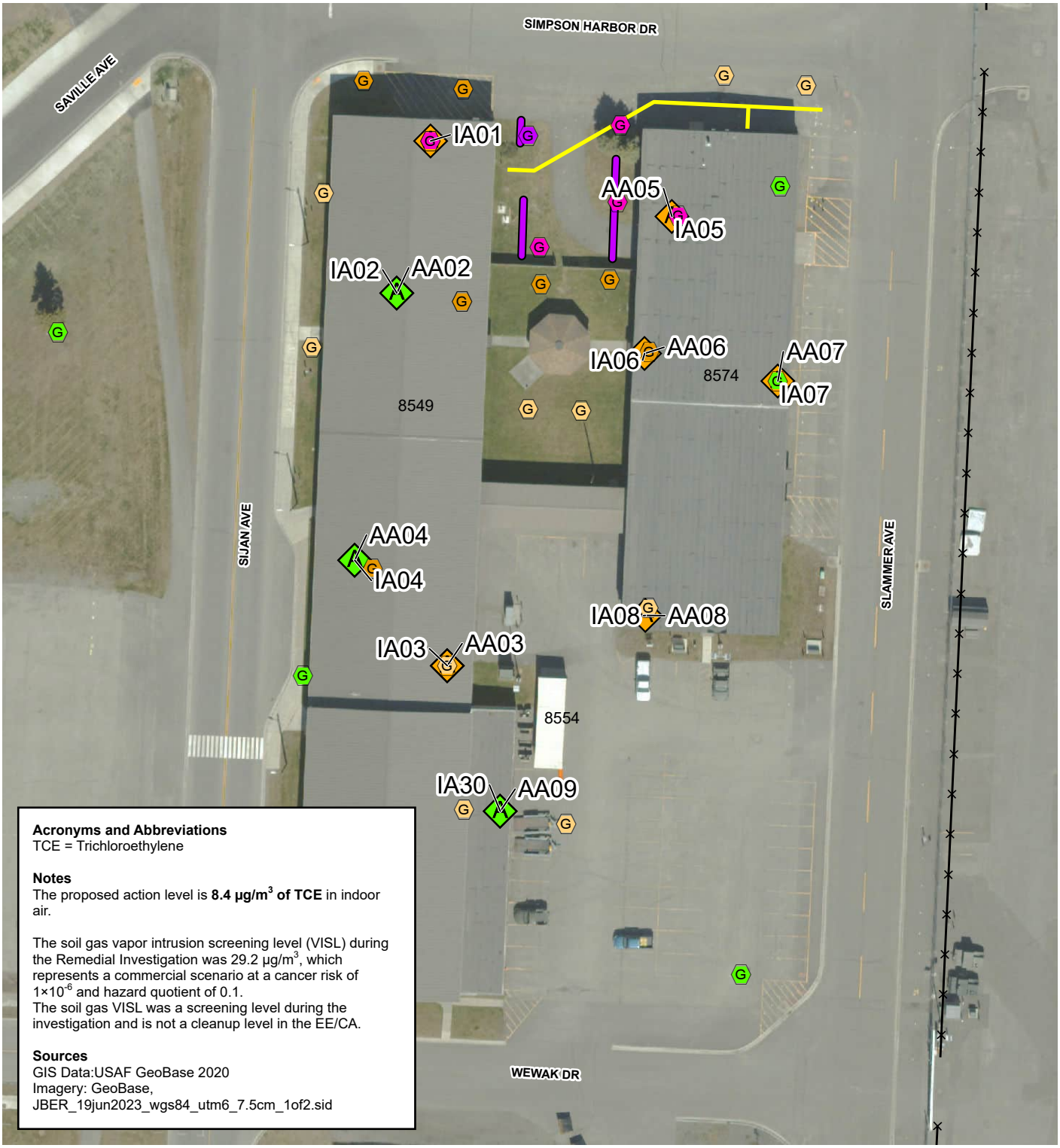
Figure 5-3 shows the conceptual design for Alternative 4. Under Alternative 4, SVE trenches adjacent to both buildings would cut off the source of TCE in subslab soil gas and thereby reduce concentrations of TCE in indoor air below the EPA Region 10 short-term action level of 8.4 $\mu g/m^3$. The conceptual design of the SVE trenches is intended only to mitigate VI at the buildings, not to address the source area. The source area would be addressed in a future remedy in the FS/PP/ROD.

The systems could be installed as a series of SVE wells adjacent to the buildings, but the system has instead been conceptually designed as a series of 8-feet-deep trenches. As explained in the RI report (USAF 2025), the TCE concentrations in the soil gas within the courtyard is relatively high (up to approximately 70,000 $\mu g/m^3$). To ensure that the system would cut off this source of TCE in the subslab soil gas beneath the buildings, the system was conceptually designed as trenches. The competing radius of influence (ROI) for individual wells could potentially allow for soil gas to penetrate some areas of the system.

The assumed ROI for the trenches is 20 feet. The conceptual design for the SVE trenches places the trenches where their ROI would cut off the upper 99 percent of soil gas concentrations of TCE adjacent to the buildings. The SVE system may also provide depressurization of the portion of the building slabs adjacent to the trenches and therefore closest to the source area. It is not necessary to extend the trenches across the entire area of soil gas containing TCE above its VISL during the RI for two reasons:

- The VISL is a highly conservative screening level, not a cleanup level, and an exceedance alone does not constitute an unacceptable risk.
- The operation of the trenches would be expected to reduce the concentration of TCE in soil gas further away from the source area because the higher concentrations of TCE in soil gas would no longer diffuse out to the outlying areas.

A significant constraint on the SVE trench adjacent to Building 8549 is the presence of a natural gas line at the northeast corner of the building (Figure 5-3). This SVE trench has been split in two sections to avoid the gas line. Each section of the SVE trench is assumed to approach no closer than 10 feet from the gas line as a safety precaution. The trenches were placed 10 feet from the building foundation or monitoring wells. The system enclosure is assumed to be placed within the northern courtyard.



Acronyms and Abbreviations
TCE = Trichloroethylene

Notes
The proposed action level is **8.4 µg/m^3 of TCE** in indoor air.

The soil gas vapor intrusion screening level (VISL) during the Remedial Investigation was 29.2 µg/m^3, which represents a commercial scenario at a cancer risk of 1×10^{-6} and hazard quotient of 0.1.
The soil gas VISL was a screening level during the investigation and is not a cleanup level in the EE/CA.

Sources
GIS Data:USAF GeoBase 2020
Imagery: GeoBase, JBER_19jun2023_wgs84_utm6_7.5cm_1of2.sid

- Indoor Air Sample - No Exceedance
- Indoor Air Sample - Exceedance
- Soil gas concentration less than VISL
- Soil gas concentation up to 10x VISL
- Soil gas concentration between 10 to 100x VISL
- Soil gas concentration between 100 to 1000x VISL
- Soil gas concentation greater than 1000x VISL
- Proposed Soil Vapor Extraction (SVE) Trench
- Fence
- Gas Line

1 inch = 65 feet
0 30 60 90 120
Feet
WGS 1984 UTM Zone 6N

N

ALTERNATIVE 4
PROPOSED SOIL VAPOR EXTRACTION TRENCHES FOR VAPOR INTRUSION MITIGATION
TU091 EE/CA REPORT

JOINT BASE ELMENDORF-RICHARDSON, ALASKA

DATE:	PROJECT MANAGER:	FIGURE NO:
01 JUL 2025	K. MAHER	5-3

\\dc1vs01\gisproj\AK\Airforce\AK_JBER_ORC\MapFiles\TU091\EECA\TU091_EECA.aprx Layout: JBER_ORC_TU091_EECA_Fig5-3_All4_8x11_ICAIN4 7/1/2025, 3:09 PM

This page intentionally left blank.

Another constraint is the that trenches would be installed a short distance from the edges of the buildings to provide clearance for the excavator or one-pass trencher to work and to ensure that the trench installation does not cause any instability for the building foundation. For these reasons, the trenches were placed approximately 10 feet from the edges of the buildings. To protect the two monitoring wells on the east side of Building 8549 (the white squares visible on the east side of Building 8549 on Figure 5-3), the adjacent SVE trench segment was assumed to be constructed 10 feet east of the bollards for these wells.

Prior to system installation, cracks in the floor slab and floor penetrations would be sealed to reduce TCE flux into indoor air. Sealing could be performed using elastomeric compounds and insulating foam sealants to reduce or prevent TCE from being transported through these vapor entry points. Attempting to identify and seal every potential entry point can be impractical. However, this approach would address the most obvious and potentially largest points of vapor entry.

For purposes of cost estimation, the following are assumed for the SVE system:

- Eight feet deep SVE trenches, with asphalt over the top of the trenches to prevent short-circuiting of atmospheric air into the system
- Four feet deep trenches for conveyance piping
- One-third of the excavated soil is sent offsite for disposal as TSCA-regulated waste due to the presence of polychlorinated biphenyls (PCBs) at a concentration of greater than 50 parts per million at a Toxic Substances Control Act (TSCA)-permitted facility in Oregon
- Two-thirds of the excavated soil is sent offsite for disposal as non-hazardous waste under CERCLA. This soil is assumed to be transported to a Subtitle D facility in Oregon to comply with the CERCLA offsite rule
- A 8-feet by 12-feet Connex to house the system, located within the northern courtyard
- A 100-cubic-foot-per-minute, skid-mounted SVE blower
- A 1,000 pound (0.5 ton) vapor-phase GAC unit to treat the system exhaust

No pilot testing was included in the cost estimate due to data being available from multiple sites at JBER that were historically treated with SVE or bioventing, such as FT023, SD025, SS010, and SS109. If pilot testing is determined to be necessary, a segment of the proposed trenches could be installed and tested prior to installing the entire system.

Appendix A3 contains an estimate of the potential quantity of TCE and total VOCs discharged through the exhaust stack. The potential discharges from any removal action at TU091 would fall under the category of “insignificant emissions” in 18 AAC 50.326(d) and no treatment of the vented gas would be required. However, as a best management practice for SVE systems, GAC treatment is assumed for the exhaust gas to ensure that no inadvertent exposures occur to the contaminants in the exhaust gas.

5.1.4.2 Operations, Maintenance, and Monitoring

For cost estimation purposes, the SVE system is assumed to be inspected quarterly to ensure that it is operating within the design parameters. For cost estimation purposes, the GAC is assumed to be changed out annually. This would ensure adequate capacity for the GAC to sorb the contaminants in the exhaust. As shown in Appendix A3, up to approximately 0.12 ton per year of VOCs are expected to be discharged by the system, and the GAC is expected to be able to sorb about 33 percent of its weight with TCE. (Appendix A2 contains GAC sorption ratings.) Therefore, up to 0.36 ton of GAC are needed to sorb the contaminants per year, leaving a contingency of over 25 percent in the system capacity. The gas extracted from each extraction trench and the exhaust before and after GAC treatment are assumed to be sampled quarterly. The SVE exhaust (prior to and after the GAC unit) would be sampled quarterly to confirm the system performance and the schedule for the GAC changeout.

VI monitoring would be performed to confirm whether concentrations of TCE in indoor air within Buildings 8549 and 8574 decrease below the action level and to provide information to assess whether those changes are related to the SVE trench operation. This sampling would consist of indoor air sampling and subslab soil gas sampling at the same locations sampled during the RI. VI monitoring is assumed to occur annually in winter months because the concentrations of TCE in all locations were less than the action level during the summer sampling.

The results of the system operation/inspections, GAC replacement/disposal, and VI monitoring would be documented in an annual report for ADEC/EPA review. For cost estimation purposes, the SVE trenches are assumed to operate for 10 years until the NTCRA is replaced by a permanent remedy through the FS/PP/ROD process.

If the operation of the initial trenches does not achieve the action level of 8.4 µg/m^3 at all indoor air sampling locations, the analytical data and system operation data would be reviewed to assess modifications or enhancements to the system to ensure that TCE concentrations at all indoor air sampling locations would decrease below the action level. Such enhancements could include the installation of SVE wells in targeted locations. However, the cost of contingency SVE wells have not been included in the cost estimate. Based on the operation of historical SVE systems at JBER, no pilot testing is assumed to be necessary.

5.2 Individual Analysis of Alternatives

The analyses of the individual alternatives are presented in the following subsections. Note that all costs are rounded to the nearest thousand dollars.

5.2.1 Alternative 1: No Action

5.2.1.1 Effectiveness

Alternative 1 (No Action) would not reduce potential exposures for current or future workers to indoor air exceeding the EPA Region 10 short-term action level of 8.4 µg/m^3 at Buildings 8549 and 8574. Therefore, no action would not meet the RAO.

Long-term Effectiveness and Permanence

No action does not provide treatment and would not provide long-term effectiveness in reducing TCE concentrations to levels less than the action level or reducing current or future exposures.

No action would be ineffective over the long term. The RAO would not be achieved within the foreseeable future, the magnitude of concentrations would remain approximately the same, and no control would be in place to minimize exposure to current or future receptors.

Reduction of Toxicity, Mobility, or Volume through Treatment

Under the No Action alternative, the toxicity, mobility, and volume of TCE in indoor air within Buildings 8549 and 8574 would not be reduced beyond natural attenuation (that is, depletion of mass in subslab soil gas over time, which is the source of the TCE in indoor air), which is not considered to be treatment as defined under CERCLA. Therefore, no action does not prevent current or future human exposure to TCE in indoor air above the action level within these buildings.

Short-term Effectiveness

No action would be ineffective in the short term in reducing TCE concentrations or exposure to those concentrations within indoor air at Buildings 8549 and 8574 at TU091.

5.2.1.2 Implementability

No technical and administrative issues exist, and no services or materials are required. The No Action alternative is easily implemented.

5.2.1.3 Cost

The total present-value estimated cost for this alternative is $0.

