Hill Air Force Base, Utah

Final

Operable Unit 4
Record of Decision Amendment

SEPTEMBER 2017

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14. ABSTRACT

This Operable Unit 4 Record of Decision (ROD) Amendment specifies an expanded remedy for the source and non-source areas at Operable Unit (OU) 4 at Hill Air Force Base, Utah. The 2013 Five-Year Review of OU 4 found that the existing remedy is not functioning as intended, but remains protective of human health and the environment in the short term. As a result, additional remedy components are required to accelerate progress toward achieving ROD objectives and reducing total life-cycle costs. This ROD Amendment expands the ROD remedy for the source and non-source areas at OU 4. The existing remedy at OU 4 consists of a low-permeability cap covering the western portion of Landfill 1, passive extraction of groundwater, monitoring of groundwater quality, and institutional controls. The expanded remedy will install an additional low-permeability landfill cap to cover the eastern portion of Landfill 1 and adds in situ treatment of groundwater in both the source and non-source areas through the installation of a subgrade biogeochemical reactor and enhanced reductive dechlorination biobarriers while maintaining the existing remedy.

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FINAL

Hill Air Force Base, Utah
Performance-Based Remediation

Operable Unit 4
Record of Decision Amendment

Contract No: FA8903-09-D-8560
Task Order 0006

Prepared for:
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Acronyms and Abbreviations

µg/kg	Microgram(s) per kilogram
µg/L	Microgram(s) per liter
µg/m^3	Microgram(s) per cubic meter
AFB	Air Force Base
AFCEC	Air Force Civil Engineer Center
ARAR	Applicable or Relevant and Appropriate Requirement
bgs	Below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
COC	Contaminant of concern
CWSID	Central Weber Sewer Improvement District
DCA	Dichloroethane
DCE	Dichloroethene
DNAPL	Dense non-aqueous phase liquid
DO	Dissolved oxygen
DWRi	Division of Water Rights
EA	EA Engineering, Science, and Technology, Inc. (prior to 12 December 2014) or EA Engineering, Science, and Technology, Inc., PBC (12 December 2014 and thereafter)
EPA	U.S. Environmental Protection Agency
ERD	Enhanced reductive dechlorination
ESD	Explanation of Significant Difference for Operable Unit 4
EVO	Emulsified vegetable oil
HDUS	Horizontal drain upgrade system
IC	Institutional control
JBSA	Joint Base San Antonio
MCL	Maximum Contaminant Level
MEK	Methyl ethyl ketone
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFRAP	No Further Remedial Action Planned
O&M	Operation and maintenance
ORP	Oxidation reduction potential
OU	Operable Unit
PCE	Tetrachloroethene
POTW	Publicly owned treatment works

RA-O	Remedial action-operations
RAO	Remedial action objective
RD/RAWP	Remedial Design/Remedial Action Work Plan
RI	Remedial Investigation
ROD	Final Record of Decision and Responsiveness Summary for OU 4
RSL	Regional Screening Level
SAR	Same as Report
SVE	Soil vapor extraction
TCE	Trichloroethene
TMV	Toxicity, mobility, or volume
UCACP	Utah Corrective Action Cleanup Policy
UDEQ	Utah Department of Environmental Quality
USAF	U.S. Air Force
VOC	Volatile organic compound

1.0 Introduction and Statement of Purpose

1.1 Site Name and Location

Facility Name: Hill Air Force Base
Site Location: Davis and Weber Counties, Utah
CERCLIS ID Number: UT0571724350
Operable Unit/Site: Operable Unit 4

Hill Air Force Base (AFB) is located in northern Utah, approximately 30 miles north of Salt Lake City and 7 miles south of Ogden. Operable Unit (OU) 4 is located on a steep, terraced, north-facing hill that forms the south side of Weber River Valley (Figure 1-1).

1.2 Statement of Basis and Purpose of this Amendment

OU 4 has been previously investigated to evaluate the nature and extent of soil and groundwater contamination. The remedial investigation and feasibility study were conducted according to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and CERCLA guidance under the Federal Facility Agreement between the U.S. Air Force (USAF), U.S. Environmental Protection Agency (EPA), and Utah Department of Environmental Quality (UDEQ). Following the Remedial Investigation (RI) Report for Operable Unit 4 (U.S. Geological Survey 1992) and the Final Feasibility Study Report for Operable Unit 4 (Montgomery Watson 1993a), the Proposed Plan for Operable Unit 4 (IRP Sites LF11, LF12, OT020, OT041, OT042) (Montgomery Watson 1993b) and the Final Record of Decision and Responsiveness Summary for OU 4 (ROD) (Hill AFB 1994) were accepted. The selected remedy was chosen in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act, and to the extent practicable, the NCP. The ROD was signed by the USAF, EPA, and UDEQ in June 1994. Since 1994, operations and remediation efforts at OU 4 have progressed in accordance with the ROD and the Explanation of Significant Difference for Operable Unit 4 (ESD) (Hill AFB 2006).

The 2013 Five-Year Review (Leidos 2013) found that the existing remedy for OU 4 is not functioning as intended, but remains protective of human health and the environment in the short term. The findings of the Five-Year Review are based on an increase in trichloroethene (TCE) concentrations since 2002 in monitoring wells immediately downgradient of the western capped portion of Landfill 1, which indicates that the landfill remains a continuing source of TCE contamination. An investigation into the increased TCE concentrations identified additional source areas in the eastern uncapped portion of Landfill 1 and in Landfill 2 (EA Engineering, Science, and Technology, Inc., PBC [EA] 2015a). The existing source area remedy (low-permeability cap installed on western Landfill 1) does not address these additional source areas. With an ongoing source of TCE contamination, the remedial timeframe for OU 4 is indefinite. Additional remedy components are required to accelerate progress toward achieving ROD objectives and to reduce total life-cycle costs. Therefore, the USAF will implement an expanded remedy to contain ongoing sources of contamination and treat the areas of highest TCE concentrations in groundwater to accelerate cleanup of the dissolved-phase plume at OU 4.

In accordance with 42 United States Code Section 9617(c) of CERCLA, *40 Code of Federal Regulations* (CFR) Section 300.435(c)(2)(i and ii) of the NCP, and Section 7 of EPA 540-R-98-031, sites that undergo a fundamental change to their original remedy must include public involvement through a revised proposed plan with final documentation in a ROD Amendment. A Revised Proposed Plan for OU 4 was

finalized in July 2015 (Hill AFB 2015). Pre-design data collected following the Revised Proposed Plan led to a substantial change in the proposed expanded remedy. The pre-design data are summarized in Section 2.1.3 and will be presented in full as part of the Remedial Design/Remedial Action Work Plan (RD/RAWP). As a result, an Updated Revised Proposed Plan for OU 4 was prepared (Hill AFB 2016). This ROD Amendment presents a fundamental change to the existing OU 4 remediation strategy as described in the Updated Revised Proposed Plan: implementation of an intensive source area and non-source area treatment remedy to accelerate the remedial timeframe as compared to the existing remedy. This ROD Amendment will become part of the Administrative Record file for this site.

This ROD Amendment expands the existing ROD remedy for OU 4 to address the 2013 Five-Year Review findings that the existing remedy is not protective of human health and the environment in the long term by implementing an active treatment remedy in the source area and non-source area of OU 4. The existing remedy at OU 4 consists of a low-permeability cap covering the western portion of Landfill 1, passive extraction of groundwater, monitoring of groundwater quality, and institutional controls (ICs). The expanded remedy will install an additional low-permeability cap to cover the eastern portion of Landfill 1 and add both source area and non-source area in situ treatment of groundwater through the installation of a subgrade biogeochemical reactor and enhanced reductive dechlorination (ERD) biobarriers. Due to the No Further Remedial Action Planned (NFRAP) designation given to Landfill 2, there was no remedy selected for Landfill 2 in the 1994 ROD. Additional investigation is required at Landfill 2 to better characterize the source and to provide the foundation for future remedy selection. Therefore, Landfill 2 will be addressed separately from this ROD Amendment.

This document is issued by the USAF, which is the lead agency for cleanup actions at Hill AFB, and EPA, which is the lead regulatory agency for CERCLA response actions at Hill AFB. The USAF and EPA jointly selected this amended remedy with concurrence by the UDEQ.

The USAF signatory for this document will be the Director of the Environmental Management Directorate, Air Force Civil Engineer Center (AFCEC).

1.3 Authorizing Signatures and Regulatory Agency Acceptance of Remedy

The following signatures signify that the parties agree to the expanded remedy and the contents of the OU 4 ROD Amendment.

U.S. ENVIRONMENTAL PROTECTION AGENCY

Betsy Smidinger — 9/25/17

BETSY SMIDINGER
Assistant Regional Administrator
Office of Ecosystems Protection and Remediation
U.S. Environmental Protection Agency Region 8

Date

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STATE OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

ALAN MATHESON
Executive Director
State of Utah Department of Environmental Quality

9-25-2017
Date

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AIR FORCE CIVIL ENGINEER CENTER

Suzanne W. Bilbrey

SUZANNE W. BILBREY, P.E., GS-15
Director, Environmental Management Directorate
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13 Dec 2017
Date

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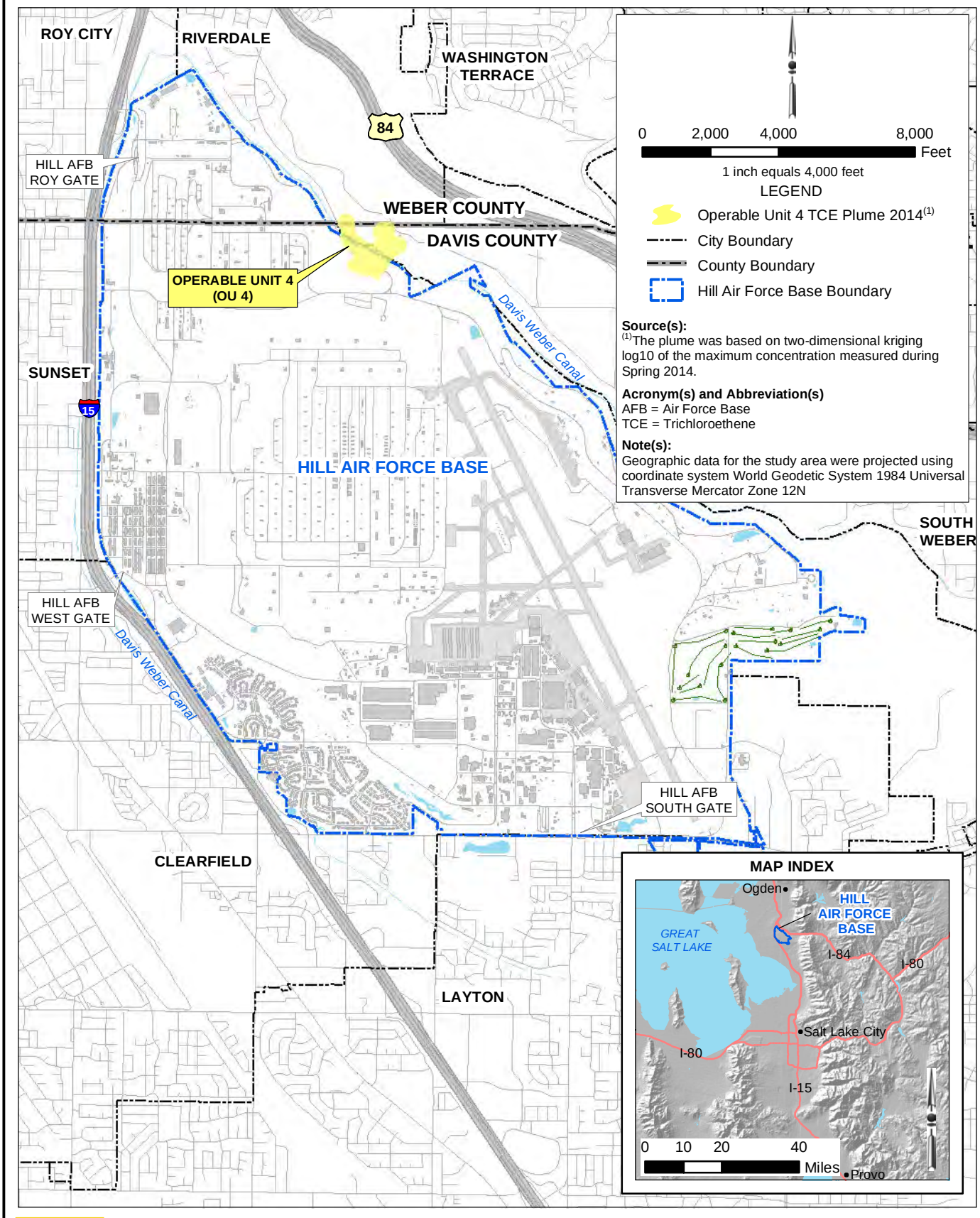

FIGURE 1-1
LOCATION MAP
OPERABLE UNIT 4 RECORD OF DECISION AMENDMENT
HILL AIR FORCE BASE, UTAH

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2.0 Site History, Contamination, and Selected Remedy

2.1 Site History and Contamination

2.1.1 Site History

Hill AFB occupies approximately 6,700 acres within portions of Davis and Weber counties. Since 1920, Hill AFB has been the site of military activities including distribution of military equipment, aircraft rehabilitation and maintenance, and missile assembly. A variety of ongoing industrial operations support the missions of Hill AFB, including metal plating, degreasing, paint stripping, painting, sanding, and other operations associated with aircraft, missile, and vehicle repair and maintenance. These industrial operations have generated numerous spent chemicals and wastes, including chlorinated and non-chlorinated solvents and degreasers, petroleum hydrocarbons, acids, bases, metals, and other chemicals.

For many years, chemicals and associated waste products were disposed in chemical disposal pits and landfills or released from storage or process areas. Since the 1970s, Hill AFB has changed its procedures to reduce or eliminate its use of chemicals and has developed stringent protocols for waste management, storage, and disposal procedures that meet state and federal requirements adopted by regulatory agencies over the last 40 years. Historical disposal sites associated with OU 4 include:

- Landfill 1 (Site LF011)
- Landfill 2 (Site LF012)
- Spoil Pit (Site OT020)
- North Gate Dump (Site OT041)
- Munitions Dump (Site OT042).

Records indicate that solid wastes were dumped and burned at Landfill 1 from approximately 1955 to 1967, and at Landfill 2 from 1963 to 1965 (Figure 2-1). Historical records do not, however, indicate disposal of hazardous wastes at Landfills 1 and 2. The other OU 4 sites include the Spoil Pit, which was active from 1972 until 1989, and received construction debris such as concrete, wood, and soil from the Base; the North Gate Dump, which was never an official dumping area, but was reportedly used for an unknown period of time to dispose of waste solvents; and the Munitions Dump, which was active from 1940 through 1946 for aboveground storage of surplus weapons. In 2007, the Munitions Dump was transferred to OU 14 (Leidos 2013).

The 1987 to 1992 RI identified Landfill 1 as a potential source area for several volatile organic compounds (VOCs) including TCE (U.S. Geological Survey 1992). Based on data collected during the RI, Landfill 2, the Spoil Pit, the North Gate Dump, and the Munitions Dump were designated as NFRAP. As part of the RI process, a baseline risk assessment (James M. Montgomery, Consulting Engineers, Inc. 1991) and a Feasibility Study (Montgomery Watson 1993a) were performed. In 1994, the ROD specified the following remedial actions: capping the contents of Landfill 1 and treating the source of contamination by soil vapor extraction (SVE); extracting contaminated groundwater using horizontal drains, treating the groundwater with air stripping, and discharge to a publicly owned treatment works (POTW); monitoring water quality of groundwater, springs, and seeps within the lateral boundary of the TCE-contaminated groundwater plume; air monitoring in basements of residences overlying contaminated groundwater; collecting surface water and treating it with carbon adsorption when a

sufficient volume of water is produced to operate the treatment system; and implementation and maintenance of ICs to prevent human contact with contaminated soil and groundwater (Hill AFB 1994).

In 1996, a low-permeability cap was installed only over the western portion of Landfill 1 but the eastern portion of Landfill 1 is uncapped. Visual inspections of the low-permeability cap are conducted on a semi-annual basis. The results of these inspections are reported in semi-annual inspection reports and in the annual Inspection Maintenance and Monitoring Reports. The results of these inspections have concluded that the integrity of the cap is being maintained in a condition that prevents surface water infiltration.

The horizontal drain upgrade system (HDUS) was installed in 1996 and 1997 to passively drain and discharge groundwater to a POTW. The HDUS consists of eight 300- to 400-foot-long perforated pipes installed in borings drilled at an upward angle into the hillside below Landfill 1. Sufficient volume of surface water has never been observed at OU 4 and therefore a carbon treatment system has not been installed. A groundwater monitoring program and ICs have been in place since the ROD was signed.

The Davis-Weber Canal, a privately owned irrigation canal used each year from April to October, is located approximately 600 feet north and 100 feet below Landfills 1 and 2. The Davis-Weber Canal is the primary surface water body near OU 4. Near OU 4, the canal flows in a northwesterly direction. Water-level data presented in the Final RI Report (U.S. Geological Survey 1992) indicate that, in the past, water has infiltrated from the canal to the shallow aquifer via leaks. However, portions of the canal were lined with concrete in 2000, which has decreased or eliminated infiltration from the canal and reduced or cut off flow to some of the seeps. Results of analyses of canal water during the RI indicated that the canal has not been a source of contamination, nor has it been contaminated by chemicals from OU 4.

The 2006 ESD documented the following changes to the remedy: allow untreated groundwater effluent from OU 4 to be directly discharged to the Central Weber Sewer Improvement District (CWSID), remove the Landfill 1 SVE remedy, and replace the original ROD requirement for semi-annual air monitoring of homes located within the boundaries of the groundwater plume with the monitoring requirements of the Basewide Indoor Air Sampling Program (i.e., OU 15), which allow homeowners to opt-in or out of the program (Hill AFB 2006).

Semi-annual air monitoring has not been conducted because no homes are located within the boundaries of the groundwater plume. Since the completion of the ROD, Hill AFB has developed a Basewide Indoor Air Sampling Program to identify and mitigate vapor intrusion in all affected off-Base areas. As part of this program, residents located above or near areas of shallow groundwater contamination from any OUs are asked to participate (allow air sampling in their home) on a schedule established in the Final Basewide Air Sampling and Analysis Plan (MWH 2012). This plan has a number of sampling frequencies ranging from annual to quarterly sampling depending on what is discovered in each home. Hill AFB proposes to follow the sampling frequencies outlined in this or future amended versions of this plan. The Restoration Advisory Board is updated periodically at board meetings regarding ongoing indoor air sampling program activities. These updates include results of air sampling, as well as plans for future sampling and any extensions into new neighborhoods near areas of groundwater contamination. Implementation of this sampling plan represents a significant difference from the semi-annual indoor air monitoring included in the ROD.

Soil sample results from the 2013-2014 data gap investigation (EA 2014) confirmed that additional sources of TCE contamination are present within the eastern uncapped portion of Landfill 1 and Landfill 2. Continued monitoring indicates that an ongoing source of TCE contamination to groundwater is still present within the western capped portion of Landfill 1, despite the presence of an intact and functional cap.

