THE UNITED STATES AIR FORCE
INSTALLATION RESTORATION PROGRAM

SITE CHARACTERIZATION REPORT
FOR SOURCE AREA SS515
EIELSON AIR FORCE BASE, ALASKA

Prepared for:
U.S. Air Force Civil Engineer Center

FINAL
January 2019

(This page intentionally left blank)

RPT-10583-001

Final
Site Characterization Report
for Source Area SS515
Eielson Air Force Base, Alaska

ADEC File Number 107.38.096

January 2019

Contract No. W911KB-11-D-0006, Task Order 0010

Prepared for:
U.S. Air Force Civil Engineer Center
AFCEC-CZOP
2310 Central Ave., Suite 213
Eielson AFB, Alaska 99702

Prepared by:
North Wind, Inc.
2525 C Street, Suite 130
Anchorage, Alaska 99503

(This page intentionally left blank)

EXECUTIVE SUMMARY

North Wind, Inc. conducted site characterization activities at the Chena River Research Annex of the Eielson Air Force Base (AFB), Alaska, identified as Source Area SS515 under the Eielson AFB Installation Restoration Program. The area was previously operated as a Cold War remote data receiving/transmitting facility, and later as a control center for the Atomic Energy Detection System, which monitored seismic activity related to nuclear detonations.

Source Area SS515 is managed under the State Air Force Petroleum Agreement. Preliminary interim land use controls (LUCs) are in effect at Source Area SS515 that prohibit the use of surface and groundwater, restrict ground disturbance activities, and restrict access to the site. These controls will remain in effect until site characterization results support remedial actions to remove hazardous substances, implementation of LUCs and institutional controls, or a combination of both.

The site was added to the State Contaminated Sites Program database in 1992. Previous studies identified fuel and hydrocarbon contamination associated with underground storage tanks (USTs), polychlorinated biphenyls (PCBs), and metals and organic compounds associated with film processing. Areas identified for further characterization to delineate the extent of contamination included:

- 30,000-gallon diesel and gasoline USTs,
- 10,000-gallon heating oil UST,
- Former building leach well,
- Former lube oil drum pit,
- Former burn barrel, and
- Former septic tank.

The scope of this site characterization was to delineate the extent of soil and groundwater contamination at six areas of known contamination at Source Area SS515. Historical sampling events were primarily focused on the immediate vicinity of each area. This site characterization consisted of collecting and analyzing 101 soil samples and seven groundwater samples for fuels and polycyclic aromatic hydrocarbons, volatile compounds, metals (including mercury and hexavalent chromium), and PCBs. Additionally, dioxins were analyzed for only at the burn barrel area.

Project action levels (PALs) were derived from ADEC regulations (18 AAC 75; revised November 2016), where available. Background threshold values (BTVs) for the upper confidence limit of fluvial soil from the Eielson Background Metals Study (USAF, 2014a) were utilized as PALs for metals when the values were higher than ADEC's most stringent cleanup levels or 2016 Environmental Protection Agency (EPA) residential soil regional screening levels (RSLs). If EPA RSLs were available, they were used when ADEC values and BTVs were unavailable.

The following is a summary of the results of the site characterization activities:

- Fuel and hydrocarbon related contamination remains in soils at concentrations exceeding the PALs around the 30,000-gallon diesel and gasoline USTs, 10,000-gallon heating oil UST, leach building leach well, and septic tank.

- Trichloroethene (TCE) was detected in soils on the west side of the site area in samples collected from the burn barrel area, heating oil UST, drum pit, and building leach well. Historically, TCE was detected in a water sample collected from the bottom of the building leach well excavation.

- PCBs were detected in one sample collected south of the heating oil UST.

- Several metals, including calcium, iron, molybdenum, and potassium, were detected in a few samples at concentrations exceeding the PAL at three of the source areas.

- Silver and dioxin were detected at concentrations exceeding the PAL in samples collected in the vicinity of the former burn barrel.

- Hexavalent chromium was detected at concentrations exceeding the PAL in 15 samples collected at varying depths throughout the site. All of the hexavalent chromium analytical data were estimated and the quality of the data is insufficient to make remedial decisions.

- Thallium was detected in all soil samples at estimated concentrations collected during the 2012 Source Evaluation. The quality of this historical analytical data is also suspect. Thallium was not detected at concentrations exceeding the PAL during the 2016/2017 site characterization.

Groundwater results showed the presence of diesel range organics in one well near the heating oil UST downgradient of the fuel USTs in excess of the 2016 state clean-up level, and a detection of fuel in the furthest downgradient well near the former leach well. Other groundwater exceedances were exclusively for the metals arsenic, cobalt, and sodium.

The 2016/2017 site characterization efforts did not fully delineate the extent of soil contamination in some of the source areas. It is recommended that additional characterization be conducted to better estimate the extent of soil contamination at each source area prior to making any remedial recommendations. Additionally, the 12 monitoring wells be sampled at the same time – once in the spring and once in the fall – to better document the effects of seasonal groundwater fluctuations and to provide comparable data across the entire site.

TABLE OF CONTENTS

1. INTRODUCTION 1-1

1.1 Purpose 1-1

1.2 Objectives 1-1

1.3 Project Scope 1-2

1.4 Key Milestones 1-2

1.5 Key Personnel 1-3

2. SITE DESCRIPTION 2-1

2.1 Climate 2-1

2.2 Geology 2-1

2.3 Hydrogeology 2-1

2.4 Surface Water 2-2

3. SITE BACKGROUND 3-1

3.1 Background 3-1

3.2 Previous Investigations 3-2

3.2.1 1993 Preliminary Assessment 3-2
3.2.2 1996 - 2000 Release Investigation, Limited Removal, and Monitoring Well Installation 3-2
3.2.3 2001 – 2002 Site Wide Monitoring Program 3-6
3.2.4 2013 Phase I Source Evaluation 3-6

3.3 Institutional Controls and Land Use Controls 3-11

4. SITE CHARACTERIZATION ACTIVITIES 4-1

4.1 Mobilization and Field Work 4-1

4.2 Soil Sampling 4-1

4.3 Monitoring Well Installation 4-2

4.4 Groundwater Sampling 4-2

4.5 Groundwater Level Monitoring 4-2

5. CHARACTERIZATION RESULTS 5-1

5.1 Soil Sample Results 5-1

5.1.1 30,000-Gallon Diesel and Gasoline USTs 5-1
5.1.2 10,000-Gallon Heating Oil UST 5-3
5.1.3 Former Building Leach Well 5-5
5.1.4 Former Lube Oil Drum Pit 5-7
5.1.5 Former Burn Barrel 5-9
5.1.6 Former Septic Tank 5-10

5.2 Groundwater Sample Results 5-13

6. CONCEPTUAL SITE MODEL 6-1

6.1 Contaminants of Concern 6-1

6.2 Release Mechanisms 6-1

6.3 Fate and Transport 6-1

6.3.1 Exposure Pathways and Receptors 6-4

7. WASTE MANAGEMENT AND DISPOSAL 7-1

8. PROJECT ACTION LEVELS AND CONTAMINANTS OF POTENTIAL CONCERN 8-1

9. DATA QUALITY INDICATORS 9-1

9.1 Precision 9-1

9.2 Accuracy 9-2

9.3 Sample Preservation and Holding Times 9-2

9.4 Blank Contamination 9-2

9.5 Representativeness, Comparability, and Sensitivity 9-2

9.6 Data Completeness 9-4

9.7 Assessment of Data Usability and Reconciliation with QAPP Goals 9-5

10. SUMMARY AND CONCLUSIONS 10-1

10.1 Summary of Results 10-1

10.2 Recommendations 10-4

10.2.1 Soil 10-4
10.2.2 Groundwater 10-7

11. REFERENCES 11-1

12. FIGURES 12-1

FIGURES

Figure 1-1. Location of Eielson AFB and Chena River Research Annex SS515. 12-3

Figure 1-2. Source Area SS515....12-4

Figure 3-1. Historical Sample Locations. 12-5

Figure 3-2. Historical Site Characterization Results: Fuels, PAHs, and SVOCs....12-7

Figure 3-3. Historical Site Characterization Results: Metals....12-9

Figure 3-4. Historical Groundwater Locations and Analytical Results. 12-11

Figure 4-1. Source Area SS515 Sample Boreholes and Monitoring Wells. 12-13

Figure 5-1. Source Area SS515 2016 and 2017 Sample Boreholes and Monitoring Well Locations....12-15

Figure 5-2. Analytical Data Greater than the PAL for the 30,000-Gallon Diesel and Gasoline USTs. 12-17

Figure 5-3. Analytical Data Greater than the PAL for the 10,000-Gallon Heating Oil UST....12-19

Figure 5-4. Analytical Data Greater than the PAL for the Former Building Leach Well....12-21

Figure 5-5. Analytical Data Greater than the PAL for the Former Lube Oil Drum Pit. 12-23

Figure 5-6. Analytical Data Greater than the PAL for the Former Burn Barrel Area. 12-25

Figure 5-7. Analytical Data Greater than the PAL for the Former Septic Tank. 12-27

Figure 5-8. Groundwater Analytical Data Greater than the PAL for the Former Septic Tank. 12-29

Figure 6-1. CSM Graphic Form for Source Area SS515-Chena River Research Annex, Eielson AFB, Alaska....12-31

TABLES

Table 1-1. Timeline of key site characterization milestones....1-3

Table 1-2. Key personnel and subcontractor contact information. 1-3

Table 4-1. Groundwater monitoring well construction details. 4-3

Table 4-2. Groundwater quality parameters. 4-3

Table 4-3. Groundwater level measurements....4-4

Table 5-1. Soil sample summary and exceedances for the 30,000-gallon diesel and gasoline USTs....5-2

Table 5-2. Summary of soil analytical results for the 30,000-gallon diesel and gasoline USTs. 5-3

Table 5-3. Soil sample summary and exceedances for the 10,000-gallon heating oil UST....................... 5-4

Table 5-4. Summary of soil analytical results for the 10,000-gallon heating oil UST. 5-4

Table 5-5. Soil sample summary and exceedances for the former building leach well. 5-6

Table 5-6. Summary of soil analytical results for the former building leach well.................................... 5-6

Table 5-7. Soil sample summary and exceedances for the former lube oil drum pit. 5-8

Table 5-8. Summary of soil analytical results for the former lube oil drum pit.. 5-8

Table 5-9. Soil sample summary and exceedances for the former burn barrel. 5-9

Table 5-10. Summary of soil analytical results for the former burn barrel.. 5-10

Table 5-11. Soil sample summary and exceedances for the former septic tank. 5-11

Table 5-12. Summary of soil analytical results for the former septic tank. 5-12

Table 5-13. Groundwater sample summary and exceedances. 5-13

Table 5-14. Summary of groundwater analytical results. 5-13

Table 6-1. Contaminants of human health concern at Source Area SS515-Chena River Research Annex. 6-2

Table 8-1. COPCs in soil. 8-3

Table 8-2. COPCs in groundwater. 8-5

APPENDICES

Appendix A: Previous Investigation Results

Appendix B: Project Action Level Data

Appendix C: Logbooks and Field Forms

Appendix D: Soil Boring Logs

Appendix E: Photographic Log

Appendix F: Monitoring Well Survey Report

Appendix G: Well Completion Diagrams

Appendix H: Analytical Data and Laboratory Reports

Appendix I: Conceptual Site Model Scoping Data

Appendix J: Response to Comments

ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ADOT	Alaska Department of Transportation
AFB	Air Force Base
AFCEC	U.S. Air Force Civil Engineer Center
ags	above ground surface
AST	aboveground storage tank
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
BTOC	below top of casing
BTV	background threshold value
°C	degrees Celsius
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CES/CEI	Civil Engineering Squadron/Installation Management Flight
COC	contaminant of concern
COPC	contaminant of potential concern
CSM	conceptual site model
CY	cubic yards
DO	dissolved oxygen
DQI	data quality indicator
DRO	diesel range organics
EDB	ethylene dibromide
EPA	U.S. Environmental Protection Agency
°F	degrees Fahrenheit
GPS	global positioning system
GRO	gasoline range organics

IC	institutional control
ID	identification
IDW	investigation derived waste
LCS	laboratory control sample
LOQ	limit of quantitation
LUC	land use control
MCL	maximum contaminant level
MDL	method detection limit
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MS/MSD	matrix spike/matrix spike duplicate
msl	mean sea level
mV	millivolt
MW	monitoring well
NAPL	non-aqueous phase liquid
ng/kg	nanogram per kilogram
North Wind	North Wind, Inc.
NTU	nephelometric turbidity unit
ORP	oxidation reduction potential
PAH	polycyclic aromatic hydrocarbon
PAL	project action level
PCB	polychlorinated biphenyl
PILUC	Preliminary Interim Land Use Control
PM	Project Manager
POL	petroleum, oil, and lubricant
PVC	polyvinyl chloride
QAPP	Quality Assurance Project Plan

QC	quality control
RCRA	Resource Conservation and Recovery Act
RL	reporting limit
RPD	relative percent difference
RRO	residual range organics
RSL	regional screening level
SGS	SGS Environmental Services
SSL	soil screening level
SVOC	semivolatile organic compound
TCE	trichloroethene
TOC	top of casing
TPH	total petroleum hydrocarbons
µg/L	micrograms per liter
UPL	Upper Prediction Limit
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
UST	underground storage tank
VOC	volatile organic compound

(This page intentionally left blank)

1. INTRODUCTION

The U.S. Air Force Civil Engineer Center (AFCEC) has tasked North Wind, Inc. (North Wind) with performing site characterization activities at Source Area SS515 on Eielson Air Force Base (AFB), Alaska. The work has been performed under U.S. Army Corps of Engineers (USACE) Contract Number W911KB-11-D-006, Task Order 0010.

This document provides the characterization methods used at Source Area SS515 and the results of the effort.

1.1 Purpose

Site characterization activities were conducted at Source Area SS515 at the Chena River Research Annex (Figures 1-1 and 1-2) for the purpose of providing additional data to determine the nature and extent of contamination and to identify potential remedies associated with known sources and past operations of the research site. Source Area SS515 is the location of a former concrete building constructed in 1954 as a remote data receiving/transmitting facility. Data collected during previous investigations indicated that fuels, metals, and polychlorinated biphenyls (PCBs) contamination remained in soils near former underground storage tanks (USTs), the septic tank, and leach well, and that the vertical and horizontal extent has not been fully delineated. Section 3 provides additional background and previous studies information.

Source Area SS515 is managed under the State-Air Force Petroleum Agreement by the AFB's Installation Restoration Program. Preliminary Interim LUCs (PILUCs) are in effect at Source Area SS515 that prohibit the use of surface and groundwater, restrict ground disturbance activities, and restrict access to the site. These PILUCs will remain in effect until site characterization is complete and results support remedial actions to remove hazardous substances, or until LUCs and institutional controls (ICs) are implemented, or a combination of both.

Analytical results and findings from this characterization effort, combined with previous findings, will be used to support the decision process for development of remedial action objectives or potential alternatives, as necessary, to meet the objectives of the 2-Party Agreement.

1.2 Objectives

The following objectives for this site characterization were developed per Title 18, Alaska Administrative Code (AAC), Chapter 75 (18 AAC 75.335[b]):

- Evaluate remaining data gaps from previous investigations and removal actions,
- Delineate the nature and extent of soil and groundwater contamination,
- Collect data to support the development of remedial action objectives and potential remedial alternatives, and
- Provide recommendations for proposed remedial action.

1.3 Project Scope

Project scope was limited to soil and groundwater characterization activities at the Chena River Research Annex associated with Source Area SS515 (North Wind, 2016). In order to achieve the project purpose and objectives, the following activities were performed:

- **Access Road Repair.** Road repair was necessary at two sections of the site access road; one location on Grange Hall Road and the other on the site access road. Activities consisted of placing culverts at both sections, placing geotextile material on the road surface, covering the road with additional imported gravel, and grading the road to prevent ponding or overflow from adjacent flow.

- **Subsurface Investigation.** A direct-push drill rig was used to advance boreholes, collect soil cores, and install monitoring wells at locations where contamination was known or suspected to exist. Contaminants of concern (COCs) included volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), diesel range organics (DRO), gasoline range organics (GRO), residual range organics (RRO), polycyclic aromatic hydrocarbons (PAHs), Resource Conservation and Recovery Act (RCRA) metals, PCBs, dioxins/furans, and ethylene dibromide (EDB). Soil and groundwater characteristics, including field screening of VOCs, were documented by an Alaska Department of Environmental Conservation (ADEC) Qualified Environmental Professional, as defined by 18 AAC 75.333.

- **Soil and Groundwater Sampling.** Subsurface soil and groundwater grab samples were collected at known locations of historic contamination.

- **Laboratory Analysis of Samples.** Soil and groundwater samples were sent to SGS Environmental Services (SGS) in Anchorage for analysis. SGS forwarded samples for EDB analysis to Test America Laboratories-Denver and dioxin/furan analysis to ALS Houston. These laboratories are ADEC-approved and Department of Defense Environmental Laboratory Accreditation Program-accredited for their respective analyses.

- **Decontamination and Site Restoration**. Non-disposable investigative equipment was decontaminated between uses. Disposable sampling equipment was disposed of after each use. Restoration activities included plugging boreholes and leaving the site as close as possible to the way it was found.

- **Waste Management and Disposal**. Waste streams were collected in appropriate containers and are currently stored on site while final characterization sampling is completed and disposition pathways determined. Transportation, handling, and disposal will be conducted in accordance with Alaska and Department of Transportation (ADOT) regulations.

- **Global Positioning System (GPS) Survey**. Sample locations and site features were surveyed to sub-meter horizontal accuracy and sub-foot vertical accuracy.

All mobilization, demobilization, and field activities were conducted in accordance with the project Accident Prevention Plan and associated Site Safety and Health Plan (North Wind, 2016). No safety incidents or accidents took place during performance of the project work scope.

1.4 Key Milestones

Collection of field characterization data sufficient to meet project objectives for delineating the nature and extent of contamination was performed over two separate attempts and was based on the review of analytical results showing continued exceedances of project action levels (PALs) between events. A timeline of key milestones is provided in Table 1-1.

Table 1-1. Timeline of key site characterization milestones.

Milestone	Date
Contract award	September 2015
Approved Work Plan	August 2016
Field characterization complete (initial)	September 2016
Sample results received/data gaps evaluated	November 2016
Approved change order	January 2017
Field characterization complete (2nd attempt)	May 2017
Sample results received/data gaps evaluated	June 2017
AFCEC and USACE notified of remaining data gaps	August 2017
Draft Site Characterization Report complete	June 2018

1.5 Key Personnel

Key personnel are provided in Table 1-2.

Table 1-2. Key personnel and subcontractor contact information.

Project Role	Personnel
AFCEC Technical Lead	Mr. Joe Price Telephone: (907) 377-3578 joseph.price.17@us.af.mil
USACE Contracting Officer	Mr. Aldone Graham Telephone: 907-753-2528 Aldone.Graham@usace.army.mil
USACE Contracting Officer Representative / Project Engineer	Ms. Lisa Geist Lisa.K.Geist@usace.army.mil
USACE Project Manager (PM)	Ms. Julie Sharp-Dahl Telephone: 907-687-5908 Julie.L.Sharp-Dahl@usace.army.mil
ADEC Representative	Mr. Dennis Shepard Telephone: 907-451-2180 dennis.shepard@alaska.gov Ms. Bri Clark Telephone: 907-451-2156 bri.clark@alaska.gov
North Wind PM	Mr. Erik Whitmore (Sept. 2015 – July 2017) Mr. Steven Vaughn (July 2017 – Present) Telephone: 907-277-5488 svaughn@northwindgrp.com

Table 1-2. (continued).

Project Role	Personnel
North Wind Site Manager	Mr. Arden Bailey Telephone: 208-520-7138 abailey@northwindgrp.com
North Wind Project Chemist	Mr. Kishor Gala Telephone: 720-254-2250 kgala@northwindgrp.com Christopher Whitehead Telephone: 206-823-3397 cwhitehead@northwindgrp.com
North Wind Environmental Scientist	Mr. Joe Hansmeyer Telephone: 907-891-8805 jhansmeyer@northwindgrp.com
Primary Analytical Laboratory	SGS Ms. Tori Pennick Telephone: 907-550-3208 victoria.pennick@sgs.com
Subcontract Analytical Laboratory	TestAmerica Denver Betsy Sara Telephone: (303) 736-0189 Betsy.Sara@testamericainc.com
Subcontract Analytical Laboratory	ALS-Houston Arthi Kodur Telephone: (281) 575-2279 Arthi.kodur@als.com
Professional Surveyor	PDC Engineers Craig Ranson Telephone: 907-452-1414 Craigranson@pdceng.com
Waste Handling, Shipping, and Disposal	Emerald Alaska, Inc. Ms. Roni MacKenzie Telephone: 907 258-1558 roni.mackenzie@emeraldnw.com

2. SITE DESCRIPTION

The Chena Annex is one of two parcels of land that comprise the Chena River Research Site. It is located approximately 11 miles northeast of the main Eielson AFB facility. Transmitter Road provides access to the site from near the main gate of Eielson AFB. A secondary gravel road runs northwest from Transmitter Road to the site. The Chena Annex is approximately 665 acres and extends 2.5 miles south from the Chena Annex Campground, a recreation area owned by Alaska Department of Natural Resource and facilities formerly operated by United States Air Force, master title plat number F010082. It is located at latitude 64.830996 and longitude -146.974997 (horizontal datum WGS84). This site characterization focuses solely on the vicinity of the former facility, as described in Section 3. The site's location and vicinity are shown in Figures 1-1 and 1-2.

The Chena Annex topography is relatively flat, as it is located within the 100-year floodplain of the Chena River, and is approximately 600 feet above sea level (Von Rueden, 2003-2008).

2.1 Climate

The Chena Annex is located within an area classified as a continental climate zone. This zone extends over much of the interior of Alaska. The Alaska and Brooks Ranges inhibit coastal storms, resulting in semiarid conditions (e.g., low regional precipitation and humidity) (Péwé, 1975). Large seasonal temperature and daylight variations exist due to its high latitude, with the average winter temperature at -3 degrees Fahrenheit (°F) and the average summer temperature at 59°F. This region receives an average of 11.65 inches of rainfall and additional 65 inches of snow accumulation. July and August are typically the wettest months (Alaska Climate Research Center, 2015).

2.2 Geology

Soil at the Chena Annex is composed of well stratified fluvial silt, sand, and gravel deposits overlain by up to 15 feet of silt as a result of river meanders and flood events associated with the Chena River. A 1-foot thick layer of peat was encountered during construction activities at the site (USAF, 1999). Lenses of permafrost, often up to several hundred feet thick, are typical of the area. The site sits within a large tectonic basin filled with alluvium shed from the Alaska Range that was primarily deposited by glacial and fluvial processes. No bedrock outcrops are located within the Chena Annex; however, regional geologic bedrock mapping infers that the bedrock that underlies the Tanana Valley overburden consists of a Precambrian and Paleozoic complex of gneiss and schist, which has been prolifically intruded by igneous rocks during the Cretaceous to lower Tertiary age (Péwé and Reger, 1983).

2.3 Hydrogeology

Groundwater at the Chena Annex and surrounding area exists within unconsolidated glaciofluvial sediment in a regionally unconfined aquifer up to 400 feet thick. Local lenses of permafrost act as either seasonal or permanent confining layers and may create localized artesian conditions. Local lenses of clay and silty clay are also typical of the area and act as aquitards. The water table at the site ranges from 10 to 15 feet below ground surface (bgs) (USAF, 1999). Groundwater flow direction at the Chena Annex is to the west-southwest, with a relatively flat gradient of 0.0006 to 0.0007 feet per foot (USAF, 2001). It is in the opposite direction of the topographic gradient, which slopes gently northwest toward the Chena River and in the same direction as the Tanana River. Local flow is likely influenced by localized sediment with higher hydraulic conductivity (i.e., a buried stream channel). The primary regional source of groundwater recharge is glacial melt from the northern aspect of the Alaska Range, with secondary contributions of water from seasonal precipitation and snow melt. Groundwater elevations at Eielson AFB are typically at their highest in May, with a seasonal elevation variance of 2 feet during spring break-up.

2.4 Surface Water

The Chena Annex is approximately 0.5 miles south of the Chena River, within its 100-year floodplain. Topography in the region consists of low, undulating hills; consequently, the Chena River is a slow-flowing, meandering river. The Chena River is a tributary of the larger Tanana River; the confluence of which is 30 miles from the Chena Annex.

The former facility was built up from its original topography with fill and is slightly elevated above the surrounding landscape; therefore, surface runoff is reported to locally drain in every direction away from the site. On a more regional scale, surface water infiltrates the vadose zone and ultimately drains north to the Chena River. Small oxbow lakes exist within the Chena Annex as the result of former meanders from the Chena River; however, no lakes, ponds, or perennial streams exist in close proximity to the former facility. A pond south of the former facility was identified and sampled as a part of the 1992 Preliminary Assessment (USAF, 1993); however, it was backfilled in 1999 as a part of demolition of the former facility (USAF, 2013).

3. SITE BACKGROUND

3.1 Background

The Chena River Annex/Chena River Research Site facility was added to the ADEC Contaminated Sites Program database (File Number 107.38.096; Hazard Identification [ID] Number 1684) on July 15, 1992 (Spill Number 92-2-5-149-2). It was originally referred to as SS01 but has since been updated to Source Area SS515. It consists of a former facility (Building 500) that was constructed by the U.S. Air Force (USAF) in 1954 as a Cold War remote data receiving/transmitting facility. From 1966 to 1977, the facility was used by the USAF as a control center for the Atomic Energy Detection System, which monitored seismic activity related to nuclear detonations. Site activities included the daily development of one 500-foot roll of black and white film. One gallon per day of photographic chemicals was disposed of via the septic system, and used film was incinerated in a burn barrel north of the building. The U.S. Army then utilized the facility for urban warfare training, including live fire exercises from 1988 to 1995.

The building was a two-story, reinforced-concrete structure with a footprint measuring 110 feet × 228 feet. It contained living space for approximately 20 residents as well as offices and equipment rooms. The western portion of the building was a garage and maintenance area that also housed diesel generators (USAF, 1993). An antenna and associated structure (referred to as the “Helix House”) were located approximately 1,000 feet north of the building (USAF, 2000). The facility was self-sustaining and included the following support infrastructure:

- Two USTs – one 30,000-gallon diesel fuel UST and one 30,000-gallon gasoline UST;
- One 10,000-gallon heating oil UST;
- Two large electrical generators;
- Two electrical transformers;
- Septic system with a 3,400-gallon concrete septic tank and five leach wells located 350 feet south of the building;
- Wastewater leach field;
- Drinking water well;
- Tile sump and leach pit for wastewater disposal, with a leach well located 50 feet south of the building;
- Lube oil drain pit located 15 feet north of the generator room utilized for used oil disposal; and
- Burn barrel located 50 feet north of the building.

The USTs were removed prior to 1990; however, the concrete ballasts remain in place. The facility was demolished and all associated infrastructure was removed in 1999 (USAF, 1999). The site is currently not in use. A detailed history of investigations that have occurred at Source Area SS515 is provided below.

3.2 Previous Investigations

There have been four historical investigations/characterizations at Source Area SS515 dating from 1993 through 2013. Findings from these previous investigations are summarized below. All historical sample locations are illustrated on Figure 3-1. The historical analytical data were compared to the most current PALs identifying contaminants and locations where the PALs are exceeded. Figures 3-2 and 3-3 present all historical data that exceed the PALs. The contaminants of potential concern (COPCs) are summarized in Table 3-1.