5.2.2 Alternative 2: SSD Systems

5.2.2.1 Effectiveness

Alternative 2 would reduce TCE concentrations in indoor air within Buildings 8549 and 8574 below the EPA Region 10 short-term action level of 8.4 µg/m^3 by inducing a negative pressure differential between the indoor air and the subslab soil gas. SSD systems are one of the most common technologies used to mitigate VI.

Long-term Effectiveness and Permanence

Alternative 2 would be expected to reduce TCE concentrations within indoor air at Buildings 8549 and 8574 through the duration of the NTCRA. Performance monitoring would be employed to evaluate the effectiveness of the removal action in protecting human health.

Reduction of Toxicity, Mobility, or Volume through Treatment

While SSD systems are highly capable of reducing concentrations of contaminants in indoor air caused by VI, they operate by changing the pressure differential between the indoor air and the subslab soil gas. In other words, they operate as containment systems. EPA guidance (EPA 1999) does not define containment as treatment. However, this alternative would prevent potential human exposure to TCE in indoor air above the EPA Region 10 short-term action level within these buildings. The future permanent remedy for TU091 is expected to address the source area and reduce the toxicity, mobility, or volume of TCE through treatment. EPA guidance indicates that the preference for treatment should be met "whenever practicable" in an EE/CA (EPA 1993). For these reasons, the lack of reduction of toxicity, mobility, or volume of the TCE through treatment in Alternative 2 for the NTCRA is considered acceptable.

Short-term Effectiveness

In the short term, construction hazards during implementation would be minimal and would be mitigated with adequate planning and controls and implementation of a comprehensive health and safety plan (HSP). Alternative 2 would be effective in reducing the risk to workers due to TCE in indoor air at Buildings 8549 and 8574, which would be confirmed through VI monitoring.

5.2.2.2 Implementability

Technical Feasibility

SSD systems are well-established mitigation technologies for addressing VI. These systems are the same as the systems installed to mitigate radon in homes and businesses, thus local subcontractors would be available to install the systems. The necessary supplies and equipment can be easily ordered and delivered to the site. Vapor pins have already been installed through the foundations, so there would be no issue with coring the SSD floor penetrations. It would be possible to install vent pipes through the walls or roofs.

Administrative Feasibility

The systems would take up only a limited area along the inner perimeter of Buildings 8549 and 8574. The buildings are accessible by staff to install the systems. Field activities would not impact base operations.

The estimated discharges of contaminants to the air from the SSD systems (Appendix A) would constitute *de minimis* quantities and would not require any new air permitting or modifications of existing air permits for JBER. Alternative 2 is administratively feasible.

5.2.2.3 Cost

The cost analysis is based on a 10-year O&M period with an assumption that the NTCRA would be superseded by a permanent remedy under the FS/PP/ROD at that time. The estimated capital cost for this alternative is $300,000. This includes a pilot test, NTCRA implementation work plan, installation of six SSD systems (five with two floor penetrations [nodes] and one with a single floor penetration), and a report for the system installation. The estimated O&M cost over 10 years, which includes quarterly system O&M and annual VI monitoring and reporting, is approximately $535,000. The estimated present-value cost, which uses a 10-year discount rate of 1.9 percent, is $783,000. The present-value cost for this alternative is expected to be within -30 to +50 percent accuracy (EPA 1988). The detailed cost estimate and assumptions for Alternative 2 are included in Appendix B.

5.2.3 Alternative 3: APUs

5.2.3.1 Effectiveness

Alternative 3 would reduce TCE concentrations in indoor air within Buildings 8549 and 8574 below the EPA Region 10 short-term action level of 8.4 µg/m^3 by filtering the air through GAC. APUs are commonly used to address indoor air contaminants. This alternative would attain the RAO.

The GAC in the APUs would be replaced annually, with the spent GAC addressed by regeneration, offsite disposal, or offsite incineration, in accordance with Resource Conservation and Recovery Act (RCRA) guidelines. The GAC is expected to be classified as non-hazardous waste, with the majority of the sorbed contaminants consisting of bulk petroleum hydrocarbons.

Long-term Effectiveness and Permanence

Alternative 3 would be expected to reduce TCE concentrations within indoor air at Buildings 8549 and 8574 through the duration of the NTCRA. Performance monitoring would be employed to evaluate the effectiveness of the removal action in protecting human health.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 3 would reduce the toxicity, mobility, and volume of the TCE in the indoor air. The treatment would occur offsite for the TCE in the spent GAC.

Short-term Effectiveness

In the short term, construction hazards during implementation would be minimal and would be mitigated with adequate planning and controls and implementation of a comprehensive HSP. Alternative 3 would be effective in reducing the risk to workers due to TCE in indoor air at Buildings 8549 and 8574, which would be confirmed through indoor air monitoring.

5.2.3.2 Implementability

Technical Feasibility

APUs are a well-established mitigation technology for addressing contaminants in indoor air. Local subcontractors would be available to install the systems. The necessary supplies and equipment can be easily ordered and delivered to the site. The systems could be installed as overhead units on the ceiling or as wheeled units on the floor, providing for flexibility in the installation method while minimizing impacts to building operations.

Administrative Feasibility

The systems would take up only a limited space within Buildings 8549 and 8574. Field activities would not impact JBER operations. Alternative 3 is administratively feasible.

5.2.3.3 Cost

The cost analysis is based on a 10-year O&M period with an assumption that the NTCRA would be superseded by a permanent remedy under the FS/PP/ROD at that time. The estimated capital cost for this alternative is $318,000. This includes a NTCRA implementation work plan, installation of 11 APUs, and a report for the system installation. The estimated O&M cost over 10 years, which includes annual system O&M, replacement of the GAC, VI monitoring, and reporting, is approximately $731,000. The estimated present-value cost, which uses a 10-year discount rate of 1.9 percent, is $978,000. The present-value cost for this alternative is expected to be within -30 to +50 percent accuracy (EPA 1988). The detailed cost estimate and assumptions for Alternative 3 are included in Appendix B.

5.2.4 Alternative 4: SVE Trenches

5.2.4.1 Effectiveness

Alternative 4 would be expected to reduce TCE concentrations in indoor air within Buildings 8549 and 8574 below the EPA Region 10 short-term action level of 8.4 $\mu g/m^3$ by cutting off the source of TCE in subslab soil gas. SVE is commonly used to address VOCs, such as TCE, in soil gas, but this technology can also be used to mitigate VI.

As described in Section 5.1.4, trenches are assumed for cost estimation purposes rather than a series of SVE wells because trenches are more likely to cut off the source of the soil gas contamination from the buildings. Alternative 4 has the advantage of not having any system component within Buildings 8549 or 8574, however, this alternative has the disadvantage of producing soil for offsite disposal during system installation.

As described in Section 5.1.4, the SVE exhaust is assumed to be filtered through the GAC. The GAC would be replaced annually, with the spent GAC addressed by regeneration, offsite disposal, or offsite incineration, in accordance with RCRA guidelines. For cost estimation purposes, the GAC is assumed to be classified as non-hazardous waste.

Long-term Effectiveness and Permanence

Alternative 4 would be expected to reduce TCE concentrations within indoor air at Buildings 8549 and 8574 through the duration of the NTCRA. Performance monitoring would be employed to evaluate the effectiveness of the removal action in protecting human health.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 4 would reduce the toxicity, mobility, and volume of the TCE in soil gas prior to reaching the indoor air through VI. The treatment would occur offsite for the TCE in the spent GAC.

Short-term Effectiveness

In the short term, site workers would be exposed to common work-related safety and health hazards (that is, operations of an excavator) during construction activities. All construction workers would need to be HAZWOPER-trained and use appropriate personal protective equipment during work in the contaminated area. A temporary increase in traffic and equipment also would occur during the construction activities. These potential exposures and hazards would be mitigated with adequate planning and controls and implementation of a comprehensive HSP. There would be no significant risk to the general public during the implementation of the NTCRA because JBER restricts public access by providing active security personnel at the gate entrances and fencing around the base perimeter, and because the northern courtyard between Buildings 8549 and 8574 would be fenced off during construction. Alternative 4 would be

effective in reducing the risk to workers due to TCE in indoor air at Buildings 8549 and 8574, which would be confirmed through VI monitoring.

5.2.4.2 Implementability

Technical Feasibility

SVE is a well-established remediation technology for addressing volatile contaminants in soil and soil gas. Local subcontractors would be available to install the system. The necessary supplies and equipment can be easily ordered and delivered to the site. A potential limit in the technical feasibility of this alternative involves the driveway on the northwest side of Building 8574. It appears that this driveway is the normal access point to deliver equipment into Building 8574 for storage. The driveway would be blocked for the duration of the trenching for the system installation.

If JBER operations allow for a temporary suspension for the movement of vehicles through the driveway, or if equipment can temporarily be transferred in/out through the door on the east side of Building 8574, then Alternative 4 is technically feasible.

Administrative Feasibility

After GAC treatment, the estimated discharges of contaminants to the air would constitute *de minimis* quantities and would not require any new air permitting or modifications of existing air permits for JBER. Therefore, there are no regulatory impediments for installing the SVE system in the northern courtyard between Buildings 8549 and 8574. Alternative 4 is administratively feasible.

5.2.4.3 Cost

The cost analysis is based on a 10-year O&M period with an assumption that the NTCRA would be superseded by a permanent remedy under the FS/PP/ROD at that time. The estimated capital cost for this alternative is $620,000. The estimated O&M cost over 10 years, which includes annual system O&M, replacement of the GAC, system and VI monitoring, and reporting, is approximately $966,000. The estimated present-value cost, which uses a 10-year discount rate of 1.9 percent, is $1,492,000. The present-value cost for this alternative is expected to be within -30 to +50 percent accuracy (EPA 1988). The detailed cost estimate and assumptions for Alternative 4 are included in Appendix B.

6. COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section provides a comparative analysis of the removal action alternatives described and evaluated in Sections 4 and 5. The comparative analysis of alternatives includes an evaluation of the expected performance of each alternative relative to the other alternatives with respect to the criteria of effectiveness, implementability, and cost described in Section 5. The objective of this analysis is to identify the advantages and disadvantages of the alternatives relative to each other and to identify the preferred alternative.

Table 6-1 summarizes the comparative analysis using a numerical scoring system. Each alternative is given a score that ranges from 1 (poor) to 5 (good). A score of 1 indicates the alternative does not meet the criterion. A score of 3 indicates the alternative partially meets the criterion (partial compliance or compliance after a long period of time). A score of 5 indicates an alternative fully meets the evaluation criterion. For each alternative, the sum of the scores for various criteria is calculated. The recommended alternative has a higher score than the other alternatives.

6.1 Effectiveness

Based on the scores in Table 6-1, Alternative 3 (APUs) ranks the highest for effectiveness, closely followed by Alternative 2 (SSDs) and Alternative 4 (SVE Trenches). This is because subslab depressurization, though effective in achieving the RAO, does not meet the preference for reduction of toxicity, mobility, or volume through treatment. Alternative 4 (SVE Trenches) meets the preference or reduction of toxicity, mobility, or volume through treatment but may not be as effective at meeting the RAO due to the location of the trenches outside of the buildings. Details are provided in the following subsections.

6.1.1 Overall Protection of Human Health and the Environment

Alternatives 2 (SSDs) and 3 (APUs) provide the best overall protection of human health because these alternatives are well-established, proven technologies to reduce concentrations of chemicals in indoor air due to VI. These alternatives directly address the mechanism for VI (migration from the subsurface to indoor air) or treat the indoor air directly. Alternative 4 (SVE Trenches) is likely to be protective. However, the locations of the trenches in the courtyard near the buildings, where the trenches would cut off soil gas contamination prior to reaching the buildings, slightly increases the uncertainty that the alternative would achieve the RAO compared to Alternatives 2 and 3, which address the subslab soil gas or indoor air directly. Alternative 4 provides the benefit that it would remove TCE mass from the source area in the northern courtyard. However, without a full remedy analysis for the contaminants in the courtyard, it is not possible to assess the benefit of Alternative 4 in that aspect, and source removal is not directly relevant to the RAO in this NTCRA. Alternative 1 does not satisfy this criterion, because no action is taken to reduce potential exposures to human health.

6.1.2 Long-term Effectiveness and Permanence

For the reasons cited for overall protection of human health, Alternatives 2 (SSDs) and 3 (APUs) would provide long-term effectiveness and permanence over the 10-year expected duration of the NTCRA. Alternative 4 ranks closely to these alternatives due to the slight uncertainty in its ability to achieve the RAO compared to Alternatives 2 and 3. Alternatives 2, 3, and 4 would all include performance (VI) monitoring to evaluate effectiveness of the removal action. Alternative 1 would not provide long-term effectiveness or permanence because no action would be taken to attain the RAO at the site.

6.1.3 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives 3 and 4 achieve reduction of toxicity, mobility, or volume through treatment. The TCE captured from indoor air (Alternative 3) or from subslab soil gas, prior to entering the buildings through VI (Alternative 4) by sorption into the GAC would be treated offsite when the GAC is regenerated or incinerated. Alternative 2 does not achieve reduction of toxicity, mobility, or volume of TCE through treatment. As discussed in Section 5.2.2.1, containment does not qualify as treatment under CERCLA, but the preference for treatment as a principal element of the removal action or remedy will be satisfied in the permanent remedy for TU091 identified in the future FS/PP/ROD.

6.1.4 Short-term Effectiveness

Under Alternatives 2, 3 and 4, construction workers would be exposed to common construction safety hazards that would easily be mitigated with adequate planning and controls and implementation of a comprehensive HSP. Work areas within the buildings can be easily cordoned off during the brief installation of the systems in Alternatives 2 and 3 to protect building workers, and the outdoor work area in Alternative 4 can similarly be cordoned off to protect workers and the public from the construction hazards. Alternatives 2 and 3 do not involve any belowground treatment infrastructure, thus the short-term construction-related risks are lower than Alternative 4. Under Alternative 1, no impact to workers, community, or the environment would occur because this alternative involves no action.