Additional information for these sites can be found in the Administrative Record file for OU 4, available online at the AFCEC, Air Force Administrative Record, http://afcec.publicadmin-record.us.af.mil/.

2.1.2 Site Contamination

Contamination at OU 4 is described as being either in the source areas or in the non-source area. The source areas are on-Base and consist of Landfills 1 and 2 (Figure 2-1). The non-source area is located on-Base and off-Base, and includes shallow groundwater, seeps, and springs containing elevated concentrations of chlorinated solvents, where TCE concentrations in groundwater exceed the Federal Drinking Water Maximum Contaminant Level (MCL) for TCE (5 micrograms per liter [µg/L]). The area of contaminated groundwater is approximately 70 acres (Figure 2-1).

Both on-Base and off-Base portions of OU 4 are located on a steep, terraced, north-facing hill that forms the south side of Weber River Valley. Depths to the water table range from approximately 30 feet below ground surface (bgs) near Landfill 1 to approximately 5 feet bgs near South Weber Drive. Because depth to groundwater varies across the site, contamination is present up to 95 feet bgs. In general, contaminant concentrations are highest near the water table and decrease with depth in the shallow aquifer. In most areas, contamination at OU 4 is limited to 25 to 40 feet below the water table. In some locations, contamination is present to approximately 60 to 65 feet below the water table.

Groundwater flow in the shallow aquifer is to the north (Figure 2-1). The TCE plume consists of western and eastern lobes, each extending approximately 2,000 feet from their respective source areas (Figure 2-1). TCE-breakdown products (1,1-dichloroethene [DCE], cis-1,2-DCE, and trans-1,2-DCE) are widespread throughout the plume. However, only six locations, all within the core of the eastern lobe of the TCE plume, have concentrations of TCE-breakdown products greater than their respective MCL. Vinyl chloride has been sporadically detected at trace concentrations (below the MCL) within the core of the eastern lobe of the TCE plume (U.S. Geological Survey 1992; Hill AFB 2014). TCE concentrations in groundwater are highest (greater than 10,000 µg/L) in Monitoring Well U4-047, immediately downgradient of the western capped portion of Landfill 1.

Based on the results of semi-annual inspections, the low-permeability cap over the western portion of Landfill 1 is intact and is likely functioning as intended to limit infiltration of surface water. However, an increase in TCE concentrations since 2002 in monitoring wells immediately downgradient of the western capped portion of Landfill 1 indicates that the contents of the western capped portion of Landfill 1 remain a continuing source of TCE contamination to groundwater. The magnitude of detected TCE concentrations in groundwater near Landfill 1 suggests the possible presence of dense non-aqueous phase liquid (DNAPL) in the western capped portion of the Landfill 1 source area. However, there is no direct evidence of DNAPL observed in or around the capped portion of Landfill 1. Because the Landfill 1 cap is intact, leaching of contaminated landfill contents is not likely the mechanism by which contamination of groundwater with TCE is continuing. This increase in TCE concentrations may be due to liquid TCE-contaminated waste migrating downward through the landfill contents to groundwater. To assess where the high TCE concentrations were coming from, data, which are summarized in Section 2.1.3 and will be presented in the RD/RAWP, were collected from the northeast portion of the western capped Landfill 1 as part of a pre-design assessment following approval of the OU 4 Revised Proposed Plan (Hill AFB 2015). The data did not conclusively identify the location of the ongoing source of TCE contamination to groundwater, but did indicate that the ongoing source is likely further upgradient within the landfill rather than near the northern edge as originally thought.

Vadose zone TCE contamination in the uncapped eastern portion of Landfill 1 is primarily located in an approximately 200- by 200-foot area south of Monitoring Well U4-176A. Data were collected from the eastern uncapped Landfill 1 as part of a pre-design assessment following approval of the OU 4 Revised Proposed Plan (Hill AFB 2015). These new data, which are summarized in Section 2.1.3 and will be presented as part of the RD/RAWP for OU 4, were collected to better define the area of high TCE concentrations. The new data show that the area of highest TCE concentrations is more extensive than previously known. Vertically, vadose zone TCE contamination is between 0 and 35 feet bgs (EA 2015a). The highest TCE concentration measured in soil samples collected at uncapped Landfill 1 was 2,280,000 micrograms per kilogram (µg/kg) at 10 feet bgs (MWH 2010), which exceeds the MCL-based EPA Protection of Groundwater Regional Screening Level (RSL) for TCE in soil of 1.8 µg/kg.

Vadose zone TCE contamination at Landfill 2 is primarily located in an approximately 100- by 100-foot area near Monitoring Well U4-074 (Figure 2-1). Vertically, vadose zone TCE contamination is between 10 and 26 feet bgs (EA 2015a). The highest TCE concentration measured in soil samples collected at Landfill 2 was 300,000 µg/kg at 10 to 15 feet bgs (MWH 2010), which also exceeds the MCL-based EPA Protection of Groundwater RSL for TCE in soil of 1.8 µg/kg. Concentrations of TCE in soil at Landfill 2 exceed the MCL-based EPA Protection of Groundwater RSL.

Groundwater monitoring at OU 4 has been ongoing since 1986. Long-term groundwater monitoring results indicate that the TCE plume has not expanded significantly since the plume was originally delineated, and TCE concentrations have remained fairly constant in most areas of the plume. The leading edges of both the eastern and western lobes of the TCE plume are delineated and continue to remain isolated from the Weber River flood plain. The eastern and western lobes are confirmed to be from separate sources, Landfills 1 and 2, respectively. An exception to the temporal consistency of TCE concentrations is immediately downgradient of the western capped portion of Landfill 1, where TCE concentrations have increased since approximately 2002(Hill AFB 2014; EA 2015b).

2.1.3 Summary of Pre-Design Data

The following sections summarize the findings of pre-design data collection at OU 4. The data will be presented in their entirety in the OU 4 RD/RAWP. The objectives of pre-design data collection, as outlined in the OU 4 – Site LF011 Pre-Design Data Collection Letter Work Plan (Pre-Design Work Plan) (EA 2015c), were to obtain additional soil and groundwater contaminant concentration data and to further define soil lithology to design and optimize the expanded remedy. As stated in Section 1.2, the pre-design data collected following the Revised Proposed Plan (Hill AFB 2015) led to a substantial change in the proposed expanded remedy, which was documented in the Updated Revised Proposed Plan (Hill AFB 2016).

2.1.3.1 Western Landfill 1 – Capped

Soil and groundwater grab samples were collected for VOC analysis from western capped Landfill 1 (Figure 2-2). The highest concentrations of TCE measured in soil at capped Landfill 1 were 161,000 µg/kg (U4-233 at 20 feet bgs), 112,000 µg/kg (U4-232 at 19 feet bgs) and 19,400 µg/kg (U4-226 at 10 feet bgs). Concentrations of TCE in HydroPunch™ groundwater samples were lowest (less than 250 µg/L) on the western edge of the study area and highest (greater than 1,000 µg/L) in the center and southern portions of the study area. The highest TCE concentrations in HydroPunch groundwater samples (9,500 and 14,200 µg/L) were from the southernmost (furthest upgradient) locations: U4-229 and U4-234, respectively.

TCE contamination is widespread, both laterally and vertically, throughout the vadose zone (landfill contents) beneath the western Landfill 1 cap. However, a vertical soil contamination profile of an ongoing point source of TCE contamination to groundwater (high TCE concentrations of similar magnitude from a suspected source in the vadose zone down to the water table) was not identified. Groundwater concentrations (the highest groundwater concentrations are furthest upgradient) suggest that the ongoing source of TCE contamination to groundwater is further upgradient of the sampling locations (Figure 2-2). Based on these data, a subgrade biogeochemical reactor will be installed near the downgradient edge of western Landfill 1.

2.1.3.2 Eastern Landfill 1 – Uncapped

Soil samples were collected for VOC analysis from eastern uncapped Landfill 1 (Figure 2-3). The highest TCE concentrations measured in soil at the eastern uncapped portion of Landfill 1 were 2,280,000 µg/kg (U4-221 at 10 feet bgs), 679,000 µg/kg (U4-217 at 2 feet bgs), 657,000 µg/kg (U4-218 at 2 feet bgs), 649,000 µg/kg (U4-219 at 2 feet bgs), and 606,000 µg/kg (U4-213 at 2 feet bgs). Two soil samples were collected for grain-size distribution testing from locations U4-217 (0 to 10 feet bgs; landfill contents) and U4-218 (10 to 15 feet bgs; underlying native soil). Results of the grain-size distribution testing classified the landfill contents as a dark brown silty sand with gravel and the underlying native soil as a brown clay. Visual inspection of the landfill contents indicated that the material largely consisted of a dark brown to black granular (sand and gravel size) carbonaceous material with various other materials such as gravel, broken glass, and wood.

Soil sample results indicate that the area of high TCE concentrations in soil (greater than 100,000 µg/kg) is much more extensive than previously known. Results of the grain-size distribution testing indicate a stark contrast in the permeability of the landfill contents (silty sand with gravel-size carbonaceous material) as compared with the underlying native soil (clay). It is likely that the sorptive properties of the carbonaceous landfill contents have kept TCE from volatilizing from surface and shallow soil and possibly from leaching downward to groundwater.

Based on the expansive area of high TCE concentrations (greater than 100,000 µg/kg), the contrast in permeability between the landfill contents and the underlying clay soil and the unknown sorptive properties of the carbonaceous material that accounts for a large percentage of the landfill contents, the previously proposed remedies of targeted shallow soil excavations and SVE are not considered to be feasible for the eastern uncapped area of Landfill 1. Instead, the results of pre-design data collection support the installation of a low-permeability landfill cap on the eastern uncapped portion of Landfill 1. A landfill cap will prevent exposure to landfill contents and limit surface water infiltration and further leaching of contamination from the landfill contents.

Monitoring Well U4-176A is immediately downgradient of the area of high TCE concentrations (Figure 2-3). An analysis of historical TCE concentrations in groundwater at U4-176A indicates that the current TCE concentration (110 µg/L) is considerably lower than the historical high TCE concentration (4,000 µg/L in 2011). A comparison of groundwater elevation versus TCE concentration at Monitoring Well U4-176A indicates a strong correlation between groundwater elevations and TCE concentrations (Figure 2-4). As a result, a row of monitoring/injection wells will be installed immediately downgradient of the new low-permeability eastern Landfill 1 cap. This will allow monitoring of water levels and TCE concentrations in groundwater flowing from beneath eastern Landfill 1 and treatment, in the event that TCE concentrations in groundwater increase immediately downgradient of the new eastern Landfill 1 cap.

2.1.3.3 Landfill 2

Soil samples were collected for VOC analysis from Landfill 2 location U4-212 (Figure 2-5). TCE was measured in soil at concentrations of 55,900 µg/kg (13 feet bgs) and 231,000 µg/kg (18 feet bgs). Two soil samples were collected for grain-size distribution testing. Results of the grain-size distribution testing indicate that the shallow soil is a brown silty sand and the deeper soil is a brown clay.

Soil sampling at U4-212 confirmed previous TCE results collected in 2009 at location U4-7170. The highest TCE concentrations present at Landfill 2 are deeper than 10 feet bgs. Results of the grain-size distribution testing indicate a stark contrast in the permeability of the landfill contents (silty sand) as compared with the underlying native soil (clay). Based on these pre-design data, it was determined that additional investigation at Landfill 2 is needed to provide the foundation for any future remedy selection. Therefore, Landfill 2 is not addressed in this ROD Amendment, and any future remedy selection will be dependent on additional characterization of Landfill 2.

2.1.3.4 Dissolved-Phase Plume

Six soil boring locations were selected to (1) constrain the vertical and horizontal distribution of TCE concentrations in groundwater in the downgradient plume near Monitoring Wells U4-065 and U4-001, and (2) further define geologic features that may affect contaminant distribution to optimize the design of the planned ERD biobarrier (Figure 2-6). Based on the lithology of the six soil borings, groundwater flows primarily through thin (0.5- to 6-inch-thick) sand layers interbedded in clay. Saturated sand layers were discovered to be shallower (approximately 15 feet bgs) than previously thought in the area between Monitoring Wells U4-117 and U4-058. Concentrations of TCE in the shallow groundwater samples range from 1,670 µg/L (U4-211) to 8.2 µg/L (U4-207). Concentrations of TCE in the deep groundwater samples range from 7.26 µg/L (U4-208) to 0.24 µg/L (U4-207).

TCE concentrations in groundwater are highest near the water table, decreasing to near the MCL (5 µg/L) at a depth of approximately 20 feet below the water table. There is some lateral variability of TCE concentrations near the water table with concentrations generally decreasing from east to west.

2.2 Summary of the Existing Selected Remedy

The following is the existing selected remedy after completion of the ESD:

- Installation of a low-permeability cap covering the contents of Landfill 1 (currently only applied to the western portion of Landfill 1)
- Passive extraction and discharge of groundwater to the CWSID via the HDUS
- Monitoring water quality of groundwater, springs, and seeps within the lateral boundary of the TCE plume.
- ICs including land use controls and restrictions on domestic use of groundwater.

The selected remedy in the 1994 ROD also specified that surface water be collected and treated using carbon adsorption when a sufficient volume of surface water was available to operate a treatment system. However, since the signing of the 1994 ROD, there has never been a sufficient volume of surface water available from seeps and springs to implement a carbon adsorption treatment system at OU 4.

The ROD estimated that the remedial timeframe to achieve MCLs was greater than 30 years. Based on presence of an ongoing source of TCE contamination to groundwater, the estimated remedial timeframe for the current remedy is indefinite.

2.2.1 Source Area

The existing remedy for the source area consists of the capping of Landfill 1 contents (cap installed in 1996 on only the western portion of Landfill 1) to prevent surface water infiltration that could subsequently mobilize contaminants. Six horizontal drain lines installed in three sets of two were placed beneath western Landfill 1. These drain lines remove leachate from beneath western Landfill 1 and collect it into three sumps located on the eastern side of the low-permeability cap where it could be pumped out and transported to the Industrial Wastewater Treatment Plant at Hill AFB for disposal or discharged to the CWSID system with effluent from the HDUS.

2.2.2 Non-Source Area

The existing non-source area remedy includes passive collection and discharge of groundwater via the HDUS and monitoring the water quality of groundwater, springs, and seeps within the lateral boundary of the TCE plume. The HDUS consists of nine (three sets of three drains, although one drain line collapsed and was abandoned in 1993), 300- to 400-foot-long perforated pipes drilled at an upward angle into the hillside, thus crossing numerous water-bearing zones. These perforated pipes allow groundwater to flow into the pipes and drain via gravity into one main discharge pipe. The HDUS was installed in 1996 and 1997 during a second phase of remediation to retrofit the original horizontal drain system (which was installed as part of a pilot study) to create a more permanent drain configuration. Until 2001, extracted groundwater was treated using an air stripper and subsequently discharged to the CWSID system. Air stripper treatment was discontinued due to the low contaminant concentrations and changes in the publicly owned treatment works pretreatment permit (Permit # HAFB/OU1246) for OU 4, which now allows direct discharge to the CWSID system.

2.2.3 Institutional Controls

This section describes the ICs that were put in place at OU 4 in accordance with the ROD (Hill AFB 1994). The extent of ICs associated with OU 4 is shown on Figure 2-7. Although no fundamental changes have been made to the ICs, one minor change related to access control of seep/spring areas is described in this section. The following language supersedes the IC language in the ROD with the intention of clarifying how ICs will be administered and maintained.

ICs are used when contamination remains onsite at a level that does not allow for unlimited use and unrestricted exposure. The following risks necessitate that ICs be implemented:

- Groundwater is not safe for drinking water because it is contaminated at levels that exceed MCLs. Accordingly, the Base must impose ICs to ensure that groundwater is not used for drinking water purposes until it is remediated to MCL levels.

- Residual soil contamination is not safe for recreational or residential use. ICs are therefore necessary to preclude such uses and to control the disposition and use of any soil excavated from the site.

The USAF is responsible for implementing, monitoring, maintaining, reporting on, and enforcing the ICs on-Base, including specific actions as described in the Base General Plan and the Restricted Areas Use Map. For groundwater plumes extending off-Base, the Utah Division of Water Rights (DWRi) has imposed restrictions on the installation of new wells and does not permit installation of wells in the off-Base area with groundwater contamination in the shallow aquifer, as described in more detail below. However, the USAF is responsible for ensuring that ICs that are part of this ROD Amendment, but are performed by other parties, are established, monitored, maintained and reported on to ensure protection of human health and the environment. The USAF will retain ultimate responsibility for remedy integrity. The USAF shall inform, monitor, enforce, and bind, where appropriate, authorized lessees, tenants, contractors, and other authorized occupants of the site regarding the ICs affecting the site. Where State agencies bear a significant enforcement role, the USAF will maintain regular communication with the State agencies and request appropriate notification of enforcement actions. If the USAF and EPA determine that specific IC requirements are not being met, it is understood that the remedy may be reconsidered and that additional measures may be required to protect human health and the environment.

The following are the performance objectives for the ICs at OU 4:

- Maintain the integrity of any current or future remedy components, such as the low-permeability cap, HDUS, subgrade biogeochemical reactor, ERD biobarriers, and monitoring wells.
- Prevent access or use of contaminated groundwater, seeps, springs, and surface water until cleanup levels are met.
- Prevent the use of contaminated soil in the event of excavation, and implement the soils management plan.
- Prohibit the development and use of property for residential housing, elementary and secondary schools, or childcare facilities and playgrounds.

2.2.3.1 Land Uses

Since Hill AFB is expected to remain under the jurisdiction of the Department of Defense for the foreseeable future, the future on-Base land use for OU 4 is expected to be industrial and/or commercial. No development or use of the on-Base portion of OU 4 will include residential housing, elementary and secondary schools, childcare facilities, or playgrounds until the on-Base landfills are remediated to levels that allow for unlimited use and unrestricted exposure.

Off-Base, the OU 4 plume underlies an area at the border of Riverdale City and South Weber City, which consists of residences and agricultural land. Future off-Base land use overlying OU 4 is expected to remain residential and agricultural.

The ICs selected to protect human health and the environment consider these potential future land use scenarios. ICs will be maintained until contaminant concentrations in groundwater and the on-Base landfills are remediated to levels that allow for unlimited use and unrestricted exposure.

2.2.3.2 Administration of Institutional Controls

ICs prohibiting use of shallow groundwater within OU 4 have been instituted to prevent exposure until contaminants are at concentrations that allow for unlimited use and unrestricted exposure. The current extent of ICs is shown on Figure 2-7. Groundwater monitoring is used to track the direction and rate of

movement of each contaminant plume. These restrictions will remain in place and be monitored for effectiveness until contaminant concentrations in groundwater are at levels that allow for unlimited use and unrestricted exposure.

Off-Base ICs will include the following measures:

- Utah DWRi restrictions on the installation of new wells in the shallow aquifer in off-Base areas will be maintained as described in the Utah DWRi documentation. State water rights and well-drilling restrictions will be maintained to prevent human exposure to off-Base groundwater from the shallow aquifer that contains contaminant of concern (COC) concentrations above the MCL. The Utah DWRi regulates appropriation and distribution of all water within the State of Utah and has developed a groundwater management plan entitled, Ground-Water Management Plan for the Weber Delta Sub-Area of the East Shore Area (Utah DWRi 1995), which includes the off-Base areas of groundwater contamination associated with Hill AFB. This plan does not permit installation of wells in the off-Base areas that have groundwater contamination in the shallow aquifer associated with OU 4 (and other Hill AFB OUs). The USAF will send a letter to the Utah DWRi annually requesting verification of continuing enforcement of these restrictions throughout the life of the remedy, though the USAF will ultimately be responsible for maintaining the integrity of the remedy.