3.2.1 1993 Preliminary Assessment

A Preliminary Assessment and subsequent Site Investigation were conducted in 1992 by Woodward-Clyde (USAF, 1993). The primary contaminant source areas identified at this time were underground diesel tanks and potential electrical transformers. Soil samples were collected at the following three locations:

- Drainage of a concrete pad on the south side of the building,
- Location of the former diesel UST, and
- Concrete pad on the north side of the building.

One water sample was collected from a pond south of the facility. The approximate sample locations are illustrated on Figure 3-1.

All samples were analyzed for DRO; benzene, toluene, ethylbenzene, and xylene (BTEX); VOCs; and PCBs. PCBs, including Aroclor 1260, were detected in Chena Site #1 and #3 samples at concentrations less than the U.S. Environmental Protection Agency (EPA) regional screening level for Aroclor 1260 (.24 milligrams per kilogram [mg/kg]) (Figure 3-3). DRO was detected in the pond sample at 0.85 milligrams per liter (mg/L). No other analytes were detected at concentrations greater than the method detection limit in any of the samples.

3.2.2 1996 - 2000 Release Investigation, Limited Removal, and Monitoring Well Installation

A release investigation and limited removal were conducted in 1996 through 1998 by AGRA Earth & Environmental, Inc. (USAF, 2000). In addition to the investigation of potential source areas, the work included the removal of the building leach well and associated piping, septic tank, septic leach wells, lube oil drain pit and piping, and approximately 700 cubic yards (CY) of contaminated soil. The locations of three previously removed USTs were also investigated. The following subsections summarize the analytical results of the excavation and confirmation sampling. Sampling locations and analytical results that exceed the PALs are shown on Figures 3-1 through 3-3.

Former 30,000-Gallon Diesel and Gasoline USTs

Excavation of contaminated soil and confirmation sampling at the location of the two former 30,000-gallon USTs occurred in 1997. The final 2,200-square foot excavation area extended to groundwater that was encountered at 15 feet bgs. Fifteen soil samples were collected from the excavation base and sidewalls and analyzed for BTEX, DRO, and GRO. The excavation base samples were collected at a depth of 15 feet, and the sidewall samples were collected at a depth of 14 feet. One groundwater grab sample from the base of the excavation was also collected and analyzed for BTEX, DRO, GRO, and RRO.

The following contaminants were detected at concentrations exceeding the PAL:

- DRO exceeded the PAL in 11 soil samples at concentrations ranging from 1,800 to 23,000 mg/kg.
- Ethylbenzene exceeded the PAL in nine soil samples at concentrations ranging from 0.13 to 2.3 mg/kg.
- Xylene exceeded the PAL in six soil samples at concentrations ranging from 1.6 to 8.1 mg/kg.
- DRO exceeded the PAL at the excavation base groundwater grab sample with a concentration of 19 mg/L.

Figure 3-2 shows the locations where these COPCs exceeded the respective PAL.

Former 10,000-Gallon Heating Oil UST

Excavation of contaminated soil and confirmation sampling at the location of the former 10,000-gallon UST occurred in 1997. The final excavation was approximately 700 square feet in area and extended to groundwater that was encountered at 12 feet bgs. Six soil samples from the excavation base and sidewalls were collected and analyzed for BTEX, DRO, and GRO.

The following contaminants were detected at concentrations exceeding the PAL:

- DRO exceeded the PAL in four soil samples at concentrations ranging from 294 to 6,800 mg/kg.
- GRO exceeded the PAL in one soil sample with a concentration of 310 mg/kg.
- Ethylbenzene exceeded the PAL in one soil sample with a concentration of 1.7 mg/kg.
- Xylene exceeded the PAL in one soil sample with a concentration of 5.1 mg/kg.

Figure 3-2 shows the locations where these COPCs exceeded the respective PAL.

Building Leach Well and Piping

A tile sump from former Building 500, with piping extending 50 feet south of the building to a 12-foot diameter, 10-foot deep concrete leach well (Class V injection well), was removed in 1997. Contaminated soil and confirmation sampling was conducted concurrently. Black staining was observed along piping joints leading to the leach well. At the time of excavation activities, the building was still in place; the release investigation and limited removal report states that the piping and tile sump beneath the building were left in place and it is unknown whether they were removed at the time of building demolition (USAF, 2000). The final excavation was approximately 196 square feet in area and extended to groundwater that was encountered at 12 feet bgs. Ten soil samples were analyzed for DRO, GRO, RRO, metals, PCBs, and VOCs. One groundwater sample was collected at the base of the excavation and analyzed for DRO, GRO, RRO, metals, and VOCs.

The following contaminants were detected at concentrations exceeding the PAL:

- DRO exceeded the PAL in two soil samples collected from the piping trench excavation and two samples collected from the leach well excavation. DRO concentrations exceeding the PAL ranged from 290 to 14,000 mg/kg.

- Chromium exceeded the PAL in one soil sample from the leach well excavation, with a concentration of 72 mg/kg.

- Silver exceeded the PAL in one soil sample collected from the leach piping trench, with a concentration of 19 mg/kg.

- DRO exceeded the PAL in the ground water sample with a concentration of 5.72 mg/L.

- RRO exceeded the PAL in the groundwater sample with a concentration of 2.74 mg/L.

- Trichloroethene (TCE) exceeded the PAL in the groundwater sample with a concentration of 0.190 mg/L (Figure 3-4).

Figures 3-2 and 3-3 show the locations where these COPCs exceeded the respective PAL.

Septic Tank, Piping, and Leach Field

A septic system from former Building 500, with piping extending 350 feet south of the building to a septic tank connected to five leach wells, was removed in 1997. The septic system was reported to have been used for the disposal of used photographic chemicals. Residual sludge from the septic piping and system was containerized prior to excavation activities. Concurrent contaminated soil excavation and confirmation sampling commenced after the sludge had been removed. Eighteen soil samples were collected from the trench excavation (one at the location of each piping joint) and analyzed for metals and RCRA characteristics. Black staining was observed to extend to the septic tank 50 feet along the septic piping, indicating contents from the tank had leaked into the surrounding soil. One sample (Septic-300) was collected within the area of black staining and was analyzed for oil and grease, total petroleum hydrocarbons (TPH), metals, PCBs, and VOCs.

The following contaminants were detected at concentrations exceeding the PAL:

- Lead exceeded the PAL in one soil sample at the 40-foot joint location with a concentration of 910 mg/kg.

- Silver exceeded the PAL at the 20, 40, 60, 80, 100, and 160-foot joint locations soil samples with concentrations ranging from 15 mg/kg to 43 mg/kg.

- Oil/grease exceeded the PAL in one soil sample at the black staining at the 300-foot joint location, with a concentration of 28,800 mg/kg.

TPH exceeded the PAL in one soil sample at the black staining at the 300-foot joint location, with a concentration of 15,900 mg/kg. The final septic leach well excavation was approximately 600 square feet and extended to groundwater that was encountered at 12 feet bgs. Two excavation confirmation samples were collected and analyzed for DRO, RRO, VOCs, and PCBs. No contaminants were detected at concentrations exceeding the PALs.

Five septic leach wells were individually excavated and extended to the groundwater table at 10 feet bgs. Soil overlying the wells and the connecting piping was assumed to be clean based on visual observation. Five excavation confirmation samples were collected (one from each excavation) and analyzed for GRO, DRO, RRO, VOCs, SVOCs, and metals. DRO was the only contaminant that exceeded the PAL in two samples – STLW-1 (287 mg/kg) and STLW-3 (12,000 mg/kg).

Figures 3-2 and 3-3 show the locations where these COPCs exceeded the respective PAL.

Lube Oil Drum Pit

A lube oil drum pit was located north of former Building 500. It consisted of a concrete enclosure designed to hold a 55-gallon drum that received used generator oil with piping that extended from the building to the drum. The concrete structure, drum, and piping were removed in 1998. The vault and piping appeared to be in good condition, and field screening measurements for organic vapor ranged from 0 to 1 parts per million (ppm). One excavation base confirmation sample (i.e., lube well) was collected and analyzed for GRO, DRO, RRO, metals, VOCs, SVOCs, and PCBs. Sample results were all below PALs.

Transformer Pad

Four test pits were dug in locations surrounding a 27-foot × 14-foot concrete pad located adjacent to the north side of former Building 500. One composite sample (TP-6) was collected, consisting of one aliquot collected from each test pit at 6 and 12 inches bgs, and analyzed for PCBs. Sample results were all below the PALs.

Burn Barrel

A burn barrel located north of former Building 500 was used to burn black and white film associated with daily operations of the facility. A composite sample (BB-6) was collected from six locations surrounding the barrel at 6 inches bgs and analyzed for RCRA characteristics, metals, and PAHs. Silver exceeded the PAL in the soil sample at 174 mg/kg.

Figure 3-3 shows the locations where these COPCs exceeded the respective PAL.

Monitoring Well Installation and Sampling

Five permanent monitoring wells were installed in March of 1999 at the following locations:

- SS01MW-01 – Transformer pad northwest of the former building,
- SS01MW-02 – North of the 10,000-gallon heating oil UST,
- SS01MW-03 – North of the 30,000-gallon diesel and gasoline USTs,
- SS01MW-04 – Former leach well, and
- SS01MW-05 – Former septic tank.

Soil samples were collected for analysis from drilling cuttings, and groundwater samples were collected from three sampling events at each monitoring well. A bailer was used to purge and sample groundwater for the first event, which biased the concentrations for total metals high due to high turbidity. The low flow sampling technique was subsequently utilized, producing results below groundwater PALs for metals in all of the wells. DRO was detected above the groundwater PAL in SS01MW-02 and SS01MW-05 (Figure 3-4). RRO was detected above the groundwater PAL in SS01MW-05 (USAF, 1999).

Local Groundwater Gradient Determination and Sampling

During building demolition activities in the summer of 1999, three of the five monitoring wells were destroyed (SS01MW-02, SS01MW-03, and SS01MW-04). SS01MW-06 was installed in the vicinity of SS01MW-02 in June 2000 to collect data for the calculation of a local groundwater gradient. It was determined that the local groundwater flow direction is to the southwest with a relatively flat gradient. Samples were collected and analyzed for BTEX, GRO, and DRO. DRO exceeded the PAL in SS01MW-05 at 21 mg/L (Figure 3-4) (USAF, 2001).

3.2.3 2001 – 2002 Site Wide Monitoring Program

Source Area SS515 (then referred to as SS01) was incorporated into the Eielson Sitewide Monitoring Program in 2001 and 2002, although it was identified as not subject to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program. Groundwater samples were collected from monitoring wells SS01-MW01, SS01-MW05, and SS01-MW06 and analyzed for BTEX, GRO, DRO, RRO, total dissolved solids, and alkalinity in 2001. Analytical results for all chemical constituents were below laboratory detection limits (USAF, 2001). In 2002, three temporary wells (SS01PMW01, SS01PMW012, and SS01PMW03) were installed to determine whether contamination was migrating downgradient from known sources. SS01PMW01, SS01PMW012, SS01PMW03, SS01MW-05, and SS01MW-06 were sampled and analyzed for BTEX, PAH, DRO, and RRO. No analytes exceeded PALs; however, DRO was detected in SS01MW05, SS01PMW01, and SS01PMW03 at 0.562 mg/L, 1.31 mg/L, and 0.686 mg/L, respectively. Toluene was detected in SS01MW-5 at 0.0844 mg/L. All other chemical constituents were non-detect (USAF, 2002).

3.2.4 2013 Phase I Source Evaluation

The Phase I Source Evaluation was conducted in July 2012 for six locations at Source Area SS515 (then referred to as SS-C515) to assess whether contaminated surface and subsurface soil and/or groundwater remained onsite (USAF, 2013). A surface soil sample, subsurface soil sample, and groundwater sample were collected from each of the six following contaminant sources:

1. Former 30,000-gallon USTs,
2. Former 10,000-gallon heating oil UST,
3. Former leach well,
4. Former lube oil drum site,
5. Former burn barrel location, and
6. Former septic tank.

Samples were analyzed for GRO, DRO, VOCs, SVOCs, metals, PCBs, pesticides, and dioxins/furans. The following subsections summarize the analytical results of the sampling. Sampling locations and analytical results that exceed the PALs are shown on Figures 3-1, 3-2, and 3-3.

30,000-Gallon Diesel and Gasoline USTs

A single boring, EIC515DP001, was installed in the approximate center of the excavation footprint where the two former 30,000-gallon diesel and gasoline tanks had been removed. Soil samples were collected from depth intervals 0 to1 foot, 1 to 2 feet, 9 to 10 feet, and 14 to 15 feet. All soil samples were analyzed for DRO, GRO, VOCs, SVOCs, dioxins/furans, metals, pesticides, and PCBs.

The following contaminants were detected at concentrations exceeding the PAL:

- Thallium exceeded the PAL in all four soil samples at estimated concentrations ranging from 0.55 to 0.84 mg/kg.
- DRO exceeded the PAL at the 14- to 15-foot depth interval with a concentration of 2,200 mg/kg.
- GRO exceeded the PAL at the 14- to 15-foot depth interval with a concentration of 588 mg/kg.
- Naphthalene exceeded the PAL at the 14- to 15-foot depth interval with a concentration of 0.083 mg/kg.

A temporary well was used to collect a groundwater sample from the borehole location, EIC515MW001GW01-20. The groundwater sample was analyzed for DRO, RRO, GRO, VOCs, SVOCs, total metals, dioxin/furan, pesticide, and PCBs. Cobalt and lead were found in the blank associated with this sample.

The following contaminants were detected at concentrations exceeding the PAL:

- Arsenic exceeded the PAL with a concentration of 0.0108 mg/L.
- Cobalt exceeded the PAL with a concentration of 0.0013 mg/L.
- Iron exceeded the PAL with a concentration of 7.0 mg/L.
- Lead exceeded the PAL with a concentration of 0.0035 mg/L, which is within the range of the background threshold values (BTVs) of less than 0.005 mg/L to 0.066 mg/L.
- Manganese exceeded the PAL with a concentration of 0.257 mg/L.

10,000-Gallon Heating Oil UST

A single boring, EIC515DP002, was installed at the approximate center of the excavation footprint of the former 10,000-gallon capacity heating oil UST. Soil samples were collected from depth intervals 0 to 1 foot, 1 to 2 feet, 9 to 10 feet, and 14 to 15 feet. All soil samples were analyzed for DRO, GRO, VOCs, SVOCs, metals, pesticides, and PCBs.

The following contaminants were detected at concentrations exceeding the PAL:

- DRO exceeded the PAL at the 9- to 10-foot and the 14- to 15-foot depth intervals with concentrations of 557 mg/kg and 6,090 mg/kg, respectively.
- Naphthalene exceeded the PAL at the 14- to 15-foot depth interval with a concentration of 0.0522 mg/kg.
- Thallium exceeded the PAL in all four soil samples at estimated concentrations ranging from 0.45 to 0.80 mg/kg.

A temporary well was used to collect a groundwater sample from the borehole location, EIC515MW002GW01-20. The groundwater sample was analyzed for DRO, RRO, GRO, VOCs, SVOCs, total metals, dioxin/furan, pesticide, and PCBs. Cobalt and lead were found in the blank associated with this sample.

The following contaminants were detected at concentrations exceeding the PAL:

- DRO exceeded the PAL with a concentration of 19 mg/L.
- RRO exceeded the PAL with a concentration of 1.23 mg/L.
- Arsenic exceeded the PAL with a concentration of 0.0093 mg/L.
- Cadmium exceeded the PAL with a concentration of 0.00079 mg/L, which is within the range of background values of less than 0.009 mg/L to 0.010 mg/L.
- Cobalt exceeded the PAL with a concentration of 0.0011 mg/L.
- Iron exceeded the PAL with a concentration of 6.71 mg/L.
- Lead exceeded the PAL with a concentration of 0.0052 mg/L, which is within the range of background values of less than 0.005 mg/L to 0.066 mg/L.
- Manganese exceeded the PAL with a concentration of 0.164 mg/L.

Former Leach Well

A single boring, EIC515DP003, was installed at the approximate center of the excavation footprint of the former leach well. Soil samples were collected from depth intervals 0 to 1 foot, 1 to 2 feet, 9 to 10 feet, and 14 to 15 feet. All soil samples were analyzed for DRO, GRO, VOCs, SVOCs, metals, pesticides, and PCBs.

The following contaminants were detected at concentrations exceeding the PAL:

- Silver exceeded the PAL at the 0- to 1-foot and 4- to 5-foot depth intervals with concentrations of 29.9 mg/kg and 64.1 mg/kg, respectively.
- Thallium exceeded the PAL in three soil samples at estimated concentrations ranging from 0.42 to 0.94 mg/kg.

A temporary well was used to collect a groundwater sample from the borehole location, EIC515MW003GW01-20. The groundwater sample was analyzed for DRO, RRO, GRO, VOCs, SVOCs, total metals, dioxin/furan, pesticide, and PCBs. Lead was found in the blank associated with this sample.

The following contaminants were detected at concentrations exceeding the PAL:

- Arsenic exceeded the PAL with a concentration of 0.0213 mg/L.
- Cobalt exceeded the PAL with a concentration of 0.0035 mg/L.
- Iron exceeded the PAL with a concentration of 14.8 mg/L.
- Lead exceeded the PAL with a concentration of 0.0061 mg/L, which is within the range of background values of less than 0.005 mg/L to 0.066 mg/L.
- Manganese exceeded the PAL with a concentration of 0.631 mg/L.

Former Lube Oil Drum Pit

A single boring, EIC515DP004, was installed at the approximate center of the excavation footprint of the former lube oil drum pit. Soil samples were collected from depth intervals 0 to1 foot, 4 to 5 feet, 9 to 10 feet, and 14 to 15 feet. All soil samples were analyzed for DRO, GRO, VOCs, SVOCs, metals, pesticides, and PCBs.

The following contaminant was detected at concentrations exceeding the PAL:

- Thallium exceeded the PAL in all four soil samples at estimated concentrations ranging from 0.40 to 0.76 mg/kg.

A temporary well was used to collect a groundwater sample from the borehole location, EIC515MW004GW01-20. The groundwater sample was analyzed for DRO, RRO, GRO, VOCs, SVOCs, total metals, dioxin/furan, pesticide, and PCBs. Cobalt and lead were found in the blank associated with this sample.

The following contaminants were detected at concentrations exceeding the PAL:

- Cobalt exceeded the PAL with a concentration of 0.001 mg/L.

- Iron exceeded the PAL with a concentration of 4.81 mg/L.

- Lead exceeded the PAL with a concentration of 0.0022 mg/L, which is within the range of background values of less than 0.005 mg/L to 0.066 mg/L.

- Manganese exceeded the PAL with a concentration of 0.227 mg/L.

Former Burn Barrel

A single boring, EIC515DP005, was installed at the approximate location of the former burn barrel. Soil samples were collected from depth intervals 0 to1 foot, 1 to 2 feet, 9 to 10 feet, and 14 to 15 feet. All soil samples were analyzed for DRO, GRO, VOCs, SVOCs, and metals.

The following contaminants were detected at concentrations exceeding the PAL:

- Methylene chloride exceeded the PAL at the 14- to 15-foot depth interval with an estimated concentration of 0.0348 mg/kg.

- Thallium exceeded the PAL in three soil samples at estimated concentrations ranging from 0.62 to 0.78 mg/kg (estimated).

A temporary well was used to collect a groundwater sample from the borehole location, EIC515MW005GW01-20. The groundwater sample was analyzed for DRO, RRO, GRO, VOCs, SVOCs, total metals, dioxin/furan, pesticide, and PCBs. Chromium, cobalt, and nickel were found in the blank associated with this sample.

The following contaminants were detected at concentrations exceeding the PAL:

- Aluminum exceeded the PAL with a concentration of 5.630 mg/L.
- Arsenic exceeded the PAL with a concentration of 0.0235 mg/L.
- Chromium exceeded the PAL with a concentration of 0.014 mg/L, which is within the range of background values of less than 0.020 mg/L to 0.125 mg/L.
- Cobalt exceeded the PAL with a concentration of 0.0068 mg/L.
- Iron exceeded the PAL with a concentration of 21.7 mg/L.
- Lead exceeded the PAL with a concentration of 0.0144 mg/L, which is also within the range of background values of less than 0.005 mg/L to 0.066 mg/L.
- Manganese exceeded the PAL with a concentration of 0.435 mg/L.
- Nickle exceeded the PAL with a concentration of 0.015 mg/L.

Former Septic Tank

A single boring, EIC515DP006, was installed at the approximate location of the former septic tank. Soil samples were collected from depth intervals 0 to 1 foot, 1 to 2 feet, 4 to 5 feet, and 9 to 10 feet. All soil samples were analyzed for DRO, GRO, VOCs, SVOCs, and metals.

- Thallium exceeded the PAL in three soil samples at estimated concentrations ranging from 0.62 to 1.06 mg/kg.
- Silver exceeded the PAL in depth intervals 0 to 1 foot and 4 to 5 feet at concentrations of 11.2 to 64.1 mg/kg, respectively.

A temporary well was used to collect a groundwater sample from the borehole location, EIC515MW006GW01-15. The groundwater sample was analyzed for DRO, RRO, GRO, VOCs, SVOCs, total metals, dioxin/furan, pesticide, and PCBs. Lead and nickel were found in the blank associated with this sample.

The following contaminants were detected at concentrations exceeding the PAL:

- Cadmium exceeded the PAL with a concentration of 0.00098 mg/L.
- Cobalt exceeded the PAL with a concentration of 0.0203 mg/L.
- Iron exceeded the PAL with a concentration of 9.28 mg/L.
- Lead exceeded the PAL with a concentration of 0.0056 mg/L, which is also within the range of background values of less than 0.005 mg/L to 0.066 mg/L.
- Manganese exceeded the PAL with a concentration of 2.05 mg/L.
- Nickle exceeded the PAL with a concentration of 0.0179 mg/L.

3.3 Institutional Controls and Land Use Controls

ICs and LUCs were put in place as an interim measure until the site could be fully characterized and potential remediation actions determined. Current controls are as follows (USAF, 2015):

- The installation of drinking water wells is restricted.
- All monitoring wells must be secured with locks to prevent unauthorized access to groundwater.
- Any activity that may result in access to contaminated groundwater or affect the movement of contaminated groundwater requires approval by Installation Management (i.e., Civil Engineering Squadron/Installation Management Flight [CES/CEI]).
- Any activity that may result in the disturbance of soil requires approval by Installation Management (CES/CEI). A Base Civil Engineering Work Clearance (Form 103) must be completed and approval obtained prior to conducting any work (intrusive or otherwise) at the site.
- In the event that contaminated soil or groundwater is removed from the source area, it will be disposed of or treated in accordance with applicable state and federal regulations.
- A 200-foot buffer area boundary has been established on the site until better delineation is defined.

(This page intentionally left blank)

4. SITE CHARACTERIZATION ACTIVITIES

4.1 Mobilization and Field Work

The North Wind field crew mobilized to Source Area SS515 for the site characterization on September 8, 2016; the 2016 fieldwork was conducted during the month of September. The truck-mounted AMS Power Probe 9620 drill rig, field vehicle, all other equipment, and initial supplies were mobilized to the site from Anchorage, Alaska by road network. At the end of the 2016 field season, analytical data showed that the areas of contamination had not been fully delineated. Consequently, the field crew remobilized for additional work on May 8, 2017; the 2017 fieldwork was conducted into the middle of May. For the 2017 additional work, the drill rig, field vehicle, and supplies were mobilized to the site from Fairbanks, Alaska by road network.

4.2 Soil Sampling

A total of 101 characterization soil samples were collected, as shown on Figure 4-1. Initial sampling efforts, as prescribed in the 2016 Work Plan (North Wind, 2016) and previously discussed in the characterization approach in Section 3.2, did not successfully delineate the extent of contamination. Strategic follow-on sampling was conducted in 2017 but was also unsuccessful in fully delineating the extent of contamination. The soil sampling methods are presented here, while the sampling results are presented in Section 5.

Soil sampling was conducted by ADEC-qualified samplers in accordance with the ADEC *Field Sampling Guidance* (ADEC, 2016) and as incorporated into the Work Plan (North Wind, 2016). The soil samples were collected discretely using direct push drilling methods and continuous core sample collection. The general sampling strategy was based on the collection of two samples per borehole, with a shallow surface or subsurface sample followed by a second sample at the groundwater surface or near the expected groundwater level. Final sample intervals were chosen based on visual examination of the core and screening with a photoionization detector. Samples were collected (1) where there were indications of fuel or other contamination, (2) at lithology changes, or (3) at the expected groundwater level.

Sampling with the drill rig consisted of using a lexan liner inserted within the direct push extension of the drill rig. The probe drive string and lexan sampler were advanced through the soil to obtain a continuous soil core in 4-foot sections until the sample depth was reached. After each tube was filled, it was removed and placed on the sampling table where it was opened and logged. Once the tube containing the targeted sample interval was delivered to the table, it was immediately opened and sample jars for volatile compounds were filled, preserved, and capped. Care was taken to collect some soil from the entire interval for analyses. The remaining soil was homogenized and placed in sample jars for non-volatile analyses, as required. Samples were placed in plastic bags to protect labels from dirt or excessive moisture and then placed in field coolers with gel ice packs for preservation and protected from breakage until they could be shipped.

Soil boring geology was logged according to the *Alaska Field Guide for Soil Classification* (ADOT, 2005). Sampling and logging activities were performed by an ADEC-qualified sampler. Sampling details, including sample ID, date, time, requested analyses, preservatives, locations, and depth, were recorded in a field sampling logbook (see Appendix C). Soil boring logs are included in Appendix D. A photographic log of the field activities is included in Appendix E.

All soil boring locations were backfilled with 3/8-inch bentonite chips and hydrated in accordance with ADEC *Monitoring Well Guidance* (ADEC, 2013). Sample locations were marked with a stake, labeled with the sample ID, and then surveyed to sub-meter accuracy with a GeoXH 6000 GPS unit. Decontamination rinse water and waste soils were containerized and placed (or transferred) into designated waste containers for management.

4.3 Monitoring Well Installation

Six temporary monitoring wells were installed in 2016, as shown on Figure 4-1 and listed in Table 4-1. Wells were installed in accordance with ADEC *Monitoring Well Guidance* (ADEC, 2013). Completed monitoring wells were surveyed by PDC Engineers to within 0.01 foot vertical and 1 foot horizontal with tieback to existing on-site survey monuments. The resulting survey report is provided in Appendix F.

Monitoring wells were constructed of 2-inch Schedule 40 polyvinyl chloride (PVC) threaded well casings and 2-inch pre-pack screens. All wells were installed using direct push drilling methods. The drill casing (3-1/2 inches in diameter) was advanced to depth with an expendable drive point. The well string, which consisted of a bottom cap, a length of screen sufficient to extend above the expected piezometric surface, and blank casing to extend above ground surface, was placed inside the drill casing. Foam bridges were used to form a seal above the pre-packed screened interval. The drill casing was extracted and the remaining borehole filled with 3/8-inch bentonite chips and hydrated. Completion diagrams are provided in Appendix G. Completion details are provided in Table 4-1.

Monitoring wells were developed no sooner than 24 hours after installation to allow annular materials to seal. Development was accomplished using a combination of surging and pumping. Wells were surged using a surge block followed by pumping with a submersible pump. Development continued with alternating surging and pumping until water clarity stabilized. Care was taken to develop the full length of screened zones. Development water was containerized for sampling and disposal.

Wells were sampled no sooner than 48 hours after development. Purging and sampling methods are discussed in Section 4.4.

4.4 Groundwater Sampling

Samples were collected from six monitoring wells (designated as MW-07 through MW-12), which were purged prior to sampling using a low-flow peristaltic pump. Purge water was captured and managed as investigation derived waste (IDW), as was water used to decontaminate all equipment between samples. Field parameters for temperature, pH, conductivity, oxidation-reduction potential (ORP), dissolved oxygen (DO), and turbidity were measured with a Yellow Springs Industry Company multi-meter during purging (see Table 4-2). Well purge and sampling field sheets are provided in Appendix C.