6.2 Implementability

SSDs, APUs, and SVE are all well-established, readily available technologies that are commonly used in the Anchorage area. As such, there would be no issues with obtaining subcontractors, materials, or equipment. However, there is potential uncertainty regarding the implementability of the SVE trenches under Alternative 4 because that would block off access to the northwest entrance of Building 8574. Additionally, the construction of Alternative 4 involves trenching and offsite disposal of contaminated soil, which is implementable but would require more coordination and review than the in-building systems in Alternatives 2 and 3. Alternative 2 would be easier to implement than Alternative 3 because no offsite disposal of GAC would be required for Alternative 2. Therefore, while all three action alternatives would be implementable, Alternative 2 would be the easiest action alternative to implement and Alternative 4 would be the most difficult to implement. Alternative 1 would be the easiest to implement because no actions are required.

6.3 Cost

Table 6-2 summarizes the costs for the various alternatives. Appendix B includes the detailed cost estimates and related assumptions. Note that all costs in this subsection are rounded to the nearest thousand dollars.

The cost of Alternative 1 (No Action) is $0. The estimated present-value costs range from a low of $783,000 (Alternative 2) to a high of $1,492,000 (Alternative 4), a difference of $709,000. Alternative 3, with a present-value cost of $978,000, is a median value between the other two alternatives, approximately $195,000 more than Alternative 2. The estimated capital costs to implement each alternative range from a low of $300,000 (Alternative 2) to a high of $620,000 (Alternative 4). The capital cost of Alternative 3 ($318,000) is similar to that of Alternative 2.

The greater present-value cost for Alternative 3, compared to Alternative 2, is driven by higher O&M costs due to replacement and disposal of the GAC from the APUs. Alternative 4 has the highest present-value cost because it has the highest capital and O&M costs. Alternative 4 has higher O&M costs than Alternative 3 due to higher labor costs and analytical costs, in addition to the replacement and disposal of GAC. Alternative 2 (SSDs) has no transportation and disposal costs for installation or operation.

Table 6-1 Comparative Analysis of Removal Action Alternatives

Criteria	Alternative 2 SSD Systems	Alternative 3 APUs	Alternative 4 SVE Trenches
Effectiveness	4	5	4
Implementability	5	4	3
Cost	5	3	1
TOTAL SCORE	14	12	8

Notes:

Each alternative is given a score that ranges from 1 (poor) to 5 (good). A score of 1 indicates the alternative does not meet the criterion. A score of 3 indicates the alternative partially meets the criterion (partial compliance or compliance after a long period of time). A score of 5 indicates an alternative fully meets the evaluation criterion.

Alternative 1: No Action is not included in the comparative analysis table because this alternative does not achieve the RAO.

Table 6-2 Cost Summary of Removal Action Alternatives

Removal Action Alternatives	Capital Cost	O&M Cost	Total Cost	Present Value	Duration
Alternative 1 – No Action	$0	$0	$0	$0	NA
Alternative 2 – SSD Systems	$300,000	$535,000	$835,000	$783,000	10 years
Alternative 3 – APUs	$318,000	$731,000	$1,049,000	$978,000	10 years
Alternative 4 – SVE Trenches	$620,000	$966,000	$1,586,000	$1,492,000	10 years

Notes:

Cost estimates based on HCSS HeavyBid Cost Estimating Software, RS Means, vendor quotes, and engineering judgment. Estimated costs are rounded to the nearest thousand dollars.

Markups, including contingency and project management have been applied as shown in the detailed cost estimate in Appendix B.

Present value uses the 10-year discount rate of 1.9 percent obtained from the Office of Management and Budget Circular No. A-94 (OMB 2024).

The estimated cost is expected to be within -30 to +50 percent (EPA 1988).

NA = not applicable

7. RECOMMENDED REMOVAL ACTION ALTERNATIVE

The RAO for this NTCRA is to prevent exposure by industrial workers to indoor air containing TCE concentrations greater than 8.4 µg/m^3. Based on the individual and comparative analysis of the alternatives discussed in Sections 5 and 6, Alternative 2 (SSD Systems) is the recommended removal action for Buildings 8549 and 8574 at TU091.

Alternative 2 (SSD Systems) and Alternative 3 (APUs) are comparable in most evaluation criteria, as shown in Table 6-1. Both employ well-established, proven technologies for VI mitigation or removal of indoor air contamination at Buildings 8549 and 8574. Because Alternative 2 does not require any offsite transportation and disposal of material, it would be easier and less costly to implement than Alternative 3. Alternative 4 (SVE Trenches) has the advantage of being outside of the buildings, but it would be more difficult and more costly to implement than Alternatives 2 and 3. Thus, Alternative 2 (SSD Systems) is preferable over Alternatives 3 and 4.

The designs in this EE/CA are conceptual, for purposes of cost estimation and alternative evaluation. The design of the selected removal action alternative may be refined in the NTCRA implementation work plan.

Sections 300.415(n) and 300.820 of the NCP specify community relations and Administrative Record activities as two forms of public participation necessary for all removal actions. After this EE/CA is finalized, a notice of its availability will be provided in the *Anchorage Daily News* and in the *Mat-Su Valley Frontiersman*, which are newspapers of circulation in Anchorage and Palmer/Wasilla, respectively, followed by a 30-day public comment period. The AM will provide a summary of comments received during the comment period and written responses to significant comments.

This page intentionally left blank.

8. REFERENCES

Cupolex Engineering Solutions. 2024. Thinking Beyond Standard Mitigation Systems. Accessed 18 December 2024. https://cupolex.ca/active-or-passive-vapour-intrusion-mitigation.

(U.S.) Environmental Protection Agency (EPA). 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*. EPA/540/G-89/004. October.

EPA. 1993. *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA*. EPA 540-R-93-057. August.

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

EPA. 2012. *OEA Recommendations Regarding Trichloroethylene Toxicity in Human Health Risk Assessments*. Technical Memorandum. Region 10. Office of Environmental Assessment. Seattle, WA. 13 December. http://www.environmental-law.net/wp-content/uploads/2015/08/Region-10-TCE-Memo1.pdf.

U.S. Air Force (USAF). 1991. Federal Facility Agreement Under CERCLA Section 120. Elmendorf Air Force Base, Anchorage, Alaska. Administrative Docket Number: 1089-07-19-120. 19 September.

USAF. 2024. *Buildings 8549 & Building 8574 Questions*. Email from Sarah Runck (USAF) to Jeremy Cox (Jacobs), summarizing conversations with Mr. Gerald Tree (AGE Production Superintendent at Buildings 8549 and 8574). 5 November 2024.

USAF. 2025. *TU091 Remedial Investigation Report, Joint Base Elmendorf-Richardson, Alaska*. Draft. March.

U.S. Air Purifiers. 2024. *Amaircare ES3X Tri-Carbon Heavy Duty Air Filtration System for Heavy VOCs Stand Alone Suspended Unit Optional Controller*. Accessed 26 December 2024. https://www.usairpurifiers.com/amaircare-ES3X-Tri-carbon-air-filtration-system-heavy-voc.html.

White House Office of Management and Budget (OMB). 2024. *Discount Rates for Cost-Effectiveness, Lease Purchase, and Related Analyses*. OMB Circular No. A-94, Appendix C. 14 November.

This page intentionally left blank.

Appendix A
Air Discharge Calculations

This page intentionally left blank.

Appendix A1
Alternative 2 Air Discharge Calculation

This page intentionally left blank.

Alternative 2. Air Discharge Calculations

System and Site Parameters

Item	Amount	Unit
Flow Rate[a]	150	ft^3/min
	4.24752	m^3/min
TCE Concentration[b]	3.05E-03	g/m^3
VOC Concentration[c]	6.87E-03	g/m^3

Estimated TCE Discharges[d]

Item	Amount	Unit
Mass Discharge	6,809	g/year
	0.008	ton/year

Estimated VOC Discharges[d]

Item	Amount	Unit
Mass Discharge	15,337	g/year
	0.017	ton/year

[a]Assumes six separate fans, each operating at 25 cubic feet per minute.

[b]Maximum detected concentration of TCE in subslab soil gas via Method TO-15 analysis.

[c]Maximum detected concentration of gasoline-range organics in subslab soil gas via Method TO-15, plus the maximum detected concentration of TCE in soil gas.

[d]Assumes the systems operate continuously through the year.

Notes:

ft^3/min = cubic foot(feet) per minute

g/m^3 = gram(s) per minute

g/year = gram(s) per year

m^3/min = cubic meter(s) per minute

TCE = trichloroethylene

ton/year = ton(s) per year

VOC = volatile organic compound

This page intentionally left blank.

Appendix A2
Alternative 3 Air Discharge Calculation

This page intentionally left blank.

Alternative 3. Air Discharge Calculations

Given information	Value	Units	Source
Flow Rate	2,000	ft^3/min	For Amaircare ES3X Tri-Carbon Heavy Duty Air Filtration Systems for Heavy VOCs. U.S. Air Purifiers, 2024
GAC weight	90	pounds	
Sorbed weight of contaminants	0.2	lb cont./lb GAC	Amaircare activated carbon ratings (attached) (worst case)
Removal Efficiency	95%		Assumes APUs are 95% efficient in removing indoor air contaminants, as expressed by the starting (untreated) contaminant concentrations in indoor air versus the concentration of the contaminants in indoor air during steady-state operation
TCE Concentrations In Indoor Air (Starting)	21.6	µg/m^3	TU091 RI Report, maximum detected concentration at Building 8549/8574
Petroleum Concentrations In Indoor Air (Starting)	8.76	mg/m^3	TU091 RI Report, sum of maximum detects for gasoline-range organics and diesel-range organics in indoor air

Calculations	Value	Units	Comments
TCE Concentrations In Indoor Air (Steady State)	1.1	µg/m^3	Maximum expected concentration during APU operation (for comparison)
Petroleum Concentrations In Indoor Air (Steady State)	0.44	mg/m^3	Maximum expected concentration during APU operation
Lifespan for GAC in Each Unit	**7**	**months**	**Based on steady-state petroleum concentration (worst case)**

Notes:

µg/m^3 = microgram(s) per cubic meter

APU = air purifying unit

ft^3/min = cubic foot(feet) per minute

GAC = granular activated carbon

lb cont./lb GAC = pound(s) of concentration per pound(s) of GAC

mg/m^3 = milligram(s) per cubic meter

TCE = trichloroethylene

VOC = volatile organic compound

Activated Carbon Adsorbency Ratings

The capacity index has the following meaning:

4: High capacity for all materials in this category. One pound takes up about 20% to 50% of its own weight average about 1/3 (33 1/35). This category includes most of the odor causing substances.
3: Satisfactory capacity for all items in this category these constitute good applications but the capacity is not as high as for category 4. Absorbs about 10% to 25% of its weight - average about 1/6 (16 7Z)
2: Includes substances which are not highly adsorbed but which might be taken up sufficiently to give good service under the particular conditions of operation. These require individual checking.
1: Adsorption capacity is low for these materials Activated charcoal cannot be satisfactorily used to remove them under ordinary circumstances.

Some of the contaminants listed in the table are specific chemical co-pounds, some represent classes of co-pounds, and others are mixtures and of variable composition. Activated charcoal's capacity for odors varies somewhat with the concentration in air, with humidity, and temperature,and with the actual velocity used through the filters. The numbers given represent typical or average conditions and might vary in specific instances. The values in the table have been assembled from many sources including laboratory tests and field experience. This table should be used as a general rule only.

*Straight activated charcoal does not have much capacity for some reactive gases, such as ammonia, formaldehyde, etc. In some cases where the gas is chemically reactive, appropriate impregnated activated charcoal can be recommended.