Internal procedures that the Hill AFB will use to implement ICs include but are not limited to the following:

- The USAF will maintain maps of the geographic extent of the OU in the geographic information system database. This information will be included in the Base Comprehensive (or General) Plan to ensure that the USAF planners are aware of the OU and of the restriction of activities within the OU.

- The USAF will update and distribute to Base organizations a Restricted Areas Use Map identifying areas where soil and groundwater contamination may be encountered and where remedial systems are present.

- The USAF will review all construction proposals using the Base Civil Engineer Work Order request form (USAF Form 332) to address potential environmental risks at each construction site.

- Under the Hill AFB dig permit process, 775 CES “civil engineering” will review the construction proposals to prevent activities that would result in breaches of the landfill cover or damage to remedial systems.

- Fencing, signs, and locks, as applicable, will be installed and maintained to ensure the integrity of the remedy components.

- The USAF will notify the EPA and UDEQ in advance of any changes to internal procedures associated with the selected remedies that might affect the ICs.

Monitoring of the ICs located both on and off-Base will be conducted annually by the USAF. The annual evaluation will address whether the use restrictions and controls referenced above were communicated in the deed(s), whether the owners and state and local agencies were notified of the use restrictions and controls affecting the property, and whether use of the property has conformed with such restrictions and controls. Monitoring results will be included in a separate report or as a section of another environmental

report, if appropriate, and provided to the EPA and UDEQ. Annual monitoring reports will be used in preparation of the Five-Year Review to evaluate the effectiveness of the remedy. The annual monitoring report, submitted to the regulatory agencies by the USAF, will evaluate the status of ICs and how any IC deficiencies or inconsistent uses have been addressed.

2.2.3.3 Breaches of Institutional Controls

Any activity that is inconsistent with the ICs or use restrictions, or any other action that may interfere with the effectiveness of the ICs will be addressed by the USAF as soon as practicable, but in no case will the process be initiated later than 10 days after the USAF becomes aware of the breach. The USAF will notify the EPA and the UDEQ as soon as practicable, but no longer than 10 days after discovery, of any activity that is inconsistent with the ICs or use restrictions, or any other action that may interfere with the effectiveness of the ICs. The USAF will notify the EPA and UDEQ regarding how the USAF has addressed or will address the breach within 10 days of sending EPA and UDEQ notification of the breach.

2.2.3.4 Land Use Changes and Transfers

The USAF must provide notice to the EPA and UDEQ at least 6 months prior to any transfer or sale of property associated with OU 4, so that the EPA and UDEQ can be involved in discussions to ensure that appropriate provisions are included in the transfer or conveyance documents to maintain effective ICs. If it is not possible for the USAF to notify the EPA and UDEQ at least 6 months prior to any transfer or sale, then the USAF will notify the EPA and UDEQ as soon as possible but no later than 60 days prior to the transfer or sale of any property subject to ICs. The USAF agrees to provide the EPA and UDEQ with such notice, within the same timeframes, for federal-to-federal transfer of property accountability. In the case of federal-to-federal transfers, there is no deed transfer since the property continues to be owned by the U.S. government. However, a transfer assembly document is used to transfer property from one federal agency to another. The USAF shall provide a copy of the executed deed or transfer assembly to the EPA and UDEQ.

Although the USAF may later transfer procedural responsibilities to another party by contract, agreement, or through other means, the USAF shall retain ultimate responsibility for remedy integrity. The USAF shall notify the EPA and UDEQ 45 days in advance of any proposed land use changes that are inconsistent with ICs or the selected remedy.

2.2.3.5 Modification or Termination

The USAF shall not modify or terminate ICs, implementation actions, or land uses that are associated with the selected remedy without the approval of the EPA and the opportunity for concurrence by the UDEQ. Hill AFB will seek prior approval by the EPA and concurrence from the UDEQ before any anticipated action that may disrupt the effectiveness of the ICs or any action that may alter or negate the need for ICs.

2.3 Existing Remedy Performance

The 2013 Five-Year Review (Leidos 2013) found that the existing remedy for OU 4 is not functioning as intended but remains protective in the short-term. The existing source area remedy (low-permeability cap over the western portion of Landfill 1) likely limits infiltration of surface water; however, an increase in TCE concentrations since 2002 in monitoring wells immediately downgradient of the capped portion of Landfill 1 indicates that the landfill remains a continuing source of TCE contamination to groundwater. This increase in TCE concentrations may be due to liquid TCE-contaminated waste migrating downward

through the landfill contents to groundwater. With an ongoing source of TCE contamination, the remedial timeframe for OU 4 is indefinite.

Additional source areas have been identified in the eastern uncapped portion of Landfill 1 and in Landfill 2. The 2013 Five-Year Review (Leidos 2013) recommended that additional investigation be conducted in the eastern uncapped portion of Landfill 1 and in Landfill 2 to delineate the extent of contamination and that a ROD amendment may be necessary to address a remedy modification. The 2013-2014 data gap investigation (EA 2015a) confirmed that, in addition to the ongoing source underneath the capped portion of Landfill 1, the uncapped portion of Landfill 1 and Landfill 2 also may be continuing sources of TCE contamination to groundwater at OU 4. The existing source area remedy does not address these additional source areas.

The existing non-source area remedy (HDUS) has passively extracted approximately 35 million gallons of groundwater and removed 224 pounds of TCE since 1996. An evaluation of site data indicates that HDUS has removed only a small percentage of the calculated TCE mass in the OU 4 groundwater plume, has had minimal impact on TCE concentrations in nearby monitoring wells, and has done relatively little to hydraulically control plume migration (Hill AFB 2014). Consequently, a more aggressive strategy is required to address source areas and deplete portions of the plume with elevated TCE concentrations to achieve contaminant concentrations below MCLs. Landfill 2 will be addressed separately from this ROD Amendment after additional data are collected to understand the nature of the potential source.

2.4 Contaminants of Concern and Remediation Goals

COCs associated with OU 4 are provided in the RI Report (U.S. Geological Survey 1992) and the ROD; current maximum COC concentrations at OU 4 are similar to the maximum COC concentrations listed in the ROD. Since a continuing source of TCE contamination remains on-Base, risks associated with TCE contamination at OU 4 remain the same as described in the RI Report (U.S. Geological Survey 1992) and ROD. Risk exposure assumptions are presented in the OU 4 ROD (Hill AFB 1994).

Contaminants detected at OU 4 consist of the VOCs benzene, chloroform, 1,1-DCE, cis- and trans-1,2-DCE, 1,2-dichloroethane (DCA), methyl ethyl ketone (MEK), tetrachloroethene (PCE), toluene, TCE, and xylenes; and the metals arsenic, barium, boron, cobalt, nickel, and selenium (Table 2-1). VOCs were detected in groundwater, surface water from seeps, and soils, and metals were detected only in groundwater. TCE is the principal contaminant at OU 4 because it is the only VOC consistently detected in groundwater at concentrations exceeding its MCL. Historically, TCE was detected at concentrations exceeding the MCL in seeps, however, TCE has not been detected at concentrations above its MCL in any seeps in more than 15 years. Benzene and DCE have been detected in groundwater at concentrations slightly above their MCLs. Metals have been identified in groundwater at concentrations above background levels in various wells, but occurrences above MCLs are sporadic, localized, and within the TCE plume. Metals that have been found at concentrations in groundwater above MCLs are arsenic, nickel, and selenium.

Table 2-1 presents the remediation goals for OU 4. Unless otherwise specified, acceptable concentrations for groundwater and surface water are the MCLs established under the federal Safe Drinking Water Act and/or Utah Primary Drinking Water Standards.

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TABLE 2-1
Contaminants of Concern and Remediation Goals
Operable Unit 4 Record of Decision Amendment, Hill Air Force Base, Utah

Media	Contaminant of Concern	Remediation Goal	Units
Groundwater	Benzene	5	µg/L
	Chloroform[(1)]	80	µg/L
	1,2-Dichloroethane	5	µg/L
	1,1-Dichloroethene	7	µg/L
	cis-1,2-Dichloroethene	70	µg/L
	trans-1,2-Dichloroethene	100	µg/L
	Methyl ethyl ketone[(2)]	830	µg/L
	Tetrachloroethene	5	µg/L
	Toluene	1,000	µg/L
	Trichloroethene	5	µg/L
	Total xylenes	10,000	µg/L
	Arsenic	10	µg/L
	Barium	2,000	µg/L
	Boron[(2)]	2,700	µg/L
	Nickel[(2)]	100	µg/L
	Selenium	50	µg/L
Surface Water	Chloroform[(1)]	80	µg/L
	cis-1,2-Dichloroethene	70	µg/L
	trans-1,2-Dichloroethene	100	µg/L
	Trichloroethene	5	µg/L
Air	Trichloroethene[(2)]	5	µg/m^3

NOTES:
[(1)] The remediation goal for chloroform is the MCL for total trihalomethanes.
[(2)] The remediation goal for these chemicals are risk-based levels (Leidos 2013).

µg/L = Microgram(s) per liter.
µg/m^3 = Microgram(s) per cubic meter.
MCL = Maximum Contaminant Level.

Unless otherwise specified, concentrations for groundwater and surface water are MCLs established under the federal Safe Drinking Water Act and/or Utah Primary Drinking Water Standards.

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Source(s):
(1)The plume was based on two-dimensional kriging log10 of the maximum concentration measured during Spring 2014.

Acronym(s) and Abbreviation(s):
µg/L = Microgram(s) per liter.
HDUS = Horizontal Drain Upgrade System.
NFRAP = No Further Remedial Action Planned.
TCE = Trichloroethene.

Note(s):
Geographic data for the study area were projected using coordinate system World Geodetic System 1984 Universal Transverse Mercator Zone 12N.

0 175 350 700 Feet

1 inch equals 350 feet

LEGEND

- Monitoring Well
- Piezometer
- HDUS Extraction Point
- Seep
- Spring
- Area Boundary
- Hill Air Force Base Boundary
- Fenceline
- Horizontal Drain Piping
- Horizontal Drain
- Horizontal Drain (Abandoned)
- Approximate Groundwater Flow Direction

TCE Concentration in Groundwater (µg/L)(1)

- 5-10
- 10-100
- 100-1,000
- >1,000

Landfill 2 (NFRAP 1994)
North Gate Dump (NFRAP 1994)
Western Landfill 1 (Capped)
Munitions Dump (NFRAP 1994)
Landfill 1 (Uncapped)
Spoils Pit (NFRAP 1992)
HILL AIR FORCE BASE BOUNDARY
BROWNING AVE
QUINCE LN

MAP INDEX

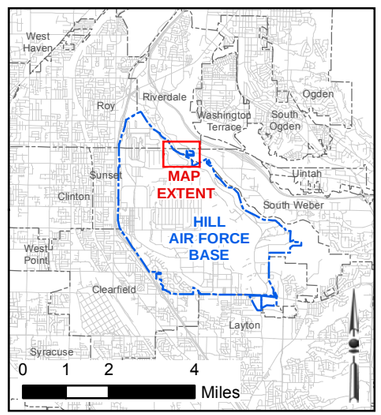

FIGURE 2-1
PLUME MAP
OPERABLE UNIT 4 RECORD OF DECISION AMENDMENT
HILL AIR FORCE BASE, UTAH

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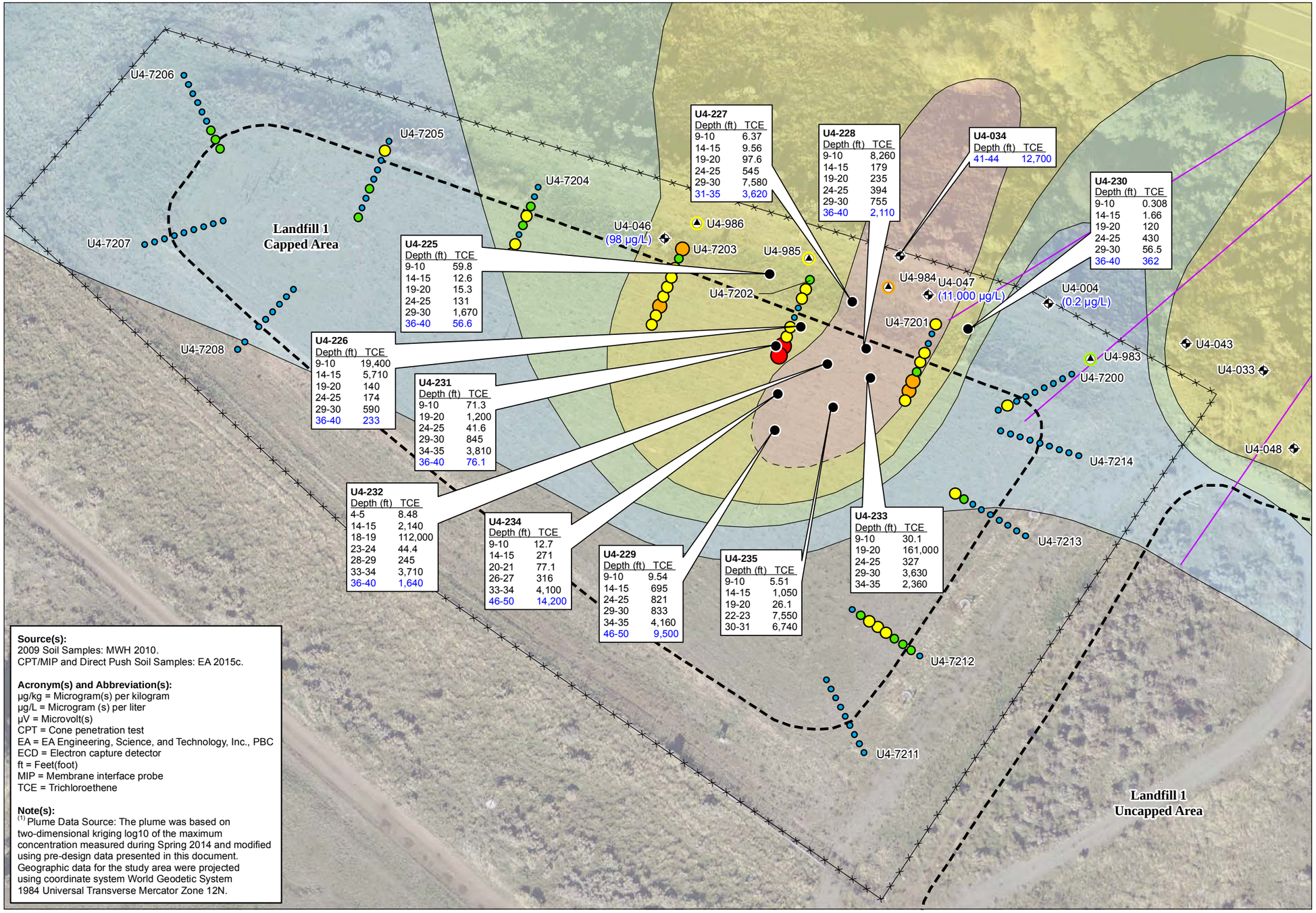

Source(s):
2009 Soil Samples: MWH 2010.
CPT/MIP and Direct Push Soil Samples: EA 2015c.

Acronym(s) and Abbreviation(s):
µg/kg = Microgram(s) per kilogram
µg/L = Microgram (s) per liter
µV = Microvolt(s)
CPT = Cone penetration test
EA = EA Engineering, Science, and Technology, Inc., PBC
ECD = Electron capture detector
ft = Feet(foot)
MIP = Membrane interface probe
TCE = Trichloroethene

Note(s):
(1) Plume Data Source: The plume was based on two-dimensional kriging log10 of the maximum concentration measured during Spring 2014 and modified using pre-design data presented in this document. Geographic data for the study area were projected using coordinate system World Geodetic System 1984 Universal Transverse Mercator Zone 12N.

MAP INDEX

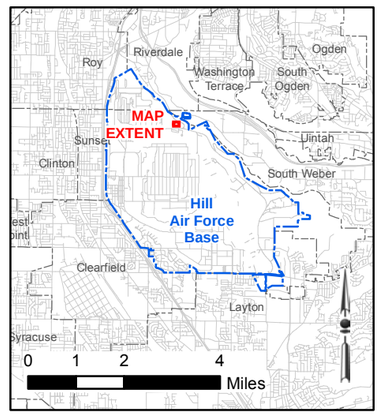

FIGURE 2-2
WESTERN CAPPED LANDFILL 1 - PRE-DESIGN RESULTS
OPERABLE UNIT 4 RECORD OF DECISION AMENDMENT
HILL AIR FORCE BASE, UTAH

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U4-033
U4-044
U4-048
U4-989
U4-980
U4-981
U4-978
U4-060
U4-971
U4-176A
U4-976
U4-975
U4-177
U4-987
U4-982

U4-979
Depth (ft)	TCE (µg/kg)
16	800
28[(1)]	6,870

U4-977
Depth (ft)	TCE (µg/kg)
12	0.7 J
18	6.7

U4-7135 (2009)
Depth (ft)	TCE (µg/kg)
0-5	9,400
5-10	97
10-15	350

U4-7130
Depth (ft)	TCE (µg/kg)
0-5	16,000
5-10	250

U4-970 (2009)
Depth (ft)	TCE (µg/kg)
6	75.8
12	2,370
25	4,670
28	881

U4-972
Depth (ft)	TCE (µg/kg)
10	170
19	260
24	367

U4-217
Depth (ft)	TCE (µg/kg)
2	679,000
5	130,000
7	52,900
10	193,000

U4-218
Depth (ft)	TCE (µg/kg)
2	657,000
5	2,260
9	209

U4-214
Depth (ft)	TCE (µg/kg)
2	27,100
5	7,480
8	2,210

U4-221
Depth (ft)	TCE (µg/kg)
2	23,900
5	549,000
7	263,000
10	2,280,000

U4-222
Depth (ft)	TCE (µg/kg)
2	11,800
5	8,600
10	294

U4-973
Depth (ft)	TCE (µg/kg)
10	103
16	12.4

U4-7136 (2009)
Depth (ft)	TCE (µg/kg)
0-5	110,000
5-10	34,000
10-15	140

U4-215
Depth (ft)	TCE (µg/kg)
2	33,100
5	66,000

U4-213
Depth (ft)	TCE (µg/kg)
2	606,000
5	4,030
8	12,100
10	113

U4-216
Depth (ft)	TCE (µg/kg)
2	417,000
5	68,000
7	111,000
10	2,310

U4-219
Depth (ft)	TCE (µg/kg)
2	649,000
5	190,000
7	179,000
10	1,300

U4-220
Depth (ft)	TCE (µg/kg)
2	7,560
5	198,000
7	341,000
10	1,590

U4-7129 (2009)
Depth (ft)	TCE (µg/kg)
0-5	390,000
5-10	15,000

U4-974
Depth (ft)	TCE (µg/kg)
15	984
20	2,080

U4-224
Depth (ft)	TCE (µg/kg)
2	4,870
5	448,000
7	261,000
10	2,460

U4-223
Depth (ft)	TCE (µg/kg)
2	5,940
5	2,190
7	80,400
10	688

Landfill1 Uncapped Area

0 20 40 80 Feet

1 inch equals 40 feet

LEGEND

- Monitoring Well
- Pre-Design Sample
- 2009 Soil Sample
- CPT/MIP
- CPT/MIP and Direct-Push Soil Sample

MIP ECD Response

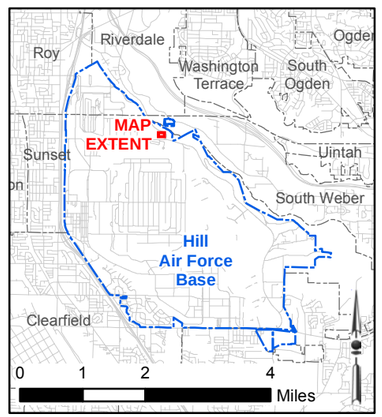
- < $5x10^5$ µV
- > $1x10^7$ µV
- $5x10^5$ - $1x10^7$ µV
- Area of Primary Vadose Zone TCE Contamination
- Fence
- Area Boundary

Source(s):
2009 Soil Samples: MWH 2010.
CPT/MIP and Direct Push Soil Samples: EA 2015c.