Samples were collected after purging activities were completed and field parameters had stabilized. Appropriate sample containers and preservatives were provided by the analytical laboratory. Sample containers were filled in a manner to minimize turbulence and agitation. For volatile analyses, sample containers were filled with a positive meniscus prior to being capped to minimize air bubbles. Containers were labeled with unique sample ID numbers, requested analyses, and sample dates and times, and were placed in field sample coolers with sufficient gel ice packs to cool samples to 4±2 degrees Celsius (°C). Samples were transferred to the temperature-controlled sample refrigerator upon returning to the field office. PAH and SVOC samples were packaged and shipped within 2 days of collection to meet the 7-day holding time. Groundwater sampling results are presented in Section 5.2.

4.5 Groundwater Level Monitoring

Groundwater levels were measured at the time of monitoring well sampling in the fall of 2016 and again in the spring of 2017 while additional soil sampling was being conducted. Water levels between fall and spring rose predictably by approximately 1.2 feet in all wells except MW-09, where the level rose 8.3 feet. Field personnel were interviewed regarding the initial installation, completion, and location of the well, as well as the anomalous water level measurement.

Table 4-1. Groundwater monitoring well construction details.

Well Identification[a]	Location	Date Installed	TOC Elevation (ft msl)[b]	Well Casing Stickup (ft ags)[b]	Total Depth (BTOC)[c]	Depth to Water (BTOC)[c]	Ground Surface Elevation (ft msl)	Well Depth (ft bgs)	Depth to Water (ft bgs)	Ground Water Elev. (ft msl)	Screen Interval (ft bgs)
MW-07	Eielson AFB	9/16/16	553.76	2.32	20.8	14.45	551.44	18.48	12.13	539.31	8.18 - 18.18
MW-08	Eielson AFB	9/16/16	555.21	2.40	20.8	15.80	552.81	18.40	13.40	539.41	8.10 - 18.10
MW-09	Eielson AFB	9/16/16	554.81	2.20	20.8	15.40	552.61	18.60	13.20	539.41	8.30 - 18.30
MW-10	Eielson AFB	9/16/16	554.43	2.24	20.9	15.03	552.19	18.66	12.79	539.40	8.36 - 18.36
MW-11	Eielson AFB	9/19/16	553.86	2.32	20.8	14.50	551.54	18.48	12.18	539.36	8.18 - 18.18
MW-12	Eielson AFB	9/22/16	547.31	1.95	15.8	8.20	545.36	13.85	6.25	539.11	3.55 - 13.55

Notes:
a. All wells are constructed of 2-inch inside diameter PVC with prepacked well screens.
b. From surveyor's report.
c. Field measured at time of installation and initial sampling.
BTOC – below top of casing
TOC - top of casing
ags - above ground surface
bgs - below ground surface
msl - mean sea level

Table 4-2. Groundwater quality parameters.

Well ID	Date Developed	Water Level (ft BTOC)	pH	Cond (mS/cm)	Turbidity (NTUs)	DO (mg/L)	Temp (°C)	ORP (mV)	Observations
MW-07	9/24/16	14.45	6.2	0.407	48.2	0.55	5.67	-307.1	Amber color, no odor
MW-08	9/24/16	15.80	6.11	0.284	4.2	0.15	6.19	-89.5	Clear, fuel odor
MW-09	9/24/16	15.40	5.78	0.141	0.2	0.36	5.27	76.6	Clear, no odor
MW-10	9/25/16	15.03	6.06	0.171	11.0	0.37	4.46	46.3	Clear, no odor
MW-11	9/25/16	14.50	5.48	0.183	1.6	0.41	4.49	4.6	Clear, no odor
MW-12	9/25/16	8.20	5.48	0.179	1.5	1.01	7.67	24.8	Clear, no odor

Notes:
pH – a measurement of free hydrogen ions, where rain water is typically 5.5 to 6.0.
Cond – Conductivity, a measurement of electrical conductivity due to dissolve solids, where drinking water typically ranges from 0.05 to 0.8 mS/cm.
Turbidity – light scatter measured in nephelometric turbidity units (NTUs), indicative of the amount of suspended solids, where water appears clear until approximately 55 NTUs, which is equivalent to approximately 40 mg/L suspended solids.
DO – dissolved oxygen, a measurement of the amount of free oxygen where values less than 1.0 mg/L are considered anaerobic.
Temp – Temperature in °C.
ORP – Oxidation reduction potential, measured in millivolts, indicative of pH and dissolved solids, where drinking water typically ranges from 200 to 400 mV.

The field lead who performed the well installation stated there were no notable difficulties with well installation or completion and that the well's location was not visibly within a depression or surface drainage feature subject to potential ponding[1]. Additionally, the field lead noted that the spring 2017 water level measurement was comparatively high, so the level was remeasured multiple times prior to recording the final measurement.

Field personnel returned to the study area on September 11, 2017 to perform a visual evaluation of the condition and integrity of MW-09 and recollect water level measurements. There was no visible indication that the well integrity or completion had been compromised (i.e., the casing was secure in the ground and undamaged, and the annular seal appeared to be intact). There was no evidence of surface erosion or ponding around the well casing. The water level in MW-09 had dropped 9.9 feet and was now consistent with site-wide water levels, which dropped approximately 1.6 feet below the initially recorded levels from September 2016. Table 4-3 provides the sequence of water level measurements, which are also shown graphically on the monitoring well completion diagrams provided in Appendix G.

Table 4-3. Groundwater level measurements.

Well ID	Date Installed	Well Casing Stickup (ft ags)	Water Level (ft BTOC)	Date Measured	Change Fall 2016 to Spring 2017	Change Spring 2017 to Fall 2017	Change Fall 2016 to Fall 2017
MW-07	9/16/16	2.32	14.45	9/24/16	+1.26	-2.83	-1.57
			13.19	5/13/17			
			16.02	9/11/17			
MW-08	9/16/16	2.40	15.80	9/24/16	+1.29	-2.86	-1.57
			14.51	5/13/17			
			17.37	9/11/17			
MW-09	9/16/16	2.20	15.40	9/24/16	+8.27	-9.85	-1.58
			7.13	5/13/17			
			16.98	9/11/17			
MW-10	9/16/16	2.24	15.03	9/25/16	+1.32	-2.84	-1.52
			13.71	5/13/17			
			16.55	9/11/17			
MW-11	9/19/16	2.32	14.50	9/25/16	+1.30	-2.81	-1.51
			13.20	5/13/17			
			16.01	9/11/17			
MW-12	9/22/16	1.95	8.20	9/25/16	+1.13	-2.87	-1.74
			7.07	5/13/17			
			9.94	9/11/17			

ags = above ground surface
BTOC = below top of casing

Groundwater elevations show little gradient site-wide, with less than a 0.48-inch difference between northern-most well MW-11 and southern-most well MW-12, separated by approximately 480 feet, for a gradient of 0.001 foot/feet in the southerly direction. Elevation differences between eastern-most well MW-10 and western-most well MW-07 were less than 0.1-inch over 240 feet, for a gradient of 0.0006 foot/feet in the westerly direction. The overall groundwater flow direction appears to be to the southwest, fairly consistent with past investigations, though potentially more southerly.

[1] Email communication between Joe Hansmeyer (North Wind) and Sue Johnson (North Wind), "Anomalous May 2017 Water Level in MW-09," August 31, 2017.

5. CHARACTERIZATION RESULTS

5.1 Soil Sample Results

The following sections provide sampling details and summary tables of analytical results for each potential source area. Sample locations for the 2016/2017 site-wide characterization are shown on Figure 5-1. Tables of analytical detections and PAL exceedances are provided in Appendix H.

5.1.1 30,000-Gallon Diesel and Gasoline USTs

A total of 18 primary and duplicate soil samples were collected from eight borehole locations around the former 30,000-gallon diesel and gasoline UST location. Four boreholes were installed in 2016 and four additional boreholes were installed in 2017 in an attempt to define the extent of contamination.

Analytical results from the 2016/2017 site-wide characterization detected fuel related compounds and hexavalent chromium in soils at concentrations exceeding the PALs. Table 5-1 presents the 2016/2017 sample summary results and Table 5-2 summarizes the analytical results. Figure 5-2 presents all historical and recent analytical data collected in the vicinity of the 30,000-gallon diesel and gasoline USTs.

A summary of the 2016/2017 site characterization and historical analytical results is presented below:

- Historical sampling and analysis has confirmed that the bottom and sidewalls of the former excavation contain residual concentrations of fuel related contaminants (i.e., DRO, GRO, ethylbenzene, and xylenes), most of which were present at depths greater than 14 feet. Thallium was also detected at concentrations greater than the PAL in one boring drilled in the center of the excavation during the 2013 Phase 1 Source Evaluation (USAF, 2013). However, it should be noted that the samples may have been collected from fill material and the concentrations were estimated.

- Areas to the north, east, and west of the former excavation are defined with no contaminants present at concentrations exceeding the PALs. These areas are defined by three borings drilled during the 2016 site characterization, each less than 20 feet from the original excavation – 16CHEFSSB02 (north), 16CHEFSSB03 (east), and 16CHEFSSB04 (west).

- During the 2016/2017 site characterization, four borings (16CHEFSSB01, 17CHEFSSB06, 17CHEFSSB07, and 17CHEFSSB08) were drilled and sampled to the south of the former excavation to define the extent of the contaminant plume. Each of these borings encountered fuel related compounds (i.e., DRO, naphthalene, 1-methylnaphthalene, 2-methylnaphthalene, 1,2,4-trimethylbenezene, 1,3,5-trimethylbenezene, ethylbenzene, and benzo(a)pyrene) at concentrations exceeding the PALs. These contaminants were detected along the southern side of the former excavation extending up to 40 feet south.

- Hexavalent chromium was also detected in three (17CHEFSSB06, 17CHEFSSB07, and 17CHEFSSB08) of the four borings at estimated concentrations exceeding the PAL. Hexavalent chromium also exceeded the PAL in one sample collected from the center of the excavation at a depth of 14 to 16 feet bgs. All hexavalent chromium concentrations are estimated.

Table 5-1. Soil sample summary and exceedances for the 30,000-gallon diesel and gasoline USTs.

Sample ID	Depth (ft)	Analyses (shading indicates at least one analyte present at a concentration > PAL)						
		Fuels	**PAHs/ SVOCs**	**VOCs/ EDB**	**Metals/ Hg**	**Cr-VI**	**PCBs**	**Dioxins/ Furans**
16CHEFSSB01S01	9.5-11.0	X	X	X	X	N/A	X	N/A
16CHEFSSB01S02	12.0-13.5	X	X	X	X	N/A	X	N/A
16CHEFSSB02S01	10.0-13.0	X	X	X	X	N/A	X	N/A
16CHEFSSB02S02	13.5-16.0	X	X	X	X	N/A	X	N/A
16CHEFSSB02S91	10.0-13.0	X	X	X	X	N/A	X	N/A
16CHEFSSB03S01	5.0-7.0	X	X	X	X	N/A	X	N/A
16CHEFSSB03S02	13.0-16.0	X	X	X	X	N/A	X	N/A
16CHEFSSB04S01	7.0-9.0	X	X	X	X	N/A	X	N/A
16CHEFSSB04S02	14.0-16.0	X	X	X	X	N/A	X	N/A
17CHEFSSB05S01	7.0-10.0	X	X	X	X	N/A	X	N/A
17CHEFSSB05S02	14.0-16.0	X	X	X	X	X	X	N/A
17CHEFSSB05S91	7.0-10.0	X	X	X	X	X	X	N/A
17CHEFSSB06S01	8.0-11.0	X	X	X	X	X	X	N/A
17CHEFSSB06S02	12.0-15.0	X	X	X	X	X	X	N/A
17CHEFSSB07S01	8.0-10.0	X	X	X	X	X	X	N/A
17CHEFSSB07S02	14.0-16.0	X	X	X	X	X	X	N/A
17CHEFSSB08S01	4.0-6.0	X	X	X	X	X	X	N/A
17CHEFSSB08S02	14.0-16.0	X	X	X	X	X	X	N/A
Total Samples		**18**	**18**	**18**	**18**	**8**	**18**	**0**
Samples Exceeding Cleanup Value		**5**	**3**	**3**	**0**	**5**	**0**	**N/A**

Notes:
N/A – not analyzed

Table 5-2. Summary of soil analytical results for the 30,000-gallon diesel and gasoline USTs.

Chemical – (EPA Method)	**PAL (mg/kg)**	**Number of Analyses**	**Number of Detects**	**Concentration Range (mg/kg)**	**# Samples >PAL**
DRO- (AK102)	250	18	17	8.86 (QN) - 7570	5
GRO- (AK101)	300	18	12	0.913 (J) – 31.6 (QH)	0
RRO- (AK103)	10,000	18	15	43.5 (QN) – 437 (QL)	0
PAHs- (8270D- SIM), SVOCs- (8270D)					
Naphthalene	*0.038*	*36*	*6*	*0.174 (J) – 15.3*	*3*
1-Methylnaphthalene	*0.41*	*36*	*7*	*0.16 (J) – 25*	*3*
2-Methylnaphthalene	*1.3*	*36*	*9*	*0.0099 (J) – 40.5*	*2*
Benzo(a)anthracene	*0.28*	*36*	*2*	*0.0115 (J) – 0.301 (J)*	*1*
Benzo[a]pyrene	*0.2*	*36*	*1*	*0.214 (J)*	*1*
VOCs- (8260B), EDB- (8011)					
1,2,4-Trimethylbenzene	*0.16*	*18*	*2*	*0.0749 – 1.61*	*1*
Naphthalene	*0.038*	*18*	*3*	*0.054 (MN) – 3.47 (MN)*	*3*
Total Metals- (6020A), Mercury- (7470A)					
Hexavalent Chromium - (7196A)	0.089	9	5	0.1 (J) – 0.62 (J)	5
PCBs - (8082A)	1	126	0	All non-detect	0

Notes:
PAL – Project Action Level
mg/kg – milligram per kilogram
DRO – diesel-range organics
GRO – gasoline range organics
RRO – residual range organics
PAH – polynuclear aromatic hydrocarbons
SVOC – semi-volatile organic compounds
VOC – volatile organic compounds
EDB – ethylene dibromide (1,2-dibromoethane)
PCB – polychlorinated biphenyl

5.1.2 10,000-Gallon Heating Oil UST

Twelve soil samples were collected from six borehole locations around the former 10,000-gallon heating oil UST location. Two boreholes were drilled in 2016 and, when analytical results showed exceedances of DRO, PAHs, and TCE in borehole 16CHEHTSB02, an additional four boreholes were drilled.

Analytical results from the 2016/2017 site-wide characterization detected fuel related compounds, TCE, and hexavalent chromium at concentrations exceeding the PALs. Table 5-3 presents the 2016/2017 sample summary results and Table 5-4 summarizes the analytical results. Figure 5-3 presents all historical and recent analytical data collected in the vicinity of the 10,000-gallon heating oil UST.

Table 5-3. Soil sample summary and exceedances for the 10,000-gallon heating oil UST.

Sample ID	Depth (ft)	Analyses (shading indicates at least one analyte present at a concentration > PAL)						
		Fuels	PAHs/ SVOCs	VOCs/ EDB	Metals/ Hg	Cr-VI	PCBs	Dioxins/ Furans
16CHEHTSB01S01	9.0-11.0	X	X	X	X	N/A	X	N/A
16CHEHTSB01S02	13.0-15.0	X	X	X	X	N/A	X	N/A
16CHEHTSB02S01	9.0-11.0	X	X	X	X	N/A	X	N/A
16CHEHTSB02S02	13.0-15.0	X	X	X	X	N/A	X	N/A
17CHEHTSB03S01	4.0-6.0	X	X	X	X	X	X	N/A
17CHEHTSB03S02	12.0-14.0	X	X	X	X	X	X	N/A
17CHEHTSB04S01	1.0-3.0	X	X	X	X	X	X	N/A
17CHEHTSB04S02	14.0-16.0	X	X	X	X	X	X	N/A
17CHEHTSB05S01	2.0-4.0	X	X	X	X	X	X	N/A
17CHEHTSB05S02	13.0-15.0	X	X	X	X	X	X	N/A
17CHEHTSB06S01	8.0-10.0	X	X	X	X	X	X	N/A
17CHEHTSB06S02	14.0-16.0	X	X	X	X	X	X	N/A
Total Samples		**12**	**12**	**12**	**12**	**8**	**12**	**0**
Samples Exceeding Cleanup Value		**5**	**3**	**4**	**2**	**2**	**1**	**N/A**

Notes:
N/A – not analyzed

Table 5-4. Summary of soil analytical results for the 10,000-gallon heating oil UST.

Chemical – (EPA Method)	PAL (mg/kg)	Number of Analyses	Number of Detects	Concentration Range (mg/kg)	# Samples >PAL
DRO- (AK102)	250	12	11	10.5 (J) – 6,290	5
GRO- (AK101)	300	12	7	1.48 (J) – 58.6	0
RRO- (AK103)	10,000	12	12	13.9 (J) – 688	0
PAHs- (8270D- SIM), SVOCs- (8270D)					
Naphthalene	*0.038*	*26*	*6*	*0.0235 – 1.72 (J)*	*4*
1-Methylnaphthalene	*0.41*	*26*	*7*	*0.088 – 3.46*	*2*
2-Methlynaphthalene	*1.3*	*26*	*8*	*0.116 (J) – 3.54*	*1*
VOCs- (8260B), EDB- (8011)					
Naphthalene	*0.038*	*12*	*2*	*0.365 (MN) – 1.72*	*2*
1,2,4-Trimethylbenzene	*0.16*	*12*	*3*	*0.0213 (J) – 0.813*	*1*
TCE	*0.011*	*12*	*3*	*0.009 (J) – 0.0431*	*2*

Table 5-4. (continued).

Chemical – (EPA Method)	PAL (mg/kg)	Number of Analyses	Number of Detects	Concentration Range (mg/kg)	# Samples >PAL
Total Metals- (6020A), Mercury- (7470A)					
Iron	*32,002*	*4*	*4*	*6,720 – 32,200*	*1*
Molybdenum	*2*	*4*	*4*	*0.634 (J) – 2.59*	*1*
Hexavalent Chromium - (7196A)	0.089	8	2	0.16 (J)– 0.21 (J)	2
PCBs - (8082A)	1	84	2	0.608 (QH)– 1.01 (QH)	1

Notes:
PAL – Project Action Level
mg/kg – milligram per kilogram
DRO – diesel-range organics
GRO – gasoline range organics
RRO – residual range organics
PAH – polynuclear aromatic hydrocarbons
SVOC – semi-volatile organic compounds
VOC – volatile organic compounds
EDB – ethylene dibromide (1,2-dibromoethane)
PCB – polychlorinated biphenyl

A summary of the 2016/2017 site characterization and historical analytical results is presented below:

- Historical sampling and analysis has confirmed that residual fuel related compounds (i.e., DRO, GRO, naphthalene, xylenes, ethylbenzene, and naphthalene) are present in the bottom of the former excavation at concentrations greater than the PALs. Generally, the fuel related contamination was detected at depths greater than 9 feet.

- Historical sampling defined the boundaries of contamination to the north and west of the former excavation, as demonstrated by sample locations CS-5/EX2 and CS6/EX2.

- The 2016 site characterization boring, 16CHEHTSB01, verified that the extent of contamination does not extend further to the northeast.

- Fuel related contaminants (i.e., DRO, naphthalene, 1-methylnaphthalene, 2-methylnaphthalene, and 1,2,4-trimethylbenezene) were detected at concentrations exceeding the PALs in three borings (16CHEHTSB02, 17CHEHTSB05, and 17CHEHTSB06) drilled during the 2016/2017 to the south-southwest of the former excavation.

- TCE was detected above the PAL in two boring locations (16CHEHTSB02 and 17CHEHTSB05) at a depth of 13 to 15 feet bgs.

- PCB (Aroclor-124) was detected at 1.1 mg/kg in a sample collected from a depth of 1 to 3 feet at boring location 17CHEHTSB04.

- Hexavalent chromium was detected at concentrations exceeding the PAL in two samples collected from boring locations 17CHEHTSB03 and 17CHEHTSB06.

5.1.3 Former Building Leach Well

Thirteen primary and duplicate soil samples were collected from six borehole locations around the Former Building Leach Well (see Figure 4-1). One of the boreholes installed in 2016 (16CHELWSB04) showed exceedances of DRO and TCE. An additional borehole installed in 2017 returned no exceedances for DRO or other organic compounds.

Analytical results from the 2016/2017 site-wide characterization detected fuel related compounds and hexavalent chromium at concentrations exceeding the PALs. Table 5-5 presents the 2016/2017 sample summary results and Table 5-6 summarizes the analytical results. Figure 5-4 presents all historical and recent analytical data collected in the vicinity of the Former Leach Well.

Table 5-5. Soil sample summary and exceedances for the former building leach well.

Sample ID	Depth (ft)	Analyses (shading indicates at least one analyte present at a concentration > PAL)						
		Fuels	PAHs/ SVOCs	VOCs/ EDB	Metals/ Hg	Cr-VI	PCBs	Dioxins/ Furans
16CHELWSB01S01	0.5-2	X	X	X	X	N/A	X	N/A
16CHELWSB01S02	13-15	X	X	X	X	N/A	X	N/A
16CHELWSB02S01	1-2.5	X	X	X	X	N/A	X	N/A
16CHELWSB02S02	12-15	X	X	X	X	N/A	X	N/A
16CHELWSB02S92	12-15	X	X	X	X	N/A	X	N/A
16CHELWSB03S01	1-2	X	X	X	X	N/A	X	N/A
16CHELWSB03S02	13-14	X	X	X	X	N/A	X	N/A
16CHELWSB04S01	6.5-8	X	X	X	X	N/A	X	N/A
16CHELWSB04S02	12-14	X	X	X	X	N/A	X	N/A
16CHELWSB05S01	7-8	X	X	X	X	N/A	X	N/A
16CHELWSB05S02	11-12.5	X	X	X	X	N/A	X	N/A
17CHELWSB06S01	5.0-6.0	X	X	X	X	X	X	N/A
17CHELWSB06S02	11.0-12.5	X	X	X	X	X	X	N/A
Total Samples		**13**	**13**	**13**	**13**	**2**	**13**	**0**
Samples Exceeding Cleanup Value		**1**	**0**	**1**	**2**	**1**	**0**	**N/A**
Notes: N/A – not analyzed								

Table 5-6. Summary of soil analytical results for the former building leach well.

Chemical – (EPA Method)	PAL (mg/kg)	Number of Analyses	Number of Detects	Concentration Range (mg/kg)	# Samples >PAL
DRO - (AK102)	250	13	8	9.0 (J) – 2390	1
GRO - (AK101)	300	13	7	0.826 (J) – 32.7 (QH)	0
RRO - (AK103)	10,000	13	11	7.19 (J) - 455	0
VOCs - (8260B), EDB- (8011)					
1,4-Dichlorobenzene	*0.037*	*13*	*1*	*0.0621*	*1*
TCE	*0.011*	*13*	*2*	*0.0063 (B) – 0.0273 (J)*	*1*
Total Metals- (6020A), Mercury- (7470A)					
Potassium	*1186*	*11*	*11*	*348 – 1240*	*1*
Hexavalent Chromium - (7196A)	0.089	2	1	0.27 (J)	1
PCBs - (8082A)	1	91	0	All non-detect	0

Notes:
PAL – Project Action Level
mg/kg – milligram per kilogram
DRO – diesel-range organics
GRO – gasoline range organics
RRO – residual range organics
PAH – polynuclear aromatic hydrocarbons
VOC – volatile organic compounds
EDB – Ethylene dibromide (1,2-dibromoethane)

A summary of the 2016/2017 site characterization and historical analytical results is presented below:

- Historical analyses conducted during the 1996/1998 release investigation detected DRO and RRO at concentrations greater than the PALs in soil samples collected along a trench dug through the center of the leach well area to a depth of 3 to 4 feet. Silver exceeded the PAL in one sample collected from the north end of the trench. DRO and total chromium also exceeded the PAL in samples collected from the bottom of the southern end of the excavation, at a depth of 12 feet.

- In 2012 during the source evaluation, three samples collected from one boring drilled through the south end of the excavation contained thallium at concentrations exceeding the PAL. This boring was drilled and sampled through soils used to backfill the previous excavation. All thallium concentrations were estimated.

- Soil samples collected during the 2016/2017 site characterization to the north (16CHELWSB01), east (16CHELWSB02), west (16CHELWSB03), and southwest (16CHELWSB05) of the former excavation did not detect any contaminants at concentrations exceeding the PALs. All of the soil borings were within 20 feet of the former excavation.

- Analysis of soil samples collected from the 6.5- to 8-foot depth in soil boring 16CHELWSB04 detected DRO, TCE, and 1,4-dichlorobenze at concentrations greater than the PALs. This boring was drilled south of the former excavation and along the former septic pipe.

Soil boring 17CHELWSB06 was drilled approximately 20 feet southeast of the former excavation and contained hexavalent chromium at concentrations greater than the PAL at a depth of 5 to 9 feet. The hexavalent chromium concentration was estimated.

5.1.4 Former Lube Oil Drum Pit

Based on review of historical documents, the precise location of the Former Lube Oil Drum Pit is in question. Figure 3 in the 2000 Release Investigation Report (USAF, 2000) shows the pit immediately north of the former generator room. In 2012 as part of the source evaluation, one boring was reportedly drilled through the center of the pit; this boring is located north and west of the area identified during the 2000 release investigation. Borings drilled during this 2016/2017 site characterization are in proximity to the area identified during the 2012 source evaluation.

Eleven primary and duplicate soil samples were collected from five borehole locations around the former Lube Oil Drum Pit location. TCE was detected in excess of the PAL in borehole 16CHEDPSB01, which prompted installation of an additional three boreholes in 2017.

Analytical results from the 2016/2017 site-wide characterization detected TCE and hexavalent chromium at concentrations exceeding the PALs. Table 5-7 presents the 2016/2017 sample summary results and Table 5-8 summarizes the analytical results. Figure 5-5 presents all historical and recent analytical data collected in the vicinity of the Former Lube Oil Drum Pit.

Table 5-7. Soil sample summary and exceedances for the former lube oil drum pit.

Sample ID	Depth (ft)	Analyses (shading indicates at least one analyte present at a concentration > PAL)						
		Fuels	**PAHs/ SVOCs**	**VOCs/ EDB**	**Metals/ Hg**	**Cr-VI**	**PCBs**	**Dioxins/ Furans**
16CHEDPSB01S01	9-10	X	X	X	X	N/A	X	N/A
16CHEDPSB01S02	13-14	X	X	X	X	N/A	X	N/A
16CHEDPSB02S01	9.5-11.5	X	X	X	X	N/A	X	N/A
16CHEDPSB02S02	12-14	X	X	X	X	N/A	X	N/A
17CHEDPSB03S01	8.0-11.0	X	X	X	X	X	X	N/A
17CHEDPSB03S02	12.0-15.0	X	X	X	X	X	X	N/A
17CHEDPSB04S01	8.0-11.0	X	X	X	X	X	X	N/A
17CHEDPSB04S02	13.0-16.0	X	X	X	X	X	X	N/A
17CHEDPSB04S91	8.0-11.0	X	X	X	X	X	X	N/A
17CHEDPSB05S01	6.0-8.0	X	X	X	X	X	X	N/A
17CHEDPSB05S02	11.0-15.0	X	X	X	X	X	X	N/A
Total Samples		**11**	**11**	**11**	**11**	**7**	**11**	**0**
Samples Exceeding Cleanup Value		**0**	**0**	**1**	**0**	**5**	**0**	**N/A**

Notes:
N/A – not analyzed

Table 5-8. Summary of soil analytical results for the former lube oil drum pit.