Acetaldehyde	2	Coal smoke odor	3	*Formaldehyde	2	Methyl ether	3	Propane	2
Acetic Acid	4	Combustion odors	4	*Formic acid	3	Methyl ethyl ketone	4	*Propionaldehyde	3
Acetic Anhydride	4	Cooking odors	4	Fuel gases	2	Methyl formate	3	Propionic acid	4
Acetone	3	Corrosive gases	3	Fumes	3	Methyl isobutyl ketone	4	Propyl acetate	4
Acrylic Acid	4	Creosote	4	Gangrene	4	Methyl aercaptan	4	Propyl alcohol	4
Acrylonitrile	4	Cresol	4	Garlic	4	Methrlcyclohexane	4	Propyl chloride	4
Adhesives	4	Crotonaldehyde	4	Gasoline	4	Methylcyclohexanol	4	Propyl ether	4
Air-Wick	4	Cyclohexane	4	Heptane	4	Methylcyclohexanone	4	Propyl oercaptan	4
Alcoholic Beverages	4	Cyclohexanol	4	Heptylene	4	Methylene chloride	4	*Propylene	2
*Amines	2	Cyclohexanone	4	Hexane	3	Mildew	3	*Propyne	2
*Ammonia	2	Cyclohexene	4	*Hexylene	3	Mixed odors	4	Putrefying substances	3
Amyl acetate	4	Dead animals	4	Hexyne	3	Mold	3	Putrescine	4
Amyl alcohol	4	Decane	4	Hospital odors	4	Monochlorobenzene	4	Pyridine	4
Amyl ether	4	Decaring Substances	4	Household smells	4	Moth balls	4	Radiation products	2
Animal odors	3	DeodorantsDetergents	4	Hydrogen	1	Naphtha (coal tar)	4	Radon	3
Anesthetics	3	Dibroeoethane	4	*Hydrogen bromide	3	Naphtha (petroleum)	4	Rancid oils	4
Aniline	4	Dichlorobenzene	4	*Hydrogen chloride	2	Naphthalene	4	Resins	4
Antiseptics	4	Dichlorodifluoronethane	4	*Hydrogen cyanide	3	Nicotine	4	Reodorants	4
Asphalt fumes	4	Dichloroethane	4	*Hydrogen fluoride	2	*Nitric acid	3	Ripening fruits	4
Automobile exhaust	3	Dichloroethylene	4	*Hydrogen iodide	3	Nitro benzenes	4	Rubber	4
Bathroom smells	4	Dichloroethyl ether	4	*Hydrogen selenide	2	Nitroethane	4	Sauerkraut	4
Benzene	4	Dichchloronitro*	4	*Hydrogen sulfide	3	*Nitrogen dioxide	2	Sewer odors	4
*Bleaching solutions	3	ethane	4	Incense	4	Nitroglycerine	4	Skatole	4
Body odors	4	Dichloropropane	4	Indole	4	Nitroaethane	4	Slaughtering odors	3
Borane	3	Diesel fumes	4	Inorganic chemicals	3	Nitropropane	4	Smog	4
Bromine	4	*Diethylamine	3	Incomplete combustion	3	Nitrotoluene	4	Soaps	4
Burned flesh	4	Diethyl ketone	4	Industrial wastes	3	Nonane	4	Smoke	4
Burned food	4	Di-ethylaniline	4	Iodine	4	Noxious gases	3	Solvents	3
Burning fat	4	Dinethylsulfate	4	Iodoform	4	Octalene	4	Sour milks	4
Butane	2	Dioxane	4	Irritants	4	Octane	4	Spilled beverages	4
Butanone	4	Dipropyl ketone	4	Isophorone	4	Odorants	4	Spoiled food stuffs	4
Butyl acetate	4	Disinfectants	4	*Isoprene	3	Onions	4	Stale odors	4
Butyl alcohol	4	Embalming odors	4	Isopropyl acetate	4	Organic chemicals	4	Stoddard solvent	4
Butyl cellosolve	4	Ethane	1	Isopropyl alcohol	4	Ozone	4	Stuffiness	4
Butyl chloride	4	Ether	3	Isopropyl ether	4	Packing house odors	4	Styrene monomer	4
Butyl ether	4	Ethyl acetate	4	Kerosene	4	Paint and redecorating	4	*Sulfur dioxide	2
*Butylene	2	Ethyl acrylate	4	Kitchen odors	4	0odors	4	*Sulfur trioxide	3
*Butyne	2	Ethyl alcohol	4	Lactic acid	4	Palmitic acid	4	Sulfuric acid	4
Cancer odor	4	*Ethyl anine	3	Lingering odors	4	Paper deterioration	4	Tar	4
Caprylic acid	4	Ethyl benzene	4	Liquid fuels	4	Paradichlorobenzene	4	*Tarnishing gases	3
Carbolic acid	4	Ethyl bromide	4	Liquor odors	4	Paste and glue	3	Tobacco smoke odor	4
Carbon disulfide	4	Ethyl chloride	3	Lubricating oils	4	Pentane	4	Toilet odors	4
*Carbon dioxide	1	Ethyl ether	3	Lysol	4	Pentanone	3	Toluene	4
Carbon monoxide	1	Ethyl formate	3	Masking agents	4	*Pentylene	3	Trichloroethylene	4
Carbon tetrachloride	4	Ethyl mercaptan	3	Medicinal odors	4	*Pentyne	3	Trichloroethane	4
Cellosolve	4	Ethyl silicate	4	Melons	4	Perchloroethylene	4	Turpentine	4
Cellosolve acetate	4	*Ethylene	1	Menthol	4	Perfumes, cosmetics	4	Urea	4
Charred materials	4	Ethylene chlorohydrin	4	Mercaptans	4	Perspiration	4	Uric acid	4
Cheese	4	Ethylene dichloride	4	Mesityl oxide	4	Persistent odors	4	Valeric acid	4
*Chlorine	3	Ethylene oxide	3	Methane	1	Pet odors	4	Valericaldehyde	4
Chlorobenzene	4	Essential oils	4	Methyl acetate	3	Phenol	3	Vinegar	4
Chlorobutadiene	4	Eucalyptole	4	Methyl acrylate	4	Phosgene	3	Vinyl chloride	3
Chloroform	4	Exhaust fumes	3	Methyl alcohol	3	Pitch	4	Volatile materials	3
Chloronitropropane	4	Female odors	4	Methyl bromide	3	Plastics	4	Waste products	4
Chloropierin	4	Fertilizer	4	Methyl butyl ketone	4	Poison gases	3	Wood alcohol	3
Cigarette saoke odor	4	Film processing odors	3	Methyl cellosolve	4	Pollen	3	Xylene	4
Citrus and other fruits	4	Fish odors	4	Methyl chloride	3	Popcorn and candy	4		
Cleaning compounds	4	Fluorotrichloromethane	3	Methyl chloroform	4	Poultry odors	4		

Amaircare®

Cleaning the air you breathe.

Appendix A3
Alternative 4 Air Discharge Calculation

This page intentionally left blank.

Alternative 4. Air Discharge Calculations

System and Site Parameters

Item	Amount	Unit
Flow Rate[a]	100	ft^3/min
	2.83168	m^3/min
TCE Concentration[b]	6.91E-02	g/m^3
VOC Concentration[c]	7.27E-02	g/m^3

Estimated TCE Discharges[d]

Item	Amount	Unit
Mass Discharge	102,844	g/year
	0.11	ton/year

Estimated VOC Discharges[d]

Item	Amount	Unit
Mass Discharge	108,157	g/year
	0.12	ton/year

[a]Maximum detected concentration of TCE in soil gas via HAPSITE screening or Method TO-15 analysis..

[b]Maximum detected concentration of GRO in soil gas via Method TO-15, plus the maximum detected concentration of TCE in soil gas.

[c]Assumes the system operates continuously for each year.

Notes:

ft^3/min = cubic foot(feet) per minute

g/m^3 = gram(s) per minute

g/year = gram(s) per year

m^3/min = cubic meter(s) per minute

TCE = trichloroethylene

ton/year = ton(s) per year

VOC = volatile organic compound

This page intentionally left blank.

Appendix B
Cost Estimates

This page intentionally left blank.

COST SUMMARY AND COMPARISON FOR REMEDIAL ALTERNATIVES

Site:	Joint Base Elmendorf-Richardson	**Base Year:**	2024
Location:	Anchorage, AK	**Date:**	Jan-25
Phase:	Remedial Technology Screening	**ROM Level:**	AACE Class 4

	Buildings 8549/8574 Alternative 2	**Buildings 8549/8574 Alternative 3**	**Buildings 8549/8574 Alternative 4**
Remedial Technology	Sub-Slab Depressurization	Air Purifying Units	Soil Vapor Extraction and Treatment
Description	Sealing of building floor cracks and penetrations, installation of six sub-slab depressurization (SSD) systems, annual VI monitoring and inspection of SSDs and LUC	Sealing of building floor cracks and penetrations, installation of 11 air purifying units, annual VI monitoring and LUC inspection, and annual inspection of and changeout of GAC filters of APUs	Installation of SVE Collection Trench and Treatment System, annual VI Monitoring and LUC inspection, quarterly SVE O&M, and annual GAC changeout.
Contracted Direct Capital Cost	$300,000	$318,000	$620,000
Initial Year O&M Cost	$53,539	$73,090	$96,558
Total Initial Costs	$353,539	$391,090	$716,558
Upper ROM Range	$530,309	$586,636	$1,074,837
Lower ROM Range	$247,477	$273,763	$501,591
Total Present Worth	$783,000	$978,000	$1,492,000
O&M Period	10 years	10 years	10 years

This is not an offer for construction and/or project execution. The costs presented in this estimate are considered Class 2 with an accuracy range of -30% to +50% of the actual cost, according to the Recommended Practice No. 107R-19: Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Environmental Remediation Industries (AACE International 2021). The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor, material costs, and competitive variable factors. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific decisions to help ensure proper project evaluation and adequate funding.

Ver8- Updated May 13, 2024

TU091 Engineering Evaluation / Cost Analysis - Alternative Cost Estimates

Joint Base Elmendorf-Richardson
Buildings 8549/8574/9549, Alt. 2
Anchorage, AK

Description of Option:
Sealing of building floor cracks and penetrations, installation of six sub-slab depressurization (SSD) systems, annual VI monitoring and inspection of SSDs

WORK PLANNING, REPORTING AND PROJECT MANAGEMENT					
Item/Activity	**Qty**	**Unit**	**Unit Cost**	**Cost**	**Comments**
SSD Pilot Testing Work Plan	150	Hr	$ 150	$ 22,500	Assumes draft, draft final, and final version.
Health and Safety (Plan, AHAs, Audit)	20	Hr	$ 150	$ 3,000	
3rd Party Utility Locate	1	LS	$ 1,000	$ 1,000	Based on similar projects
Pilot Testing Equipment/Supplies	1	LS	$ 500	$ 500	
SSD Installation (single location per building, for pilot testing)	2	EA	$ 10,840	$ 21,680	2 floor penetrations, 60 LF 4" PVC, 1 radon fan, 1 vacuum gauge, 1 sample port; HCSS
Pilot Testing Labor	160	Hr	$ 150	$ 24,000	Assumes two people, four days per building, 10 hours per day
NTCRA Implementation Work Plan	360	Hr	$ 150	$ 54,000	Includes results of pilot testing and design. Assumes pre-draft, draft, draft final, and final versions; moderate complexity.
Permitting (Building, SESC, air discharge, etc.)	40	Hr	$ 150	$ 6,000	Air Permitting
Quality Management (Plan and Audit)	20	Hr	$ 150	$ 3,000	
Project Chartering (team charter and Operational Readiness Review Meetings)	20	Hr	$ 150	$ 3,000	
Procurement of Subcontractors (Pre-qual, RFP development, bid eval, contracting, close-outs)	30	Hr	$ 150	$ 4,500	
Installation Report	200	Hr	$ 150	$ 30,000	Assumes pre-draft, draft, draft final, and final versions; moderate complexity
Waste Management (Plan development, sampling, characterization, landfill acceptance, etc.)	0	Hr	$ 150	$ -	
Project Management	50	Hr	$ 150	$ 7,500	
Work Planning / Project Management Contingency	20%			$ 21,600	
SUBTOTAL WORK PLANNING, REPORTING, AND PROJECT MANAGEMENT				**$ 202,000**	**Section A**

DESIGN					
SUBTOTAL DESIGN				**$ -**	**Section B (included in NTCRA Implementation Work Plan)**

CONSTRUCTION					
Item/Activity	**Qty**	**Unit**	**Unit Cost**	**Cost**	**Comments**
3rd Party Utility Locate	1	LS	$ 1,000	$ 1,000	Based on similar projects
Sealing of Floor Cracks and Penetrations	500	LF	$ 7.10	$ 3,550	Qty. assumed. Based on the building survey, surface cracks are present but few in number and limited in extent. Clean/Grind Surface, Rout and blowout crack, fill 2-part epoxy 1/4" W x 1" crack; RS Means 03 01 30.71 2010/2020/2410
SSD Installation	4	EA	$ 10,840	$ 43,360	2 floor penetrations, 60 LF 4" PVC, 1 radon fan, 1 vacuum gauge, 1 sample port per unit; HCSS
SSD Startup	6	EA	$ 500	$ 3,000	2 hours per Unit; HCSS
Subtotal *Construction*				$ 47,910	
Subcontractor Mobilization / Demobilization	10%	Percent		$ 4,791	
Subcontractor General Conditions	10%	Percent		$ 4,791	
Subcontractor Bonding	2%	Percent		$ 958	
State and Local Taxes	0%	Percent		$ -	
Subtotal *Subcontractor/Allowance*				$ 58,450	
Construction Contingency	15%			$ 8,768	
Subtotal *Construction*				**$ 67,218**	
Subtotal Construction with 5% mark up	5%			**$ 70,579**	
General Contractor Field Oversight	**10**	**day**	**$ 1,540**	**$ 15,400**	**10 Hour Day, assume local staff**
General Contractor Engineering Oversight	**0**	**day**	**$ 1,350**	**$ -**	**10 Hour Day**
General Contractor Field Office Equipment / Supply	**10**	**day**	**$ 150**	**$ 1,500**	

Contractor Field Truck Rental /Fuel	**10**	**day**	**$**	**75**	**$**	**750**	
Contractor Travel Costs for Field staff	**2**	**each**	**$**	**1,500**	**$**	**3,000**	
General Contractor Field Office Personnel Per Diem	**20**	**day**	**$**	**200**	**$**	**4,000**	
SubTotal - Oversight Costs					**$**	**24,650**	
Oversight Contingency	10%				**$**	**2,465**	
TOTAL CAPITAL COST					**$**	**300,000**	**Section C = A + B + Construction**

ANNUAL O&M COST

Item/Activity	Qty	Unit	Unit Cost	Cost	Comments
SSD Unit Inspection	24	HR	$ 165	$ 3,960	(1) Inspections (1 hr per SSD) 1 staff, per unit, quarterly
TO-17 Indoor Air and TO-15 Sub-Slab Soil Gas Sampling Labor	56	HR	$ 150	$ 8,400	Assumes local staff, four hours on two dates for TO-17 deployment / pickup, and ten hours each on two dates for TO-15 sampling), 2 staff per event
Field Truck Rental/Fuel	4	day	$ 75	$ 300	Assume local staff
Sample Equipment/Supplies	1	LS	$ 250	$ 250	
Sample Shipment	4	EA	$ 150	$ 600	Shipments to separate labs for TO-15/TO-17 analysis; up to 4 Summa canisters per box
TO-17 Indoor Air Sample Analysis	11	EA	$ 300	$ 3,300	20-day passive sampler analysis; includes QC sample
TO-15 Sub-Slab Soil Gas Sample Analysis	11	EA	$ 250	$ 2,750	SUMMA canister samples; includes QC sample
VI Sampling and SSD Inspection Report	140	HR	$ 150	$ 21,000	Assumes 20 hours for data validation and ERPIMS submittal; pre-draft, draft, draft final, and final versions
Subtotal *Annual O&M*				$ 40,560	
O&M Contingency	10%	Percent		$ 4,056	
Subtotal *Annual O&M Cost*				$ 44,616	
Project Management	10%	Percent		$ 4,462	
Technical Support	10%	Percent		$ 4,462	
SUBTOTAL ANNUAL O&M COST				**$ 53,539**	**Section D**

TOTAL O&M COST

Number of Years of Operation =	10	years
TOTAL O&M COST		**$ 535,392**

TOTAL ALTERNATIVE COST	**$ 835,392**

PRESENT WORTH ANALYSIS

Number of Years of Operation =	10	years	
Real Discount Rate	1.9%		From OMB Circular A-94 (https://www.whitehouse.gov/wp-content/uploads/2023/12/CircularA-94AppendixC.pdf)
		Present Worth	
Contracted Capital Cost =		$ 300,000	
10 Years O&M Cost =		$ 483,446	
TOTAL PRESENT WORTH COST		**$ 783,000**	

ROM	**50.00%**	**$**	**1,174,500**
RANGE	**-30.00%**	**$**	**548,100**

This is not an offer for construction and/or project execution. The costs presented in this estimate are considered Class 2 with an accuracy range of -30% to +50% of the actual cost, according to the Recommended Practice No. 107R-19: Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Environmental Remediation Industries (AACE International 2021). The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor, material costs, and competitive variable factors. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific decisions to help ensure proper project evaluation and adequate funding.