Acronym(s) and Abbreviation(s):
µg/kg = Microgram(s) per kilogram
µV = Microvolt(s)
CPT = Cone penetration test
EA = EA Engineering, Science, and Technology, Inc., PBC
ECD = Electron capture detector
ft = Feet(foot)
J = Estimated value
MIP = Membrane interface probe
TCE = Tricholorethene

Note(s):
[(1)] Field duplicate collected at this location; highest result is shown.
Geographic data for the study area were projected using coordinate system World Geodetic System 1984 Universal Transverse Mercator Zone 12N.

MAP INDEX



AIR FORCE CIVIL ENGINEER CENTER

FIGURE 2-3
EASTERN UNCAPPED LANDFILL 1 - PRE-DESIGN RESULTS
OPERABLE UNIT 4 RECORD OF DECISION AMENDMENT
HILL AIR FORCE BASE, UTAH

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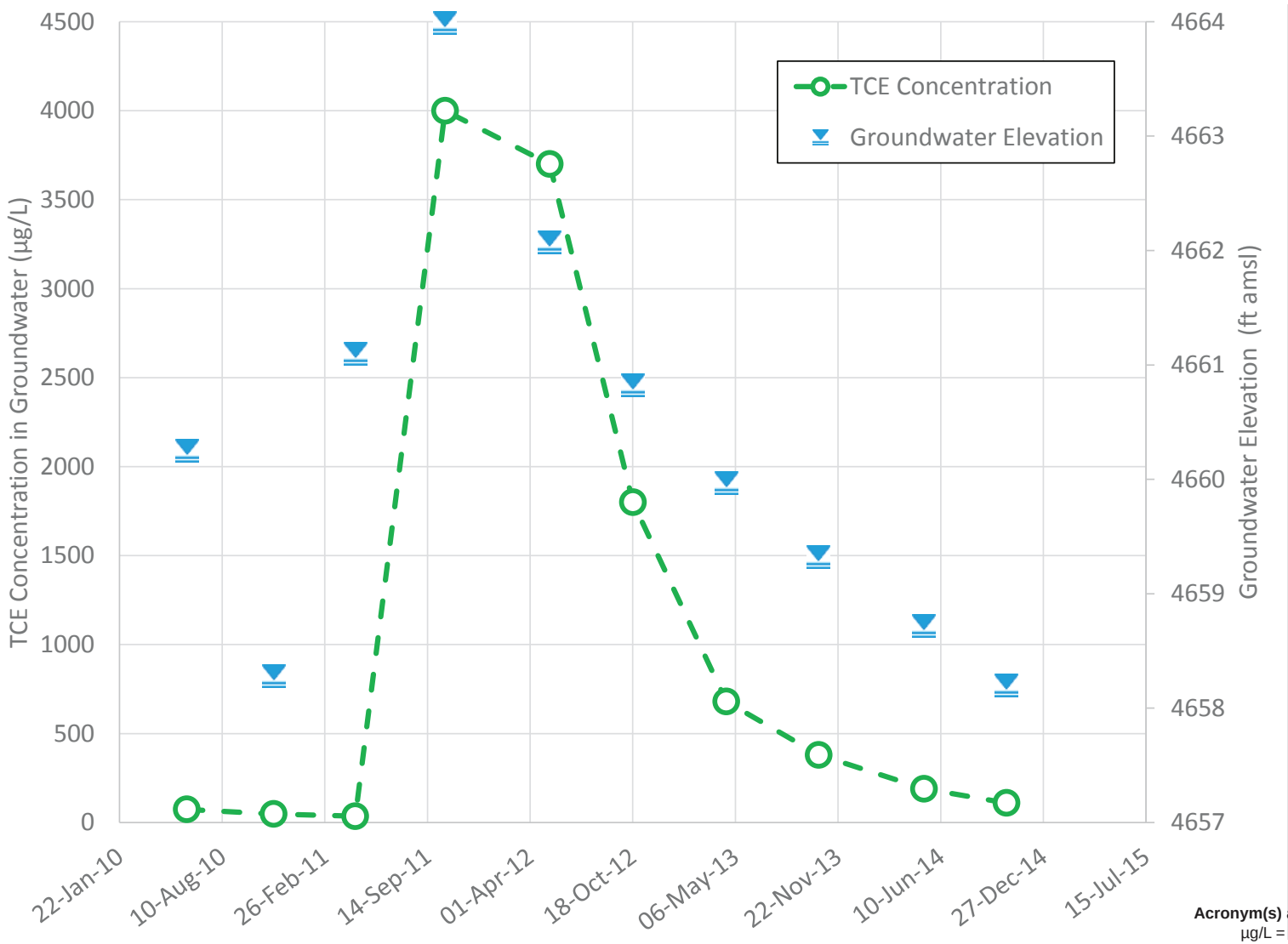
Fig03-07_CSS_OU4_U4TCE_Chart_v2_SStearns 05/17/2016



Acronym(s) and Abbreviation(s):
µg/L = Microgram(s) per liter
amsl = Above mean sea level
ft = Feet(foot)
TCE = Trichloroethene

FIGURE 2-4

COMPARISON OF TCE CONCENTRATIONS TO GROUNDWATER ELEVATIONS AT MONITORING WELL U4-176A

OPERABLE UNIT 4 RECORD OF DECISION AMENDMENT
HILL AIR FORCE BASE, UTAH

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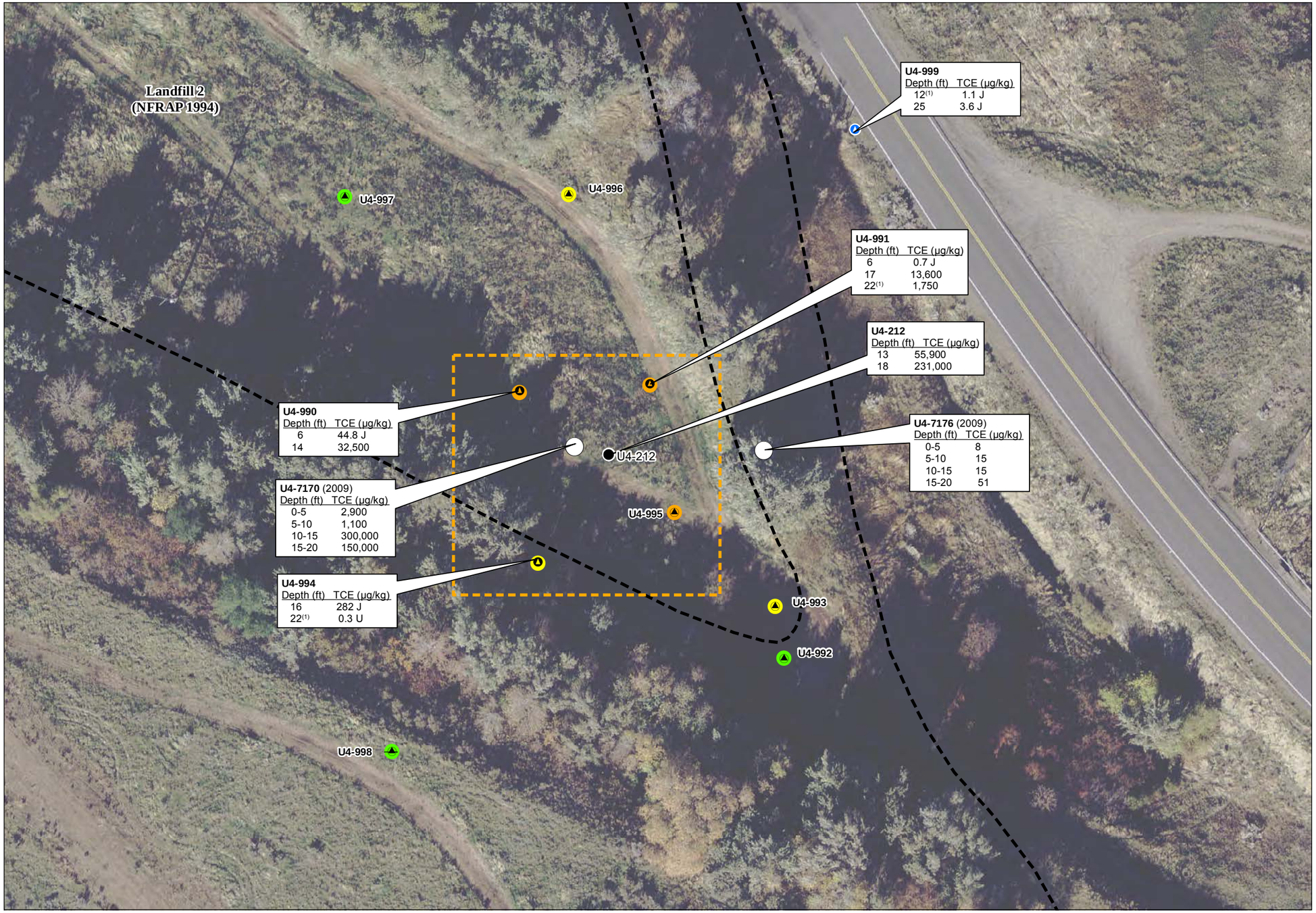


0 20 40 80 Feet

1 inch equals 40 feet

LEGEND

- Pre-Design Sample
- 2009 Soil Sample Location
- CPT/MIP Location
- CPT/MIP and Direct-Push Soil Sample Location
- Direct-Push Soil Sample Location

MIP ECD Response (µV)

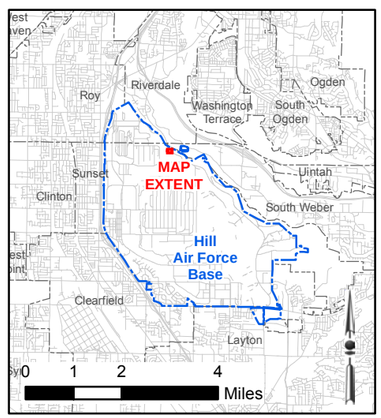
- < $5x10^5$
- $5x10^5$ - $1x10^7$
- > $1x10^7$
- Area of Primary Vadose Zone TCE Contamination
- Area Boundary

Source(s):
2009 Soil Samples: MWH 2010
CPT/MIP and Direct-Push Soil Samples: EA 2015c

Acronym(s) and Abbreviation(s):
µg/kg = Microgram(s) per kilogram
µV = Microvolt(s)
CPT = Cone penetration test
EA = EA Engineering, Science, and Technology, Inc., PBC
ECD = Electron capture detector
ft = Feet(foot)
J = Estimated value
MIP = Membrane interface probe
NFRAP = No Further Response Action Planned
TCE = Tricholorethene
U = Not detected

Note(s):
(1) Field duplicate collected at this location, highest result is shown.
Geographic data for the study area were projected using coordinate system World Geodetic System 1984 Universal Transverse Mercator Zone 12N.

MAP INDEX



AIR FORCE CIVIL ENGINEER CENTER

FIGURE 2-5
LANDFILL 2 - PRE-DESIGN RESULTS
OPERABLE UNIT 4 RECORD OF DECISION AMENDMENT
HILL AIR FORCE BASE, UTAH

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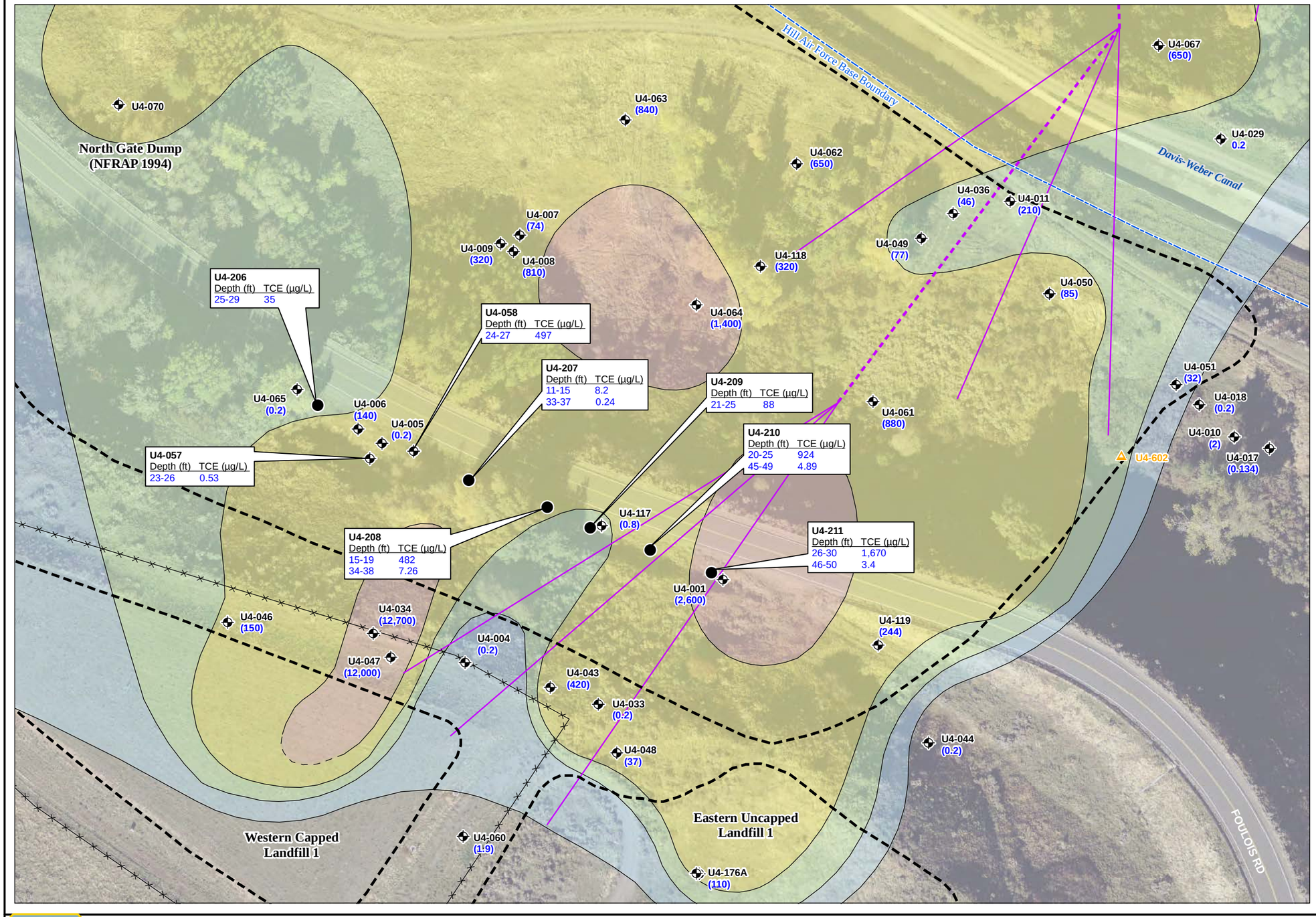

0 40 80 160 Feet

1 inch equals 80 feet

LEGEND

- Pre-Design Sample
- Monitoring Well
- Piezometer
- Horizontal Drain Piping
- Horizontal Drain
- (85) Groundwater Sample Result (µg/L)

TCE Concentration 2014 (µg/L)[1]

- 5 - 10
- 10 - 100
- 100 - 1,000
- > 1,000

Acronym(s) and Abbreviation(s):
µg/L = Microgram(s) per liter
ft = Feet(foot)
NFRAP = No Further Response Action Planned
TCE = Trichloroethene

Note(s):
[1] Plume Data Source: The plume was based on two-dimensional kriging log10 of the maximum concentration measured during Spring 2014 and modified using pre-design data presented in this document. Geographic data for the study area were projected using coordinate system World Geodetic System 1984 Universal Transverse Mercator Zone 12N.