Chemical – (EPA Method)	PAL (mg/kg)	Number of Analyses	Number of Detects	Concentration Range (mg/kg)	# Samples >PAL
DRO- (AK102)	250	11	8	9.22 (J) – 109 (QL)	0
GRO- (AK101)	300	11	4	2.08 (J) – 7.81	0
RRO- (AK103)	10,000	11	10	17.1 (J) – 690	0
PAHs- (8270D- SIM), SVOCs- (8270D)	Various	990	12	Various	0
VOCs- (8260B), EDB- (8011)					
TCE	*0.011*	*11*	*3*	*0.0119 (J)*	*1*
Total Metals- (6020A), Mercury - (7470A)	Various	156	136	Various	0
Hexavalent Chromium - (7196A)	0.089	7	5	0.1 (J) – 0.21 (J)	5
PCBs- (8082A)	1	77	0	All non-detect	0

Notes:
PAL – Project Action Level
mg/kg – milligram per kilogram
DRO – diesel-range organics
GRO – gasoline range organics
EDB – Ethylene dibromide (1,2-dibromoethane)
RRO – residual range organics
PAH – polynuclear aromatic hydrocarbons
SVOC – semi-volatile organic compounds
VOC – volatile organic compounds

A summary of the 2016/2017 site characterization and historical analytical results is presented below:

- One sample collected from the bottom of the excavation during the 2000 release investigation did not contain any contaminants at concentrations exceeding the PAL.
- One boring (EIC515DP004001) drilled during the 2012 source evaluation contained thallium at estimated concentrations (90.4 to 0.76 mg/kg) in all soil samples collected.
- Soil samples collected from three borings (17CHEDPSB03, 17CHEDPSB04, and 17CHEDPSB05) drilled during the 2016/2017 site characterization contained hexavalent chromium at concentrations exceeding the PAL. All hexavalent chromium concentrations were estimated.
- One soil boring (16CHEDPSB01) contained TCE at concentrations exceeding the PAL at a depth of 9 to 10 feet.

5.1.5 Former Burn Barrel

Fourteen primary and duplicate soil samples were collected from 10 borehole or surface sample locations around the Former Burn Barrel location. Six locations were sampled in 2016 and based on those results, four additional locations were sampled in 2017.

Analytical results from the 2016/2017 site-wide characterization detected fuel related compounds and hexavalent chromium at concentrations exceeding the PALs. Table 5-9 presents the 2016/2017 sample summary results and Table 5-10 summarizes the analytical results. Figure 5-6 presents all historical and recent analytical data collected in the vicinity of the Former Burn Barrel.

Table 5-9. Soil sample summary and exceedances for the former burn barrel.

Sample ID	Depth (ft)	Analyses (shading indicates at least one analyte present at a concentration > PAL)						
		Fuels	PAHs/ SVOCs	VOCs/ EDB	Metals/ Hg	Cr-VI	PCBs	Dioxins/ Furans
16CHEBBSB01S01	0.5-2	X	X	X	X	N/A	X	X
16CHEBBSB01S02	7-9	X	X	X	X	N/A	X	X
16CHEBBSB02S01	0.5-3	X	X	X	X	N/A	X	X
16CHEBBSB02S02	14-16	X	X	X	X	N/A	X	X
16CHEBBSB02S91	0.5-3	N/A	N/A	N/A	N/A	N/A	N/A	X
16CHEBBSB03S01	0.0-0.5	N/A	N/A	N/A	X	N/A	N/A	X
16CHEBBSB04S01	0.0-0.5	N/A	N/A	N/A	X	N/A	N/A	X
16CHEBBSB05S01	0.0-0.5	N/A	N/A	N/A	X	N/A	N/A	X
16CHEBBSB06S01	0.0-0.5	N/A	N/A	N/A	X	N/A	N/A	X
17CHEBBSB07S01	0.5-1.5	N/A	N/A	N/A	X	N/A	N/A	X
17CHEBBSB08S01	0.5-1.5	N/A	N/A	N/A	X	N/A	N/A	X
17CHEBBSB09S01	0.5-1.5	X	X	X	X	X	X	X
17CHEBBSB10S01	0.5-1.5	X	X	X	X	X	X	X
17CHEBBSB10S91	0.5-1.5	X	X	X	X	X	X	X
Total Samples		**7**	**7**	**7**	**13**	**3**	**7**	**14**
Samples Exceeding Cleanup Value		**0**	**0**	**2**	**5**	**2**	**0**	**2**

Table 5-10. Summary of soil analytical results for the former burn barrel.

Chemical – (EPA Method)	PAL (mg/kg)	Number of Analyses	Number of Detects	Concentration Range (mg/kg)	# Samples >PAL
DRO - (AK102)	250	7	5	11.9 (J) – 32.8	0
GRO - (AK101)	300	7	2	0.852 (J) – 1.36 (J)	0
RRO - (AK103)	10,000	7	5	58.2 – 177	0
PAHs - (8270D- SIM), SVOCs - (8270D)	Various	630	9	Various	0
VOCs - (8260B), EDB- (8011)					
TCE	*0.011*	*7*	*4*	*0.0046 (J) – 0.0273*	*2*
Total Metals- (6020A), Mercury- (7470A)					
Calcium	*7,331*	*13*	*13*	*0.263 - 21300*	*1*
Molybdenum	*2*	*8*	*8*	*0.655 (J) – 9.02*	*1*
Silver	*11*	*13*	*11*	*0.149 (J) – 381*	*5*
Hexavalent Chromium - (7196A)	0.089	3	2	0.15 (J) – 0.22 (J)	**2**
PCBs - (8082A)	1	49	0	All non-detect	0
Dioxins-Furans - (8290)					
Total Tetra-Dioxins	*3.9*	*14*	*5*	*0.243 (J) – 16.2*	*1*
Total TCDD TEQ	*3.9*	*14*	*14*	*0.0053 – 6.49*	*1*

Notes:
PAL – Project Action Level
mg/kg – milligram per kilogram
DRO – diesel-range organics
GRO – gasoline range organics
EDB – Ethylene dibromide (1,2-dibromoethane)
RRO – residual range organics
PAH – polynuclear aromatic hydrocarbons
SVOC – semi-volatile organic compounds
VOC – volatile organic compounds

A summary of the 2016/2017 site characterization and historical analytical results is presented below:

- One composite soil sample collected around the burn barrel during the 1996/1998 release investigation contained silver at concentrations exceeding the PAL.
- In the one boring (EIC515DP005001) drilled during the 2013 source evaluation, methylene chloride and toluene were detected in one sample at estimated concentrations exceeding the PAL. Thallium was detected in all three samples at estimated concentrations exceeding the PAL.
- During the 2016/2017 site characterization, silver was detected at concentrations exceeding the PAL in five samples southeast of the Former Burn Barrel location. All five of these samples were collected from depths of less than 1.5 feet. Additionally, TCE and hexavalent chromium were detected at concentrations exceeding the PAL at the boring location (17CHEBBSB010) immediately south of the burn barrel. The hexavalent chromium concentrations were estimated. Total tetra-dioxins exceeded the PAL at sample location 17CHEBBSB009.

5.1.6 Former Septic Tank

Twenty-six primary and duplicate soil samples were collected from 11 boreholes along the leach line from the leach well south of the area around the Former Septic Tank.

Analytical results from the 2016/2017 site-wide characterization detected fuel related compounds and hexavalent chromium at concentrations exceeding the PALs. Table 5-11 presents the 2016/2017 sample summary results and Table 5-12 summarizes the analytical results. Figure 5-7 presents all historical and recent analytical data collected in the vicinity of the Former Septic Tank and Septic Line.

Table 5-11. Soil sample summary and exceedances for the former septic tank.

Sample ID	Depth (ft)	Analyses (shading indicates at least one analyte present at a concentration > PAL)						
		Fuels	**PAHs/ SVOCs**	**VOCs/ EDB**	**Metals/ Hg**	**Cr-VI**	**PCBs**	**Dioxins/ Furans**
16CHESTSB01S01	5-6.5	X	X	X	X	N/A	X	N/A
16CHESTSB01S02	9-11	X	X	X	X	N/A	X	N/A
16CHESTSB02S01	5.5-7	X	X	X	X	N/A	X	N/A
16CHESTSB02S02	9-10	X	X	X	X	N/A	X	N/A
16CHESTSB03S01	6-8	X	X	X*	X	N/A	X	N/A
16CHESTSB03S02	11-12	X	X	X*	X	N/A	X	N/A
16CHESTSB03S91	6-8	X	X	X*	X	N/A	X	N/A
16CHESTSB04S01	7-8	X	X	X*	X	N/A	X	N/A
16CHESTSB04S02	14-16	X	X	X*	X	N/A	X	N/A
16CHESTSB05S01	4-8	X	X	X*	X	N/A	X	N/A
16CHESTSB05S02	8-12	X	X	X	X	N/A	X	N/A
16CHESTSB06S01	4.5-7.5	X	X	X	X	N/A	X	N/A
16CHESTSB06S02	10-12	X	X	X	X	N/A	X	N/A
16CHESTSB06S91	4.5-7.5	X	X	X	X	N/A	X	N/A
16CHESTSB07S01	1.5-4	X	X	X*	X	N/A	X	N/A
16CHESTSB07S02	5-7	X	X	X	X	N/A	X	N/A
16CHESTSB07S92	5-7	X	X	X*	X	N/A	X	N/A
16CHESTSB08S01	4-7	X	X	X*	X	N/A	X	N/A
16CHESTSB08S02	9-12	X	X	X	X	N/A	X	N/A
16CHESTSB09S01	7-10	X	X	X	X	N/A	X	N/A
16CHESTSB09S02	13-16	X	X	X	X	N/A	X	N/A
16CHESTSB10S01	7-11	X	X	X	X	N/A	X	N/A
16CHESTSB10S02	13-16	X	X	X	X	N/A	X	N/A
16CHESTSB10S91	7-11	X	X	X	X	N/A	X	N/A
16CHESTSB11S01	7-9	X	X	X	X	N/A	X	N/A
16CHESTSB11S02	12-15	X	X	X	X	N/A	X	N/A
Total Samples		**26**	**26**	**26**	**26**	**0**	**26**	**0**
Samples Exceeding Cleanup Value		**0**	**0**	**9**	**2**	**N/A**	**0**	**N/A**

Notes:
* Exceedances for chloroform only which was also detected in the trip blanks associated with these samples at similar concentrations indicating potential contamination during shipment or during analysis.
N/A – not analyzed

Table 5-12. Summary of soil analytical results for the former septic tank.

Chemical – (EPA Method)	PAL (mg/kg)	Number of Analyses	Number of Detects	Concentration Range (mg/kg)	# Samples >PAL
DRO - (AK102)	250	26	10	7.04 (J) – 81.5	0
GRO - (AK101)	300	26	6	1.03 (J) – 3.19 (J)	0
RRO - (AK103)	10,000	26	15	7.55 (J) – 507	0
PAHs - (8270D- SIM), SVOCs - (8270D)	Various	2,340	14	Various	0
VOCs - (8260B), EDB - (8011)					
Chloroform (see Note 1)	*0.0071*	*26*	*9*	*0.008 (J) – 0.02 (J)*	*9*
Total Metals - (6020A), Mercury - (7470A)					
Calcium	*7,331*	*26*	*26*	*932 – 8,000*	*1*
Molybdenum	*2*	*26*	*26*	*0.497 (J) – 2.04*	*1*
PCBs - (8082A)	1	182	0	All non-detect	0

Notes:
1. Chloroform was also detected in the trip blanks associated with these samples at similar concentrations indicating potential contamination during shipment or during analysis.

PAL – Project Action Level
mg/kg – milligram per kilogram
DRO – diesel-range organics
GRO – gasoline range organics
RRO – residual range organics
PAH – polynuclear aromatic hydrocarbons
SVOC – semi-volatile organic compound
VOC – volatile organic compound
EDB – Ethylene dibromide (1,2-dibromoethane)

A summary of the 2016/2017 site characterization and historical analytical results is presented below:

- Historical analytical data from the 1996/1998 release investigation identified silver at concentrations greater than the PAL in four samples (SEPTIC-40, 60, 80, and 100) collected from along the former septic pipe line. These four samples were collected from the point where the pipe line leaves the leach well area to 100 feet south. Lead was also detected at concentrations greater than the PAL in one sample collected 40 feet south of the leach well area. All septic pipe line samples were collected from a depth of 4 feet.

- During the 1996/1998 release investigation, DRO was detected at concentrations greater than the PAL in two samples (STLW-2 and STLW-3) collected from the excavation base of Septic Leach Wells 1 and 3.

- One boring drilled during the 2012 source evaluation, immediately north of the former septic tank, contained thallium at estimated concentrations and silver at concentrations exceeding the PAL.

- During the 2016/2017 site characterization, chloroform was detected in nine samples at concentrations greater than the PAL. Chloroform was also detected in two field trip blanks at similar concentrations, suggesting potential contamination during sample shipment or during analysis of the sample.

- Molybdenum was detected in one sample (16CHELWSB04S02) at a concentration slightly exceeding the EPA risk screening level.

5.2 Groundwater Sample Results

In 2016, monitoring wells MW-07 through MW-12 were installed and sampled. DRO was detected at concentrations exceeding the PAL in monitoring well MW-08, located south of the 10,000-gallon heating oil UST. No other petroleum related contaminants were detected at concentrations exceeding the PAL. Several total metals (e.g., arsenic, cobalt, and sodium) were detected at concentrations exceeding the PALs. These detected total metals concentrations are likely the result of turbidity in the samples. Table 5-13 provides a summary of groundwater samples, analyses, and locations of exceedances. Table 5-14 provides a summary of the number of analyses, detections, and exceedances. Figure 5-8 shows where current and historical DRO and metal exceedances occurred.

Table 5-13. Groundwater sample summary and exceedances.

		Analyses (shading indicates at least one analyte present at a concentration > PAL)						
Sample ID	**Near Area**	**Fuels**	**PAHs**	**SVOCs**	**VOCs**	**EDB**	**Metals/ Hg**	**PCBs**
16CHEMW0701	Leach Well	X	X	X	X	X	X	X
16CHEMW0801	Heat Oil UST	X	X	X	X	X	X	X
16CHEMW0901	Drum Pit	X	X	X	X	X	X	X
16CHEMW1001	Fuel USTs	X	X	X	X	X	X	X
16CHEMW1101	Burn Barrel	X	X	X	X	X	X	X
16CHEMW1102	Burn Barrel	X	X	X	X	X	X	X
16CHEMW1201	Septic Tank	X	X	X	X	X	X	X
Total Samples		**7**	**7**	**7**	**7**	**7**	**7**	**7**
Samples Exceeding Cleanup Value		**1**	**0**	**0**	**0**	**0**	**3**	**0**

Table 5-14. Summary of groundwater analytical results.

Chemical – (EPA Method) DRO- (AK102)	**PAL (µg/L)**	**Number of Analyses**	**Number of Detects**	**Concentration Range**	**Exceedances**	
					Number	**Location**
GRO - (AK101)	1,500	7	3	320 (J) – 2,730 µg/L	**1**	MW-08
RRO - (AK103)	2,200	7	1	35.1 (J) µg/L	0	---
Chemical - (EPA Method)	1,100	7	1	392 (J) µg/L	0	---
PAHs - (8270D-SIM), SVOCs - (8270D)	*Note 1	630	23	Various	0	---
VOCs - (8260B), EDB - (8011)	*Note 1	476	2	Various	0	---

Table 5-14. (continued).

Chemical – (EPA Method) DRO- (AK102)	**PAL (µg/L)**	**Number of Analyses**	**Number of Detects**	**Concentration Range**	**Exceedances**	
					Number	**Location**
Total Metals- (6020A), Mercury- (7470A)						
Arsenic	5.4	7	6	2.25 (J) – 14.4 µg/L	3	MWs 07, 11, 12
Cobalt	6	7	7	0.553 (J) – 6.6 µg/L	2	MWs 07, 11
Sodium	4,900	7	7	1,850 – 23,100 µg/L	1	MW-07
PCBs - (8082A)	0.5	49	0	All non-detect	0	---
Total Analyses		**1,349**	**112**	**---**	**7**	**---**

Notes:
1. Samples collected for metals analysis were not filtered and results are total metals.

PAL – Project Action Level
DRO – diesel-range organics
GRO – gasoline range organics
RRO – residual range organics
PAH – polynuclear aromatic hydrocarbons
SVOC – semi-volatile organic compounds
VOC – volatile organic compounds
EDB – Ethylene dibromide (1,2-dibromoethane)
J - estimated value
µg/L – micrograms per Liter

6. CONCEPTUAL SITE MODEL

The conceptual site model (CSM) presented in this section was developed following the ADEC *Guidance on Developing Conceptual Site Models* (ADEC, 2017).

6.1 Contaminants of Concern

Sampling of soil and groundwater was performed at the Chena River Research Annex for fuels, PAHs, SVOCs, VOCs, PCBs, metals, dioxins, and chromium-VI. Sampling results confirmed detections or exceedances of all of these COCs at the characterization area. Analytical results were compared to the ADEC Method 2 migration to groundwater cleanup levels, under 40-inch precipitation zone human health risk levels, or EPA risk SSLs (whichever is most stringent). ADEC Method 2 health-based cleanup levels, and results greater than one-tenth of the cleanup levels, were considered for potential cumulative human health risk.

Table 6-1 lists the COCs identified in soil and groundwater that exceed the Method 2 cleanup level or one-tenth of the "Under 40-inch Precipitation Zone Human Health Risk Levels," as specified in 18 AAC 75. Additionally, the table lists the maximum concentration of the analyte detected and specifies whether the chemical is considered to be a risk for dermal exposure, is a bioaccumulative compound, or is a volatile compound of potential concern. Some compounds may present risk in more than one of these pathways.

6.2 Release Mechanisms

The primary release mechanisms for petroleum, oil, and lubricants (POLs), PAHs, and solvent contamination found at the characterization area would most likely be from leaks, spills, or direct discharge from, or associated with, the following:

- USTs and their distribution piping,
- Aboveground storage tanks (ASTs) and their distribution piping or hoses,
- Drums during storage, transfer of contents, or when discarded,
- Burning of waste items and spent flammable fluids, and
- Housekeeping activities (i.e., disposing of solvents or waste water in the septic system).

Impacted media include surface and subsurface soils, groundwater, and biota. In general, the releases of contamination occurred at the surface of the soil or potentially within the shallow subsurface in vadose zone soils. It is not likely that contaminants were directly discharged to groundwater. Biota, specifically fauna living or tunneling within surface soil, would be impacted.

6.3 Fate and Transport

There are no known primary contaminant sources (i.e., ASTs or USTs) still present or being utilized at the investigation area. Operation of the receiving/transmitting station halted in 1977. The site was left unused until 1988, when it was used for live fire exercises that took place until 1995. The buildings and structures were removed in 1999, and several documented cleanup efforts have since taken place to remove debris, contaminated soil, equipment, and discarded drums.

Table 6-1. Contaminants of human health concern at Source Area SS515-Chena River Research Annex.

Analyte	**Cleanup Level* (mg/kg)**	**1/10th Health Level (mg/kg)**	**Did Analyte Exceed Cleanup Level?**	**Did Analyte Exceed Health Screening Level?**	**Risk Pathway****			**Maximum Concentration (mg/kg)**
Surface Soils (0-2 ft bgs)								
Benzo(a)pyrene	0.2	0.02		X	B	D		0.26
PCBs	1	0.1	X	X	B	D		1.01
Naphthalene	0.038	2.9	X	X		D	V	0.365
TCE	0.011	0.49	X				V	0.43
Total Tetra-Dioxins	3.9 (ng/kg)	8.2 (ng/kg)	X	X	B	D		16.2 (ng/kg)
Total TCDD TEQ	3.9 (ng/kg)	8.2 (ng/kg)	X	X	B	D		6.49 (ng/kg)
Aluminum	30,000	3,000		X				13,700
Chromium-VI	0.089	0.39	X		B			0.22
Lead	400	40		X	B			68.6
Molybdenum	2	0.2	X	X				9.02
Silver	11	51	X	X	B			381
Subsurface Soils (2-15 ft bgs)								
DRO	250	1,025	X	X				7,570
1,2,4-Trimethylbenzene	0.16	4.3	X				V	1.61
1,4-Dichlorobenzene	0.037	2.1	X				V	0.06
1-Methylnaphthalene	0.41	6.8	X	X		D	V	24.7
2-Methylnaphthalene	1.3	31	X	X		D	V	40.5
Naphthalene	0.038	2.9	X	X		D	V	15.3
Benzo[a]anthracene	0.28	0.2	X	X	B	D	V	0.3

Table 6-1. (continued).

Analyte	Cleanup Level* (mg/kg)	1/10th Health Level (mg/kg)	Did Analyte Exceed Cleanup Level?	Did Analyte Exceed Health Screening Level?	Risk Pathway**			Maximum Concentration (mg/kg)
Benzo[b]fluoranthene	2	0.2		X	B	D		0.35
Benzo(a)pyrene	0.2	0.02	X	X	B	D		0.21
TCE	0.011	0.49	X				V	0.043
Aluminum	30,000	3,000		X				17,900
Boron	13	1.3		X				12.4
Chromium-VI	0.089	0.39	X	X	B			0.62
Molybdenum	2	0.2		X				2.04
Vanadium	510	51		X				56.9
Groundwater								
DRO	1.5 (mg/L)	0.15 (mg/L)	X	X				2.73 (mg/L)
RRO	1.1 (mg/L)	0.11 (mg/L)		X				0.392 (mg/L)
TCE	2.8 µg/L	0.28 µg/L		X			V	0.48 µg/L
Cobalt^	6 µg/L	0.6 µg/L	X	X				6.6 µg/L
Iron^	14,000 µg/L	1,400 µg/L		X				9,590 µg/L
Mercury	0.52 µg/L	0.052 µg/L		X			V	0.25 µg/L

*ADEC Method 2 Migration to Groundwater or Under 40-in. Precipitation Zone Human Health Risk Levels, or EPA Risk SSLs, whichever is most stringent.
**Risk Pathways: B- Bioaccumulative, D- Dermal Exposure, V- Volatile Compound of Concern.
^ Iron and Cobalt groundwater cleanup levels are EPA tap water screening levels.

ng/kg = nanograms per kilogram

Typically, fuel and related hydrocarbons released to the soil in the non-aqueous phase liquid (NAPL) phase would be held in the soil pores by capillary forces as an immobile, residual body that will not migrate downgradient into previously uncontaminated soils. Individual constituents that comprise the fuel would tend to partition from the NAPL phase into vapor, dissolved, or adsorbed phases according to their phase partitioning relationships and migrate away from the NAPL source.

Vapors would tend to migrate away from the source area by the processes of diffusion and advection. Dissolved constituents in unsaturated soils would tend to migrate downward with infiltrating precipitation. Dissolved constituents in the saturated soils would migrate downgradient with groundwater flow. Both vapor and dissolved phase constituents would tend to be attenuated during transport by sorption and biodegradation.

Precipitation runoff and sheet wash are not considered significant transport mechanisms of dissolved or adsorbed phase contaminants to surface water or sediment because the area is relatively flat and surrounded by vegetation.

Groundwater transport to surface water is not considered a significant exposure route because dissolved phase contaminants would be expected to be attenuated further before reaching surface water.

6.3.1 Exposure Pathways and Receptors

All potential exposure pathways were evaluated based on the release mechanisms and fate and transport evaluations discussed above. Scoping forms from the CSM guidance document (ADEC, 2017) were used to document investigation findings and the reasoning used to determine which exposure pathways were considered complete or incomplete. The CSM scoping forms and supporting data tables are provided in Appendix I. A synopsis of decisions and determinations is provided in the CSM graphic form included as Figure 6-1.

The land currently belongs to the Alaska Department of Natural Resources but is under the operational control of the USAF, and remains unoccupied and under current interim LUC measures, but is open and available to public recreation. The results of this investigation did not fully define the nature and extent of contamination needed to support further evaluation of a combination of remediation options and long-term LUCs. It is likely that additional site characterization and remedial investigation will be required before LUC measures are minimized. A future residential land use scenario was not considered at this time. The potential current human receptor categories are:

- Commercial or industrial workers, and
- Visitors / trespassers / recreational users.

The exposure pathway of greatest potential and greatest risk to human receptors is the incidental ingestion or dermal absorption of PCBs, dioxins, or PAH contaminants in soils. Persons contacting soils could potentially ingest soil from their hands, clothes, or food in contact with the soil. Should construction operations be scheduled in the future, or land use restrictions be relaxed, construction workers and subsistence harvesters/consumers would be potential future receptors.

Inhalation of fugitive dust is also a complete pathway. The characterization area contains areas of bare soil from previous demolition and characterization activities. The potential for soil to be dispersed as dust particles is likely to happen during subsequent environmental characterization efforts or future ground disturbing activities. Construction workers and subsistence harvesters/consumers would be the potential future receptor.

The ingestion of groundwater is considered a complete pathway because contaminants have been detected slightly above one-tenth of the human risk cleanup level. The groundwater is not a current source of drinking water and extraction of groundwater is not allowed without permission under current LUCs. Therefore, ingestion of groundwater is considered an insignificant pathway at this time. Potential future receptors, should the area be considered for development in the future, would be industrial or commercial workers.

The ingestion of wild meat is a potential transport mechanism to humans because the PAHs present are determined to be bioaccumulative (ADEC, 2017). Though these contaminants are not taken up by plants, herbivores may ingest contaminated soil while grazing, and omnivores (i.e., wild fowl) eat soil-dwelling animals as well as roots and vegetation. Though considered a contaminant pathway to human ingestion, the risk to humans is considered small because the risk to animals consumed by humans is also small (i.e., at the limited concentrations present, it would be difficult for transient animals to bioaccumulate concentrations harmful to humans over the lifetime of the animal).

(This page intentionally left blank)

7. WASTE MANAGEMENT AND DISPOSAL

The IDW streams generated during the characterization effort consisted of environmental solids (i.e., soil), liquids (i.e., development and purged groundwater and spent equipment decontamination fluids), and disposable trash (i.e., used supplies, paper towels, plastic bags, etc.). All IDW was containerized in approved Department of Transportation containers and labeled with generator, waste type, point of contact, and generation date. Solid waste trash was disposed of in accordance with the Eielson AFB IDW Management Plan (AFCEC, 2015) or Hazardous Waste Management Plan (AFCEC, 2014), as appropriate and shortly after the time of generation. Other IDW soils and liquid wastes currently remain on site.

Solid waste consists of two 55-gallon metal drums containing soil cuttings. The soil is individually separated and identifiable by borehole.

Liquid waste consists of six 15-gallon plastic drums, labeled by well, with bung openings in the lids. These contain purge water from well development and sampling activities for each of the six wells.

The IDW will be moved off site and disposed of in early spring of 2018.

(This page intentionally left blank)

8. PROJECT ACTION LEVELS AND CONTAMINANTS OF POTENTIAL CONCERN

COPCs were identified from previous investigation results for those analytes that exceeded one-tenth of the 2016 ADEC Method 2 most stringent cleanup levels for either migration to groundwater or under 40-inch zone.

PALs were derived from ADEC regulations (18 AAC 75; revised November 2016), where available. BTVs for the upper confidence limit of fluvial soil from the Eielson Background Metals Study (USAF, 2014a) were utilized as PALs for metals when the values were higher than ADEC's most stringent cleanup levels or 2016 EPA residential soil regional screening levels (RSLs). If EPA RSLs were available, they were used when ADEC values and BTVs were unavailable. Screening levels established by the World Health Organization (WHO, 2005) were used as PALs for dioxins and furans. Appendix B provides a list of all analytes, the PAL, and the source for the PAL.