TU091 Engineering Evaluation / Cost Analysis - Alternative Cost Estimates

Joint Base Elmendorf-Richardson
Buildings 8549/8574/9549, Alt. 3
Anchorage, AK

Description of Option:
Sealing of building floor cracks and penetrations, installation of 11 air purifying units, annual VI monitoring, and annual inspection of and changeout of GAC filters of APUs

WORK PLANNING, REPORTING AND PROJECT MANAGEMENT					
Item/Activity	**Qty**	**Unit**	**Unit Cost**	**Cost**	**Comments**
NTCRA Implementation Work Plan (Agency submittal and /or Internal)	320	Hr	$ 150	$ 48,000	Includes Design. Assumes pre-draft, draft, draft final, and final versions; moderate complexity
Permitting (Building, SESC, air discharge, etc.)	40	Hr	$ 150	$ 6,000	Air Permitting
Quality Management (Plan and Audit)	20	Hr	$ 150	$ 3,000	
Health and Safety (Plan, AHAs, Audit)	20	Hr	$ 150	$ 3,000	
Project Chartering (team charter and Operational Readiness Review Meetings)	20	Hr	$ 150	$ 3,000	
Procurement of Subcontractors (Pre-qual, RFP development, bid eval, contracting, close-outs)	30	Hr	$ 150	$ 4,500	
Installation Report	200	Hr	$ 150	$ 30,000	Assumes pre-draft, draft, draft final, and final versions; moderate complexity
Waste Management (Plan development, sampling, characterization, landfill acceptance, etc.)	0	Hr	$ 150	$ -	
Project Management	50	Hr	$ 150	$ 7,500	
Work Planning / Project Management Contingency	20%			$ 21,000	
SUBTOTAL WORK PLANNING, REPORTING, AND PROJECT MANAGEMENT				**$ 126,000**	**Section A**

DESIGN					
SUBTOTAL DESIGN				**$ -**	**Section B (included in NTCRA Implementation Work Plan)**

CONSTRUCTION					
Item/Activity	**Qty**	**Unit**	**Unit Cost**	**Cost**	**Comments**
Sealing of Floor Cracks and Penetrations	500	LF	$ 7.10	$ 3,550	Clean/Grind Surface, Rout and blowout crack, fill 2-part epoxy 1/4" W x 1" crack; RS Means 03 01 30.71 2010/2020/2410
APU Installation	11	EA	$ 9,710	$ 106,810	Amaircare ES3X Tri-Carbon for Heavy VOCs suspended from ceiling, HCSS
APU Startup	11	EA	$ 150	$ 1,650	1 hour per unit, HCSS
Subtotal *Construction*				$ 112,010	
Subcontractor Mobilization / Demobilization	10%	Percent		$ 11,201	
Subcontractor General Conditions	10%	Percent		$ 11,201	
Subcontractor Bonding	2%	Percent		$ 2,240	
State and Local Taxes	0%	Percent		$ -	
Subtotal *Subcontractor/Allowance*				$ 136,652	
Construction Contingency	15%			$ 20,498	
Subtotal *Construction*				**$ 157,150**	
Subtotal Construction with 5% mark up	5%			**$ 165,008**	
General Contractor Field Oversight	**10**	**day**	**$ 1,540**	**$ 15,400**	**10 Hour Day, assume local staff**
General Contractor Engineering Oversight	**0**	**day**	**$ 1,350**	**$ -**	**10 Hour Day**
General Contractor Field Office Equipment / Supply	**10**	**day**	**$ 150**	**$ 1,500**	
Contractor Field Truck Rental /Fuel	**10**	**day**	**$ 75**	**$ 750**	
Contractor Travel Costs for Field staff	**2**	**each**	**$ 1,500**	**$ 3,000**	
General Contractor Field Office Personnel Per Diem	**20**	**day**	**$ 200**	**$ 4,000**	
SubTotal - Oversight Costs				**$ 24,650**	
Oversight Contingency	10%			**$ 2,465**	
TOTAL CAPITAL COST				**$ 318,000**	**Section C = A + B + Construction**

ANNUAL O&M COST					
Item/Activity	**Qty**	**Unit**	**Unit Cost**	**Cost**	**Comments**
Annual APU Inspection	6	HR	$ 150	$ 900	(1) Inspections (1 hr per SSD) 1 staff
Annual APU Filter Changeout Labor	40	HR	$ 150	$ 6,000	2 Staff, 2 days, 10-hour days
APU Replacement GAC Filter Cost	33	EA	$ 336	$ 11,072	3 Filters per Unit, 11 Units; unit cost from U.S. Air Purifiers website (https://www.usairpurifiers.com/amaircare-voc-ultra-filter-kit-large-purifiers-scrubbers.html?opt1=Standard%20Carbon)
Vapor Phase GAC Changeout	1	EA	$ 7,900	$ 7,900	Assumes old GAC able to be reactivated; includes sampling / analysis / waste characterization / disposal, based on 2024 cost for similar project
TO-17 Indoor Air Sampling Labor	16	HR	$ 150	$ 2,400	Assumes local staff, four hours on two dates for TO-17 deployment / pickup, 2 staff per event
Field Truck Rental/Fuel	4	day	$ 75	$ 300	
Sample Equipment/Supplies	1	LS	$ 250	$ 250	
Sample Shipment	1	EA	$ 150	$ 150	
TO-17 Indoor Air Sample Analysis	11	EA	$ 300	$ 3,300	20-day passive sampler analysis; includes QC sample
Indoor Air Sampling and SSD Inspection Report	140	HR	$ 165	$ 23,100	Assumes 20 hours for data validation and ERPIMS submittal; pre-draft, draft, draft final, and final versions
Subtotal *Annual O&M*				$ 55,372	
O&M Contingency	10%	Percent		$ 5,537	
Subtotal *Annual O&M Cost*				$ 60,909	
Project Management	10%	Percent		$ 6,091	
Technical Support	10%	Percent		$ 6,091	
SUBTOTAL ANNUAL O&M COST				**$ 73,090**	**Section D**

TOTAL O&M COST				
Number of Years of Operation =	10	years		
TOTAL O&M COST			**$**	**730,904**

TOTAL ALTERNATIVE COST			
TOTAL ALTERNATIVE COST		**$**	**1,048,904**

PRESENT WORTH ANALYSIS				
Number of Years of Operation =	10	years		
Real Discount Rate	1.9%			From OMB Circular A-94 (https://www.whitehouse.gov/wp-content/uploads/2023/12/CircularA-94AppendixC.pdf)
			Present Worth	
Contracted Capital Cost =			$ 318,000	
10 Years O&M Cost =			$ 659,989	
TOTAL PRESENT WORTH COST			**$ 978,000**	

ROM	**50.00%**	**$**	**1,467,000**
RANGE	**-30.00%**	**$**	**684,600**

This is not an offer for construction and/or project execution. The costs presented in this estimate are considered Class 2 with an accuracy range of -30% to +50% of the actual cost, according to the Recommended Practice No. 107R-19: Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Environmental Remediation Industries (AACE International 2021). The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor, material costs, and competitive variable factors. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific decisions to help ensure proper project evaluation and adequate funding.

TU091 Engineering Evaluation / Cost Analysis - Alternative Cost Estimates

Joint Base Elmendorf-Richardson
Buildings 8549/8574/9549, Alt. 4
Anchorage, AK

Description of Option:
Installation of SVE Collection Trench and Treatment System, annual VI Monitoring, quarterly SVE O&M, and annual GAC changeout.

WORK PLANNING, REPORTING AND PROJECT MANAGEMENT							
Item/Activity	**Qty**	**Unit**		**Unit Cost**		**Cost**	**Comments**
NTCRA Implementation Work Plan (Agency submittal and /or Internal)	480	Hr	$	150	$	72,000	Includes design. Assumes pre-draft, draft, draft final, and final versions; moderate-high complexity
Permitting (Building, SESC, air discharge, etc.)	80	Hr	$	150	$	12,000	
Quality Management (Plan and Audit)	25	Hr	$	150	$	3,750	
Health and Safety (Plan, AHAs, Audit)	30	Hr	$	150	$	4,500	
Project Chartering (team charter and Operational Readiness Review Meetings)	20	Hr	$	150	$	3,000	
Procurement of Subcontractors (Pre-qual, RFP development, bid eval, contracting, close-outs)	30	Hr	$	150	$	4,500	
Installation Report	270	Hr	$	150	$	40,500	Assumes pre-draft, draft, draft final, and final versions; moderate-high complexity
Waste Management (Plan development, sampling, characterization, landfill acceptance, etc.)	40	Hr	$	150	$	6,000	
Project Management	75	Hr	$	150	$	11,250	
Work Planning / Project Management Contingency	20%				$	31,500	
SUBTOTAL WORK PLANNING, REPORTING, AND PROJECT MANAGEMENT					**$**	**189,000**	**Section A**

DESIGN							
SUBTOTAL DESIGN					**$**	**-**	**Section B (included in NTCRA Implementation Work Plan)**

CONSTRUCTION							
Item/Activity	**Qty**	**Unit**		**Unit Cost**		**Cost**	**Comments**
3rd Party Utility Locate	1	LS	$	1,000	$	1,000	Based on similar projects
SESC and Site Security Installation	1	LS	$	1,600	$	1,600	Silt fence, straw wattle, security fencing; HCSS
SVE Trench Construction	100	LF	$	190	$	19,000	8ft deep, 2ft wide with 4" SCH40 PVC corrugated pipe backfilled with clean aggregate, HCSS
SVE Conveyance Pipe Trench Construction	100	LF	$	60	$	6,000	4ft deep, 4" SCH40 PVC pipe, HCSS
SVE System and Enclosure	1	LS	$	66,000	$	66,000	8'x12' enclosure with rollup door, 100 SCFM Blower w1000 LB VP GAC, HCSS
Non-regulated Waste Transportation and Disposal at Subtitle D facility in Oregon	70	CY	$	1,131	$	79,170	From recent vendor quote
TSCA Waste Transportation and Disposal at WM Columbia Ridge, WA	40	CY	$	1,956	$	78,240	From recent vendor quote
Waste Characterization Sampling	4	EA	$	425	$	1,700	Includes hand augering for collection, shipping and analysis costs
Asphalt Cover Installation	90	SY	$	90	$	8,100	2" Surface Layer, 4" Base Layer, 8 feet wide across the length of the trenches; HCSS
Site Restoration	1	LS	$	1,500	$	1,500	Removing SESC and site security, restore vegetated areas; HCSS
Subtotal *Construction*					$	262,310	
Subcontractor Mobilization / Demobilization	10%	Percent			$	26,231	
Subcontractor General Conditions	10%	Percent			$	26,231	
Subcontractor Bonding	2%	Percent			$	5,246	
State and Local Taxes	0%	Percent			$	-	
Subtotal *Subcontractor/Allowance*					$	320,018	
Construction Contingency	15%				$	48,003	

Subtotal *Construction*				**$**	**368,021**	
Subtotal Construction with 5% mark up	5%			**$**	**386,422**	
General Contractor Field Oversight	**15**	**day**	**$ 1,540**	**$**	**23,100**	**10 Hour Day - Assume Local Staff**
General Contractor Engineering Oversight	**0**	**day**	**$ 1,350**	**$**	**-**	**10 Hour Day**
General Contractor Field Office Equipment / Supply	**15**	**day**	**$ 150**	**$**	**2,250**	
Contractor Field Truck Rental /Fuel	**15**	**day**	**$ 75**	**$**	**1,125**	
Contractor Travel Costs for Field staff	**4**	**each**	**$ 1,500**	**$**	**6,000**	
General Contractor Field Office Personnel Per Diem	**40**	**day**	**$ 200**	**$**	**8,000**	
SubTotal - Oversight Costs				**$**	**40,475**	
Oversight Contingency	10%			**$**	**4,048**	
TOTAL CAPITAL COST				**$**	**620,000**	**Section C = A + B + Construction**