MAP INDEX

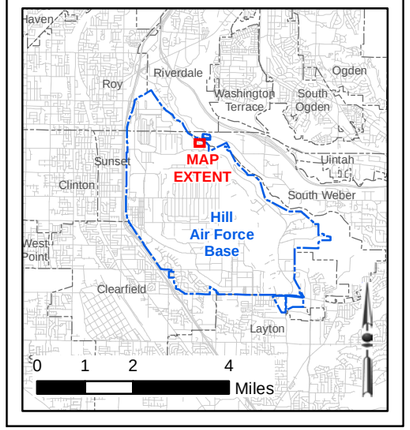

FIGURE 2-6
DISSOLVED-PHASE PLUME - PRE-DESIGN RESULTS
OPERABLE UNIT 4 RECORD OF DECISION AMENDMENT
HILL AIR FORCE BASE, UTAH

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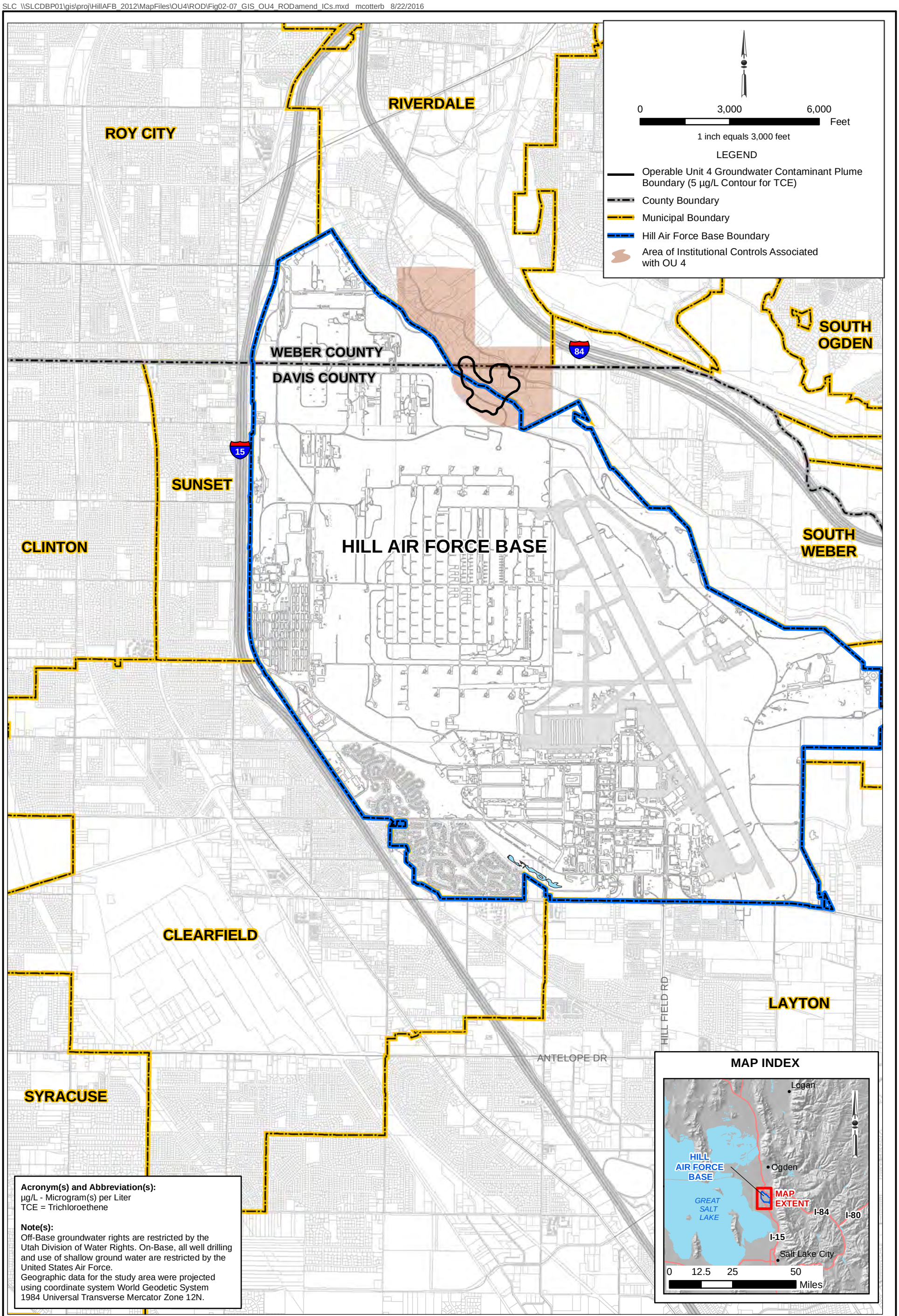

FIGURE 2-7

AREAS OF INSTITUTIONAL CONTROLS ASSOCIATED WITH OPERABLE UNIT 4

OPERABLE UNIT 4 RECORD OF DECISION AMENDMENT
HILL AIR FORCE BASE, UTAH

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3.0 Description of Expanded Remedy

3.1 Expanded Remedy

In addition to implementing the expanded remedy described below, the existing remedy (low-permeability cap, passive extraction and discharge of groundwater to the CWSID system via the HDUS, monitoring water quality of groundwater, springs, and seeps within the lateral boundary of the TCE plume, and ICs) will be maintained. Landfill 2 will be addressed separately from this ROD Amendment after additional data are collected to understand the nature of the potential source.

3.1.1 Source Area

The expanded source area remedy will consist of the following components:

- Installation of a subgrade biogeochemical reactor near the downgradient edge of western Landfill 1
- Installation of an additional low-permeability cap to cover eastern Landfill 1
- Installation of a row of monitoring/injection wells near the downgradient edge of eastern Landfill 1.

A subgrade biogeochemical reactor will be installed downgradient of the currently capped portion of Landfill 1 to biologically treat the area of highest TCE concentrations in groundwater (greater than 10,000 µg/L) at OU 4. Construction of the subgrade biogeochemical reactor typically includes the emplacement of an organic mulch, emulsified vegetable oil (EVO) or similar carbon substrate, and gravel mix into the subsurface to stimulate biodegradation (ERD) of TCE contamination. Source area groundwater will be extracted and recirculated through the subgrade biogeochemical reactor to load groundwater with dissolved carbon to promote ERD downgradient of the source. In addition to the ongoing remedial action of groundwater monitoring, groundwater performance monitoring of the subgrade biogeochemical reactor will be conducted. This groundwater performance monitoring will include COCs, TCE-breakdown products (cis-1,2-DCE, trans-1,2-DCE, vinyl chloride, and ethene), degradation by-products (methane, arsenic, manganese), and geochemical parameters (pH, dissolved oxygen [DO], oxidation reduction potential [ORP], ferrous iron).

Data collected since the ROD was signed indicate that the eastern uncapped portion of Landfill 1 is an additional source area. To address this source area, an additional low-permeability cap will be installed to cover eastern Landfill 1. A fence will also be installed around the additional low-permeability cap at eastern Landfill 1.

An analysis of historical TCE concentrations in groundwater at Monitoring Well U4-176A (within eastern Landfill 1) indicates that the current TCE concentration (110 µg/L) is considerably lower than the historical high TCE concentration (4,000 µg/L in 2011) and considerably lower than TCE concentrations at western Landfill 1 (greater than 10,000 µg/L). A comparison of groundwater elevation versus TCE concentration at Monitoring Well U4-176A indicates a strong correlation between groundwater elevations and TCE concentrations (Figure 2-4). The lower TCE concentrations in groundwater associated with eastern Landfill 1 do not warrant the installation of a subgrade biogeochemical reactor as do the higher TCE concentrations in groundwater associated with western Landfill 1. However, a row of

monitoring/injection wells will be installed immediately downgradient of the new low-permeability eastern Landfill 1 cap. This will allow monitoring of water levels and TCE concentrations in groundwater flowing from beneath eastern Landfill 1, as well as potential future treatment, by creating an ERD biobarrier through the injection of carbon substrate into the wells in the event that TCE concentrations in groundwater increase immediately downgradient of the new eastern Landfill 1 cap.

3.1.2 Non-Source Area

In addition to the existing non-source area remedy (passive extraction and discharge of groundwater to the CWSID system via the HDUS and monitoring water quality of groundwater, springs, and seeps within the lateral boundary of the TCE plume), a more active treatment remedy will be implemented to treat non-source area groundwater and reduce the overall remedial timeframe and potential for off-Base migration of the highest TCE concentrations in the plume. A series of ERD biobarriers will be installed within the core of the dissolved TCE plume (Figure 3-1). Each biobarrier will consist of a row of injection points installed across the core of the plume, typically perpendicular to groundwater flow. Injection locations and depths will be based on contaminant distribution in each area. Additional ERD biobarriers may be added at OU 4 as needed to reduce the remedial timeframe. The injection substrate will likely consist of an EVO/lactate mixture or similar carbon substrate; bioaugmentation may be used to supply additional bacteria, as needed. Monitoring of the water quality of groundwater, springs, and seeps may be optimized as appropriate to meet remedial action objectives (RAOs). Depending on ERD biobarrier locations, the upper and middle drain lines of the HDUS may be shut off to facilitate the injection of carbon substrate. The upper and middle drain lines would likely remain closed throughout the ERD treatment period.

In addition to the ongoing remedial action of groundwater monitoring, groundwater performance monitoring of the ERD biobarriers will be conducted. This groundwater performance monitoring will include COCs, TCE daughter compounds (cis-1,2-DCE, trans-1,2-DCE, vinyl chloride, and ethene), degradation by-products (methane, arsenic, manganese), and geochemical parameters (pH, DO, ORP, ferrous iron).

The components of the expanded source area and non-source area remedies are illustrated on Figure 3-1.

3.1.3 Removal of Remedy Components

The ROD specified that surface water be collected and treated using carbon adsorption when a sufficient volume of surface water from seeps and springs was available to operate a treatment system; and that access should be controlled or warning signs posted in the general areas of seeps/springs that are known to be contaminated. Since the signing of the 1994 ROD, there has never been a sufficient volume of surface water available from seeps and springs to implement a carbon adsorption treatment system at OU 4. Surface water access controls have not been implemented because the majority of OU 4 seeps/springs have been dry since at least 2002, and some landowners have declined to have fencing installed around the seeps/springs. Four of the five seeps that continue to flow have never had TCE detected in them, and the fifth has not had TCE detected above the MCL in more than 15 years. Because these springs are not contaminated, they do not warrant treatment or fencing. The remote location of the springs/seeps minimizes exposure to any potentially contaminated surface water. As a result, the 2013 Five-Year Review (Leidos 2013) recommended that the fencing of springs and seeps could be removed as part of a ROD Amendment. Therefore, this ROD Amendment removes the requirement that access to springs and seeps associated with OU 4 be controlled (that is, with fencing and warning signs). Monitoring of seeps and springs will continue, and the protectiveness of this change will continue to be assessed as part of the Five-Year Review process.

3.2 Comparison between Existing and Expanded Remedies

Table 3-1 compares the existing source area and non-source area remedies in the ROD to the expanded remedies in the ROD Amendment.

3.3 Remedial Action Objectives

RAOs are specific goals for protecting human health and the environment and describe what the cleanup will accomplish. RAOs for the expanded OU 4 remedy remain the same as the RAOs defined in the ROD; however, implementation of the expanded remedy is anticipated to reduce the remedial timeframe to achieve RAOs in the non-source area from indefinite to approximately 70 years. The source area remedial timeframe will remain indefinite due to the continuing presence of Landfill 1. The area of attainment for groundwater, springs, seeps, Landfill 1 contents, and air is defined by the area in which TCE in groundwater exceeds the Federal Drinking Water MCL of 5 μg/L.

RAOs for OU 4 site groundwater, seeps, and springs include the following:

- Meet chemical-specific ARARs, which are Federal Drinking Water MCLs
- Limit cancer risk to less than 1×10^{-4} with a target of 1×10^{-6} due to accidental ingestion, dermal contact, or inhalation of vapors
- Maintain contaminant concentrations low enough to avoid chronic health effects (as indicated by a hazard index of less than 1)
- Prevent further degradation of groundwater quality in accordance with the Utah Corrective Action Cleanup Policy (UCACP).

RAOs for OU 4 Landfill 1 contents include the following:

- Limit cancer risk to less than 1×10^{-4} with a target of 1×10^{-6} due to accidental ingestion, dermal contact, or inhalation of vapors
- Maintain contaminant concentrations low enough to avoid chronic health effects (as indicated by a hazard index of less than 1)
- Eliminate the source(s) of groundwater contamination either through removal or source control in accordance with the UCACP.

RAOs for OU 4 air include the following:

- Prevent migration of contaminated soil gas into residences
- Prevent inhalation of carcinogens in excess of 1×10^{-6} cancer risk within off-Base residences
- Prevent inhalation of non-carcinogens at levels exceeding a hazard index of 1 within off-Base residences.

Through the ESD (Hill AFB 2006), the "air" portion of OU 4 is managed through the Hill AFB Indoor Air Program (i.e., OU 15).

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TABLE 3-1
Comparison between Existing and Expanded Remedies for Operable Unit 4 Source and Non-Source Areas
Operable Unit 4 Record of Decision Amendment, Hill Air Force Base, Utah

Existing Remedy (ROD)	Expanded Remedy
Source Area	
Installation of a low-permeability cap at Landfill 1 to prevent infiltration of surface water into the landfill (currently only applied to the western portion of Landfill 1).	**Western Capped Landfill:** Maintain low-permeability cap; Install a subgrade biogeochemical reactor downgradient of the western capped portion of Landfill 1 to biologically treat TCE-contaminated groundwater. **Eastern Uncapped Landfill 1:** Install an additional low-permeability cap to cover the eastern uncapped portion of Landfill 1 to prevent infiltration of surface water into the landfill. Install a row of monitoring/injection wells along the downgradient edge of the new low-permeability Landfill 1 cap to monitor TCE concentrations in groundwater and to inject substrate to treat with ERD if TCE concentrations increase.
Non-Source Area	
Passive extraction of TCE-contaminated groundwater via the HDUS and discharge to POTW. Monitoring water quality of groundwater, springs, and seeps within the lateral boundary of the TCE plume.	Maintain HDUS, continue monitoring groundwater, springs, and seeps; Install ERD biobarriers within the core of the dissolved TCE plume.

NOTES:
ERD = Enhanced reductive dechlorination.
HDUS = Horizontal drain upgrade system.
POTW = Publicly owned treatment works.
ROD = Record of Decision.
SVE = Soil vapor extraction.
TCE = Trichloroethene.

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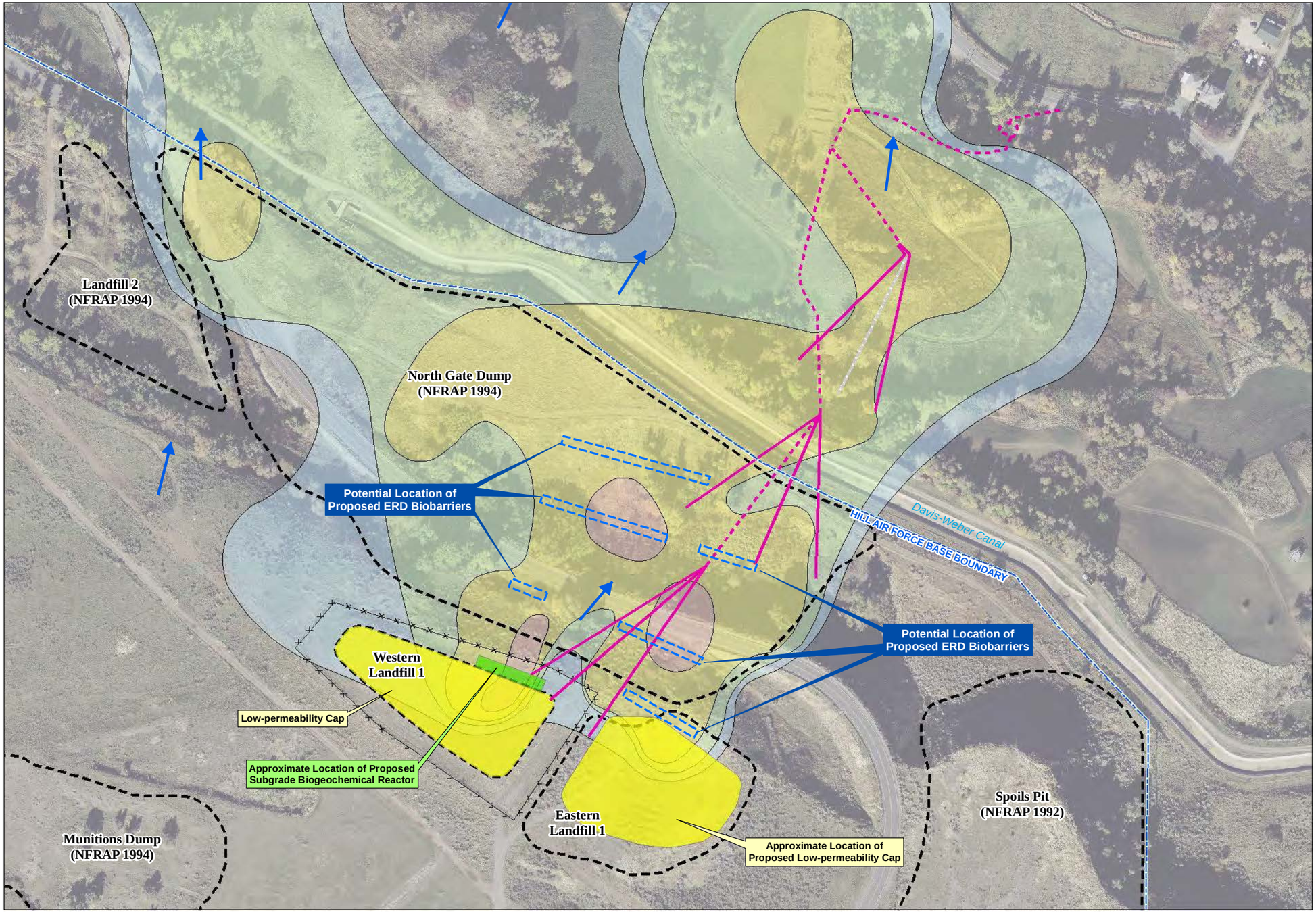


0 100 200 400 Feet

1 inch equals 200 feet

LEGEND

- Horizontal Drain Piping
- Horizontal Drain
- Horizontal Drain (Abandoned)
- Approximate Groundwater Flow Direction
- Area Boundary
- Hill Air Force Base Boundary
- Fenceline

TCE Concentration in Groundwater (µg/L)[1]

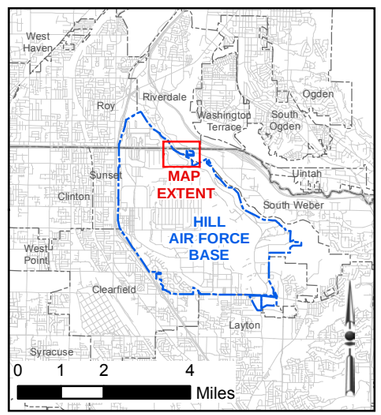
- 5-10
- 10-100
- 100-1,000
- >1,000

Source(s):
[1] The plume was based on two-dimensional kriging log10 of the maximum concentration measured during Spring 2014.

Acronym(s) and Abbreviation(s):
µg/L = Microgram(s) per liter
ERD = Enhanced reductive dechlorination
NFRAP = No Further Remedial Action Planned
TCE = Trichloroethene

Note(s):
Geographic data for the study area were projected using coordinate system World Geodetic System 1984 Universal Transverse Mercator Zone 12N.

MAP INDEX



AIR FORCE CIVIL ENGINEER CENTER

FIGURE 3-1
EXPANDED REMEDIAL APPROACH
OPERABLE UNIT 4 RECORD OF DECISION AMENDMENT
HILL AIR FORCE BASE, UTAH

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4.0 Evaluation of Alternatives

4.1 Evaluation Criteria

The NCP (40 CFR 300) (EPA 1990) (the CERCLA regulation) requires that remedial alternatives be evaluated against the nine criteria presented in Table 4-1. The existing and expanded remedies are compared to the nine criteria in the following sections.

The nine criteria are divided into three categories: threshold, balancing, and modifying. Threshold criteria include (1) overall protection and (2) compliance with ARARs. An alternative must meet these criteria to be eligible for selection as a remedial action. Balancing criteria are (3) long-term effectiveness and permanence, (4) reduction of toxicity, mobility or volume (TMV) through treatment, (5) short-term effectiveness, (6) implementability, and (7) cost. The five balancing criteria weigh the tradeoffs between alternatives, allowing low ratings on one balancing criterion to be compensated by a high rating on another. Modifying criteria are (8) EPA and state acceptance and (9) community acceptance. Community acceptance is considered following a public comment period. The EPA and UDEQ are required by CERCLA to review the responses to public comments before the ROD Amendment can be finalized.

Because it is unknown whether TCE concentrations will increase downgradient of eastern Landfill 1 and whether a source area ERD biobarrier will be implemented at eastern Landfill 1 as part of the expanded remedy, the potential source area ERD biobarrier downgradient of eastern Landfill 1 has not been included in the discussion regarding the evaluation of the expanded source area remedy. Note that for costing purposes, it was assumed that an ERD biobarrier would be implemented downgradient of eastern Landfill 1.