Tables 8-1 and 8-2 present the COPCs in soil and groundwater, respectively, as identified from historical and current analytical data. All sample locations are shown on Figures 5-1 through 5-8.

(This page intentionally left blank)

Table 8-1. COPCs in soil.

						30,000-Gallon Diesel and Gasoline USTs		10,000-Gallon Heating Oil UST		Former Building Leach Field		Former Lube Oil Drum Pit		Former Burn Barrel		Former Septic Tank	
COPC	**EPA Method**	**ADEC Cleanup Level[1]**	**Screening Level[2]**	**Metals BTV[3]**	**PAL**	**Highest Concen.**	**Sample ID**	**Highest Concen.**	**Sample ID**	**Highest Concen.**	**Sample ID**	**Highest Concen.**	**Sample ID**	**Highest Concen.**	**Sample ID**	**Highest Concen.**	**Sample ID**
GRO	AK101	300	30	--	300	**588**	EIC515DP001S O01-15	**310**	CS-2/EX2	81	Leach Well (SAS)	--	--	--	--	--	--
DRO	AK102	250	25	--	250	**23,000**	CS-5/EX1	**6,800**	CS-2/EX2	**4,800**	LWP-37	**382**	DSP-1	34.5	EIC515DP005 SO01-01	**12,000**	STLW-3
Ethylbenzene	8260B/ AK101	0.13	0.013	--	0.13	**2.3**	CS-6/EX1	**1.7**	CS-2/EX2	0.02	Leach Well	--	--	--	--	--	--
Xylene	8260B/ AK101	1.5	0.15	--	1.5	**8.1**	CS-6/EX1	**5.1**	CS-2/EX2	--	--	--	--	--	--	--	--
Naphthalene	8260B/ 8270D	0.038	0.0038	--	0.038	**0.038**	EIC515DP001S O01-15-	**1.72**	16CHEHTSB02 S02	--	--	--	--	--	--	--	--
1-Methylnaphthalene	8270D	0.41	0.041	--	0.41	**25**	17CHEFSSB06S 02	**3.46**	16CHEHTSB02 S02	--	--	--	--	--	--	--	--
2-Methylnaphthalene	8270D	1.3	0.13	--	1.3	**40.5**	17CHEFSSB06S 02	**3.54**	16CHEHTSB02 S02	--	--	--	--	--	--	--	--
Benzo(a)anthracene	8270D	0.28	0.028	--	0.28	**0.301 (J)**	17CHEFSSB06S 02		--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	8270D SIM/8310	2.7	0.27	--	2	--	--	--	--	--	--	--	--	--	--	0.4	STLW-3
Benzo(a)pyrene	8270D SIM/8310	0.27	0.027	--	0.2	**0.214 (J)**	17CHEFSSB06S 02	--	--	--	--	--	--	--	--	0.4	STLW-3
Dibenzo(a,h)anthracene	8270D SIM/8310	0.87	0.0087	--	0.28	--	--	--	--	--	--	--	--	--		0.4	STLW-3
1,2,4-Trimethylbenzene	8260B	0.16	0.016	--	0.16	**1.61**	17CHEFSSB07S 02	**0.813**	16CHEHTSB02 S02	--	--	--	--	--	--	--	--
1,4-Dichlorobenzen	8260B	0.037	0.0037	--	0.037	--	--	--	--	**0.0621**	16CHELWSB04 S01	--	--	--	--	--	--
TCE	8260B	0.011	0.001	--	0.011	--	--	**0.0431**	16CHEHTSB02 S02	**0.0273 (J)**	16CHELWSB04 S01	--	--	**0.0273**	17CHEBBSB 10S91	--	--
Aluminum*	6020A	30,000*	3,000*	13,019	30,000	10800	EIC515DP001S O01-02	9590	EIC515DP002S O01-01	9940	EIC515DP003S O01-15	8280	EIC515DP004S O01-01	13900	EIC515DP005 SO01-10	16000	EIC515DP006S O01-05
Antimony	6020A	4.6	0.46	1.141	4.6	--	--	--	--	--	--	--	--	--	--	**6**	STLW-4
Arsenic	6020A	0.2	0.02	22.72	22.7	10.2	EIC515DP001S O01-02	8.4	EIC515DP002S O01-01	11.1	EIC515DP003S O01-02	8.52	EIC515DP004S O01-01	16	BB-6	15	EIC515DP006S O01-05
Barium	6020A	2,100	210	160	2,100	--	--	--	--	--	--	--	--	--	--	184	STLW-4

Table 8-1. (continued).

						30,000-Gallon Diesel and Gasoline USTs		10,000-Gallon Heating Oil UST		Former Building Leach Field		Former Lube Oil Drum Pit		Former Burn Barrel		Former Septic Tank	
COPC	**EPA Method**	**ADEC Cleanup Level[1]**	**Screening Level[2]**	**Metals BTV[3]**	**PAL**	**Highest Concen.**	**Sample ID**	**Highest Concen.**	**Sample ID**	**Highest Concen.**	**Sample ID**	**Highest Concen.**	**Sample ID**	**Highest Concen.**	**Sample ID**	**Highest Concen.**	**Sample ID**
Cadmium	6020A	9.1	0.91	0.294	9.1	--	--	--	--	1	LEACH WELL	--	--	--	--	2	STLW-4
Total Chromium*	6020A	25	12.5	28.34	28.34	--	--	27.9	EIC515DP002S O01-05	**72**	LEACH WELL	--	--	--	--	--	--
Chromium-Hexavalent	6020A	0.89	0.089	--	0.089	**0.62 (J)**	17CHEFSSB05S 02	**0.21 (J)**	17CHEHTSB03 S01	**0.27**	17CHELWSB06 S01	**0.21 (J)**	17CHEDPSB04S 91	--	--	--	--
Cobalt*	6020A	0.27*	0.027*	14.59	14.6	7.4	EIC515DP001S O01-02	6.75	EIC515DP002S O01-01	7.05	EIC515DP003S O01-15	5.77	EIC515DP004S O01-01	9.8	EIC515DP005 SO01-10	11.4	EIC515DP006S O01-05
Copper	6020A	370	37	64.29	370	--	--	--	--	--	--	--	--	193	BB-6	53	Septic-20
Iron*	6020A	350*	35*	32,002	32000	18,900	EIC515DP001S O01-02	**32,000**	16CHEHTSB01 S01	18300	EIC515DP003S O01-15	**32,200**	16CHEDPSB01S 01	23,600	EIC515DP005 SO01-10	29,000	EIC515DP006S O01-05
Lead	6020A	400	40	11.96	400	--	--	--	--	360	LWP-20	--	--	--	--	**910**	Septic-40
Manganese*	6020A	28*	2.8*	543.5	543	264	EIC515DP001S O01-02	235	EIC515DP002S O01-01	234	EIC515DP003S O01-01	212	EIC515DP004S O01-10	316	EIC515DP005 SO01-10	0.3	STLW-2 & STLW-3
Molybdenum*	6020A	2.0*	0.2*	--	2	1.64	EIC515DP001S O01-15	**2.07**	17CHEHTSB03 S01	**3.3**	EIC515DP003S O01-02	**2.07**	16CHEDPSB01S 01	**9.02**	16CHEBBSB 02S01	**2.04**	16CHESTSB04 S02
Nickle	6020A	340	34	35.18	340	--	--	--	--	--	--	--	--	--	--	30	STLW-4 & Septic-20
Selenium	6020A	6.9	0.69	0.926	6.9	0.95	EIC515DP001S O01-01	1.07	EIC515DP002S O01-02	1	LWP-20 & LWP-37	0.8	EIC515DP004S O01-05	--	--	1	Septic-180
Silver	6020A	11	1.1	0.141	11	--	--	--	--	**64.1**	EIC515DP003S O01-05	--	--	**381**	16CHEBBSB 02S01	**43**	Septic-160
Thallium	6020A	0.19	0.019	--	0.19	**0.84**	EIC515DP001S O01-10	**0.8**	EIC515DP002S O01-10	**0.94**	EIC515DP003S O01-15	**0.76**	EIC515DP004S O01-05	**0.78**	EIC515DP005 SO01-02	**1.55**	EIC515DP006S O01-02
Total Tetra-Dioxins		3.9	0.39	--	3.9	--	--	--	--	--	--	--	--	**16.2**	17CHEBBSB 09S01	--	--
PCBs	8082A/ 8080	1	0.1	--	1	0.17	EIC515DP001S O01-01	--	--	0.115	Chena Site #3	--	--	--	--	--	--
gamma-BHC	8081A	0.0064	0.00064	--	0.0064	0.00084	EIC515DP001S O01-15	--	--	--	--	--	--	--	--	--	--
alpha-BHC	8081A	0.0064	0.00064	--	0.0064	--	--	0.00101	EIC515DP002S O01-10	--	--	--	--	--	--	--	--

--Bold highlighted cells represent PAL exceedances. All others exceed screening levels.
[1] ADEC Cleanup Level is most stringent Method 2 migration to groundwater or Under 40 inch human health risk value.
[2] Screening Level is 1/10th the ADEC most stringent Method 2 cleanup level.
[3] Metals BTV from Upper Prediction Limit (UPL) for Fluvial Soil (USAF, 2014b).
* Subject analytes do not have published ADEC Method 2 cleanup levels; therefore, cleanup levels and screening levels are derived from EPA RSLs for resident soil or protection of groundwater risk-based or maximum contaminant level (MCL)-based soil screening levels (SSLs), with preference on MCLs when they exist.

Table 8-2. COPCs in groundwater.

						30,000-Gallon Diesel and Gasoline USTs		10,000-Gallon Heating Oil UST		Former Building Leach Field		Former Lube Oil Drum Pit		Former Burn Barrel		Former Septic Tank	
COPC	**EPA Method**	**ADEC Cleanup Level[1]**	**Screening Level[2]**	**Metals BTV[3]**	**PAL**	**Highest Concen.**	**Sample ID**	**Highest Concen.**	**Sample ID**	**Highest Concen.**	**Sample ID**	**Highest Concen.**	**Sample ID**	**Highest Concen.**	**Sample ID**	**Highest Concen.**	**Sample ID**
DRO	AK102	1.5	0.15	--	1.5	**19**	W-1/EX1	**57**	MW-2	**5.72**	Leach Well					**89**	MW-5
GRO	AK101	2.2	0.22	--	2.2	--	--	0.24	MW-2	--	--	--	--	--	--	--	--
RRO	AK103	1.1	0.11	--	1.1	0.8	MW-3	**1.230 B**	EIC515MW002 GW01-20	**2.74**	Leach Well	0.396	EIC515MW004 GW01-20	0.134	EIC515MW005 GW01-20	**13.2**	MW-5
Benzene	8260B/ AK101	0.0046	0.00046	--	0.0046	**0.001**	W-1/EX1	--	--	--	--	--	--	--	--	--	--
Arsenic	6020A	0.00052	0.000052	0.0054	0.00052	**0.216**	MW-3	**0.272**	MW-2	**0.273**	MW-4	--	--	**0.0235**	EIC515MW005 GW01-20	**0.316**	MW-5
Barium	6020A	3.8	0.38	0.19	3.8	1.95	MW-3	3.15	MW-2	2.48	MW-4	--	--	--	--	2.05	MW-5
Cadmium	6020A	0.0092	0.00092	0.00023	0.0092	**0.004**	MW-3	**0.021**	MW-2	**0.018**	MW-4	--	--	--	--	**0.012**	MW-5
Chromium	6020A	0.1*	0.01	--	0.1	**0.198**	MW-3	**0.207**	MW-2	**0.389**	MW-4	--	--	**0.014 B**	EIC515MW005 GW01-20	**0.286**	MW-5
Cobalt	6020A	0.006*	0.0006*	0.0051	0.006	.0013 B	EIC515MW001 GW01-20	.0011 B	EIC515MW002 GW01-20	0.0035	EIC515MW003 GW01-20	--	--	**0.0068 B**	EIC515MW005 GW01-20	**0.023**	EIC515MW006 GW01-15
Iron	6020A	14*	1.4*	2.4	14	7	EIC515MW001 GW01-20	6.71	EIC515MW002 GW01-20	**14.8**	EIC515MW003 GW01-20	4.81	EIC515MW004 GW01-20	**21.7**	EIC515MW005 GW01-20	9.28	EIC515MW006 GW01-15
Lead	6020A	0.015	0.0015	0.00035	0.015	**0.188**	MW-3	0.252	MW-2	**0.296**	MW-4	.0022 B	EIC515MW004 GW01-20	0.0144	EIC515MW005 GW01-20	**0.428**	MW-5
Manganese	6020A	0.43*	0.043*	2.9	2.9	--	--	--	--	--	--	--	--	--	--	2.05	EIC515MW006 GW01-15
Mercury	7470A/245.1	0.00052	0.000052	--	0.00052	0.0002	MW-3	0.0004	MW-2	**0.0008**	MW-4	--	--	--	--	**0.0015**	MW-5
1,4-Dichlorobenzene	8260B	0.0048	0.00048	--	0.0048	--	--	--	--	**0.018**	Leach Well	--	--	--	--	--	--
TCE	8260B	0.0028	0.00028	--	0.0028	--	--	--	--	**0.19**	Leach Well	--	--	--	--	0.0018	S.E.G.W.1
PCBs	8082A/ 8080	0.0005	0.00005	--	0.0005											0.0001	S.E.G.W.1

Bold highlighted cells represent PAL exceedances. All others exceed screening levels.
[1] ADEC Cleanup Level from Table C.
[2] Screening Level is 1/10th the ADEC most stringent Method 2 cleanup level.
[3] Metals BTV from UPL for Groundwater (USAF, 2014a).
* Subject analytes do not have published ADEC Method Two cleanup levels; therefore, cleanup levels and screening levels are derived from EPA RSLs for tap water or MCLs, with preference on MCLs when they exist.

(This page intentionally left blank)

9. DATA QUALITY INDICATORS

Data quality indicator (DQI) criteria were established to ensure precision, accuracy, representativeness, comparability, completeness, and sensitivity of analysis for the analytical fractions and for the media sampled. Analytical quality control (QC) procedures are detailed in the most current revisions of SW846 and Alaska Methods of Analyses (DRO, GRO, and RRO) methodologies and laboratory specific criteria. Analytical precision, accuracy, and sensitivity DQIs required for this project are provided in the laboratory statements of work.

The DQIs provide a mechanism for ongoing control by evaluating and measuring data quality throughout the project. These criteria are defined in the sections below. Individual sample delivery group validation reports with specific sample detail are provided in Appendix H.

9.1 Precision

Precision is a quantitative term that estimates the reproducibility of a set of replicate measurements under a given set of conditions. It is defined as a measurement of mutual agreement between measurements of the same property, and is expressed in terms of relative percent difference (RPD) between duplicate determinations.

RPD is calculated as follows:

RPD = Absolute Value [(C1-C2)/{(C1+C2)/2)}] x 100%

Where:

C1 = Concentration of split sample #1.

C2 = Concentration of split sample #2.

Laboratory analytical precision for the reported data is determined by review of the laboratory duplicate results. Field duplicate precision is determined by review of field duplicate results. Analytical precision cannot be determined if one of the reported values is less than the reporting limit (RL) (non-detect). Therefore, when an analyte is not detected in both the parent and duplicate sample, the RPD result is reported as not calculable. When one concentration is above and one below the RL, the criteria used is that the detected result must be less than two times the RL of the non-detect sample.

The field duplicate RPD criterion is 50% and the laboratory duplicate RPD criterion is 35%. Duplicate results for concentrations close to the detection limits are reviewed based on their absolute differences as compared to their respective quantitation limit values. When the analyte concentration is less than five times the RL in either sample, the criteria used is the absolute difference between the two values, which should be less than the RL.

Field duplicates were collected at the prescribed frequency of one field duplicate pair per 20 samples.

All laboratory and field duplicate RPD results were within the prescribed acceptance criteria, and all results are considered usable. The data validation reports provided in Appendix H detail these results.

9.2 Accuracy

Accuracy is the degree of agreement of a measurement with an accepted reference or true value, and is a measure of the bias in a system. Accuracy of the laboratory data was assessed by comparing laboratory control sample (LCS) recovery, MS recovery, and other applicable laboratory QC. Accuracy is expressed as a percent recovery, which was calculated as follows:

$$Percent\ Recovery = \frac{(Total\ Analyte\ Found - Analyte\ Originally\ Present)}{Analyte\ Added}\ x\ 100$$

Various dioxins, metals, VOCs, SVOCs, GRO, DRO, RROs, and hexavalent chromium were outside the prescribed acceptance criteria for matrix spike (MS)/matrix spike duplicate (MSD), LCS, and deuterated monitoring compounds/surrogates. When applicable, all non-detect results have been qualified with a “UJ” validation flag, and all associated detectable results have been qualified with a “J” validation flag. These data are still considered useful for decision making purposes.

9.3 Sample Preservation and Holding Times

Sample preservation, handling, and holding times are evaluated during the validation process.

The hexavalent chromium samples were collected on 05/09/17 through 05/13/17. The samples were shipped from SGS North America to ALS Houston and received on 05/18/17. The samples were received by ALS and cooled to 0.1 to 1.8 degrees Celsius (°C). Samples were prepared for hexavalent chromium analysis on 05/31/17 and analyzed on 06/03/17. EPA Method 7196A has an established 25-hour holding time from sample extraction/preparation to analysis. The samples were analyzed outside the 24-hour holding time. All non-detect sample results have been qualified with a “UJ” validation flag, and all detectable results have been qualified with a “J-” validation flag.

All remaining analyses by 6020A (Metals by ICP-MS), 8260B (VOCs), 8270C (SVOCs), 8011, 8270B SIM, AK103, AK102, AK101, 8082A (PCBs), and 8290 (Dioxins) were properly preserved and analyzed within the prescribed holding times.

9.4 Blank Contamination

As stated in the field sampling plan, disposable sampling equipment was utilized, which eliminated the need for equipment/rinsate blanks. Field blank were not collected for hexavalent chromium analysis.

The laboratory method blanks were non-detect at the method detection limit (MDL). This indicates that no potential sample contamination was introduced during the laboratory sample preparation procedures. The data were not impacted due to blank results.

9.5 Representativeness, Comparability, and Sensitivity

Representativeness and comparability are achieved by using approved, documented, sampling procedures and analytical methodologies. By following the approved Quality Assurance Project Plan (QAPP), sampling events should yield results representative of environmental conditions at the time of sampling. Similarly, reasonable comparability of analytical results for this, and future sampling events, can be achieved if the same approved analytical methods and sampling procedures are employed.

A review of reported sample result detection limits compared to the QAPP requirements ensures the collected data meet project objectives for sensitivity.

Representativeness

Representativeness is a qualitative term that expresses the degree to which the sample data accurately and precisely represent the environmental conditions corresponding to the location and depth interval of sample collection. Requirements and procedures for sample collection and analysis are designed to maximize sample representativeness.

Representativeness can be monitored by reviewing field documentation and/or performing field audits. Chain of custody forms and field notes were reviewed by the field team leader for the dry weather sampling event. The field team leader also performed audits of the sampling activities, including checking paperwork and sampling methods.

Field sampling accuracy was attained through strict adherence to the approved final work plan and by using approved analytical methods for sample analyses. Based on this, the data should represent as near as possible the actual field conditions at the time of the sampling.

Deviations to the planned sampling activities were minimal and did not compromise the quality of the data to represent conditions within the project area. All analytical methods were acceptable; therefore, the data collected are suitable for a representative characterization of the project area.

Comparability

Comparability is a qualitative term that expresses the confidence with which a data set can be compared with another. Strict adherence to standard sample collection procedures, analytical detection limits, and analytical methods assures that data are comparable. This comparability is independent of laboratory personnel, data reviewers, or sampling personnel. Comparability criteria are met for the project if, based on data review, the sample collection and analytical procedures are determined to have been followed, or defined, to show that variations did not affect the values reported.

To ensure comparability of data generated for the site, standard sample collection procedures and approved analytical methods were utilized by North Wind personnel. Sample analyses were performed by the subcontract laboratories using the equivalent methodology. Utilizing such procedures and methods enables the current data to be comparable with the previous data sets generated with similar methods.

For the purposes of this data usability report, comparability has been met.

Sensitivity

Sensitivity is related to the ability to compare analytical results with project-specific levels of interest (i.e., delineation levels or action levels). Analytical quantitation limits for the various sample analytes should be below the level of interest to allow for an effective comparison.

Each analytical method used during the monitoring sampling was chosen because it has a RL at or below the level of concern. For each analyte, the QAPP provided a RL that the laboratory was to achieve to provide analytical results at or below regulatory comparison criteria.

The RL is generally equal to or greater than the MDL. The RLs are set above MDLs to allow for sample matrix interferences and minimize false positives.

Development of the MDL is detailed in 40 Code of Federal Regulations (CFR) 136, Appendix B, as "…the minimum concentration of a substance that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero." Generated by statistical analysis of multiple analyses of a low-level standard, MDLs represent the best fundamental measurement of instrument sensitivity and the basis for establishing RLs.

RLs are a compromise between analytical sensitivity and precision. Setting low RLs can lead to poorly defensible data due to false positive (Type I) and/or false negative (Type II) errors, whereas elevated RLs can hamper site characterization. Laboratory determinations of MDLs are performed on non-typical samples (e.g., distilled water) leading to idealized limits. Confidence in detection limits increases when the instrument signal level is above the MDL, and higher limits mean better precision.

Laboratory results are reported according to rules that provide established certainty of detection and RLs. The laboratory reported non-detect results as “ND,” indicating the result is less than the RL.

Detection limits were low enough to meet the project objectives for all events.

9.6 Data Completeness

Completeness of the field program is defined as the percentage of samples planned for collection (as listed in the QAPP) versus the actual samples collected during the field program (see Equation A).

$$\%\,Field\ Completeness = C\ x\ \frac{100}{n} \qquad \text{(A)}$$

Where:

C = actual number of samples collected.

N = total number of samples planned.

Completeness for acceptable data is defined as the percentage of acceptable data obtained (judged to be valid) versus the total quantity of data generated (see Equation B.) Acceptable data include both data that pass all the QC criteria (i.e., unqualified data) and data that may not pass all of the QC criteria but had appropriate corrective actions taken (i.e., qualified but useable data).

$$\%\,Analytical\ Completeness = V\ x\ \frac{100}{n'} \qquad \text{(B)}$$

Where:

V = number of measurements judged valid.

n’ = total number of measurements made.

Completeness goals for both the number of samples collected in the field and for sample results that are usable for project decisions (i.e., not rejected and appropriately qualified, if required) have been met for both the sampling events. While associated results were either qualified with a “J-” or “UJ” validation flag, they were not rejected and are useful for qualitative purposes.

9.7 Assessment of Data Usability and Reconciliation with QAPP Goals

For the Chena River/Eielson AFB 2016-2017 sampling event, no qualifiers were applied due to the field QC parameters. Qualifiers were applied to all of the data sets due to laboratory QC parameters. The field QC parameters were determined to contain potential bias due to:

- Anomalous accuracy and sample results analyzed outside the holding time,
- Poor MS/MSD recoveries, and
- Poor LCS/LCS duplicate recoveries.

Data users are cautioned to use the qualified results for qualitative purposes, and they may be used to guide project decisions.

(This page intentionally left blank)

10. SUMMARY AND CONCLUSIONS

10.1 Summary of Results

The scope of this site characterization was to delineate the extent of soil and groundwater contamination at six areas of known contamination at Source Area SS515. Historical sampling events were primarily focused on the immediate vicinity of each area. This site characterization consisted of collecting and analyzing 101 soil samples and seven groundwater samples for fuels and PAHs, volatile compounds, metals (including mercury and hexavalent chromium), and PCBs. Additionally, dioxins were analyzed for only at the burn barrel area.

A summary of the results of the site characterization activities is provided below:

- Fuel and hydrocarbon related contamination remains in soils at concentrations exceeding the PALs around the 30,000-gallon diesel and gasoline USTs, 10,000-gallon heating oil UST, leach building leach well, and septic tank.
- TCE was detected in soils on the west side of the site area in samples collected from the burn barrel area, heating oil UST, drum pit, and building leach well. Historically, TCE was detected in a water sample collected from the bottom of the building leach well excavation.
- PCBs were detected in one sample collected south of the heating oil UST.
- Several metals, including calcium, iron, molybdenum, and potassium, were detected in a few samples at concentrations exceeding the PAL at three of the source areas.
- Silver and dioxin were detected at concentrations exceeding the PAL in samples collected in the vicinity of the former burn barrel.
- Hexavalent chromium was detected at concentrations exceeding the PAL in 15 samples collected at varying depths throughout the site. All of the hexavalent chromium analytical data were estimated and the quality of the data is suspect low due to:
- Holding times after extraction were exceeded,
- MS/MSD recoveries were low,
- Laboratory control sample recoveries were less the recovery criteria, and
- Reported results are less than the limit of quantitation (LOQ).

Note: The hexavalent chromium data should not be used to make remedial decisions due to quality issues.

The following paragraphs summarize the findings of historical sampling events and the 2016/2017 site characterization for each potential source area.

30,000-Gallon Diesel and Gasoline USTs

- Contaminants present at concentrations exceeding the PAL at the 30,000-gallon diesel and gasoline USTs are primarily fuel related compounds. These contaminants were identified in soils in the bottom and all four sidewalls of the former excavation at a depth of 14 to 16 feet.

- Fuel related contaminants were also detected at concentrations exceeding the PALs in soil samples collected up to 40 feet south of the former excavation. Contamination detected south of the former excavation occurs at a depth of 8 to 15 feet. The extent of contamination to the south is undefined.

- Soil contamination to the north, east, and west of the former excavation is well defined and does not extend beyond the former excavation, as documented by six borings drilled on all three sides. Analysis of soil samples collected from these borings did not detect any contaminants at concentrations exceeding the PAL.

- Thallium was detected at concentrations exceeding the PAL in all samples collected from one boring drilled through the center of the former excavation during the 2102 Source Evaluation (USAF, 2013). It should be noted that thallium was detected in all samples collected during the 2012 Source Evaluation and all of the concentrations were estimated. Thallium was not detected at concentrations exceeding the PAL during any other sampling events.

- Hexavalent chromium was detected at concentrations exceeding the PAL in five soil samples. All hexavalent chromium concentrations, which were estimated due to detections below the LOQ, exceeded the holding times.

- No contaminants were detected in groundwater at concentrations exceeding the PAL in monitoring well MW-10, which is located on the east side of the former tank hold.

10,000-Gallon Heating Oil UST

- Based on historical analytical results, fuel related contamination, at concentrations exceeding the PALs, remains in soils at the bottom of the former tank hold.

- Soil contamination to the north, northeast, and west of the former tank hold is well defined and does not extend beyond the former excavation, as documented by three borings. Analysis of soil samples collected from these borings did not detect any contaminants at concentrations exceeding the PAL.

- Fuel related contaminants, at concentrations exceeding the PALs, were detected in soil samples collected south, southeast, and southwest of the former tank hold. Fuel contamination in these areas occurs at a depth of 1 to 15 feet. The extent of fuel contamination in these directions is undefined.

- TCE was detected in two samples, at concentrations exceeding the PAL, collected immediately south of the former tank hold at a depth of 13 to 15 feet.

- Arochlor-1254 was detected in one sample collected to the southeast of the former tank hold at a depth of 1 to 3 feet.

- Thallium was detected at concentrations exceeding the PAL in all samples collected from one boring drilled through the center of the former excavation during the 2102 Source Evaluation. It should be noted that thallium was detected in all samples collected during the 2012 Source Evaluation, and all of the concentrations were estimated. Thallium was not detected during any other sampling events.

- Hexavalent chromium was detected at concentrations exceeding the PAL in two soil samples. All hexavalent chromium concentrations were estimated (due to detections below the LOQ) and exceeded the holding times.