ANNUAL O&M COST

Item/Activity	Qty	Unit	Unit Cost	Cost	Comments
Quarterly O&M Visits	32	HR	$ 150	$ 4,800	8 hr per visit, 1 person
Quarterly O&M Reports	80	HR	$ 150	$ 12,000	Assumes one review version each, for USAF only
TO-15 Sample Analysis for SVE Exhaust	12	EA	$ 250	$ 3,000	SUMMA canister samples; includes SVE exhaust samples before and after GAC treatment and QC samples; quarterly
Sample Equipment/Supplies	1	LS	$ 250	$ 250	
Sample Shipment	4	EA	$ 150	$ 600	Up to 4 Summa canisters per box
Disposal of Knock-Out Drum Water	4	EA	$ 500	$ 2,000	Assumes quarterly disposal at ESF during operation; < 55 gal per quarter
Vapor Phase GAC Changeout	1	EA	$ 7,900	$ 7,900	Assumes old GAC able to be reactivated; includes sampling / analysis / waste characterization / disposal, based on 2024 cost for similar project
TO-17 Indoor Air and TO-15 Sub-Slab Soil Gas Sampling Labor	56	HR	$ 150	$ 8,400	Assumes local staff, four hours on two dates for TO-17 deployment / pickup, and ten hours each on two dates for TO-15 sampling), 2 staff per event
Field Truck Rental/Fuel	4	day	$ 75	$ 300	Assumes local staff
Sample Equipment/Supplies	1	LS	$ 250	$ 250	
Sample Shipment	4	EA	$ 150	$ 600	Shipments to separate labs for TO-15/TO-17 analysis; up to 4 Summa canisters per box
TO-17 Indoor Air Sample Analysis	11	EA	$ 300	$ 3,300	20-day passive sampler analysis; includes QC sample
TO-15 Sub-Slab Soil Gas Sample Analysis	11	EA	$ 250	$ 2,750	SUMMA canister samples; includes QC sample
VI Sampling and Annual O&M Report	180	HR	$ 150	$ 27,000	Assumes 20 hours for data validation and ERPIMS submittal; pre-draft, draft, draft final, and final versions
Subtotal *Annual O&M*				$ 73,150	
O&M Contingency	10%	Percent		$ 7,315	
Subtotal *Annual O&M Cost*				$ 80,465	
Project Management	10%	Percent		$ 8,047	
Technical Support	10%	Percent		$ 8,047	
SUBTOTAL ANNUAL O&M COST				**$ 96,558**	**Section D**

TOTAL O&M COST					
Number of Years of Operation =	10	years			
TOTAL O&M COST			**$**	**965,580**	
TOTAL ALTERNATIVE COST			**$**	**1,585,580**	
PRESENT WORTH ANALYSIS					
Number of Years of Operation =	10	years			
Real Discount Rate	1.9%				From OMB Circular A-94 (https://www.whitehouse.gov/wp-content/uploads/2023/12/CircularA-94AppendixC.pdf)
				Present Worth	
Contracted Capital Cost =			$	620,000	
10 Years O&M Cost =			$	871,896	
TOTAL PRESENT WORTH COST			**$**	**1,492,000**	

ROM	**50.00%**	**$**	**2,238,000**
RANGE	**-30.00%**	**$**	**1,044,400**

This is not an offer for construction and/or project execution. The costs presented in this estimate are considered Class 2 with an accuracy range of -30% to +50% of the actual cost, according to the Recommended Practice No. 107R-19: Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Environmental Remediation Industries (AACE International 2021). The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor, material costs, and competitive variable factors. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific decisions to help ensure proper project evaluation and adequate funding.

Bid Item	Bid Description	HCSS Bid Quantity	HCSS Units	HCSS Labor Cost	HCSS Labor Burden	HCSS Permanent Materials	HCSS Construction Materials	HCSS Total Equipment	HCSS Subcontractor Costs	HCSS Services	HCSS Travel	HCSS Equipment Rental	**HCSS Direct Cost Total**	Equipment Escalation	**HCSS Bid Total**	JOOH	HOOH G&A	Subtotal Cost	Profit	Bond	**Contract Cost**	**Unit Cost**
	Construction													**31.26%**		**0%**	**5%**		**10%**	**1.5%**		
200	SESC and Site Security Installation	1.00	LS	472.58	338.92	0.00	360.15	113.50	0.00	0.00	0.00	0.00	1,285.15	35.48	1,320.63	$0	$66	$1,387	$139	$23	**$1,548**	**$1,600**
300	SVE Trench Construction	100.00	LF	5,671.06	4,067.01	1,640.00	72.00	3,037.00	0.00	0.00	0.00	0.00	14,487.07	949.37	15,436.44	$0	$772	$16,208	$1,621	$267	**$18,097**	**$190**
400	SVE Conveyance Pipe Trench Construction	100.00	LF	1,890.35	1,355.68	250.00	28.80	1,020.22	0.00	0.00	0.00	0.00	4,545.05	318.92	4,863.97	$0	$243	$5,107	$511	$84	**$5,702**	**$60**
410	SVE System and Enclosure	1.00	LS	6,260.70	4,106.00	43,094.68	0.00	1,621.50	0.00	0.00	0.00	0.00	55,082.88	506.88	55,589.76	$0	$2,779	$58,369	$5,837	$963	**$65,169**	**$66,000**
700	Asphalt Cover Installation	90.00	SY	1,890.36	1,355.68	1,776.00	0.00	1,225.44	0.00	0.00	0.00	0.00	6,247.48	383.07	6,630.55	$0	$332	$6,962	$696	$115	**$7,773**	**$90**
800	Site Restoration	1.00	LS	560.99	462.68	0.00	95.40	94.34	0.00	0.00	0.00	0.00	1,213.41	29.49	1,242.90	$0	$62	$1,305	$131	$22	**$1,457**	**$1,500**
900	Waste Characterization Sampling	4.00	EA	960.00	400.00	0.00	4,209.00	125.78	0.00	0.00	0.00	0.00	5,694.78	39.32	5,734.10	$0	$287	$6,021	$602	$99	**$6,722**	**$1,700**
1000	SSD Installation	6.00	EA	17,705.27	10,866.83	21,222.00	900.00	3,412.80	0.00	300.00	0.00	0.00	54,406.90	1,066.84	55,473.74	$0	$2,774	$58,247	$5,825	$961	**$65,033**	**$10,840**
1100	SSD Startup	6.00	EA	1,477.67	783.07	0.00	21.60	188.68	0.00	0.00	0.00	0.00	2,471.02	58.98	2,530.00	$0	$127	$2,657	$266	$44	**$2,966**	**$500**
1200	APU Installation	11.00	EA	16,229.84	9,961.26	61,941.00	237.60	2,075.44	0.00	0.00	0.00	0.00	90,445.14	648.78	91,093.92	$0	$4,555	$95,649	$9,565	$1,578	**$106,792**	**$9,710**
1300	APU Startup	11.00	EA	694.53	442.81	0.00	39.60	172.95	0.00	0.00	0.00	0.00	1,349.89	54.06	1,403.95	$0	$70	$1,474	$147	$24	**$1,646**	**$150**

Cost Report

Biditem

200

SESC and Site Security Installation

Takeoff Qty: 1.000 LS
Bid Qty: 1.000 LS

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	472.58	338.92	811.50	113.50	0.00	360.15	0.00	0.00	0.00	0.00	1,285.15
Total	472.58	338.92	811.50	113.50	0.00	360.15	0.00	0.00	0.00	0.00	1,285.15

Manhours	Unit/MH	MH/Unit	$/MH	Base Labor/MH	Total Labor/MH	Unit/CH
9.0000	0.1111	9.0000	142.7944	52.5089	90.1667	0.3333

Activity: 10 SESC Installation Quantity: 1.00 Unit: LS

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	472.58	338.92	811.50	113.50	0.00	360.15	0.00	0.00	0.00	0.00	1,285.15
Total	472.58	338.92	811.50	113.50	0.00	360.15	0.00	0.00	0.00	0.00	1,285.15

Crew $/Unit	Crew Hrs/Unit	Units/Crew Hr	$/Crew Hour	Shifts	Units/Shift	Shifts/Unit	$/Shift
925.0000	3.0000	0.3333	308.3333	0.2500	4.0000	0.2500	5,140.6000

Manhours	Unit/MH	MH/Unit	Total Labor/MH	Base Labor/Unit
9.0000	0.1111	9.0000	90.1667	472.5800

Calendar: 612 6 days @ 12 hours Hrs/Shift: 12 WC: Code not found.

Crew: ZZZ (Mod) ***CUSTOM CREW*** Prod: S 0.25 Eff: 100.00 Crew Hrs: 3.00 Labor Pcs: 3.00 Equipment Pcs: 2.00

Resource	Description	Pcs/Wste	Quantity	Unit	Unit Cost	Tax/OT %	Actual UC	Total
31EC100	Silt Fence w/stakes-36"x100'	1.00	1.00	ROLL	51.95	100.000	51.95	51.95
31EC102	Straw Wattle (12" x 10')	1.00	4.00	EA	29.00	100.000	29.00	116.00
31EC126	Metal Tee Posts	1.00	10.00	EA	7.43	100.000	7.43	74.30
31EC134	Safety Fence (100' roll)	1.00	1.00	EA	117.90	100.000	117.90	117.90
8LDRSS216	Skid Steer Cat 216B 1400# Cp	1.00	3.00	HR	22.11	100.000	22.11	66.33
8TRKPU55	Leased 4x4, 3/4 Ton Gas Super	1.00	3.00	HR	15.72	100.000	15.72	47.17
LGEN	Laborer-General	2.00	6.00	MH	38.25	122.220	85.31	511.83
OPLDR6	Op Eng 2- Loader <6Y	1.00	3.00	MH	52.39	122.220	99.89	299.67

Biditem

300

SVE Trench Construction

Takeoff Qty: 100.000 LF
Bid Qty: 100.000 LF

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	56.71	40.67	97.38	30.37	16.40	0.72	0.00	0.00	0.00	0.00	144.87
Total	5,671.06	4,067.01	9,738.07	3,037.00	1,640.00	72.00	0.00	0.00	0.00	0.00	14,487.07

Manhours	Unit/MH	MH/Unit	$/MH	Base Labor/MH	Total Labor/MH	Unit/CH
108.0000	0.9259	1.0800	134.1395	52.5098	90.1673	2.7778

Activity: 10 Excavation, Pipe Install, Backfill 8' deep Quantity: 100.00 Unit: CY

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	56.71	40.67	97.38	30.37	16.40	0.72	0.00	0.00	0.00	0.00	144.87
Total	5,671.06	4,067.01	9,738.07	3,037.00	1,640.00	72.00	0.00	0.00	0.00	0.00	14,487.07

Crew $/Unit	Crew Hrs/Unit	Units/Crew Hr	$/Crew Hour	Shifts	Units/Shift	Shifts/Unit	$/Shift
127.7507	0.3600	2.7778	354.8631	3.0000	33.3333	0.0300	4,829.0233

Manhours	Unit/MH	MH/Unit	Total Labor/MH	Base Labor/Unit
108.0000	0.9259	1.0800	90.1673	56.7106

Calendar: 612 6 days @ 12 hours Hrs/Shift: 12 WC: Code not found.

Crew: ZZZ (Mod) ***CUSTOM CREW*** Prod: US 33.3333 Eff: 100.00 Crew Hrs: 36.00 Labor Pcs: 3.00 Equipment Pcs: 4.00

Resource	Description	Pcs/Wste	Quantity	Unit	Unit Cost	Tax/OT %	Actual UC	Total
2AA06	3/4" Crushed Gravel	1.00	150.00	TN	8.00	100.000	8.00	1,200.00
2PVC01	4" Perforated PVC	1.10	110.00	LF	4.00	100.000	4.00	440.00
8COMPACAW6	Cat CVP40 Vibratory Plate Attach <10K	1.00	36.00	HR	3.77	100.000	3.77	135.61
8EXC006	Excavator Cat 315 (14.1-16TN)	1.00	36.00	HR	49.15	100.000	49.15	1,769.33
8TRKPU55	Leased 4x4, 3/4 Ton Gas Super	2.00	72.00	HR	15.72	100.000	15.72	1,132.06
9STGEN	Sm Tools - General	1.00	80.00	MH	0.90	100.000	0.90	72.00
LFLAG	Laborer-Flagger	1.00	36.00	MH	38.25	122.220	85.31	3,071.00
LGEN	Laborer-General	1.00	36.00	MH	38.25	122.220	85.31	3,071.00
OPEXC3	Op Eng 3- Backhoe to 3Y	1.00	36.00	MH	52.39	122.220	99.89	3,596.07

Biditem

400

SVE Conveyance Pipe Trench Construction

Takeoff Qty: 100.000 LF

Bid Qty: 100.000 LF

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	18.90	13.56	32.46	10.20	2.50	0.29	0.00	0.00	0.00	0.00	45.45
Total	1,890.35	1,355.68	3,246.03	1,020.22	250.00	28.80	0.00	0.00	0.00	0.00	4,545.05

Manhours	Unit/MH	MH/Unit	$/MH	Base Labor/MH	Total Labor/MH	Unit/CH
36.0000	2.7778	0.3600	126.2514	52.5097	90.1675	8.3333

Activity: 10 Excavation, Pipe Install, Backfill 4' deep Quantity: 40.00 Unit: CY

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	47.26	33.89	81.15	25.51	6.25	0.72	0.00	0.00	0.00	0.00	113.63
Total	1,890.35	1,355.68	3,246.03	1,020.22	250.00	28.80	0.00	0.00	0.00	0.00	4,545.05

Crew $/Unit	Crew Hrs/Unit	Units/Crew Hr	$/Crew Hour	Shifts	Units/Shift	Shifts/Unit	$/Shift
106.6563	0.3000	3.3333	355.5208	1.0000	40.0000	0.0250	4,545.0500

Manhours	Unit/MH	MH/Unit	Total Labor/MH	Base Labor/Unit
36.0000	1.1111	0.9000	90.1675	47.2588

Calendar: 612 6 days @ 12 hours Hrs/Shift: 12 WC: Code not found.