4.1.1 Overall Protection of Human Health and the Environment

The expanded remedy is protective of human health and the environment, whereas the existing remedy is not. Both the existing and expanded remedies include ICs to restrict exposure to contaminated soil and groundwater, along with remedial action-operations (RA-O) performance monitoring to track concentrations of contaminants in groundwater. However, the expanded source area remedy, which includes a subgrade biogeochemical reactor, will reduce TCE mass migration from the source areas and enhance degradation of TCE downgradient of the source areas. Installation of an additional low-permeability cap to cover eastern Landfill 1 will prevent exposure to TCE-contaminated landfill contents and reduce leaching of TCE to groundwater by limiting infiltration of surface water through the landfill contents. The expanded non-source area remedy, consisting of ERD biobarriers, will accelerate degradation of TCE in groundwater in the core of the plume. As a result, the expanded remedy will reduce remaining contaminant mass within source and non-source areas to accelerate site remediation and prevent further groundwater contamination compared to the current remedy.

4.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

Both the existing remedy and the expanded remedy will comply with ARARs. The additional actions proposed under the expanded remedy require that additional ARARs be considered (see Appendix A). ERD substrate injection will require consideration of additional federal and state action-, location-, and chemical-specific ARARs. For example, ERD substrate injection needs to comply with underground

injection control regulations. The expanded remedy will comply with all additional location-, action-, and chemical-specific ARARs not identified in the ROD (Appendix A).

4.1.3 Long-Term Effectiveness and Permanence

The expanded source area remedy, a combination of a subgrade biogeochemical reactor and a low-permeability cap, will be more effective in the long term than the existing low-permeability cap remedy alone, since the existing remedy is not effective at reducing plume mobility or contamination volume. Compared to the existing remedy, the expanded remedy will more aggressively treat contamination in groundwater. As a result, it is anticipated that the expanded remedy will enable achievement of RAOs faster than the existing remedy alone. The expanded remedy will provide a permanent solution by treating TCE-contaminated groundwater, along with capping the eastern portion of Landfill 1; thus, mitigating a continuing source of TCE contamination to groundwater. Without a continuing source to groundwater, the non-source area component of the expanded remedy will accelerate the remedial timeframe and limit long-term HDUS operation. The expanded remedy is more effective long-term and provides a more permanent solution than the existing remedy.

4.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Compared to the existing remedy, the expanded remedy will result in faster and greater reduction in TMV through treatment. Treatment of source area groundwater with a subgrade biogeochemical reactor will treat dissolved TCE mass in groundwater and limit migration of contaminated groundwater away from the source areas. ERD biobarriers in the non-source area will rapidly reduce dissolved TCE mass and prevent further downgradient TCE plume migration compared to the existing remedy. Generation and accumulation of vinyl chloride (a by-product of TCE degradation) is possible during ERD treatment but will be monitored closely. However, specific bacteria capable of degrading vinyl chloride into the less harmful daughter product ethene may be injected (bioaugmentation) as needed, to help ensure that vinyl chloride accumulation is limited. Bioaugmentation has been shown to effectively eliminate vinyl chloride accumulation at other U.S. Department of Defense facilities. ERD treatment will take place in the core of the TCE plume, where potential receptors are not present and exposure pathways are incomplete.

4.1.5 Short-Term Effectiveness

Short-term effectiveness evaluates protection of the community, workers, and environment during remedial actions. The expanded remedy for the source area presents potential traffic impacts to the community through the transportation of construction equipment and materials (e.g., remediation substrate). However, due to the abundance of much larger construction projects on-Base, the increase in construction traffic from implementation of the expanded remedy will be minimal. Impacts to workers include minor risks associated with handling contaminated soil during grading of eastern Landfill 1 prior to installation of the low-permeability cap and installation of the subgrade biogeochemical reactor and ERD biobarriers. However, all of these risks are considered to be minimal and may be controlled, but not eliminated, by following standard health and safety practices, proper construction safety measures, and by implementing appropriate traffic plans. Both the existing remedy and the expanded remedy are protective of the community, workers, and environment during remedial actions. However, based on a simple first-order decay model, it is estimated that it will take approximately 70 years following implementation of the expanded remedy to achieve RAOs in the non-source area compared to an indefinite timeframe for the existing remedy. The source area remedial timeframe will remain indefinite due to the continuing presence of Landfill 1. Therefore, the expanded remedy has greater short-term effectiveness compared to the existing remedy.

4.1.6 Implementability

The existing remedy has been implemented, and the expanded remedy for the source areas and non-source area is technically and administratively implementable. These technologies have been successfully applied at several U.S. Department of Defense and industrial sites. Subgrade biogeochemical reactors have been successfully constructed at multiple sites across the country, including one at Hill AFB. ERD injections have been performed successfully at several sites at Hill AFB. Both the existing and expanded remedies are implementable.

4.1.7 Cost

Present value cost estimates have been developed for both the existing and expanded remedies based on anticipated remedial timeframes. These estimates are order-of-magnitude engineering cost estimates that are expected to be within +50 to -30 percent of the actual project cost. The present worth of the existing remedy and expanded remedy were calculated using the real discount rates in the White House Office of Management and Budget Circular A-94 (http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c/). This is consistent with the guidance for federal facilities in the EPA guidance document A Guide to Preparing and Documenting Cost Estimates during the Feasibility Study (EPA 2000).

The remedial timeframe for the existing remedy is indefinite, due to the presence of Landfill 1 and an ongoing source of TCE contamination. However, a remedial timeframe of 200 years for the source and non-source areas was assumed to estimate costs. The estimated present value cost of the existing remedy is $3,417,000, based on recent annual operation and maintenance (O&M) costs. In comparison, the present value cost of the expanded remedy is estimated to be $5,595,000. The expanded remedy cost estimate is based on a calculated remedial timeframe model of approximately 70 years for the non-source area and the assumed 200 year remedial timeframe for the source area. Past EPA guidance recommended the general use of a 30-year period of analysis for estimating present value costs of remedial alternatives during the Feasibility Study (EPA 1988). While this may be appropriate in some circumstances, and is a commonly made simplifying assumption, the blanket use of a 30-year period of analysis is no longer recommended. The period of present value analysis, however, should not be shortened to less than the project duration (200 years for the source area), particularly when O&M costs are significant (EPA 2000). Although the later years are discounted in a present worth analysis, this approach better compares the relative life-cycle costs of the alternatives.

The present value cost comparison is presented in Table 4-2. Detailed cost estimates are presented in Appendix B. The present value cost of the expanded remedy is higher than the existing remedy. However, the expanded remedy is a more-intensive source and non-source area treatment approach that will greatly reduce the time to achieve RAOs in the non-source area compared to the existing remedy.

4.1.8 Regulatory Acceptance

USAF obtained tentative agreement on the expanded remedy from EPA and UDEQ prior to the public comment period. Regulatory acceptance is acknowledged by the approval signatures in Section 1.0 of this document.

4.1.9 Community Acceptance

Public comment on the Revised Proposed Plan for OU 4 (Hill AFB 2015) was solicited to evaluate community acceptance of the expanded remedy. The public comment period was held from 5 August to 5 September 2015. An open-house public meeting for OU 4 was held from 5:00 to 7:00 p.m. on Wednesday, 12 August 2015 at the Riverdale Community Center in Riverdale, Utah. Representatives from Hill AFB, the EPA, and UDEQ were available to explain and answer questions about the results of the investigations and the proposed remedies for OU 4. No comments were received during the public meeting, nor were any comments received during the public comment period. A sign-in sheet with the names of those in attendance at the public meeting is included in Appendix C.

Pre-design data collected following the Revised Proposed Plan and public comment period for OU 4 led to a substantial change in the proposed expanded remedy. As a result, an Updated Revised Proposed Plan for OU 4 was prepared (Hill AFB 2016). The public comment period for the Updated Revised Proposed Plan for OU 4 (Hill AFB 2016) was held from 17 June to 16 July 2016.

This section will be prepared following the second public comment period and documentation of public comments will be included following the public comment period. Compliance with public participation will be documented in Section 6.0.

4.2 Principal Threat Wastes

The NCP expects that treatment resulting in a reduction in TMV of the principal threat wastes will be used to the extent practicable. The principal threat concept refers to the source materials at a CERCLA site considered highly toxic or highly mobile that generally cannot be reliably controlled in place or present a significant risk to human health or the environment should exposure occur (EPA 1999).

A source material is material that contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater or air, or that acts as a source for direct exposure. Although materials associated with the landfill TCE hot spot may include pockets of DNAPL, at this time there is no direct evidence that mobile DNAPL is present at the site. Small amounts of DNAPL or areas of groundwater with high TCE concentrations can be controlled reliably with the proposed additional remedy components. Therefore, based on current data available, there are no principal threat wastes at OU 4.

TABLE 4-1
National Oil and Hazardous Substances Pollution Contingency Plan Evaluation Criteria (40 CFR 300)
Operable Unit 4 Record of Decision Amendment, Hill Air Force Base, Utah

1	**Overall Protection of Human Health and the Environment.** Will the alternative adequately protect human health and the environment against unacceptable risk?
2	**Compliance with ARARs.** Does the alternative attain all federal and state laws and regulations that are either “applicable” or "relevant and appropriate" to the circumstances found at a particular site or provide grounds to invoke a waiver?
3	**Long-Term Effectiveness and Permanence.** How certain is it that an alternative will be successful and if successful will the alternative provide a permanent, long-term solution to the problem considering the residual risk?
4	**Reduction in TMV through Treatment.** Will the alternative use treatment to reduce toxicity or volume of the contaminants or reduce their ability to migrate?
5	**Short-Term Effectiveness (Impact on Community).** What risks would implementing the alternative have on the community, workers, and environment; and how long until RAOs are achieved?
6	**Implementability.** Can the alternative be practically and successfully implemented, considering any technical and administrative issues that may need to be addressed?
7	**Cost.** What is the cost to design, build, and operate the system?
8	**Regulatory Acceptance (State and/or Regulatory Agency Acceptance).** Do EPA and UDEQ accept, oppose, or have comment on the alternative?
9	**Community Acceptance.** Evaluates the community’s preferences for, or concerns about, the alternative. (This stage occurs upon receiving public comment.)

NOTES:
ARAR = Applicable or Relevant and Appropriate Requirement.
CFR = Code of Federal Regulations.
EPA = U.S. Environmental Protection Agency.
RAO = Remedial action objective.
TMV = Toxicity, mobility, or volume.
UDEQ = Utah Department of Environmental Quality.

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TABLE 4-2
Present Value Cost Estimate for Existing and Expanded Remedies
Operable Unit 4 Record of Decision Amendment, Hill Air Force Base, Utah

	Existing Remedy	**Expanded Remedy**
Source Area	Maintain low-permeability cap(1)	Install subgrade biogeochemical reactor, install an additional low-permeability cap to cover eastern Landfill 1, install row of monitoring/injection wells for potential ERD biobarrier at eastern Landfill 1, maintain low-permeability cap(2)
Capital Costs	$0	$1,515,000
O&M(3)	$633,000	$1,516,000
Non-Source Area	Maintain HDUS, groundwater monitoring(4)	Install ERD Biobarriers, maintain HDUS, groundwater monitoring(5)
Capital Costs	$0	$490,000
O&M(3)	$2,784,000	$2,074,000
TOTAL COST	**$3,417,000**	**$5,595,000**

NOTES:

(1) The existing remedy does not address the ongoing source within Landfill 1; therefore, the remedial timeframe is considered to be indefinite. A 200-year remedial timeframe is assumed for the purpose of comparison. Achievement of RAOs is not possible with the existing remedy.

(2) Cost estimate includes capital costs for installation of subgrade biogeochemical reactor, installation of an additional low-permeability cap, and installation of row of monitoring/injection wells for potential ERD biobarrier. O&M is estimated at 200 years (in perpetuity) for the landfill cap and 100 years for the subgrade biogeochemical reactor and ERD biobarrier (active operation for 5 years and passive operation with periodic injections for 95 years).

(3) O&M Present Value = (O&M) x (P/A), 1.5% for remedial timeframe. $(P/A, i\%, n) = A\ [((1 + i)^n - 1) / (i\ (1+i)^n)]$ where i = 2016 Real Discount Rate (30-yr) from OMB-094A (http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c/).

(4) Cost estimate is based on O&M cost to continue maintaining the HDUS and RA-O performance monitoring for 200 years (indefinitely). Additionally, it is assumed optimization of the monitoring well network will be performed, reducing the cost of annual RA-O monitoring by 85 percent by 2016.

(5) Cost estimate includes capital cost for installation of ERD biobarriers. O&M to continue maintaining HDUS and RA-O performance monitoring is estimated to be 70 years (calculated remedial timeframe to achieve RAOs in the non-source area). Additionally, it is assumed optimization of the monitoring well network will be performed, reducing the cost of annual RA-O monitoring by 85 percent by 2016.

A = Annual amount.
ERD = Enhanced reductive dechlorination.
HDUS = Horizontal drain upgrade system.
O&M = Operation and maintenance.
P = Present worth.
RA-O = Remedial action-operations.
RAO = Remedial action objective.

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5.0 Statutory Determinations/Declarations

Under CERCLA Section 121 (as required by NCP Section 300.430[f][5][ii]), the lead agency must select a remedy that is protective of human health and the environment, complies with ARARs, is cost effective, and uses permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes:

- A preference for remedies that employ treatment that permanently and significantly reduces the TMV of hazardous wastes as a principal element
- A bias against offsite disposal of untreated wastes.

The following sections discuss how the selected remedy meets these statutory requirements.

5.1 Protection of Human Health and the Environment

The expanded remedy is protective of human health and the environment. ICs to restrict exposure to contaminated soil and groundwater will remain in place until RAOs are achieved.

The expanded source area remedy, which includes a subgrade biogeochemical reactor, will reduce TCE mass migration from the source areas and enhance degradation of TCE downgradient of the source areas. Installation of an additional low-permeability cap to cover eastern Landfill 1 will prevent exposure to TCE-contaminated landfill contents and reduce leaching of TCE to groundwater by limiting infiltration of surface water through the landfill contents. The expanded non-source area remedy, consisting of ERD biobarriers, will accelerate degradation of TCE in groundwater in the core of the plume. As a result, the expanded remedy will reduce remaining contaminant mass within source and non-source areas to accelerate site remediation and prevent further groundwater contamination.

5.2 Compliance with ARARs

Remedial actions must comply with both Federal and State ARARs, which are legal standards, criteria, or limitations of federal and state environmental laws and regulations.

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

Appendix A summarizes the ARARs for the expanded remedy at OU 4. Also, it includes a description of how the expanded remedy addresses the ARARs. The expanded remedy complies with the chemical-, location-, and action-specific ARARs. The implementation of the expanded remedy is required to meet the substantive portions of these requirements and is exempt from administrative requirements, such as permitting and notifications.

5.3 Cost Effectiveness

The expanded remedy is cost effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness" (40 CFR 300.430[f][1][ii][D]). This determination was accomplished by evaluating the overall effectiveness of those alternatives that satisfy the threshold criteria (that is, is protective of human health and the environment and ARAR compliant). Overall effectiveness was evaluated by assessing the following three of the five balancing criteria in combination: long-term effectiveness and permanence, reduction in TMV through treatment, and short-term effectiveness. Overall effectiveness was then compared to costs to determine cost effectiveness.

The cost of the expanded remedy is approximately $5,595,000 compared to $3,417,000 for the existing remedy. The expanded remedy will control contamination sources and aggressively treat contamination in groundwater and as a result will enable achievement of RAOs faster than the existing remedy alone by reducing TMV through in situ treatment. The selected remedy presents minimal short-term risk to the community or workers.

5.4 Utilization of Permanent Solutions and Alternative Treatment Technologies

The USAF has determined that the expanded remedy for the OU 4 represents the maximum extent to which permanent solutions and alternative treatment technologies can be used in a practicable manner at the site. Of those alternatives that are protective of human health and the environment and comply with ARARs, the USAF has determined that the expanded remedy provides the best balance of tradeoffs in terms of the five balancing criteria. In addition, the expanded remedy considers the statutory preference for treatment as a principal element and bias against offsite treatment and disposal, and has state and community acceptance.

The expanded remedy results in permanent removal of TCE-contaminated groundwater through in situ treatment and permanent containment of TCE-contaminated soils through the installation of a low-permeability landfill cap. The selected remedies present some short-term risks to site workers during implementation of the remedy, but these risks can be controlled using standard health and safety practices and are similar to risks associated with other alternatives. Subgrade biogeochemical reactors have been successfully constructed at multiple sites across the country, including one at Hill AFB. ERD injections have been performed successfully at several sites at Hill AFB.

5.5 Preference for Treatment as a Principal Element

The NCP establishes the expectation that treatment will be used to address the principal threats posed by a site wherever practicable (40 CFR 300.430[a][1][iii][A]). The expanded remedy for the OU 4 satisfies the statutory preference for treatment as a principal element of the remedy. The expanded remedy incorporates both a subgrade biogeochemical reactor and ERD biobarriers to provide in situ treatment to achieve ERD of TCE. ERD is a form of enhanced anaerobic bioremediation that uses highly biodegradable and soluble or emulsified organic electron donors to establish sulfate-reducing or methanogenic conditions to degrade chlorinated solvents, such as TCE into ethene and chloride ions.

5.6 Five-Year Review Requirements

CERCLA Section 121(c) and NCP Section 300.430(f)(4)(ii) requires a Five-Year Review if the remedial action results in hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for unlimited use and unrestricted exposure. A statutory review will be conducted within 5 years after initiation of remedial actions because the selected remedies will result in contaminants remaining onsite above levels that allow for unlimited use and unrestricted exposure. The objective of the Five-Year Review will be to verify that the remedies are, or will be, protective of human health and the environment. A Five-Year Review Report will be prepared to document the evaluation of the performance of the remedial systems. The report will recommend no changes to the selected remedies if the remedies are performing as expected and are continuing to protect human health and the environment. If the remedies are not performing as expected or are failing to protect human health and the environment, the Five-Year Review Report may recommend either operational changes, significant modifications of the remedies, or applications for ARAR waivers if necessary. If significant modifications of the remedies are required, including the identification of feasible innovative technologies, a ROD Amendment or an ESD may be necessary before significant modifications can be implemented. These Five-Year Reviews will continue until the selected remedies achieve concentrations of COCs that allow for unlimited use and unrestricted exposure.

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6.0 Public Participation Compliance

6.1 Overview

The purpose of this section is to present USAF responses to general public comments on the Updated Revised Proposed Plan (Hill AFB 2016). These responses are known as the responsiveness summary and are a requirement of the CERCLA process. The EPA and UDEQ are required to review and concur with the responses to public comments before the ROD Amendment can be finalized.

6.2 Background on Community Involvement

The public was informed of the selected remedial actions through the following actions:

6.2.1 Revised Proposed Plan

- A notice of availability of the Revised Proposed Plan and opportunity for public comment was published in the Ogden Standard Examiner on 5 August 2015 (Appendix C).
- A public meeting presenting the proposed remedy was held on 12 August 2015 at the Riverdale Community Center in Riverdale, Utah.
- A public comment period for the Proposed Plan was held from 5 August 2015 to 5 September 2015.
- Written comments by the public were encouraged.