- DRO was the only contaminant that exceeded the PAL in groundwater at monitoring well MW-08 during the 2016/2017 site characterization. Analysis of groundwater samples collected at open boreholes during previous investigations detected RRO, arsenic, cadmium, chromium, lead, and mercury.

Former Building Leach Well

- Based on historical analytical results, fuel related contamination, at concentrations exceeding the PALs, remains in soils at a depth of 3 to 4 feet beneath the former piping location.

- Fuel contamination in soils exceeding the PALs extends at least 10 feet south of the former excavation along the former leach well. Contamination at this location was identified at a depth of 6.5 to 8 feet. TCE was also detected at concentrations exceeding the PAL in this sample. The extent of contamination along the septic pipe is further defined and described below in the Former Septic Tank discussion.

- Soil contamination to the north, east, and west is well defined and does not extend beyond the former excavation, as documented by four borings. Analysis of soil samples collected from these borings did not detect any contaminants at concentrations exceeding the PAL.

- Thallium was detected at concentrations exceeding the PAL in all samples collected from one boring drilled through the center of the former excavation during the 2102 Source Evaluation. It should be noted that thallium was detected in all samples collected during the 2012 Source Evaluation, and all of the concentrations were estimated. Thallium was not detected during any other sampling events.

- Hexavalent chromium was detected, at concentrations exceeding the PAL, in one soil sample. All hexavalent chromium concentrations were estimated (due to detections below the LOQ) and exceeded the holding times.

- Analysis of groundwater samples from monitoring well MW-07 detected arsenic, cobalt, and sodium. Monitoring well MW-07 is located southeast of the former leach well area.

Former Lube Oil Drum Pit

- The precise location of the former Lube Oil Drum Pit is currently in question. Figure 3 in the Release Investigation Report (USAF, 2000) shows the pit immediately north of the former generator room. In 2012, as part of the source evaluation, one boring was reportedly drilled through the center of the pit. Based on figures presented in this report, the boring is located north and west of the area identified during the 2000 release investigation. Borings drilled during this 2016/2017 site characterization are in proximity to the area identified during the 2012 source evaluation.

- In 1998, no contaminants at concentrations exceeding the PALs were detected from a soil sample collected from the bottom of the excavation.

- Thallium was detected at concentrations exceeding the PAL in all samples collected from one boring supposedly drilled through the center of the former excavation during the 2102 Source Evaluation. It should be noted that thallium was detected in all samples collected during the 2012 Source Evaluation, and all of the concentrations were estimated. Thallium was not detected during any other sampling events.

- TCE was detected, at a concentration exceeding the PAL, in one sample collected at a depth of 9 to 10 feet to the northwest of the Former Lube Oil Drum Pit.

- Hexavalent chromium was detected in six samples, at concentrations exceeding the PAL, over the general area north and west of the Former Lube Oil Drum Pit. All hexavalent chromium concentrations were estimated due to detections below the LOQ.

- No contaminants exceeded the PAL in groundwater from monitoring well MW-09.

Former Burn Barrel

- Silver was detected, at concentrations exceeding the PAL, in surface soils immediately surrounding the former burn barrel and near surface soils to the southeast. The extent of silver contamination in surface soil is not well defined.

- Dioxin was detected in two surface soil samples approximately 40 to 45 feet south and southeast of the former burn barrel.

- TCE was detected, at concentrations exceeding the PAL, at one location approximately 35 feet due south of the former burn barrel.

- Groundwater results for monitoring well MW-11 showed arsenic exceeded the PAL. Analysis of groundwater samples collected from an open bore hole during previous investigations detected RRO, arsenic, chromium, cobalt, and iron.

Former Septic Tank

- Historical data indicated that soil beneath the northern 160 feet of septic pipe is impacted by silver at concentrations exceeding the PAL.

- The southern portion of the septic pipe area appears to have been adequately remediated.

- One boring drilled at the northern end of the former septic tank contained thallium at concentrations exceeding the PAL. All other samples collected in association with the former septic tank indicate the area has been remediated.

- Fuel contamination appears to remain in the septic well area south of the septic tank. Two locations exhibit DRO concentrations exceeding the PAL.

- Groundwater results for monitoring well MW-12 showed an exceedance for arsenic and cobalt only.

10.2 Recommendations

10.2.1 Soil

A majority of the contaminants remaining in soil at concentrations greater than the PALs are petroleum related contaminants; however, TCE, silver, dioxin, and PCBs were also detected in some samples. Thallium was detected in all soil samples at estimated concentrations collected during the 2012 Source Evaluation (USAF, 2013). Hexavalent chromium was detected at estimated concentrations in soil samples collected during the 2016/2017 site characterization. The 2016/2017 site characterization efforts did not fully delineate the extent of soil contamination in some of the source areas. The following sections provide recommendations for additional characterization of each potential source area.

30,000-Gallon Diesel and Gasoline USTs

- Additional characterization of petroleum related contaminants is recommended to the south and southeast of the former tank hold to better define the extent of soil contamination.
- While petroleum related contaminants are still present in the bottom and all four side walls of the former excavation, the areas immediately north, east, and west of the former excavation are well defined and require no additional characterization.

10,000-Gallon Heating Oil UST

- Additional characterization of petroleum related contaminants is recommended to better define the extent of contamination to the southwest, south, and southeast of the former heating oil tank. The characterization should include TCE, which was detected in two samples collect due south of the tank hold area.
- Petroleum contamination remains in the bottom of the former tank hold at a depth of 9 to 15 feet; however, areas to the north, east, and west are well defined and require no additional characterization.
- TCE was also detected in samples associated with the former burn barrel and the leach well area. While TCE has not been detected in groundwater, a comprehensive site-wide groundwater sampling event, as described below, will assist with characterization.
- The presence of PCBs detected to the southeast of the former tank should be further characterized by collecting additional samples in the four cardinal directions around the original sample location.

Former Building Leach Well

- Additional characterization of petroleum related contaminants is recommended to better define the extent of contamination to the south of the building leach well. Silver was also detected in several samples in the immediate vicinity and south of the building leach well and should be included in the characterization.
- Areas to the north, east, and west of the building leach well are well defined and require no additional characterization.
- TCE was detected in one sample collected due south of the building leach well and should be included with additional characterization. TCE was also detected in samples associated with the former burn barrel and the 10,000-gallon heating oil UST. While TCE has not been detected in groundwater, a comprehensive site-wide groundwater sampling event, as described below, will assist with characterization.

Former Lube Oil Drum Pit

- Reconciliation of the actual location of the former drum pit should be conducted through historical aerial photograph analysis.
- Generally, the area appears well characterized, with the exception of hexavalent chromium and thallium throughout the general area. These contaminants are discussed site wide in later paragraphs.

Former Burn Barrel

- Silver was detected in surface soils in an area to the southeast of the former burn barrel. Dioxin was also detected in two samples collected south-southeast of the former burn barrel. Additional characterization of surface soils in the vicinity of the former burn barrel should be conducted using a grid system.

- TCE detected in a boring directly south and along the western edge of the area should be further characterized. TCE was also detected in samples associated with the former building leach well and the 10,000-gallon heating oil UST. While TCE has not been detected in groundwater, a comprehensive site-wide groundwater sampling event, as described below, will assist with characterization.

Former Septic Tank

- Additional characterization is recommended along the northern end of the septic piping to better delineate silver, petroleum related contaminants, and TCE immediately south of the former leach well.

- Additional characterization is recommended at the southern end of the septic piping in the vicinity of the former leach wells to delineate DRO contamination.

- Hexavalent chromium was not analyzed in any of the historical soil samples collect from this location. Due to the proximity of hexavalent chromium detections in samples collected from the former Building Leach Well it is recommended that future soil sampling at the Former Septic Tank location include hexavalent chromium analysis.

Site Wide

Hexavalent chromium was detected at concentrations exceeding the PAL in 15 samples throughout the entire site area. All detected concentrations were estimated because:

- The result was less than the limit of quantitation,

- The holding times after extraction were exceeded,

- The MS/MSD recoveries were low, and

- Laboratory control sample recoveries were less than the recovery criteria.

Thus, the resulting data do not have a high degree of confidence. Resampling of locations where the highest concentrations were detected could be conducted to verify results. Hexavalent chromium analysis should also be conducted on soil samples collected at the Former Septic Tank location. Hexavalent chromium should be included in future site-wide groundwater sampling events, as described in the following section.

Thallium was only detected in samples collected during the 2012 Source Evaluation sampling event. Thallium was detected in nearly every sample at similar concentrations, and all detected concentrations were estimated. Because thallium was not detected at concentrations exceeding the PAL during any other sampling event, additional characterization of thallium is not recommended.

10.2.2 Groundwater

Historically, DRO and various metals have been detected in groundwater samples collected from open excavations, open boreholes, and permanent monitoring wells since 1999. Samples collected from open excavations and open boreholes are suspect due to the likelihood of turbidity introduced in the samples at the time of sampling. In 2016, groundwater samples were collected from six newly installed monitoring wells but not from the historical monitoring wells.

During the most recent sampling event, DRO was detected at concentrations exceeding the PAL in one sample. Several metals were also detected at concentrations exceeding the PAL; however, these samples were collected as total metals with no filtration. Due to the fine grain nature of the aquifer, it is recommended that both dissolved and total metals analysis be conducted and compared. Based on the recent sampling event, groundwater in the immediate vicinity of the site does not appear to be significantly impacted by historic site operations. However, due to the sporadic nature and the questionable quality of the historically collected samples, it is recommended that additional groundwater sampling be conducted.

It is recommended that all 12 monitoring wells be sampled at the same time – once in the spring and once in the fall – to document the effects of seasonal fluctuations and to provide comparable data across the entire site. Additionally, water levels should be recorded during each sample event to determine how seasonal fluctuations may affect groundwater flow directions.

Laboratory analysis for each sampling event should include DRO, GRO, RRO, PAHs, VOCs, dioxin, hexavalent chromium, and total/dissolved metals.

(This page intentionally left blank)

11. REFERENCES

18 AAC 75, *Oil and Other Hazardous Substances Pollution Control*, Alaska Department of Environmental Conservation, Alaska Administrative Code, as amended January 2016.

40 CFR 136, Title 40, "Protection of Environment," Part 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants," *Code of Federal Regulations*.

ADEC, 2013. *Monitoring Well Guidance*, Alaska Department of Environmental Conservation, September 2013.

ADEC, 2016. *Field Sampling Guidance*, Division of Spill Prevention and Response Contaminated Sites Program, State of Alaska Department of Environmental Conservation. March 2016.

ADEC, 2017. *Guidance on Developing Conceptual Site Models,* Division of Spill Prevention and Response Contaminated Sites Program, State of Alaska Department of Environmental Conservation, January 2017.

ADOT, 2005. *Alaska Field Guide for Soil Classification,* Alaska Department of Transportation and Public Facilities.

AFCEC, 2014. *Hazardous Waste Management Plan*. Eielson Air Force Base, Alaska. Compiled by 354 CES/CEIE. February.

AFCEC, 2015. *Investigation-Derived Waste Management Plan. Eielson Air Force Base, Alaska*. Prepared by The United States Air Force Installation Restoration Program. Pre-Draft. AFC-JO7-05PC1691-J16-0001. July.

Alaska Climate Research Center, 2015. Climate data for Eielson AFB retrieved from: http://climate.gi.alaska.edu/Climate/Normals on 16 November 2015.

North Wind, 2016. *Final Work Plan for Source Area SS515 Site Characterization, Eielson Air Force Base, Alaska*, ADEC File No. 107.38.096, North Wind, Inc., August 2016.

Péwé, 1975. *Quaternary Geology of Alaska*. Professional Paper 835, USGS Numbered Series.

Péwé and Reger, 1983. "Guidebook to Permafrost and Quaternary Geology along the Richardson and Glenn Highways between Fairbanks and Anchorage, Alaska." *Alaska Division of Geological and Geophysical Surveys*.

USAF, 1993. *Final Site Investigation Report Chena River Research Site*, *Eielson Air Force Base, Alaska*. Prepared by Woodward-Clyde. February 1993.

USAF, 1999. *Site Characterization Report Chena River Research Site, Eielson Air Force Base, Alaska.* Draft. Prepared by AGRA Earth and Environmental, Inc. October 1999.

USAF, 2000*. Release Investigation Report Chena River Research Site, Eielson Air Force Base, Alaska. Final*. Prepared by AGRA Earth and Environmental, Inc. December 2000.

USAF, 2001. *Summary of Groundwater Flow Direction and Gradient, June 2000 through December 2000, Chena Annex, Eielson Air Force Base, Alaska*. Prepared by AMEC Earth and Environmental, Inc. April 2001.

USAF, 2002. *2001 Sitewide Monitoring Program Report Eielson Air Force Base, Alaska*. Prepared by FosterWheeler Environmental Corporation and EA Science and Engineering Technology, Inc. March 2002.

USAF, 2013. *Final Phase 1 Source Evaluation Report for Multiple Sites at Eielson Air Force Base, Alaska*. Prepared by CH2M Hill, Inc. July 2013.

USAF, 2014a, *Final Report on the Background Study of Metals in Groundwater, Eielson Air Force Base, Alaska*, Revision 0, Prepared by EA Engineering, Science, and Technology, Inc., United States Air Force, March 2014.

USAF, 2014b. *Final Report on the Background Study of Metals in Soil, Eielson Air Force Base, Alaska*, Revision 1, Prepared by EA Engineering, Science, and Technology, Inc., United States Air Force, January 2014.

USAF, 2015. *2014 Institutional Controls/Land Use Controls Annual Report*, *Eielson Air Force Base, Alaska*, Prepared by EA Engineering, Science, and Technology, Inc., United States Air Force, August 2015.

Von Rueden, Gerald R., 2003-2008. *Integrated Natural Resources Management Plan. Eielson Air Force Base, Alaska*. First Revision. June 2003 to May 2008.

WHO, 2005. *Re-evaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-like Compounds*, World Health Organization. June.

12. FIGURES

(This page intentionally left blank)

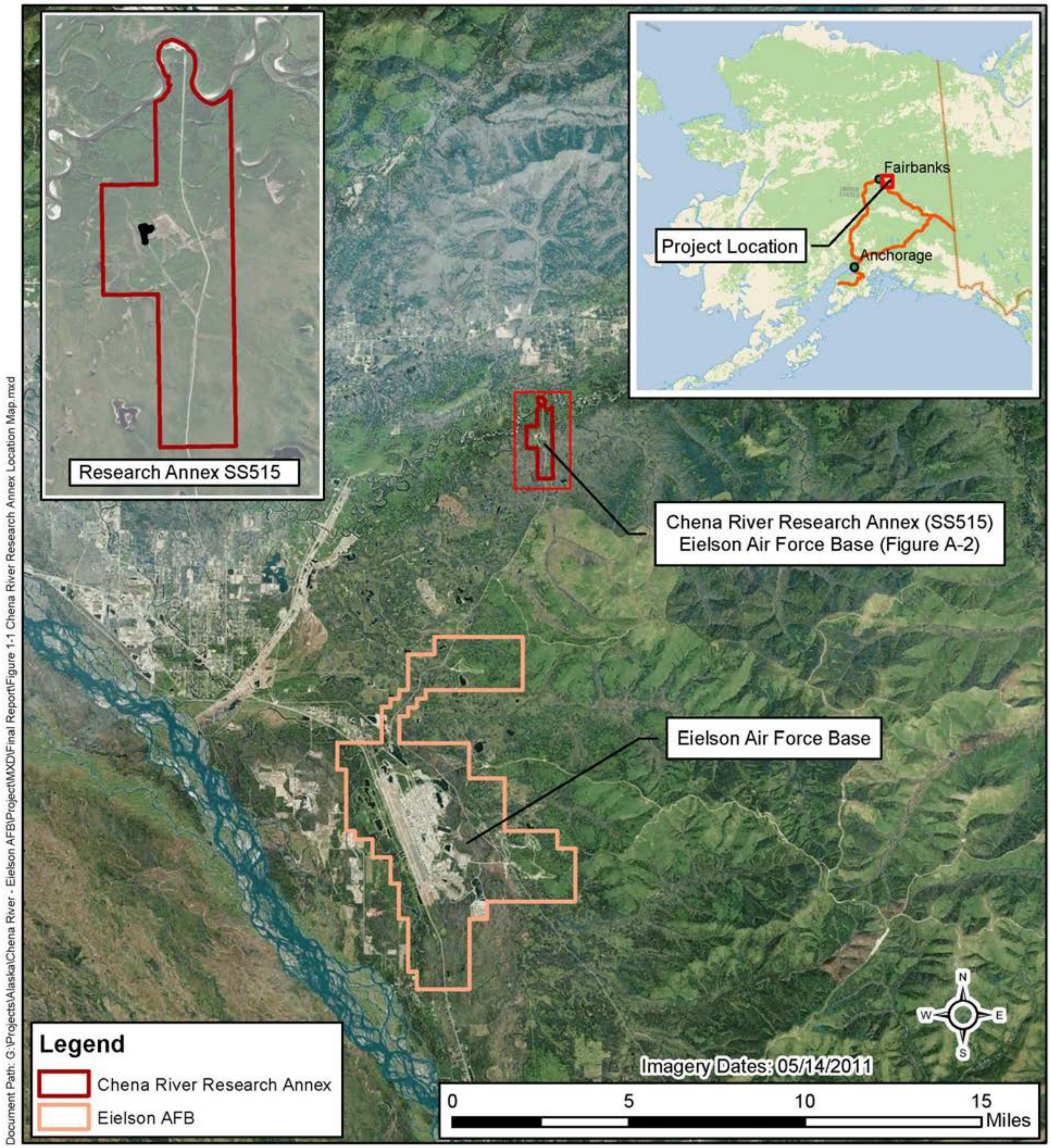


Figure 1-1 Revision Number: 1	Location of Eielson AFB and Chena River Research Annex SS515, Alaska			Air Force Civil Engineering Center
NORTHWIND A CIRI COMPANY 2525 C Street, Suite 130, Anchorage, AK 99503 Web: www.northwindgrp.com Phone: (907)277-5488	DATE:	4/18/2018	SCALE: On Map	
	DESIGNED BY:	TF		
	DRAWN BY:	RB		
	CHECKED BY:	LB	NWI FILE NAME: Left Margin	
	APPROVED BY:	LB		

Figure 1-1. Location of Eielson AFB and Chena River Research Annex SS515.

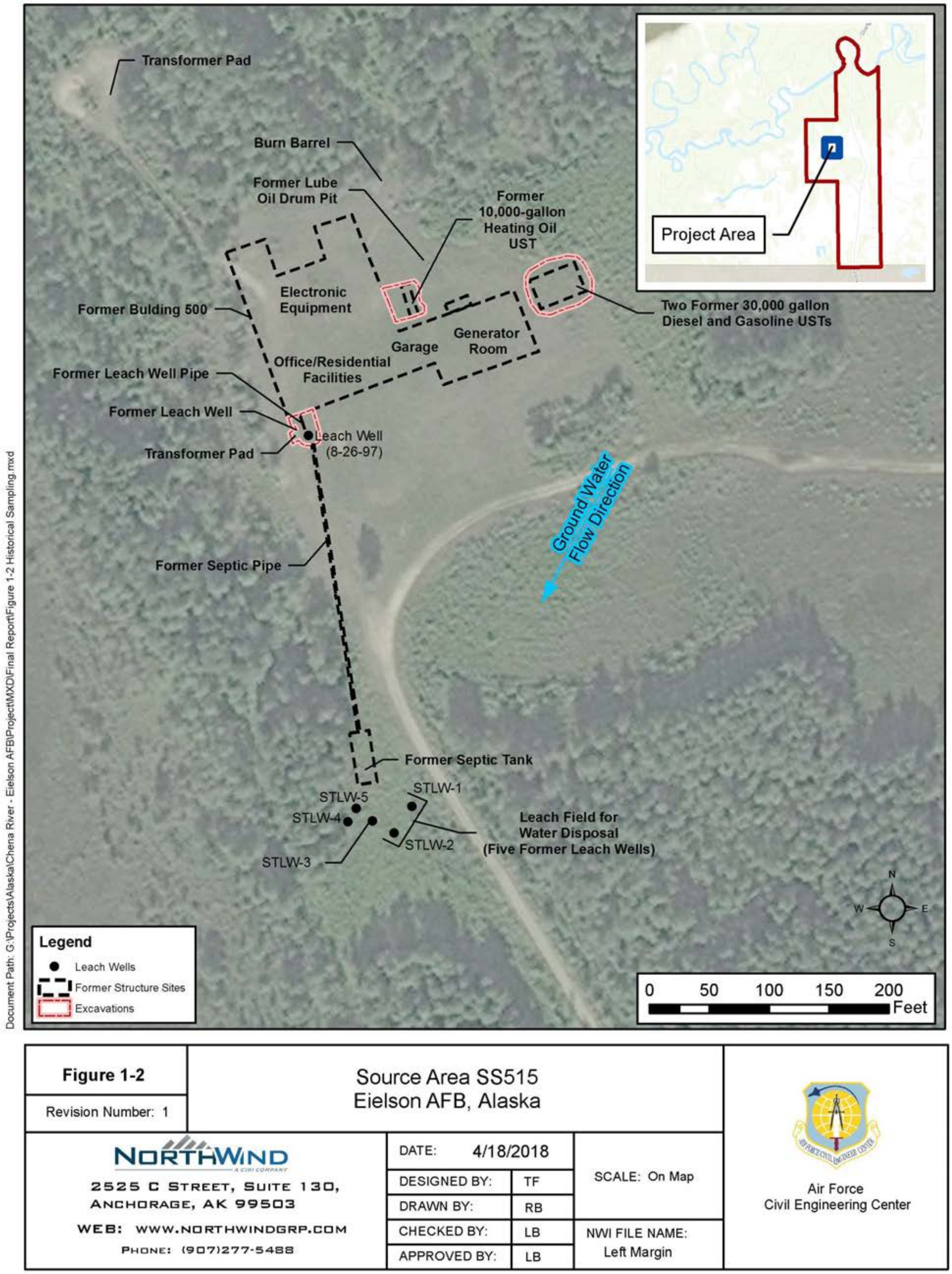


Figure 1-2. Source Area SS515.

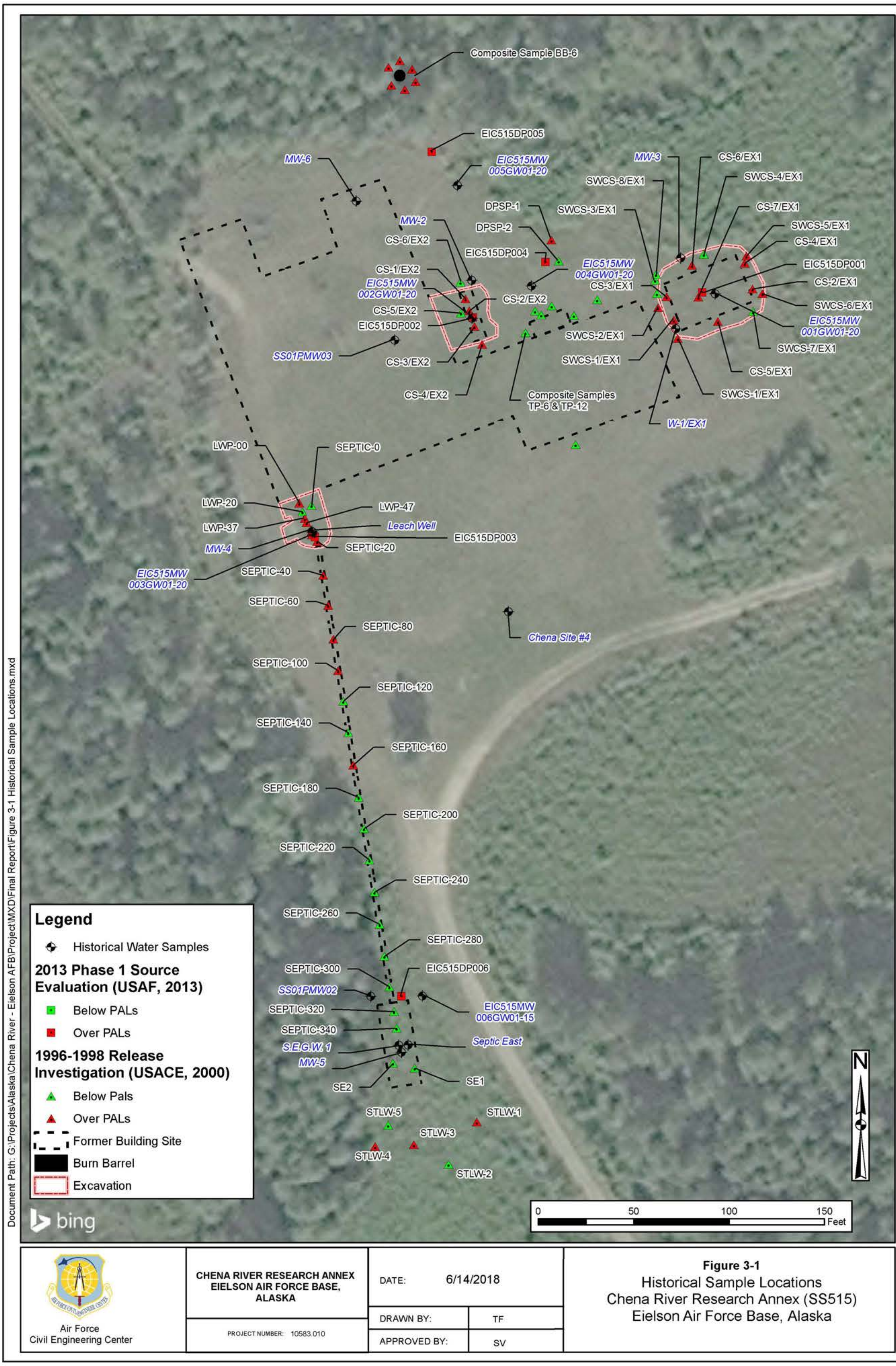


Figure 3-1. Historical Sample Locations.