Crew: ZZZ (Mod) ***CUSTOM CREW*** Prod: US 40 Eff: 100.00 Crew Hrs: 12.00 Labor Pcs: 3.00 Equipment Pcs: 4.00

Resource	Description	Pcs/Wste	Quantity	Unit	Unit Cost	Tax/OT %	Actual UC	Total
2PVC02	4" SCH 40 PVC	1.00	100.00	LF	2.50	100.000	2.50	250.00
8COMPACW04	Compactor Plate 21IN (5200#)	1.00	12.00	HR	4.42	100.000	4.42	53.09
8EXC006	Excavator Cat 315 (14.1-16TN)	1.00	12.00	HR	49.15	100.000	49.15	589.78
8TRKPU55	Leased 4x4, 3/4 Ton Gas Super	2.00	24.00	HR	15.72	100.000	15.72	377.35
9STGEN	Sm Tools - General	1.00	32.00	MH	0.90	100.000	0.90	28.80
LFLAG	Laborer-Flagger	1.00	12.00	MH	38.25	122.220	85.31	1,023.67
LGEN	Laborer-General	1.00	12.00	MH	38.25	122.220	85.31	1,023.67
OPEXC3	Op Eng 3- Backhoe to 3Y	1.00	12.00	MH	52.39	122.220	99.89	1,198.69

Biditem

410

SVE System and Enclosure

Takeoff Qty: 1.000 LS

Bid Qty: 1.000 LS

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	6,260.70	4,106.00	10,366.70	1,621.50	43,094.68	0.00	0.00	0.00	0.00	0.00	55,082.88
Total	6,260.70	4,106.00	10,366.70	1,621.50	43,094.68	0.00	0.00	0.00	0.00	0.00	55,082.88

Manhours	Unit/MH	MH/Unit	$/MH	Base Labor/MH	Total Labor/MH	Unit/CH
110.0000	0.0091	110.0000	500.7535	56.9155	94.2427	0.0353

Activity: 10 Materials Quantity: 1.00 Unit: LS

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	0.00	0.00	0.00	0.00	42,700.00	0.00	0.00	0.00	0.00	0.00	42,700.00
Total	0.00	0.00	0.00	0.00	42,700.00	0.00	0.00	0.00	0.00	0.00	42,700.00

Calendar: 612 6 days @ 12 hours Hrs/Shift: 12 WC: Code not found.

Resource	Description	Pcs/Wste	Quantity	Unit	Unit Cost	Tax/OT %	Actual UC	Total
2CONDEX01	8'x12' Condex Box with Rollup Door	1.00	1.00	EA	5,000.00	100.000	5,000.00	5,000.00
2ELE01	Electrical Conduit/Disconnect/Materials	1.00	1.00	EA	1,500.00	100.000	1,500.00	1,500.00
2GAC01	1000LB Reactivated Vapor Phase Carbon	1.00	1.00	EA	1,200.00	100.000	1,200.00	1,200.00
2SVE01	Skid-Mount SVE System (100 SCFM, 2K LB Carbon)	1.00	1.00	EA	35,000.00	100.000	35,000.00	35,000.00

Activity: 20 Installation - Electric and Conncectio Conveyance Piping Quantity: 1.00 Unit: LS

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	5,508.40	3,581.49	9,089.89	1,215.92	0.00	0.00	0.00	0.00	0.00	0.00	10,305.81
Total	5,508.40	3,581.49	9,089.89	1,215.92	0.00	0.00	0.00	0.00	0.00	0.00	10,305.81

Crew $/Unit	Crew Hrs/Unit	Units/Crew Hr	$/Crew Hour	Shifts	Units/Shift	Shifts/Unit	$/Shift
10,305.8100	24.0000	0.0417	429.4088	2.0000	0.5000	2.0000	5,152.9050

Manhours	Unit/MH	MH/Unit	Total Labor/MH	Base Labor/Unit
96.0000	0.0104	96.0000	94.6864	5,508.4000

Calendar: 612 6 days @ 12 hours Hrs/Shift: 12 WC: Code not found.

Crew: ZZZ (Mod) ***CUSTOM CREW*** Prod: S 2 Eff: 100.00 Crew Hrs: 24.00 Labor Pcs: 4.00 Equipment Pcs: 4.00

Resource	Description	Pcs/Wste	Quantity	Unit	Unit Cost	Tax/OT %	Actual UC	Total
8GEN010	Generator 10 KW	1.00	24.00	HR	3.49	100.000	3.49	83.86
8TRKPU55	Leased 4x4, 3/4 Ton Gas Super	3.00	72.00	HR	15.72	100.000	15.72	1,132.06
ELECTJ	Electrical Journeyman	2.00	48.00	MH	48.94	122.220	95.02	4,561.09
LGEN	Laborer-General	1.00	24.00	MH	38.25	122.220	85.31	2,047.33
PIPEJ	Pipefitter Journeyman	1.00	24.00	MH	51.66	122.220	103.39	2,481.47

Activity: 30 Offload and Set Quantity: 1.00 Unit: LS

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	332.34	223.25	555.59	133.94	0.00	0.00	0.00	0.00	0.00	0.00	689.53
Total	332.34	223.25	555.59	133.94	0.00	0.00	0.00	0.00	0.00	0.00	689.53

Crew $/Unit	Crew Hrs/Unit	Units/Crew Hr	$/Crew Hour	Shifts	Units/Shift	Shifts/Unit	$/Shift
689.5300	3.0000	0.3333	229.8433	0.2500	4.0000	0.2500	2,758.1200

Manhours	Unit/MH	MH/Unit	Total Labor/MH	Base Labor/Unit
6.0000	0.1667	6.0000	92.5983	332.3400

Calendar: 612 6 days @ 12 hours Hrs/Shift: 12 WC: Code not found.

Crew: ZZZ (Mod) ***CUSTOM CREW*** Prod: S 0.25 Eff: 100.00 Crew Hrs: 3.00 Labor Pcs: 2.00 Equipment Pcs: 2.00

Resource	Description	Pcs/Wste	Quantity	Unit	Unit Cost	Tax/OT %	Actual UC	Total
8FORK02	Forklift Cat TH220B 7K#, 20'	1.00	3.00	HR	28.92	100.000	28.92	86.77
8TRKPU55	Leased 4x4, 3/4 Ton Gas Super	1.00	3.00	HR	15.72	100.000	15.72	47.17
LGEN	Laborer-General	1.00	3.00	MH	38.25	122.220	85.31	255.92
OPLDR6	Op Eng 2- Loader <6Y	1.00	3.00	MH	52.39	122.220	99.89	299.67

Activity: 50 Asphalt Pad Installation Quantity: 20.00 Unit: SY

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	21.00	15.06	36.06	13.58	19.73	0.00	0.00	0.00	0.00	0.00	69.38
Total	419.96	301.26	721.22	271.64	394.68	0.00	0.00	0.00	0.00	0.00	1,387.54

Crew $/Unit	Crew Hrs/Unit	Units/Crew Hr	$/Crew Hour	Shifts	Units/Shift	Shifts/Unit	$/Shift
49.6430	0.0667	15.0004	744.6636	0.1111	180.0045	0.0056	12,488.1726

Manhours	Unit/MH	MH/Unit	Total Labor/MH	Base Labor/Unit
8.0000	2.5000	0.4000	90.1525	20.9980

Calendar: 612 6 days @ 12 hours Hrs/Shift: 12 WC: Code not found.

Crew: ACP2 (Mod) Asphalt Paving, Main Lanes Prod: S 0.1111 Eff: 100.00 Crew Hrs: 1.33 Labor Pcs: 6.00 Equipment Pcs: 3.00

Resource	Description	Pcs/Wste	Quantity	Unit	Unit Cost	Tax/OT %	Actual UC	Total
2ACP05	Asphalt - Surface Course	1.00	1.56	TN	68.00	100.000	68.00	106.08
2ACP07	Asphalt - Base Course	1.00	4.44	TN	65.00	100.000	65.00	288.60
8ACP20	Vib Roller Cat CB-22 W=39"	1.00	1.33	HR	18.58	100.000	18.58	24.71
8ACP55	Asphalt Paver Cat AP-655D	1.00	1.33	HR	169.94	100.000	169.94	226.02
8TRKPU55	Leased 4x4, 3/4 Ton Gas Super	1.00	1.33	HR	15.72	100.000	15.72	20.91
LGEN	Laborer-General	2.00	2.67	MH	38.25	122.220	85.30	227.76
LPWR	Laborer-Power Tools	2.00	2.67	MH	38.25	122.220	85.30	227.76
OPFORMAN	Op Eng- Foreman	1.00	1.33	MH	52.39	122.220	99.89	132.85
OPROLL	Op Eng - Rollers	1.00	1.33	MH	52.39	122.220	99.89	132.85

Biditem

700

Asphalt Cover Installation

Takeoff Qty: 90.000 SY

Bid Qty: 90.000 SY

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	21.00	15.06	36.07	13.62	19.73	0.00	0.00	0.00	0.00	0.00	69.42
Total	1,890.36	1,355.68	3,246.04	1,225.44	1,776.00	0.00	0.00	0.00	0.00	0.00	6,247.48

Manhours	Unit/MH	MH/Unit	$/MH	Base Labor/MH	Total Labor/MH	Unit/CH
36.0000	2.5000	0.4000	173.5411	52.5100	90.1678	15.0000

Activity: 10 Asphalt Installation Quantity: 90.00 Unit: SY

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	21.00	15.06	36.07	13.62	19.73	0.00	0.00	0.00	0.00	0.00	69.42
Total	1,890.36	1,355.68	3,246.04	1,225.44	1,776.00	0.00	0.00	0.00	0.00	0.00	6,247.48

Crew $/Unit	Crew Hrs/Unit	Units/Crew Hr	$/Crew Hour	Shifts	Units/Shift	Shifts/Unit	$/Shift
49.6831	0.0667	15.0000	745.2467	0.5000	180.0000	0.0056	12,494.9600

Manhours	Unit/MH	MH/Unit	Total Labor/MH	Base Labor/Unit
36.0000	2.5000	0.4000	90.1678	21.0040

Calendar: 612 6 days @ 12 hours Hrs/Shift: 12 WC: Code not found.

Crew: ACP2 (Mod) Asphalt Paving, Main Lanes Prod: S 0.5 Eff: 100.00 Crew Hrs: 6.00 Labor Pcs: 6.00 Equipment Pcs: 3.00

Resource	Description	Pcs/Wste	Quantity	Unit	Unit Cost	Tax/OT %	Actual UC	Total
2ACP05	Asphalt - Surface Course	1.00	7.00	TN	68.00	100.000	68.00	476.00
2ACP07	Asphalt - Base Course	1.00	20.00	TN	65.00	100.000	65.00	1,300.00
8ACP20	Vib Roller Cat CB-22 W=39"	1.00	6.00	HR	18.58	100.000	18.58	111.48
8ACP55	Asphalt Paver Cat AP-655D	1.00	6.00	HR	169.94	100.000	169.94	1,019.62
8TRKPU55	Leased 4x4, 3/4 Ton Gas Super	1.00	6.00	HR	15.72	100.000	15.72	94.34
LGEN	Laborer-General	2.00	12.00	MH	38.25	122.220	85.31	1,023.67
LPWR	Laborer-Power Tools	2.00	12.00	MH	38.25	122.220	85.31	1,023.67
OPFORMAN	Op Eng- Foreman	1.00	6.00	MH	52.39	122.220	99.89	599.35
OPROLL	Op Eng - Rollers	1.00	6.00	MH	52.39	122.220	99.89	599.35

Biditem

800

Site Restoration

Takeoff Qty: 1.000 LS

Bid Qty: 1.000 LS

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	560.99	462.68	1,023.67	94.34	0.00	95.40	0.00	0.00	0.00	0.00	1,213.41
Total	560.99	462.68	1,023.67	94.34	0.00	95.40	0.00	0.00	0.00	0.00	1,213.41

Manhours	Unit/MH	MH/Unit	$/MH	Base Labor/MH	Total Labor/MH	Unit/CH
12.0000	0.0833	12.0000	101.1175	46.7492	85.3058	0.1667

Activity: 10 Site Restoration Quantity: 1.00 Unit: LS

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	560.99	462.68	1,023.67	94.34	0.00	95.40	0.00	0.00	0.00	0.00	1,213.41
Total	560.99	462.68	1,023.67	94.34	0.00	95.40	0.00	0.00	0.00	0.00	1,213.41

Crew $/Unit	Crew Hrs/Unit	Units/Crew Hr	$/Crew Hour	Shifts	Units/Shift	Shifts/Unit	$/Shift
1,118.0100	6.0000	0.1667	186.3350	0.5000	2.0000	0.5000	2,426.8200

Manhours	Unit/MH	MH/Unit	Total Labor/MH	Base Labor/Unit
12.0000	0.0833	12.0000	85.3058	560.9900

Calendar: 612 6 days @ 12 hours Hrs/Shift: 12 WC: Code not found.

Crew: ZZZ (Mod) ***CUSTOM CREW*** Prod: S 0.5 Eff: 100.00 Crew Hrs: 6.00 Labor Pcs: 2.00 Equipment Pcs: 1.00

Resource	Description	Pcs/Wste	Quantity	Unit	Unit Cost	Tax/OT %	Actual UC	Total
31EC118	Erosion Netting	1.00	20.00	SY	0.75	100.000	0.75	15.00
31EC120	Erosion Netting Staples	1.00	1.00	BX	35.00	100.000	35.00	35.00
31EC200	Grass Seed and Fertilizer	1.00	10.00	LB	4.00	100.000	4.00	40.00
8TRKPU55	Leased 4x4, 3/4 Ton Gas Super	1.00	6.00	HR	15.72	100.000	15.72	94.34
9STGEN	Sm Tools - General	1.00	6.00	MH	0.90	100.000	0.90	5.40
LGEN	Laborer-General	2.00	12.00	MH	38.25	122.220	85.31	1,023.67

Biditem

900

Waste Characterization Sampling

Takeoff Qty: 4.000 EA

Bid Qty: 4.000 EA

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	240.00	100.00	340.00	31.45	0.00	1,052.25	0.00	0.00	0.00	0.00	1,423.70
Total	960.00	400.00	1,360.00	125.78	0.00	4,209.00	0.00	0.00	0.00	0.00	5,694.78

Manhours	Unit/MH	MH/Unit	$/MH	Base Labor/MH	Total Labor/MH	Unit/CH
16.0000	0.2500	4.0000	355.9238	60.0000	85.0000	0.5000

Activity: 10 Waste Characterization Sampling Quantity: 4.00 Unit: EA

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	240.00	100.00	340.00	31.45	0.00	1,052.25	0.00	0.00	0.00	0.00	1,423.70
Total	960.00	400.00	1,360.00	125.78	0.00	4,209.00	0.00	0.00	0.00	0.00	5,694.78

Crew $/Unit	Crew Hrs/Unit	Units/Crew Hr	$/Crew Hour	Shifts	Units/Shift	Shifts/Unit	$/Shift
371.4450	2.0000	0.5000	185.7225	0.6667	6.0000	0.1667	8,542.1701

Manhours	Unit/MH	MH/Unit	Total Labor/MH	Base Labor/Unit
16.0000	0.2500	4.0000	85.0000	240.0000

Calendar: 612 6 days @ 12 hours Hrs/Shift: 12 WC: Code not found.