6.2.2 Updated Revised Proposed Plan

- A notice of availability of the Updated Revised Proposed Plan and opportunity for public comment was published in the Ogden Standard Examiner on 17 June 2016 (Appendix C).
- A public meeting presenting the proposed remedy was held on 22 June 2016 at the Riverdale Community Center in Riverdale, Utah.
- A public comment period for the Updated Revised Proposed Plan was held from 17 June 2016 to 16 July 2016.
- Written comments by the public were encouraged.
- Items contained within the Administrative Record file for OU 4 are available online at the AFCEC Air Force Administrative Record, http://afcec.publicadmin-record.us.af.mil/.

6.3 Summary of the Public Meeting and Public Comments

Public comment on the Revised Proposed Plan for OU 4 (Hill AFB 2015) was solicited to evaluate community acceptance of the expanded remedy. The public comment period was held from 5 August to 5 September 2015. An open-house public meeting for OU 4 was held from 5:00 to 7:00 p.m. on Wednesday, 12 August 2015 at the Riverdale Community Center in Riverdale, Utah. Representatives from Hill AFB, the EPA, and UDEQ were available to explain and answer questions about the results of the investigations and the proposed remedies for OU 4. No comments were received during the public meeting, nor were any comments received during the public comment period. A sign-in sheet with the names of those in attendance at the public meeting is included in Appendix C.

Pre-design data collected following the Revised Proposed Plan and public comment period for OU 4 led to a substantial change in the proposed expanded remedy. As a result, an Updated Revised Proposed Plan for OU 4 was prepared (Hill AFB 2016).

Public comment on the Updated Revised Proposed Plan for OU 4 (Hill AFB 2016) was solicited to evaluate community acceptance of the expanded remedy. The public comment period was held from 17 June to 16 July 2016. A public meeting for OU 4 was held from 7:00 to 8:00 p.m. on Wednesday, 22 June 2016 at the Riverdale Community Center in Riverdale, Utah. Representatives from Hill AFB and EPA were available to explain and answer questions about the results of the investigations and the proposed remedy for OU 4. No comments were received during the public meeting, nor were any comments received during the public comment period. A sign-in sheet with the names of those in attendance at the public meeting is included in Appendix C.

7.0 References

EA Engineering, Science and Technology Inc., PBC (EA). 2015a. *Operable Unit 4 – Site LF011 Data Gap Investigation Report,* Hill Air Force Base, Utah. Final. May.

EA. 2015b. *Operable Unit 4 – Site LF011 Optimization of Remedial Action-Operations Groundwater Monitoring Technical Memorandum,* Hill Air Force Base, Utah. Final. October.

EA. 2015c. *Operable Unit 4 – Site LF011 Pre-Design Data Collection Letter Work Plan,* Hill Air Force Base, Utah. October.

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

EPA. 1990. *National Oil and Hazardous Substances Contingency Plan (NCP),* Federal Register. Vol. 55, No. 46.

EPA. 1999. *A Guide for Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents.* July.

EPA. 2000. *A Guide to Preparing and Documenting Cost Estimates during the Feasibility Study*. EPA 540-R-00-002. July.

EPA. 2014. *Regional Screening Levels for Chemical Contaminants at Superfund Sites.* May.

Hill Air Force Base (AFB). 1994. *Final Record of Decision and Responsiveness Summary for Operable Unit 4 (IRP Sites LF11, LF12, OT020, OT041, OT042),* Hill Air Force Base, Utah. Final. June.

Hill AFB. 2006. *Explanation of Significant Difference for Operable Unit 4,* Hill Air Force Base, Utah. July.

Hill AFB. 2014. *Performance Standard Verification Report for Operable Unit 4,* Hill Air Force Base, Utah. September.

Hill AFB. 2015. *Operable Unit 4 Revised Proposed Plan,* Hill Air Force Base, Utah. July.

Hill AFB. 2016. *Operable Unit 4 Updated Revised Proposed Plan,* Hill Air Force Base, Utah. Final. June.

Leidos. 2013. *Five-Year Review Report, 2013 Five-Year Review for Hill Air Force Base,* Hill Air Force Base, Utah. Final. December.

Montgomery Watson. 1993a. *Final Feasibility Study Report for Operable Unit 4,* Hill Air Force Base, Utah. Final.

Montgomery Watson. 1993b. *Proposed Plan for Operable Unit 4 (IRP Sites LF11, LF12, OT020, OT041, OT042),* Hill Air Force Base, Utah. September.

MWH. 2010. *Final Source Area and Landfill 1 Evaluation and Recommendations Report for Operable Unit 4.* Hill Air Force Base, Utah. March.

MWH. 2012. *Final Basewide Air Sampling and Analysis Plan, Indoor Residential Air Sampling, Revision 3,* Hill Air Force Base, Utah. December.

U.S. Geological Survey. 1992. *Remedial Investigation Report for Operable Unit 4,* Hill Air Force Base, Utah. June.

U.S. Geological Survey. 1993. *Addendum to Remedial Investigation Report for Operable Unit 4, Volume 2 - Final Baseline Risk Assessment,* Hill Air Force Base, Utah. July.

Utah Division of Water Rights (Utah DWRi). 1995. *Groundwater Management Plan for the Weber Delta Sub-area of the East Shore Area*. October.

White House Office of Management and Budget. *Circular A-94*. http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c/.

Appendix A
Summary of Applicable or Relevant and Appropriate Requirements for the Operable Unit 4 Expanded Remedy

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APPENDIX A
Summary of Applicable or Relevant and Appropriate Requirements for the Operable Unit 4 Expanded Remedy
Operable Unit 4 Record of Decision Amendment, Hill Air Force Base, Utah

Type	Authority	Medium	Requirement	Status	Synopsis of Requirement	Action to be Taken to Attain Requirement
Chemical-Specific	Federal Regulatory Requirement	Groundwater	National Primary Drinking Water Regulations: MCLs and Maximum Residual Disinfectant Levels – 40 CFR 141 Subpart G	Relevant and Appropriate	Establishes health-based standards (MCLs) for specific organic and inorganic substances for public water systems. The COCs and associated MCLs are: • Benzene = 0.005 mg/L • Chloroform = 0.080 mg/L (MCL for total trihalomethanes as disinfection by-product) • 1,2-DCA = 0.005 mg/L • 1,1-DCE = 0.007 mg/L • cis-1,2-DCE = 0.07 mg/L • trans-1,2-DCE = 0.1 mg/L • PCE = 0.005 mg/L • TCE = 0.005 mg/L • Toluene = 1 mg/L • Xylenes (total) = 10 mg/L • Arsenic = 0.01 mg/L • Barium = 2 mg/L • Selenium = 0.05 mg/L. Note: MCLs are not available for MEK, Boron, and Nickel.	The selected remedies will comply with regulations through natural attenuation and in situ treatment in the shallow plumes.
Chemical-Specific	State Regulatory Requirement	Groundwater	Monitoring and Water Quality; Drinking Water – UAC R309-200-5, 6	Relevant and Appropriate	Establishes primary and secondary MCLs for inorganic and organic chemicals including COCs. The COCs and associated MCLs are: • Benzene = 0.005 mg/L • Chloroform = 0.080 mg/L (MCL for total trihalomethanes as disinfection by-product) • 1,2-DCA = 0.005 mg/L • 1,1-DCE = 0.007 mg/L • cis-1,2-DCE = 0.07 mg/L • trans-1,2-DCE = 0.1 mg/L • PCE = 0.005 mg/L • TCE = 0.005 mg/L • Toluene = 1 mg/L • Xylenes (total) = 10 mg/L • Arsenic = 0.01 mg/L • Barium = 2 mg/L • Selenium = 0.05 mg/L. Note: MCLs are not available for MEK, Boron, and Nickel.	The selected remedies will comply with regulations through natural attenuation and in situ treatment in the shallow plumes.
Chemical-Specific	State Regulatory Requirement	Groundwater	Environmental Quality and Water Quality; Groundwater Protection – UAC R317-1, Definitions, and UAC R317-2, Standards of Quality for Waters of the State	Applicable	Sets criteria for developing water quality standards based on beneficial uses of the water. Relevant and appropriate since the shallow aquifer is a potential drinking water source and for discharge of treated water to Weber River. The COCs and associated water quality standards are: • Benzene = 2.2 µg/L (human consumption) • Chloroform = 5.7 µg/L (human consumption) • 1,2-DCA = 0.38 µg/L (human consumption) • 1,1-DCE = 7 µg/L (human consumption) • cis-1,2-DCE = 70 µg/L (human consumption) • trans-1,2-DCE =100 µg/L (human consumption) • MEK = not listed • PCE = 0.69 µg/L (human consumption) • TCE =2.5 µg/L (human consumption) • Toluene = 1,000 µg/L (human consumption) • Xylenes (total) = 10,000 µg/L (human consumption) • Arsenic = 0.01 mg/L (domestic use) • Barium = 1.0 mg/L (domestic use) • Boron = 0.75 mg/L (agricultural use) • Nickel = 100 µg/L (human consumption) • Selenium = 0.05 mg/L (domestic use).	The selected remedies will comply with regulations through natural attenuation and in situ treatment in the shallow plumes.

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Type	Authority	Medium	Requirement	Status	Synopsis of Requirement	Action to be Taken to Attain Requirement
Chemical-Specific	State Regulatory Requirement	Groundwater	Environmental Quality and Water Quality; Groundwater Protection – UAC R317-6	Applicable	Establishes groundwater quality standards (R317-6-2), groundwater classes (R317-6-3), and groundwater class protection levels (R317-6-4). Groundwater quality standards (R317-6-2) are applicable corrective action cleanup levels for contaminated groundwater under R317-6-6.15F. The standards are the same as primary drinking water standards for the COCs at this site (i.e., MCLs). Alternate corrective action concentration limits can be established pursuant to R317-6-6.15. Groundwater class protection levels (R317-6-4) are not intended to be used as ARARs under CERCLA. Groundwater quality standards for the COCs are: • Benzene = 0.005 mg/L • 1,2-DCA = 0.005 mg/L • 1,1-DCE = 0.007 mg/L • cis-1,2-DCE = 0.07 mg/L • trans-1,2-DCE = 0.1 mg/L • PCE = 0.005 mg/L • TCE = 0.005 mg/L • Toluene = 1 mg/L • Xylenes (total) = 10 mg/L • Arsenic = 0.05 mg/L • Barium = 2.0 mg/L • Selenium = 0.05 mg/L. Note: The groundwater quality standard for arsenic is different than the MCL. All others are the same as the MCL. Groundwater quality standards are not available for MEK, boron, and nickel.	The selected remedies will comply with regulations through natural attenuation and in situ treatment in the shallow plumes.
Action-Specific	State Regulatory Requirement	Groundwater	Cleanup and Risk-Based Closure Standards: RCRA, UST, and CERCLA Sites – UAC R315-101	Applicable	R315-101 establishes information requirements to support risk-based cleanup and closure standards at sites for which remediation or removal of hazardous constituents to background levels will not be achieved. The procedures in this rule also provide for continued management of sites for which minimal risk-based standards cannot be met. Note: However for remediation goals, MCLs are used for those constituents that have an MCL. Requires removal or control of the source and no degradation beyond existing contaminant levels. R315-101-3 (Principle of Non-Degradation) requires monitoring of the site and triggers corrective action if concentrations increase.	The selected remedies will comply with regulations through implementation of institutional controls that restrict use of groundwater near the plumes. The selected remedies comply with the Principles of Non-Degradation because available information indicates concentrations are decreasing and plumes are stable or contracting. Monitoring will be conducted as part of all selected alternatives to verify that plumes are stable and concentrations are decreasing.
Action-Specific	State Regulatory Requirement	Groundwater	Corrective Action Cleanup Standards Policy; UST and CERCLA Sites – UAC R311-211	Applicable	Lists general criteria to be considered in establishing cleanup standards including source control, cleanup standards, and prevention of further degradation. UAC R311-211-2 requires elimination of the source; UAC R311-211-4 requires prevention of further degradation by eliminating the source; and UAC R311-211-5 establishes minimum cleanup standards for UST or CERCLA sites. Federal drinking water MCLs are incorporated by UAC R311-211-5 as minimum cleanup levels for water-related contamination. Soil cleanup levels for protection of groundwater quality should be based on MCLs or other appropriate standards.	The selected remedies will comply through treatment of the area of highest contaminant concentration in groundwater and the development of cleanup standards and remedial action objectives based on MCLs.
Action-Specific	Federal Regulatory Requirement	Groundwater	Underground Injection Control Program and Underground Injection Control Program Criteria and Standards – 40 CFR 144 and 146, as adopted by UAC R317-7	Applicable	Establishes permitting requirements, technical criteria, and standards for the Underground Injection Control Program.	The in situ treatment component of the selected remedies will be conducted according to established substantive requirements, criteria, and standards. Permitting and financial requirements are administrative and are not subject to CERCLA.
Action-Specific	State Regulatory Requirement	Groundwater	Underground Injection Control Program – UAC R317-7	Applicable	Sets standards and controls for the placement or injection of fluids into an aquifer or other groundwater conveyance system. The enhanced reductive dechlorination biobarrier injection wells would be considered Class V injection wells (specifically, Class 5B6 wells used for site remediation); Class V injection wells are authorized by Rule R317-7-6.3. Requirements for Class V injection wells include:· • Well information needs to be submitted to the Utah Department of Environmental Quality for the injection well inventory (R317-7-6.4[C]) • Injection wells will be properly operated and maintained (40 CFR 144.12 adopted by R317-7-1.2) • Close the well when no longer needed so that fluids cannot move into a drinking water aquifer (R317-7-6.6[A]).	The in situ treatment component of the selected remedies will be conducted according to established substantive requirements, criteria, and standards. Permitting and financial requirements are administrative and are not subject to CERCLA. The U.S. Air Force will comply with the substantive requirements of this rule. Although not a substantive requirement, the U.S. Air Force will submit the inventory as a matter of comity to facilitate compliance with this rule.

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Action-Specific	State Regulatory Requirement	Groundwater	Monitoring Well Construction and Abandonment Standards – UAC R655-4-12,13, 14, and 15	Relevant and Appropriate	Establishes standards and requirements for drilling and abandonment of wells, including monitoring wells. These requirements include the following: • Well drilling and construction design requirements • Well abandonment procedures • Installation by a Utah-licensed well driller and drill rig operator.	Installation of groundwater monitoring and injection wells will be completed in accordance with this requirement.
Action-Specific	State Regulatory Requirement	Groundwater	Antidegradation Policy – UAC R317-2-3	Applicable	Waters of the State, which include both surface and groundwater, shall be maintained to the highest level of quality (and provide certain exceptions).	The selected remedy will remediate contamination in groundwater.
Action-Specific	Federal Regulatory Requirement	Oil Storage	Oil Pollution Prevention – 40 CFR 112	Applicable	Requires specific design and management requirements for oil storage to prevent spills. This ARAR is applicable if 1,320 gallons or more of any type of oil (including vegetable oils and water treatment emulsions) are stored onsite. These requirements include the following: • Provide 100 percent secondary containment for all oil storage in containers greater than or equal to 55 gallons • Provide some sort of high level alarm for containers/tanks so they cannot be overfilled • Inspect containers/tanks and appurtenances monthly • Slope oil handling areas so that they do not drain to water bodies and but do drain towards a catchment area • Train all oil handling staff annually • Secure the oil storage areas and providing adequate lighting • Prepare an Oil Spill Prevention, Control, and Countermeasures Plan and an Oil Spill Response Plan.	The selected remedy will comply with regulations by implementing best management practices for oil and chemical storage that may be used onsite during remediation activities.
Action-Specific	State Regulatory Requirement	Water	UPDES, Definitions – UAC R317-8-1	Applicable	Provides definitions for the UPDES program.	
Action-Specific	State Regulatory Requirement	Water	UPDES, General Permits – UAC R317-8-2.5	Applicable	Allows UDEQ to issue UPDES General Permits. UDEQ has issued the UPDES General Permit for Discharges from Construction Activities (UTRC00000) under this regulation.	The substantive requirements of the UPDES General Permit for Discharges from Construction Activities (UTRC00000) are applicable to this project.
Action-Specific	State Regulatory Requirement	Water	UPDES, Application Requirements, Stormwater Discharges– UAC R317-8-3.9(2)	Applicable	Sections R317-8-3.9.2(a)(2) and R317-8-3.9.6(e) address information to be developed as part of an UPDES Construction General Permit Application. Section R317-8-3.9.2(a)(2) states: Dischargers of storm water associated with small construction activity are required to apply for an individual permit or seek coverage under a promulgated general permit. A general permit has been promulgated for discharges from construction activities. The substantive requirements of the UPDES General Permit for Discharges from Construction Activities (UTRC00000) include: implementing appropriate erosion and sediment control best management practices, controlling waste at the construction site such as concrete washout, discarded materials, chemicals, litter, sanitary waste, and implementing a SWPPP.	The substantive requirements of the UPDES General Permit for Discharges from Construction Activities (UTRC00000) are applicable to this project.
Action-Specific	State Regulatory Requirement	Water	UPDES, Pretreatment Programs – UAC R317-8-8	Applicable	The UPDES program has pretreatment requirements for pollutants that are introduced to publically owned treatment works.	Discharge from the horizontal drain upgrade system to the Central Weber Sewer Improvement District will comply with all pretreatment requirements.
Action-Specific Chemical-Specific	Federal Regulatory Requirement	Air Quality	National Primary and Secondary Ambient Air Quality Standards – 40 CFR 50	Applicable	Sets ambient air quality standards. Particulate is the only standard that would be applicable during construction operations.	Construction will address the Utah requirements for fugitive dust control (UAC R307-205-3,5); the fugitive dust control requirements are expected to control particulate emissions to meet this standard.
Action-Specific Chemical-Specific	Federal Regulatory Requirement	Air Quality	Clean Air Act Regulations including Control of Emissions from: • New and In-Use Non-Road Compression Ignition Engines, 40 CFR 89 and 40 CFR 1039 • New and In-Use Non-Road Spark Ignition Engines, 40 CFR 90 • General Compliance Provisions for Highway, Stationary, and Non-road Programs, 40 CFR 1068	Applicable	Establishes requirements for controlling emissions from non-road compression-ignition engines and non-road spark-ignition engines, including design standards, certification, and emissions testing. Potentially applicable if remedial alternative includes regulated engines, such as those associated with construction equipment and drill rigs.	The selected remedies will comply with regulations through emission controls on non-road compression-ignition engines and spark-ignition engines on drilling and associated equipment.