(This page intentionally left blank)

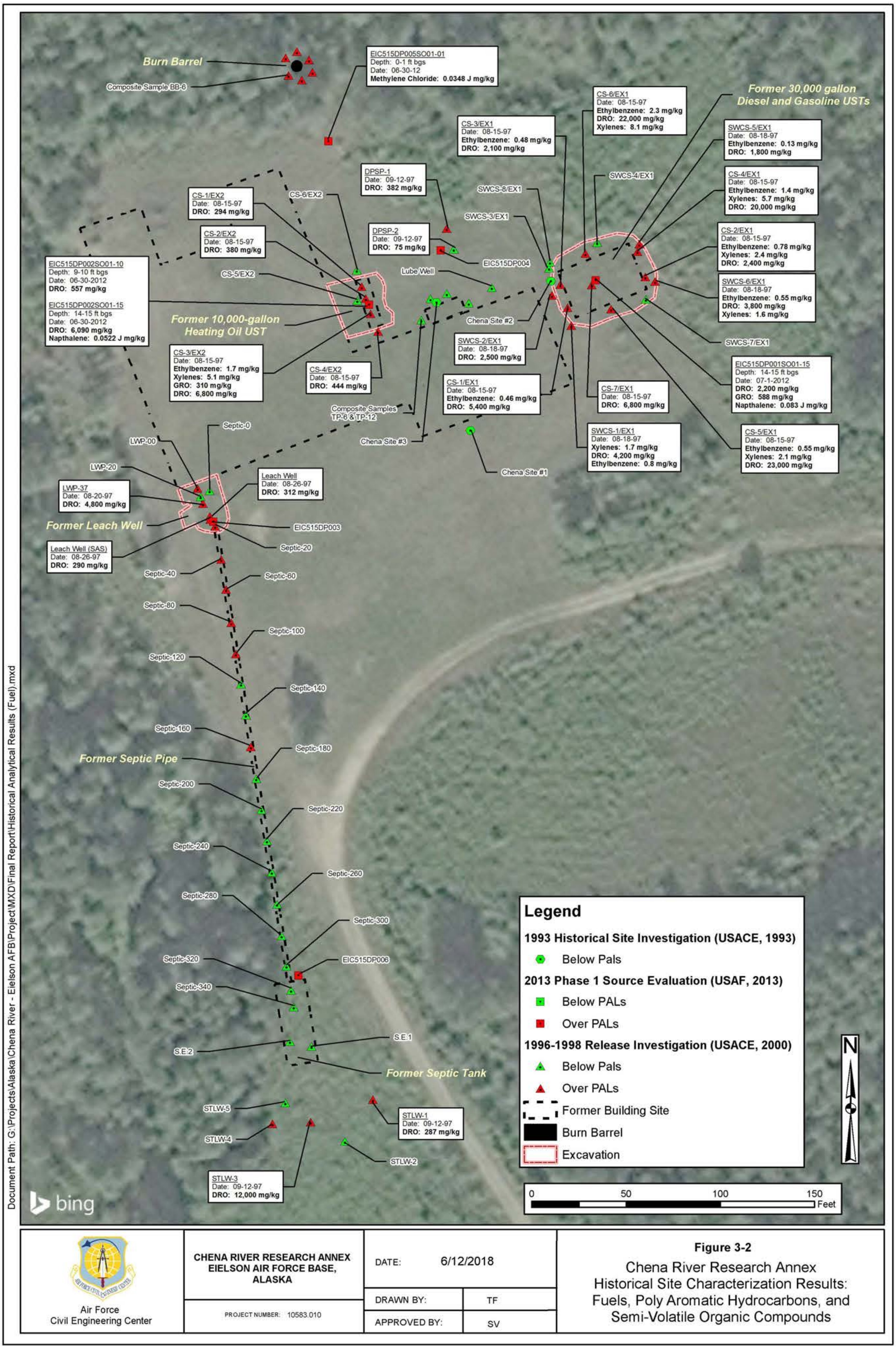


Figure 3-2. Historical Site Characterization Results: Fuels, PAHs, and SVOCs.

(This page intentionally left blank)

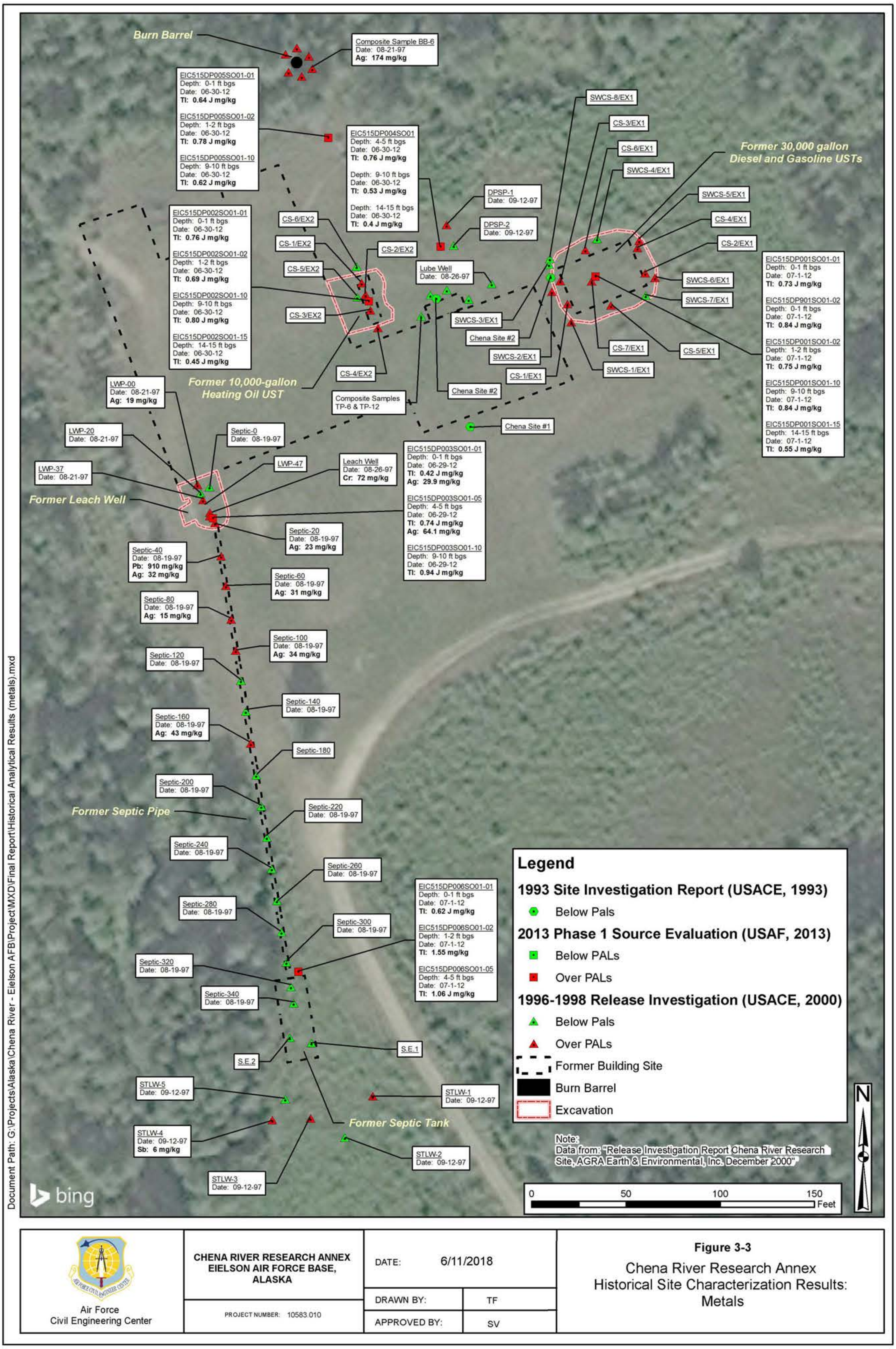


Figure 3-3. Historical Site Characterization Results: Metals.

(This page intentionally left blank)

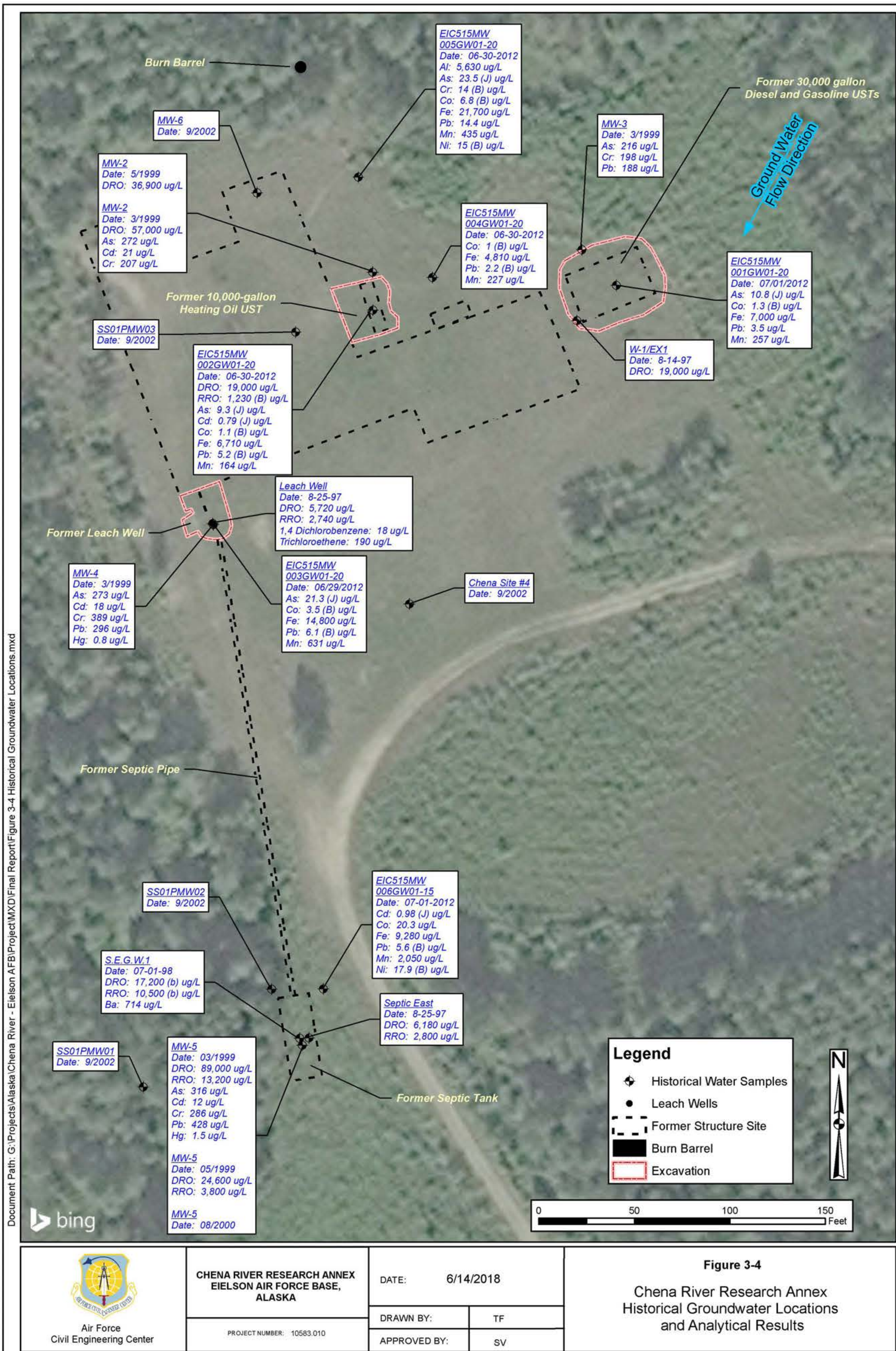


Figure 3-4. Historical Groundwater Locations and Analytical Results.

(This page intentionally left blank)

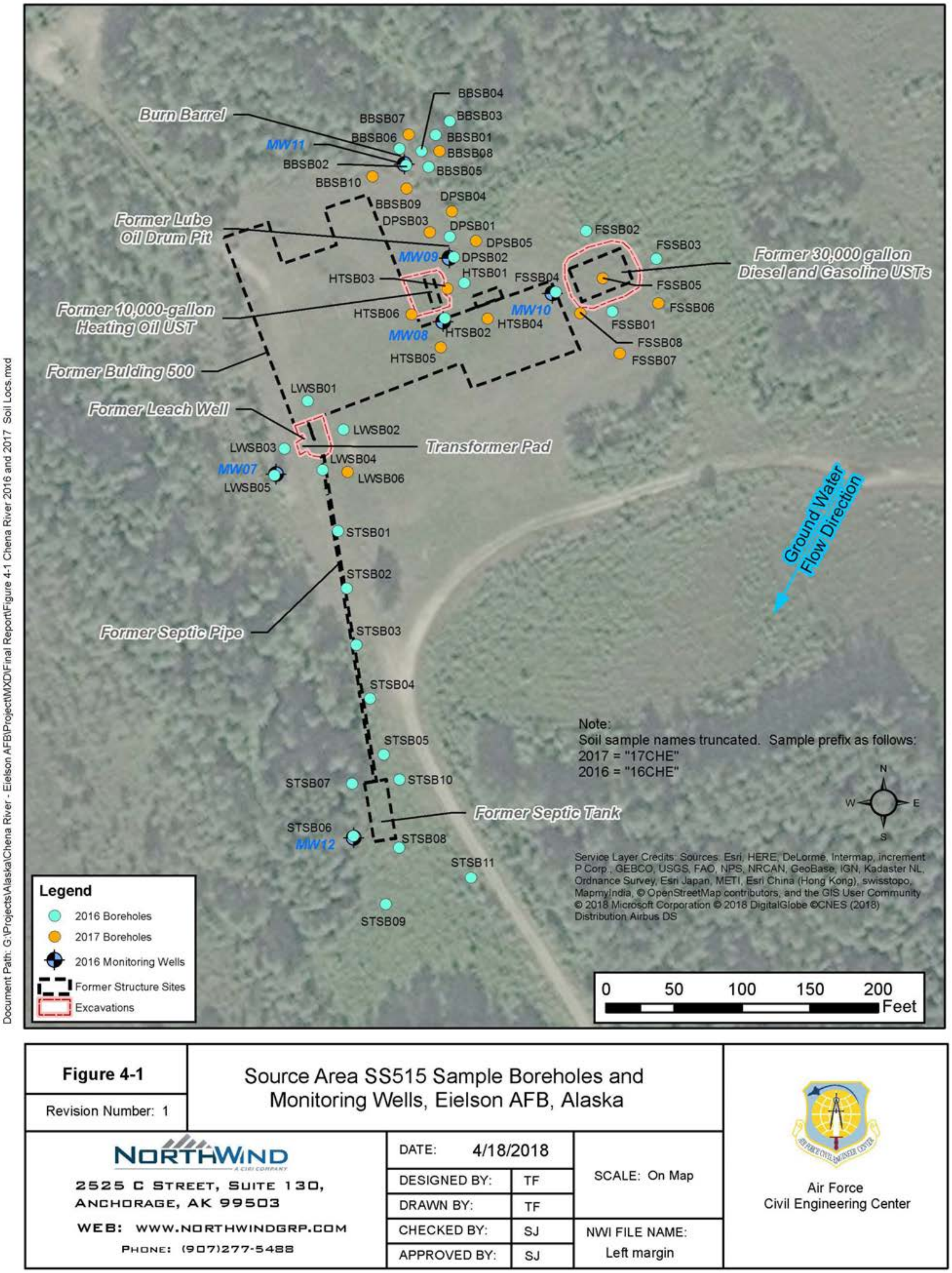


Figure 4-1. Source Area SS515 Sample Boreholes and Monitoring Wells.

(This page intentionally left blank)

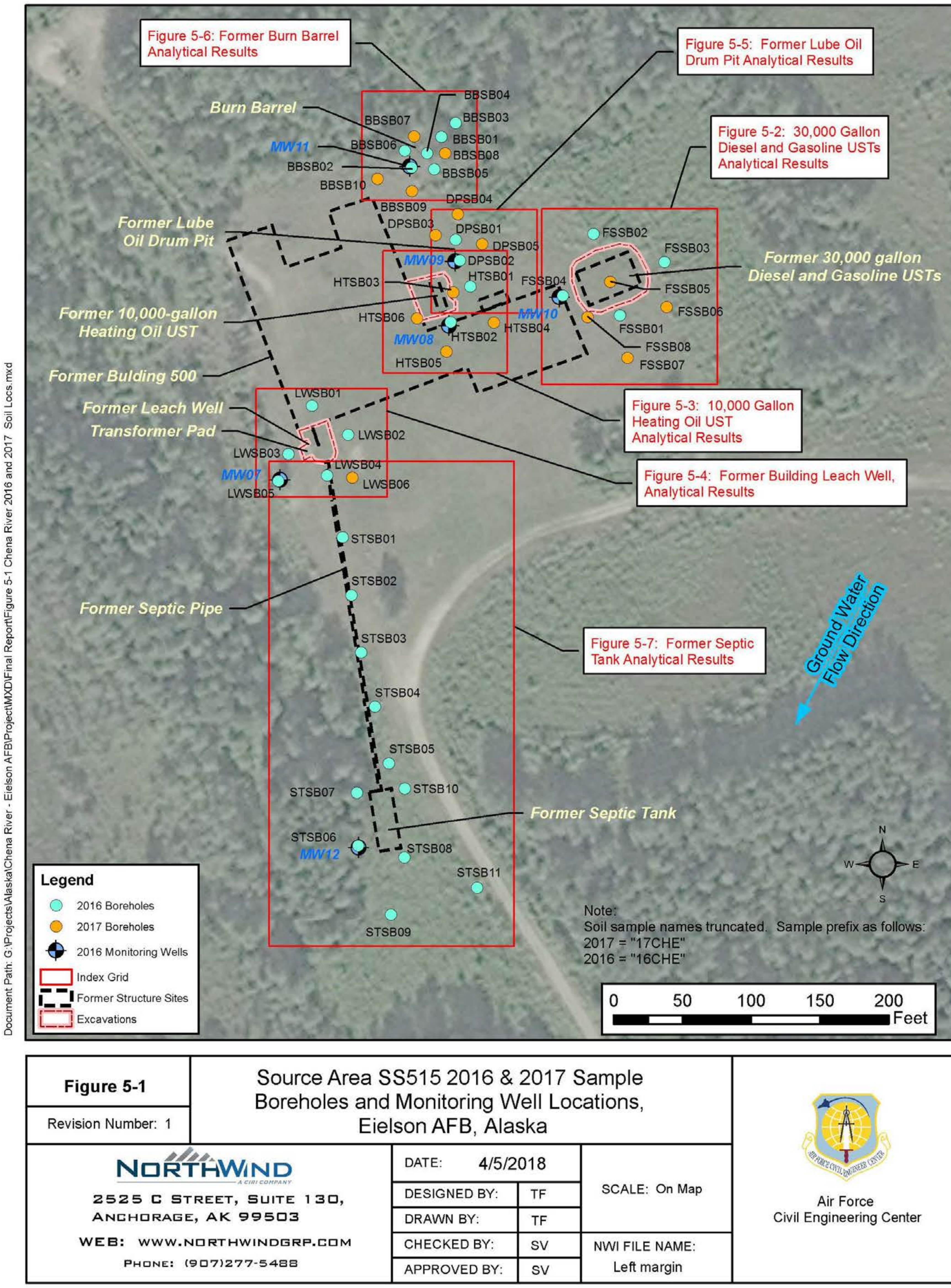


Figure 5-1. Source Area SS515 2016 and 2017 Sample Boreholes and Monitoring Well Locations.

(This page intentionally left blank)

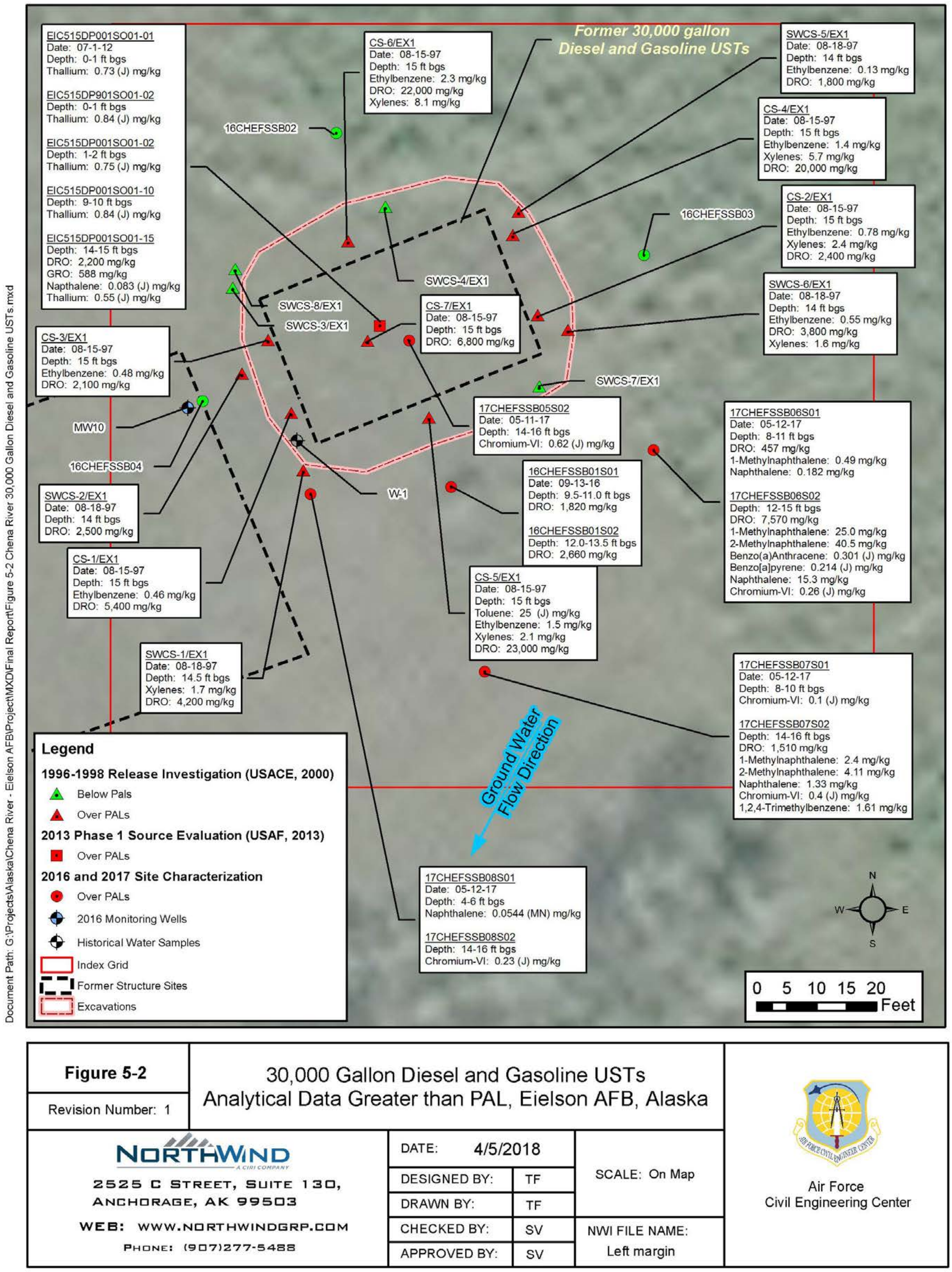


Figure 5-2. Analytical Data Greater than the PAL for the 30,000-Gallon Diesel and Gasoline USTs.

(This page intentionally left blank)

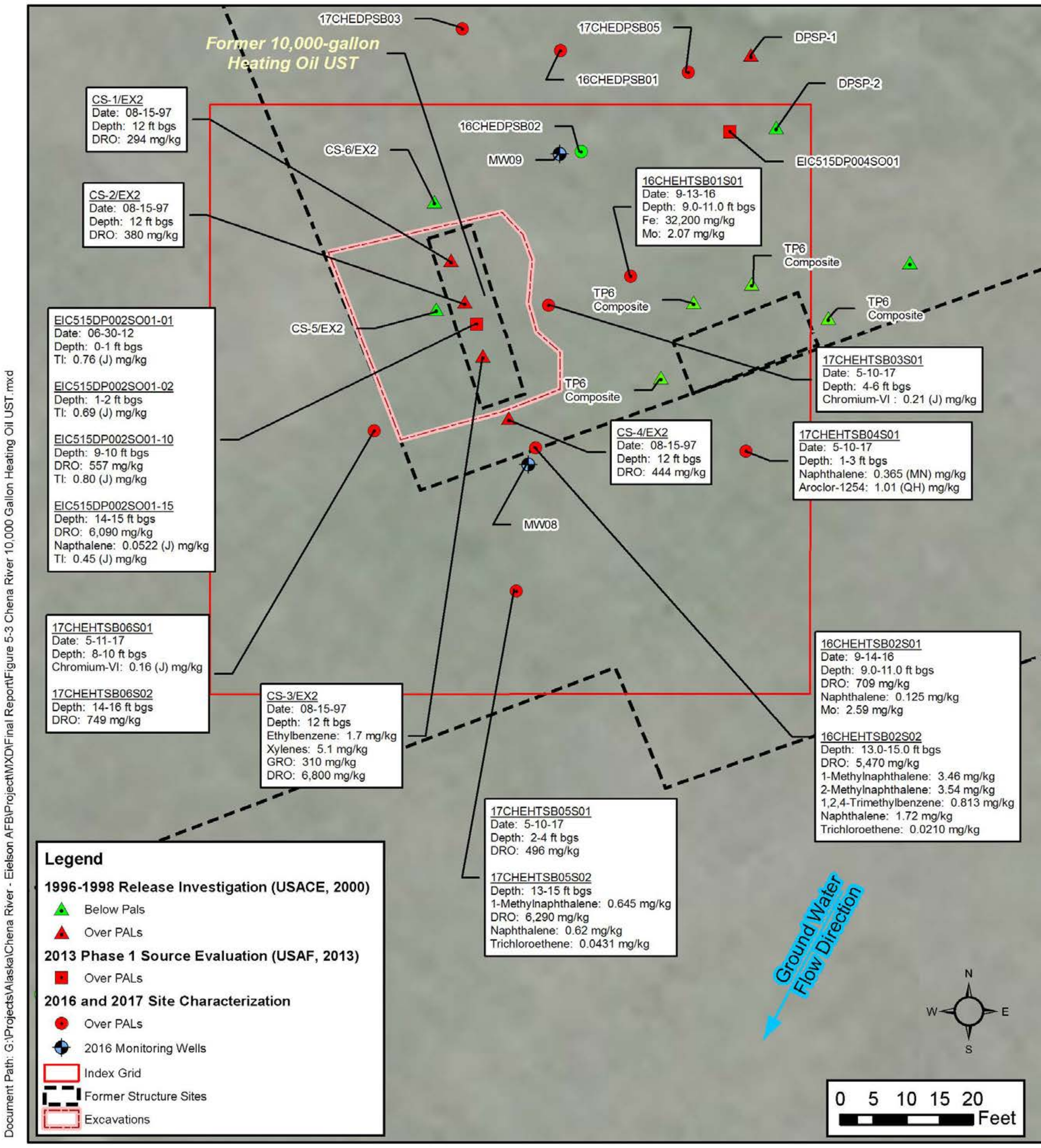


Figure 5-3	10,000 Gallon Heating Oil UST Analytical Data Greater than PAL, Eielson AFB, Alaska				Air Force Civil Engineering Center
Revision Number: 1					
NORTHWIND A CIRI COMPANY 2525 C Street, Suite 130, Anchorage, AK 99503 Web: www.northwindgrp.com Phone: (907)277-5488	DATE:	4/5/2018			
	DESIGNED BY:	TF	SCALE: On Map		
	DRAWN BY:	TF			
	CHECKED BY:	SV	NWI FILE NAME:		
	APPROVED BY:	SV	Left margin		

Figure 5-3. Analytical Data Greater than the PAL for the 10,000-Gallon Heating Oil UST.