Crew: ZZZ (Mod) ***CUSTOM CREW*** Prod: HU 2 Eff: 100.00 Crew Hrs: 8.00 Labor Pcs: 2.00 Equipment Pcs: 1.00

Resource	Description	Pcs/Wste	Quantity	Unit	Unit Cost	Tax/OT %	Actual UC	Total
31EQX582	Trimble GPS Unit	1.00	0.20	WK	300.00	100.000	300.00	60.00

31EQX588	Hand Auger Kit	1.00	1.00	EA	935.00	100.000	935.00	935.00
31EQX628	Mini Rae Plus D	1.00	1.00	DY	14.00	100.000	14.00	14.00
31WASTE01	Waste Characterization Sample Analysis	1.00	4.00	EA	750.00	100.000	750.00	3,000.00
31WASTESHIP	Waste Shipping	1.00	1.00	EA	200.00	100.000	200.00	200.00
8TRKPU55	Leased 4x4, 3/4 Ton Gas Super	1.00	8.00	HR	15.72	100.000	15.72	125.78
X110	Staff Engineer	2.00	16.00	MH	60.00	100.000	85.00	1,360.00

Biditem

1000

SSD Installation

Takeoff Qty: 6.000 EA

Bid Qty: 6.000 EA

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	2,950.88	1,811.14	4,762.02	568.80	3,537.00	150.00	0.00	50.00	0.00	0.00	9,067.82
Total	17,705.27	10,866.83	28,572.10	3,412.80	21,222.00	900.00	0.00	300.00	0.00	0.00	54,406.90

Manhours	Unit/MH	MH/Unit	$/MH	Base Labor/MH	Total Labor/MH	Unit/CH
288.0000	0.0208	48.0000	188.9128	61.4766	99.2087	0.0833

Activity: 10 Materials Quantity: 6.00 Unit: EA

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	0.00	0.00	0.00	0.00	3,537.00	150.00	0.00	0.00	0.00	0.00	3,687.00
Total	0.00	0.00	0.00	0.00	21,222.00	900.00	0.00	0.00	0.00	0.00	22,122.00

Calendar: 612 6 days @ 12 hours Hrs/Shift: 12 WC: Code not found.

Resource	Description	Pcs/Wste	Quantity	Unit	Unit Cost	Tax/OT %	Actual UC	Total
2DC04	4" PVC SCH 80 Pipe	1.00	360.00	LF	12.00	100.000	12.00	4,320.00
2DC100	4" PVC SCH 80 90	1.00	24.00	EA	30.00	100.000	30.00	720.00
2ELE01	Electrical Conduit/Disconnect/Materials	1.00	6.00	EA	150.00	100.000	150.00	900.00
2SEAL01	29-fl oz SL Sikaflex Concrete Sealant	1.00	6.00	EA	17.00	100.000	17.00	102.00
2SSD01	RadonAway HS5500	1.00	6.00	EA	2,500.00	100.000	2,500.00	15,000.00
2VG01	30 to 0 Hg Vacuum Gauge	1.00	6.00	EA	30.00	100.000	30.00	180.00
31EQV100	Soil Vapor Pin	1.00	12.00	EA	75.00	100.000	75.00	900.00

Activity: 20 SSD Installl Quantity: 6.00 Unit: EA

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	2,950.88	1,811.14	4,762.02	568.80	0.00	0.00	0.00	50.00	0.00	0.00	5,380.82
Total	17,705.27	10,866.83	28,572.10	3,412.80	0.00	0.00	0.00	300.00	0.00	0.00	32,284.90

Crew $/Unit	Crew Hrs/Unit	Units/Crew Hr	$/Crew Hour	Shifts	Units/Shift	Shifts/Unit	$/Shift
5,330.8167	12.0000	0.0833	444.2347	6.0000	1.0000	1.0000	5,380.8167

Manhours	Unit/MH	MH/Unit	Total Labor/MH	Base Labor/Unit
288.0000	0.0208	48.0000	99.2087	2,950.8783

Calendar: 612 6 days @ 12 hours Hrs/Shift: 12 WC: Code not found.

Crew: ZZZ (Mod) ***CUSTOM CREW*** Prod: US 1 Eff: 100.00 Crew Hrs: 72.00 Labor Pcs: 4.00 Equipment Pcs: 4.00

Resource	Description	Pcs/Wste	Quantity	Unit	Unit Cost	Tax/OT %	Actual UC	Total
5CONCRETE	Concrete 4" Core Drill	1.00	6.00	DY	50.00	100.000	50.00	300.00
8GEN010	Generator 10 KW	1.00	72.00	HR	3.49	100.000	3.49	251.57
8SLIFT30	Scissor Lift 30' SM3184XT	1.00	72.00	HR	12.46	100.000	12.46	897.12
8TRKPU55	Leased 4x4, 3/4 Ton Gas Super	2.00	144.00	HR	15.72	100.000	15.72	2,264.11
ELECTJ	Electrical Journeyman	2.00	144.00	MH	48.94	122.220	95.02	13,683.29
PIPEJ	Pipefitter Journeyman	2.00	144.00	MH	51.66	122.220	103.39	14,888.81

Biditem **SSD Startup**

1100

Takeoff Qty: 6.000 EA
Bid Qty: 6.000 EA

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	246.28	130.51	376.79	31.45	0.00	3.60	0.00	0.00	0.00	0.00	411.84
Total	1,477.67	783.07	2,260.74	188.68	0.00	21.60	0.00	0.00	0.00	0.00	2,471.02

Manhours	Unit/MH	MH/Unit	$/MH	Base Labor/MH	Total Labor/MH	Unit/CH
24.0000	0.2500	4.0000	102.9592	61.5696	94.1975	0.5000

Activity: 10 Startup Quantity: 6.00 Unit: EA

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	246.28	130.51	376.79	31.45	0.00	3.60	0.00	0.00	0.00	0.00	411.84
Total	1,477.67	783.07	2,260.74	188.68	0.00	21.60	0.00	0.00	0.00	0.00	2,471.02

Crew $/Unit	Crew Hrs/Unit	Units/Crew Hr	$/Crew Hour	Shifts	Units/Shift	Shifts/Unit	$/Shift
408.2367	2.0000	0.5000	204.1183	1.0000	6.0000	0.1667	2,471.0200

Manhours	Unit/MH	MH/Unit	Total Labor/MH	Base Labor/Unit
24.0000	0.2500	4.0000	94.1975	246.2783

Calendar: 612 6 days @ 12 hours Hrs/Shift: 12 WC: Code not found.

Crew: ZZZ (Mod) ***CUSTOM CREW*** Prod: HU 2 Eff: 100.00 Crew Hrs: 12.00 Labor Pcs: 2.00 Equipment Pcs: 1.00

Resource	Description	Pcs/Wste	Quantity	Unit	Unit Cost	Tax/OT %	Actual UC	Total
8TRKPU55	Leased 4x4, 3/4 Ton Gas Super	1.00	12.00	HR	15.72	100.000	15.72	188.68
9STGEN	Sm Tools - General	1.00	24.00	MH	0.90	100.000	0.90	21.60
PIPEJ	Pipefitter Journeyman	1.00	12.00	MH	51.66	122.220	103.40	1,240.74
X110	Staff Engineer	1.00	12.00	MH	60.00	100.000	85.00	1,020.00

Biditem

1200

APU Installation

Takeoff Qty: 11.000 EA
Bid Qty: 11.000 EA

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	1,475.44	905.57	2,381.01	188.68	5,631.00	21.60	0.00	0.00	0.00	0.00	8,222.29
Total	16,229.84	9,961.26	26,191.10	2,075.44	61,941.00	237.60	0.00	0.00	0.00	0.00	90,445.14

Manhours	Unit/MH	MH/Unit	$/MH	Base Labor/MH	Total Labor/MH	Unit/CH
264.0000	0.0417	24.0000	342.5952	61.4767	99.2087	0.1667

Activity: 10 Materials Quantity: 11.00 Unit: EA

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	0.00	0.00	0.00	0.00	5,631.00	0.00	0.00	0.00	0.00	0.00	5,631.00
Total	0.00	0.00	0.00	0.00	61,941.00	0.00	0.00	0.00	0.00	0.00	61,941.00

Calendar: 612 6 days @ 12 hours Hrs/Shift: 12 WC: Code not found.

Resource	Description	Pcs/Wste	Quantity	Unit	Unit Cost	Tax/OT %	Actual UC	Total
2APU01	Amaircare ES3X Tri-Carbon	1.00	11.00	EA	5,400.00	100.000	5,400.00	59,400.00
2ELE01	Electrical Conduit/Disconnect/Materials	1.00	11.00	EA	150.00	100.000	150.00	1,650.00
2MISC01	Fasteners/Brackets	11.00	11.00	LS	45.00	100.000	45.00	495.00
2UNI01	Unistrut	11.00	66.00	LF	6.00	100.000	6.00	396.00

Activity: 20 SSD Installl Quantity: 11.00 Unit: EA

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	1,475.44	905.57	2,381.01	188.68	0.00	21.60	0.00	0.00	0.00	0.00	2,591.29
Total	16,229.84	9,961.26	26,191.10	2,075.44	0.00	237.60	0.00	0.00	0.00	0.00	28,504.14

Crew $/Unit	Crew Hrs/Unit	Units/Crew Hr	$/Crew Hour	Shifts	Units/Shift	Shifts/Unit	$/Shift

2,569.6855	6.0000	0.1667	428.2809	5.5000	2.0000	0.5000	5,182.5709

Manhours	Unit/MH	MH/Unit	Total Labor/MH	Base Labor/Unit
264.0000	0.0417	24.0000	99.2087	1,475.4400

Calendar: 612 6 days @ 12 hours Hrs/Shift: 12 WC: Code not found.

Crew: ZZZ (Mod) ***CUSTOM CREW*** Prod: US 2 Eff: 100.00 Crew Hrs: 66.00 Labor Pcs: 4.00 Equipment Pcs: 2.00

Resource	Description	Pcs/Wste	Quantity	Unit	Unit Cost	Tax/OT %	Actual UC	Total
8TRKPU55	Leased 4x4, 3/4 Ton Gas Super	2.00	132.00	HR	15.72	100.000	15.72	2,075.44
9STGEN	Sm Tools - General	1.00	264.00	MH	0.90	100.000	0.90	237.60
ELECTJ	Electrical Journeyman	2.00	132.00	MH	48.94	122.220	95.02	12,543.02
PIPEJ	Pipefitter Journeyman	2.00	132.00	MH	51.66	122.220	103.39	13,648.08

Biditem

1300

APU Startup

Takeoff Qty: 11.000 EA

Bid Qty: 11.000 EA

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	63.14	40.26	103.39	15.72	0.00	3.60	0.00	0.00	0.00	0.00	122.72
Total	694.53	442.81	1,137.34	172.95	0.00	39.60	0.00	0.00	0.00	0.00	1,349.89

Manhours	Unit/MH	MH/Unit	$/MH	Base Labor/MH	Total Labor/MH	Unit/CH
11.0000	1.0000	1.0000	122.7173	63.1391	103.3945	1.0000

Activity: 10 Startup Quantity: 11.00 Unit: EA

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
U. Cost	63.14	40.26	103.39	15.72	0.00	3.60	0.00	0.00	0.00	0.00	122.72
Total	694.53	442.81	1,137.34	172.95	0.00	39.60	0.00	0.00	0.00	0.00	1,349.89

Crew $/Unit	Crew Hrs/Unit	Units/Crew Hr	$/Crew Hour	Shifts	Units/Shift	Shifts/Unit	$/Shift
119.1173	1.0000	1.0000	119.1173	0.9167	12.0000	0.0833	1,472.6073

Manhours	Unit/MH	MH/Unit	Total Labor/MH	Base Labor/Unit
11.0000	1.0000	1.0000	103.3945	63.1391

Calendar: 612 6 days @ 12 hours Hrs/Shift: 12 WC: Code not found.

Crew: ZZZ (Mod) ***CUSTOM CREW*** Prod: HU 1 Eff: 100.00 Crew Hrs: 11.00 Labor Pcs: 1.00 Equipment Pcs: 1.00

Resource	Description	Pcs/Wste	Quantity	Unit	Unit Cost	Tax/OT %	Actual UC	Total
8TRKPU55	Leased 4x4, 3/4 Ton Gas Super	1.00	11.00	HR	15.72	100.000	15.72	172.95
9STGEN	Sm Tools - General	1.00	44.00	MH	0.90	100.000	0.90	39.60
PIPEJ	Pipefitter Journeyman	1.00	11.00	MH	51.66	122.220	103.39	1,137.34

Report Summary

	Base Labor	Burden	Total Labor	Equipment	Perm Matls	Const Matls	Sub	Services	Travel	Equip Rent	Total
Total	53,813	34,140	87,953	13,088	129,924	5,964	0	300	0	0	237,229

Job Notes

Estimate created on: 11/09/2020 by User#: 0 -
Source used: C:\HEAVYBID\HBSAVE\ESMASTER19.zip (a backup) from 11/09/2020 1:13:57 PM

**********Estimate created on: 10/16/2024 by User#: 0 -
Source estimate used: C:\HEAVYBID\EST\ESMASTER19

Calendars Used In Estimate

612 6 days @ 12 hours

This page intentionally left blank.