(This page intentionally left blank)

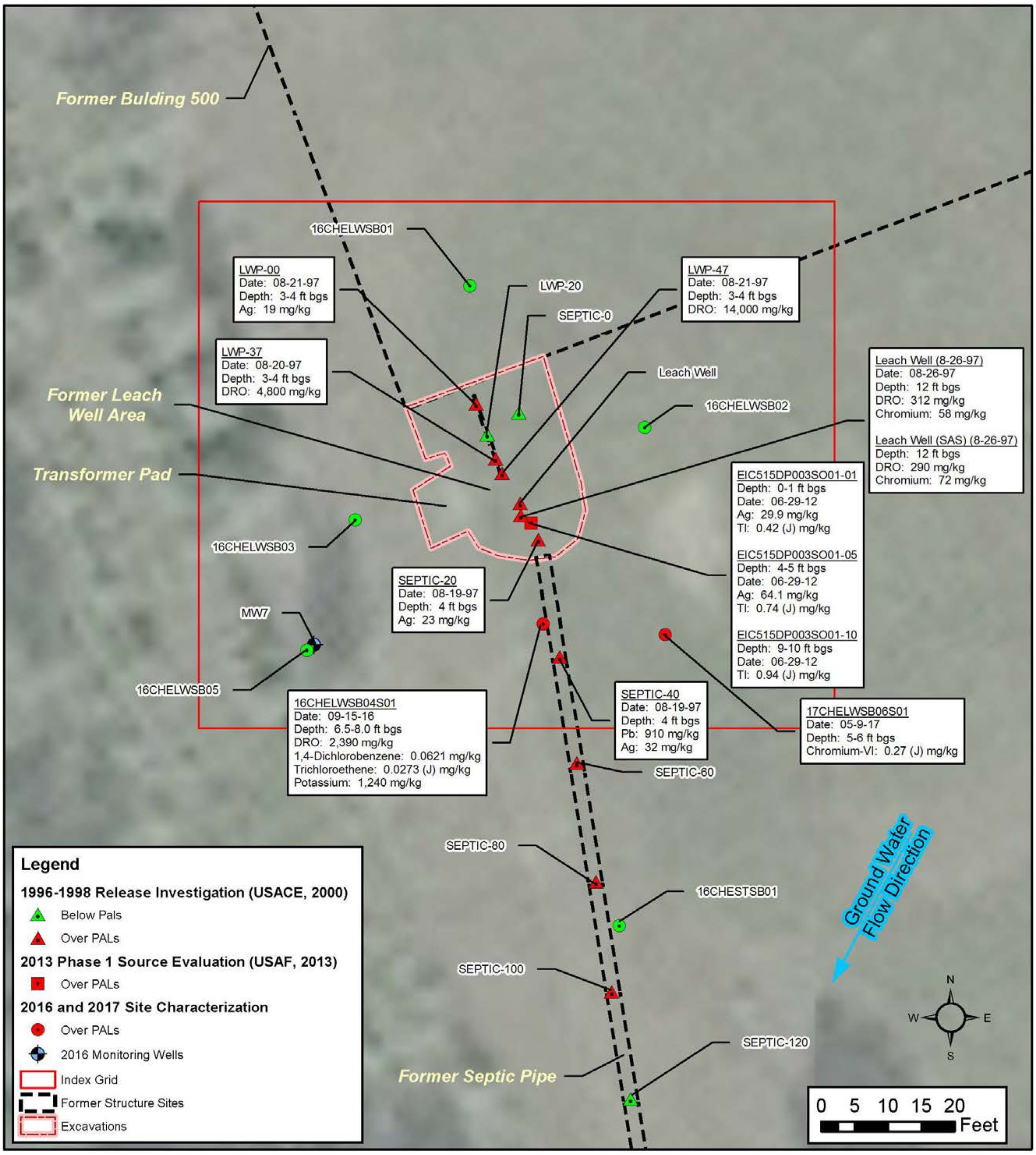


Figure 5-4	Former Building Leach Well Analytical Data Greater than PAL, Eielson AFB, Alaska	Air Force Civil Engineering Center
Revision Number: 1		

NORTHWIND
A CIRI COMPANY
2525 C Street, Suite 130,
Anchorage, AK 99503
WEB: www.northwindgrp.com
Phone: (907)277-5488

DATE:	4/5/2018	SCALE: On Map
DESIGNED BY:	TF	
DRAWN BY:	TF	
CHECKED BY:	SV	NWI FILE NAME:
APPROVED BY:	SV	Left margin

Figure 5-4. Analytical Data Greater than the PAL for the Former Building Leach Well.

(This page intentionally left blank)

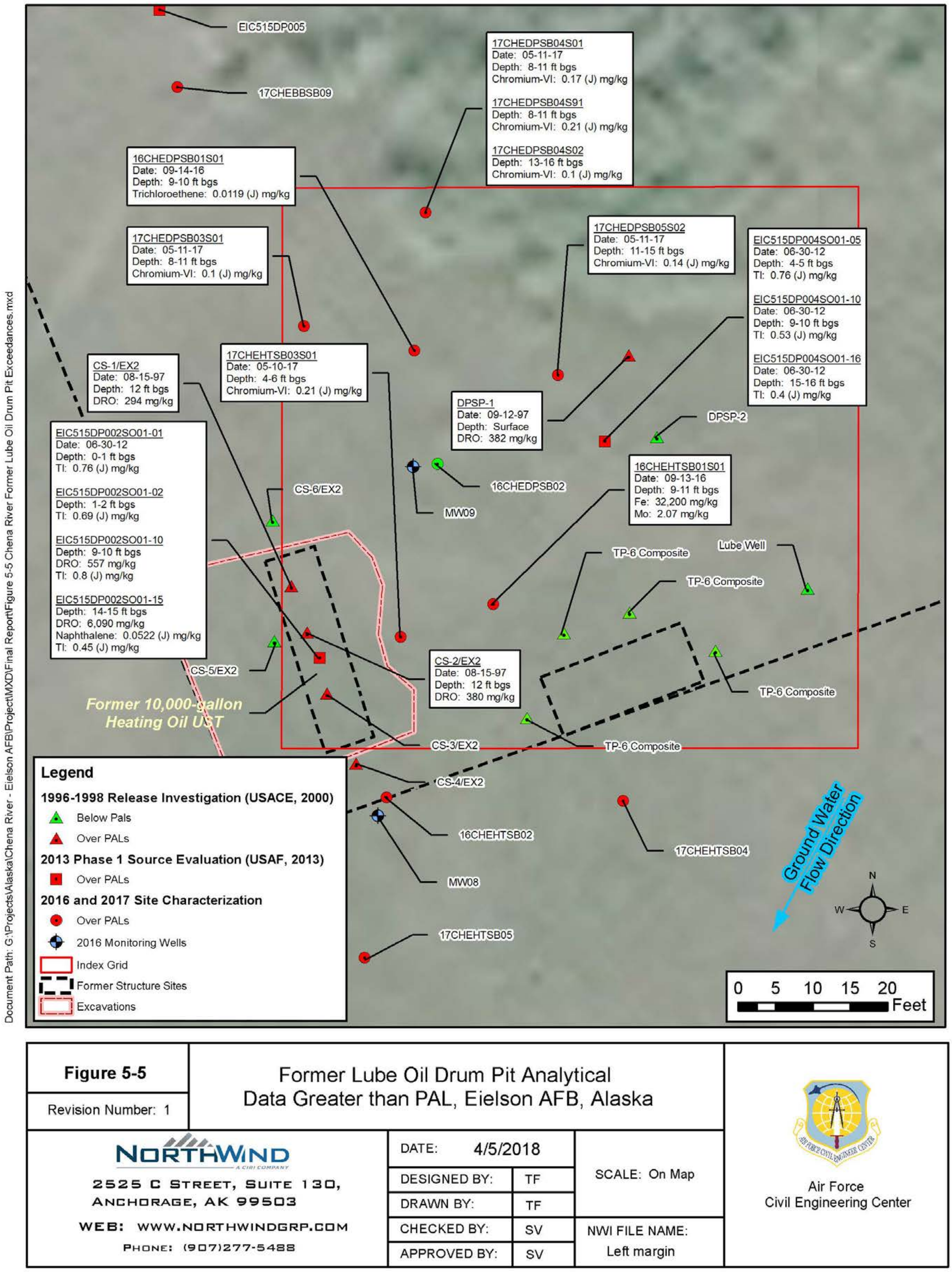


Figure 5-5. Analytical Data Greater than the PAL for the Former Lube Oil Drum Pit.

(This page intentionally left blank)

Document Path: G:\Projects\Alaska\Chena River - Eielson AFB\Project\MXD\Final Report\Figure 5-6 Chena River Former Burn Barrel Exceedances.mxd

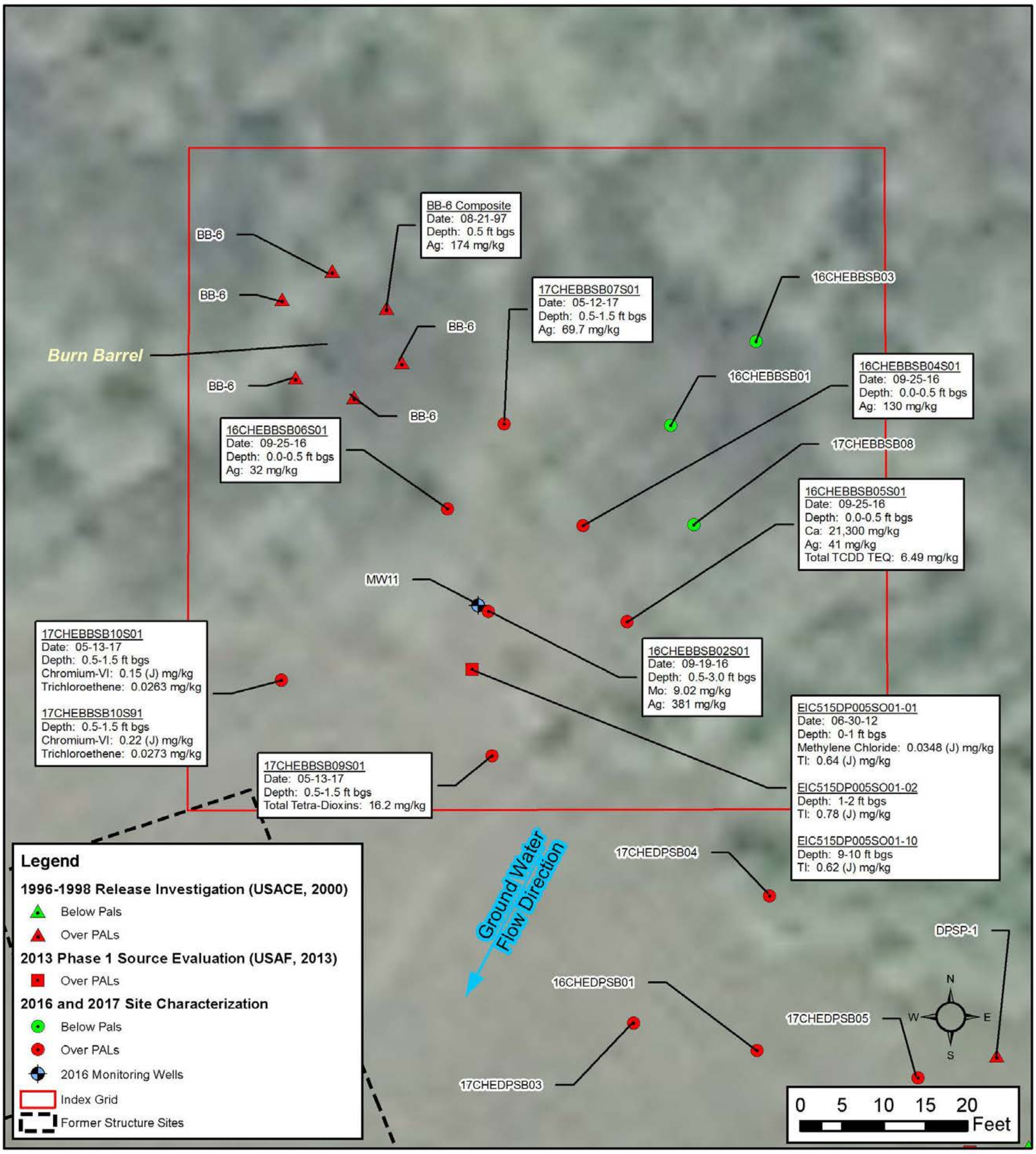


Figure 5-6	Former Burn Barrel Analytical Data Greater than PAL, Eielson AFB, Alaska				Air Force Civil Engineering Center
Revision Number: 1					
NORTHWIND A CIRI COMPANY 2525 C Street, Suite 130, Anchorage, AK 99503 WEB: www.northwindgrp.com Phone: (907)277-5488	DATE:	6/13/2018	SCALE: On Map		
	DESIGNED BY:	TF			
	DRAWN BY:	TF			
	CHECKED BY:	SV	NWI FILE NAME:		
	APPROVED BY:	SV	Left margin		

Figure 5-6. Analytical Data Greater than the PAL for the Former Burn Barrel Area.

(This page intentionally left blank)

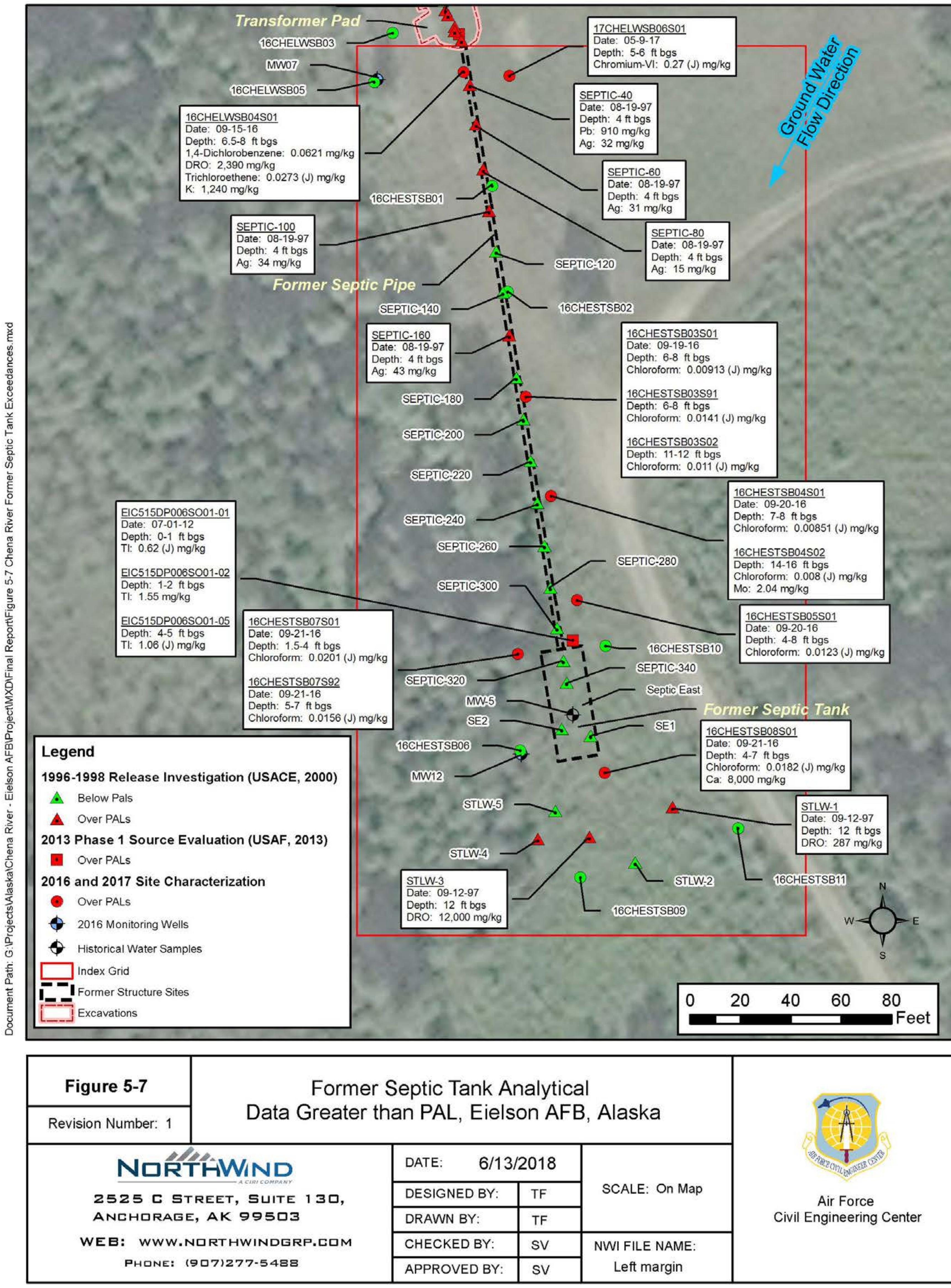


Figure 5-7. Analytical Data Greater than the PAL for the Former Septic Tank.

(This page intentionally left blank)

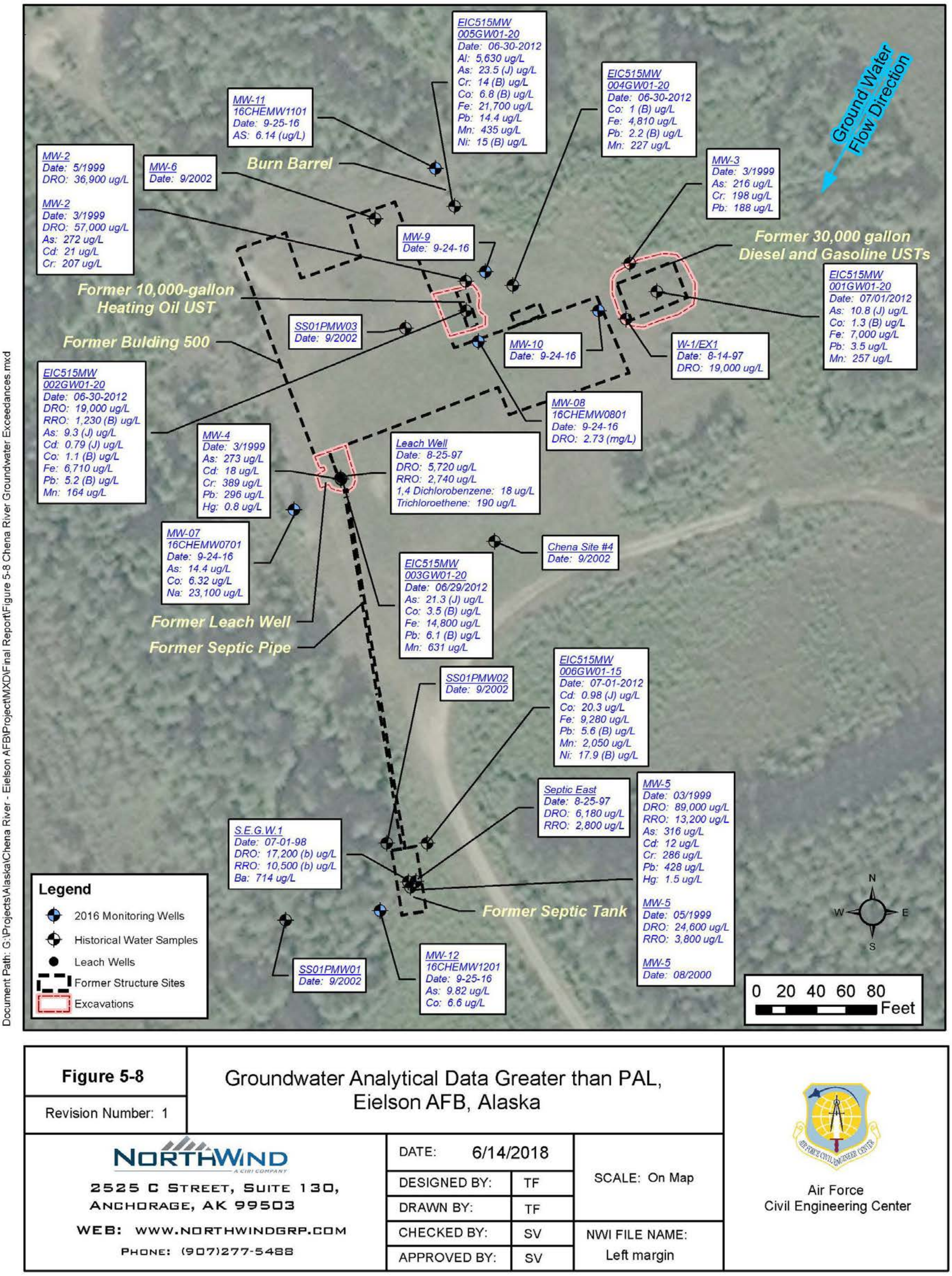
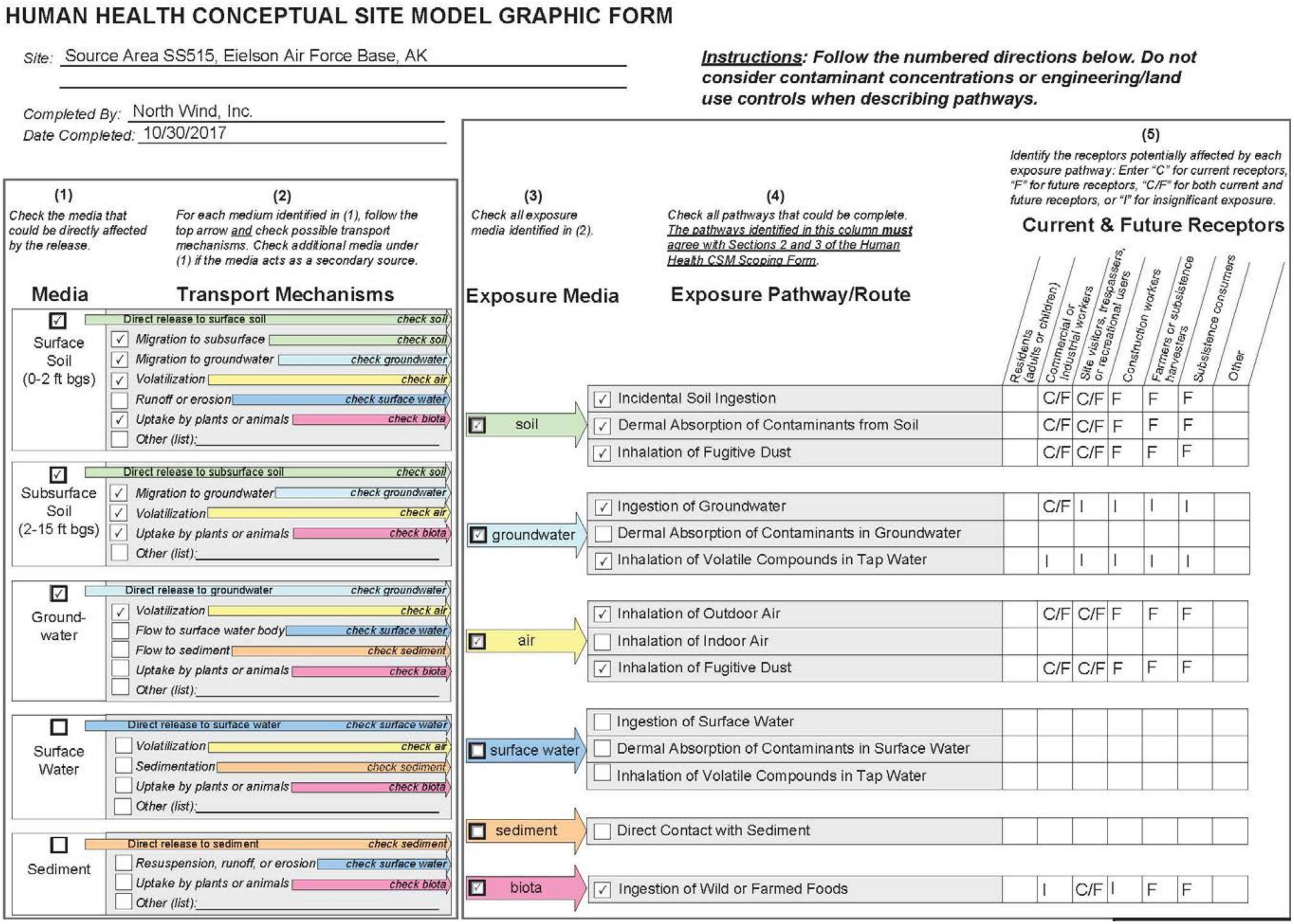


Figure 5-8. Groundwater Analytical Data Greater than the PAL for the Former Septic Tank.

(This page intentionally left blank)



HUMAN HEALTH CONCEPTUAL SITE MODEL GRAPHIC FORM

Site: Source Area SS515, Eielson Air Force Base, AK

Completed By: North Wind, Inc.

Date Completed: 10/30/2017

***Instructions*: Follow the numbered directions below. Do not consider contaminant concentrations or engineering/land use controls when describing pathways.**

(1) *Check the media that could be directly affected by the release.*

(2) *For each medium identified in (1), follow the top arrow and check possible transport mechanisms. Check additional media under (1) if the media acts as a secondary source.*

(3) *Check all exposure media identified in (2).*

(4) *Check all pathways that could be complete. The pathways identified in this column must agree with Sections 2 and 3 of the Human Health CSM Scoping Form.*

(5) *Identify the receptors potentially affected by each exposure pathway: Enter "C" for current receptors, "F" for future receptors, "C/F" for both current and future receptors, or "I" for insignificant exposure.*

Media / Transport Mechanisms

- [x] Surface Soil (0-2 ft bgs)
  - Direct release to surface soil — check soil
  - [x] Migration to subsurface — check soil
  - [x] Migration to groundwater — check groundwater
  - [x] Volatilization — check air
  - [ ] Runoff or erosion — check surface water
  - [x] Uptake by plants or animals — check biota
  - [ ] Other (list):
- [x] Subsurface Soil (2-15 ft bgs)
  - Direct release to subsurface soil — check soil
  - [x] Migration to groundwater — check groundwater
  - [x] Volatilization — check air
  - [x] Uptake by plants or animals — check biota
  - [ ] Other (list):
- [x] Ground-water
  - Direct release to groundwater — check groundwater
  - [x] Volatilization — check air
  - [ ] Flow to surface water body — check surface water
  - [ ] Flow to sediment — check sediment
  - [ ] Uptake by plants or animals — check biota
  - [ ] Other (list):
- [ ] Surface Water
  - Direct release to surface water — check surface water
  - [ ] Volatilization — check air
  - [ ] Sedimentation — check sediment
  - [ ] Uptake by plants or animals — check biota
  - [ ] Other (list):
- [ ] Sediment
  - Direct release to sediment — check sediment
  - [ ] Resuspension, runoff, or erosion — check surface water
  - [ ] Uptake by plants or animals — check biota
  - [ ] Other (list):

Exposure Media / Exposure Pathway/Route / Current & Future Receptors

Exposure Media	Exposure Pathway/Route	Residents (adults or children)	Commercial or industrial workers	Site visitors, trespassers, or recreational users	Construction workers	Farmers or subsistence harvesters	Subsistence consumers	Other
[x] soil	[x] Incidental Soil Ingestion		C/F	C/F	F	F	F	
	[x] Dermal Absorption of Contaminants from Soil		C/F	C/F	F	F	F	
	[x] Inhalation of Fugitive Dust		C/F	C/F	F	F	F	
[x] groundwater	[x] Ingestion of Groundwater		C/F	I	I	I	I	
	[ ] Dermal Absorption of Contaminants in Groundwater							
	[x] Inhalation of Volatile Compounds in Tap Water		I	I	I	I	I	
[x] air	[x] Inhalation of Outdoor Air		C/F	C/F	F	F	F	
	[ ] Inhalation of Indoor Air							
	[x] Inhalation of Fugitive Dust		C/F	C/F	F	F	F	
[ ] surface water	[ ] Ingestion of Surface Water							
	[ ] Dermal Absorption of Contaminants in Surface Water							
	[ ] Inhalation of Volatile Compounds in Tap Water							
[ ] sediment	[ ] Direct Contact with Sediment							
[x] biota	[x] Ingestion of Wild or Farmed Foods		I	C/F	I	F	F	

Figure 6-1. CSM Graphic Form for Source Area SS515-Chena River Research Annex, Eielson AFB, Alaska.

(This page intentionally left blank)

Appendix A

Previous Investigation Results

(This page intentionally left blank)

Appendix B

Project Action Level Data

(This page intentionally left blank)

Appendix C

Logbooks and Field Forms

(This page intentionally left blank)

Appendix D

Soil Boring Logs

(This page intentionally left blank)

Appendix E

Photographic Log

(This page intentionally left blank)

Appendix F

Monitoring Well Survey Report

(This page intentionally left blank)

Appendix G

Well Completion Diagrams

(This page intentionally left blank)

Appendix H

Analytical Data and Laboratory Reports

(This page intentionally left blank)

Appendix I

Conceptual Site Model Scoping Data

(This page intentionally left blank)

Appendix J

Response to Comments

(This page intentionally left blank)