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Action-Specific	State Regulatory Requirement	Air Quality	Air Quality, General, UAC R307-101	Applicable	Defines terms used in the air quality regulations and adopts certain Federal Regulations by reference.	A Fugitive Dust Control Plan, with specific technical requirements, will be implemented during remedial activities.
Action-Specific	State Regulatory Requirement	Air Quality	Air Quality, Air Pollution Prohibited, UAC R307-102-1	Applicable	Prohibits the emission of air pollutants (such as dust) in sufficient quantities to cause air pollution.	A Fugitive Dust Control Plan, with specific technical requirements, will be implemented during remedial activities.
Action-Specific	State Regulatory Requirement	Air Quality	Fugitive Dust Control Requirements for Construction and Demolition Activities – UAC R307-205-3,5	Applicable	Requires that all construction and demolition activities that require clearing or leveling of land greater than one-quarter acre in size or movement of construction equipment and trucks over access haul roads for any construction or demolition site take steps to minimize fugitive dust. Will only be applicable to remedial alternatives that may require soil disturbance such as drilling, land clearing, or soil excavation activities. Requirements include the following: • Implementing measures to minimize emissions such as planting vegetative cover, watering, chemical stabilization, wind breaks • Cleaning paved roads promptly.	Best management practices will be applied to control fugitive dust should land disturbances exceed one-quarter acre in size during implementation of the selected remedy.
Action-Specific Chemical-Specific	State Regulatory Requirement	Air Quality	NESHAP (references 40 CFR 61 Subpart A) – UAC R307-214	Applicable	Defines and establishes general requirements for HAPs. Benzene, TCE, and PCE are considered HAPs when released to the air. Temporary aboveground storage of contaminated groundwater or exposed contaminated soil could also create potential for the emission of HAPs from the volatilization of COCs.	Excavated soils will be placed in covered roll-offs which will limit potential HAP emissions.
Action-Specific Location-Specific	State Regulatory Requirement	Air Quality	Nonattainment and Maintenance Areas for PM_{10}: Fugitive Emissions – UAC R307-309	Applicable	Section 4: Fugitive emissions from any source will not exceed 15 percent opacity Section 5: Fugitive dust will not exceed 10 percent at the property boundary or 20 percent anywhere onsite Section 6: Requires a Fugitive Dust Control Plan, with specific technical requirements Section 12: Maintain records to show compliance. Fugitive dust requirements are most applicable for alternatives that include drilling or land clearing activities. Section 4 is applicable in Salt Lake and Utah Counties, Ogden City, and specific sources listed in the Utah State Implementation Plan, Section IX, Par H. Hill AFB or Davis County are in attainment for PM_{10} at this time, so Section 4.0 and Section 5.0 requirements may not apply, but may be relevant and appropriate. Section 6.0 will apply to all Operable Unit 4 areas where remedial alternatives call for land clearing activities.	A Fugitive Dust Control Plan, with specific technical requirements, will be implemented during remedial activities.
Action-Specific Location-Specific Chemical-Specific	State Regulatory Requirement	Air Quality	Davis and Salt Lake Counties and Ozone Nonattainment Areas: General Requirements – UAC R307-325	Applicable	Includes the requirement that no person may permit or cause VOCs to be spilled, discarded, stored in open containers, or handled in any other manner, which would result in evaporation in excess of that which would result from the application of reasonably available control technology as defined in 40 CFR 51.100(o). Benzene, TCE, and PCE are considered VOCs when emitted to the ambient air in vapor form. UAC R307-325 is applicable to aboveground storage of contaminated groundwater and contaminated soil or other remedial process that could produce VOC vapor.	Excavated soils will be placed in covered roll-offs which will limit potential HAP emissions.
Action-Specific	Federal Regulatory Requirement	Hazardous Waste	Hazardous Waste Management – 40 CFR 260 and Identification and Listing of Hazardous Waste – 40 CFR 261, as adopted by UAC R315-261 and R315-262	Applicable	Provides definitions and defines how to determine whether a waste is a hazardous waste. Listed wastes are not expected to be present at the site.	Wastes generated will be characterized to determine if they are hazardous wastes.
Action-Specific	Federal Regulatory Requirement	Hazardous Waste	Standards Applicable to Generators of Hazardous Waste – 40 CFR 262, as adopted by UAC R315-262	Applicable	Specifies standards for management of hazardous waste by hazardous waste generators, including management in tanks and containers.	Containerized waste (drill cuttings and other contaminated media) determined to be hazardous will be properly labeled, stored, and inspected; staff will be appropriately trained; and spill prevention and response procedures will be in place.

APPENDIX A
Summary of Applicable or Relevant and Appropriate Requirements for the Operable Unit 4 Expanded Remedy
Operable Unit 4 Record of Decision Amendment, Hill Air Force Base, Utah

Type	Authority	Medium	Requirement	Status	Synopsis of Requirement	Action to be Taken to Attain Requirement
Action-Specific Chemical-Specific	Federal Regulatory Requirement	Hazardous Waste	Contained-in Policy (63 Federal Register 28618–28620; May 26, 1998) Management of Soils Containing Hazardous Waste	To Be Considered	Contaminated media, of itself, is not hazardous waste. However, contaminated environmental media can be subject to regulation under RCRA if it "contains" hazardous waste (i.e., contains levels of contaminants that are above the waste criteria, or is contaminated with a listed hazardous waste [listed wastes are found in 40 CFR 261.24, see below]). Applicable since TCE and PCE are on the hazardous waste TCLP list and have been detected in soil and groundwater.	Soil and groundwater that are removed will be tested to determine if they are subject to this requirement. Existing contamination is not believed to be from sources that include listed hazardous wastes.
Action-Specific Chemical-Specific	Federal Regulatory Requirement	Hazardous Waste	Identification and Listing of Hazardous Waste – 40 CFR 261.24, as adopted by UAC R315-261-10 and UAC R316-261-11	Applicable	Defines solid waste that is subject to regulation as hazardous waste including the toxicity characteristic for hazardous waste (using TCLP analyses). Listed wastes are not expected to be present at the site.	The selected remedies will comply with regulations by analyzing drill cuttings and other contaminated media. If wastes are found to be hazardous, waste will be containerized, transported, and disposed of in accordance with applicable regulations.
Action-Specific	Federal Regulatory Requirement	Hazardous Waste	Hazardous Waste Closure Performance Standard, 40 CFR 264.111, as adopted by UAC R315-264-111	Relevant and Appropriate	A hazardous waste unit must be closed in a manner that: a) Minimizes the need for further maintenance; and b) Controls, minimizes, or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere; and c) Meets the closure requirements for the specific type of unit.	The selected remedy will meet these requirements through cap design and groundwater monitoring.
Action-Specific	Federal Regulatory Requirement	Hazardous Waste	Hazardous Waste Landfills, Closure and Post Closure Care – 40 CFR 264.310, as adopted by UAC R315-264-310	Relevant and Appropriate	At final closure, a landfill must be capped with a cap that meets the following requirements: 1) Provide long-term minimization of migration of liquids through the closed landfill; 2) Function with minimum maintenance; 3) Promote drainage and minimize erosion or abrasion of the cover; 4) Accommodate settling and subsidence so that the cover's integrity is maintained; and 5) Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present. The cap and associated surveying benchmarks must also be maintained, and groundwater at the landfill must be monitored.	The selected remedy will meet these requirements through cap design and groundwater monitoring.
Action-Specific Chemical-Specific	State Regulatory Requirement	Hazardous Waste	General Requirements, Identification, and Listing of Hazardous Waste – UAC R315-261; which adopts 40 CFR 261	Applicable	Defines those solid wastes that are subject to regulation as hazardous wastes. Includes definitions of characteristic and listed hazardous wastes. Toxicity characteristic hazardous wastes are above TCLP limits discussed in 40 CFR 261.24. Toxicity characteristic hazardous waste includes chlorinated compounds such as TCE and PCE.	The selected remedy will comply with regulations by analyzing drill cuttings and other contaminated media; if wastes are found to be hazardous, waste will be containerized, transported, and disposed in accordance with applicable regulations. Contamination is not believed to be due to listed hazardous waste.
Action-Specific	State Regulatory Requirement	Hazardous Waste	Hazardous Waste Definitions – UAC R315-261-3 and Identification and Listing of Hazardous Waste – UAC R315-261-10 and UAC R315-261-11; which adopts 40 CFR 261 and 262	Applicable	As discussed in R315-261-3, a generator is required to characterize waste in accordance with the standards specified in R315-261-10. A waste is considered a RCRA hazardous waste if it exhibits any characteristic of ignitability, corrosivity, reactivity, or toxicity, or if it is listed as a hazardous waste. Most waste determinations will focus on whether the generated waste (e.g., well cuttings, soil vapor extraction-produced fluids) could be classified as toxicity characteristic waste as defined by the contaminant concentrations (e.g., a D-code hazardous waste). The toxicity characteristic is determined by TCLP analysis of representative waste samples.	Waste generated during construction, monitoring, or remediation will be characterized and managed in accordance with UAC R315 requirements. Potential hazardous wastes include, but are not limited to, drill cuttings from well installation, and well development water. Solid wastes were placed in Landfill 1 from 1955 to 1967, before the effective date of RCRA. No records were found indicating that hazardous wastes were disposed of at Landfill 1; so, the source of the chlorinated organics is not known. Therefore, the source of contamination at this site is not a listed waste.
Action-Specific	State Regulatory Requirement	Hazardous Waste	Hazardous Waste Generator Requirements – UAC R315-262; which adopts 40 CFR 262	Applicable	Establishes standards for generators of hazardous waste. If waste is stored in containers for longer than 90 days, then the substantive requirements of UAC R315-262-34 for container storage would be applicable.	Containerized waste (drill cuttings and other contaminated media) determined to be hazardous will be properly labeled, stored, and inspected; staff will be appropriately trained; and spill prevention and response procedures will be in place.
Action-Specific	State Regulatory Requirement	Hazardous Waste	Hazardous Waste Closure, UAC R315-264-111 and Hazardous Waste Facility Location Standards, UAC R315-264-18; which adopts 40 CFR 264.111	Relevant and Appropriate	Adopts the general closure performance standard of 40 CFR 264.111.	The selected remedy will meet these requirements through cap design and groundwater monitoring.

Type	Authority	Medium	Requirement	Status	Synopsis of Requirement	Action to be Taken to Attain Requirement
Action-Specific	State Regulatory Requirement	Hazardous Waste	Hazardous Waste Landfill Closure and Post Closure, UAC R315-264-110; which adopts 40 CFR 264.110	Relevant and Appropriate	At final closure, a hazardous waste landfill must be capped with a cover that meets the following requirements. Cover designed and constructed to: 1) Provide long-term minimization of migration of liquids through the closed landfill; 2) Function with minimum maintenance; 3) Promote drainage and minimize erosion or abrasion of the cover; 4) Accommodate settling and subsidence so that the cover's integrity is maintained; and 5) Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present. The cap, groundwater monitoring, erosion control, and surveying benchmarks must be maintained.	The selected remedy will meet these requirements through cap design and groundwater monitoring.
Action-Specific	State Regulatory Requirement	Hazardous Waste	Hazardous Waste Emergency Controls – UAC R315-263-31	Applicable	Outlines requirements for emergency control of hazardous waste spills, including immediate action, cleanup, and reporting.	Applicable if wastes generated during remedy implementation are characterized as hazardous waste and if those wastes are spilled.
Action-Specific	Federal Regulatory Requirement	Solid Waste	Municipal Solid Waste Landfill Closure Criteria, 40 CFR 258.60(a) and (b)	Relevant and Appropriate	Requires that municipal solid waste landfills be capped at closure. The caps must minimize infiltration and erosion and must meet the following requirements: 1) Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1×10^{-5} cm/sec, whichever is less, and 2) Minimize infiltration through the closed landfill by the use of an infiltration layer that contains a minimum 18-inches of earthen material, and 3) Minimize erosion of the final cover by the use of an erosion layer that contains a minimum 6 inches of earthen material that is capable of sustaining native plant growth. Alternate infiltration layers and erosion control layers are allowed if they provide equivalent reduction or protection, respectively.	The selected remedy will meet these requirements through cap design and groundwater monitoring.
Action-Specific	State Regulatory Requirement	Solid Waste	Solid Waste Facility Location Standards, General Facility Requirements, and Closure Requirements, UAC R315-302; General Closure and Post-Closure Requirements, UAC R315-302-3	Applicable	A solid waste facility should be closed in a way that minimizes maintenance and minimizes the post-closure escape of solid waste constituents, leachate, landfill gases, contaminated run-off, or waste decomposition products to the ground, ground water, surface water, or the atmosphere. Closure may include covering, grading, seeding, landscaping, contouring, and screening.	The selected remedy will meet these requirements through cap design and groundwater monitoring.
Action-Specific	State Regulatory Requirement	Solid Waste	Landfilling Standards, UAC R315-303; Standards for Design, UAC R315-303-3; Closure, UAC R315-303-3(4)	Applicable	The final cover for landfills should meet one of the following design requirements: (a) Standard Design. The standard design of the final cover shall consist of two layers: (i) a layer to minimize infiltration, consisting of at least 18 inches of compacted soil, or equivalent, with a permeability of 1×10^{-5} cm/sec or less, or equivalent, shall be placed upon the final lifts; (A) in no case shall the cover of the final lifts be more permeable than the bottom liner system or natural subsoils present in the unit; and (B) the grade of surface slopes shall not be less than 2%, nor the grade of side slopes more than 33%, except where construction integrity and the integrity of erosion control can be demonstrated at steeper slopes; and (ii) a layer to minimize erosion, consisting of: (A) at least 6 inches of soil capable of sustaining vegetative growth placed over the compacted soil cover and seeded with grass, other shallow rooted vegetation, or other native vegetation; or (B) other suitable material. (b) Requirements for any earthen final cover at a Landfill. (i) Markers or other benchmarks shall be installed in any final earthen cover to indicate the thickness of the final cover. These markers shall be observed during each quarterly inspection and the earthen cover shall be raised to the appropriate thickness as necessary. Alternate infiltration layers and erosion control layers are allowed if they provide equivalent reduction or protection, respectively.	The selected remedy will meet these requirements through cap design.

APPENDIX A
Summary of Applicable or Relevant and Appropriate Requirements for the Operable Unit 4 Expanded Remedy
Operable Unit 4 Record of Decision Amendment, Hill Air Force Base, Utah

Type	Authority	Medium	Requirement	Status	Synopsis of Requirement	Action to be Taken to Attain Requirement
Action-Specific	State Regulatory Requirement	Solid Waste	Landfilling Standards, UAC R315-303; Standards for Design, UAC R315-303-3; Design Drawings, UAC R315-303-3(6)	Applicable	Design drawings of the final cover and run-off/run-on control system will be stamped by a Utah PE.	The cover design, if required, will be stamped by a Utah PE.
Action-Specific	State Regulatory Requirement	Solid Waste	Landfilling Standards, UAC R315-303; Standards for Design, UAC R315-303-3; Other Requirements, UAC R315-303-3(7)	Applicable	Fencing limiting access to the site, groundwater monitoring, surface water monitoring, air monitoring, and others may be needed.	Monitoring and access are addressed in the CERCLA documents and in the design of the remedy for the site.
Location-Specific	Federal Regulatory Requirement	Endangered Species	Endangered Species Act – 50 CFR 17.21	Applicable	It is unlawful to harass or jeopardize any threatened or endangered species or destroy or adversely modify critical habitat. Endangered species are known to frequent the Ogden area (i.e., peregrine falcons, bald eagles).	If threatened or endangered species are found during construction, the work will be halted, the Hill AFB Natural Resources Department will be notified, and the Hill AFB Natural Resources Plan will be followed.
Location-Specific	Federal Regulatory Requirement	Wildlife Protection	Migratory Bird Treaty Act – 16 USC 703	Applicable	The taking of any migratory species of wild bird is prohibited. Consultation with the USFWS is required if migratory birds are affected by the construction.	Applicable if migratory birds are present. Remediation activities that might affect migratory birds will require informal consultation with USFWS. Remedial action design will consider effects on migratory birds. Construction activities may be limited to certain times when birds are not nesting, if migratory birds are found in construction areas.

NOTES:
µg/L = Microgram(s) per liter.
AFB = Air Force Base.
ARAR = Applicable or Relevant and Appropriate Requirement.
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act.
CFR = Code of Federal Regulations.
cm/sec = Centimeter(s) per second.
COC = Contaminant of concern.
DCA = Dichloroethane.
DCE = Dichloroethene.
HAP = Hazardous air pollutant.
MCL = Maximum Contaminant Level.
MEK = Methyl ethyl ketone.
mg/L = Milligram(s) per liter.
NESHAP = National Emission Standards for Hazardous Air Pollutants.
PCE = Tetrachloroethene.
PE = Professional engineer.
PM_{10} = Particulate matter of 10 microns in diameter or smaller.
RCRA = Resource Conservation and Recovery Act.
SWPPP = Stormwater pollution prevention plan.
TCE = Trichloroethene.
TCLP = Toxicity characteristic leaching procedure.
UAC = Utah Administrative Code.
UPDES = Utah Pollutant Discharge Elimination System.
USFWS = U.S. Fish and Wildlife Service.
UST = Underground storage tank.
VOC = Volatile organic compound.

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Appendix B
Cost Estimates

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TABLE B-1
Source Area – Existing Remedy Cost Estimate
Operable Unit 4 Record of Decision Amendment, Hill Air Force Base, Utah

A. CAPITAL COSTS

Item No.	Cost Categories and Items	Description	Unit Cost	Quantity (#)	Units	Total Cost
1	**No Action**					
	Not applicable	Not applicable				$0
	Total Capital Cost					**$0**

B. OPERATION AND MAINTENANCE (O&M) COSTS

Item No.	Cost Categories and Items	Description	Unit Cost	Quantity (#)	Units	Total Cost
1	**O&M**					
1.1	Annual O&M/Landfill Cap Inspection	Annual O&M and Landfill Cap Inspection 2016 through 2215	$10,000	200	Year	$2,000,000
	Line Item Total					**$2,000,000**

C. PRESENT WORTH FOR O&M ACTIVITIES

O&M Present Worth = (O&M) x (P/A), 1.5% for 200 years $632,728

D. COST SUMMARY

Cost Element	Present Value Cost ($)
Capital Costs	$0
O&M/Monitoring (through 2215)	$633,000
Total 200-Year Present Worth Costs	**$633,000**

NOTES:
A = Annual amount.
i = 2016 Real Discount Rate from OMB-094A (http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c/).
n = Discount periods.
O&M = Operation and maintenance.
P = Present worth.

$(P/A, i\%, n) = A [((1 + i)^n - 1) / (i (1+i)^n)]$
Total present worth costs have been rounded to the nearest $1,000.
Present worth costs are an estimate for planning purposes only. Actual costs will vary.

TABLE B-2
Source Area – Expanded Remedy Cost Estimate
Operable Unit 4 Record of Decision Amendment, Hill Air Force Base, Utah

A. CAPITAL COSTS

Item No.	Cost Categories and Items	Description	Unit Cost	Quantity (#)	Units	Total Cost
1	**Subgrade Biogeochemical Reactor**					
1.1	Total Capital Cost	Total capital cost (refer to Table B-3 for line items)	$289,558	1	LS	$289,558
2	**Landfill Cap**					
2.1	Total Capital Cost - east side of Landfill 1	Total capital cost (refer to Table B-3 for line items)	$538,030	1	LS	$538,030
3	**Additional Monitoring Wells/Biobarriers**					
3.1	Total Capital Cost	Total capital cost (refer to Table B-3 for line items)	$53,879	1	LS	$53,879
4	**Allowances, Services, and Contingency**					
4.1	Fee	15%	$132,220	1	LS	$132,220
4.2	Professional Services (project management, design, and oversight)	15%	$152,053	1	LS	$152,053
4.3	Contingency	30%	$349,722	1	LS	$349,722
	Total Capital Cost					**$1,515,000**

B. OPERATION AND MAINTENANCE (O&M) COSTS

Item No.	Cost Categories and Items	Description	Unit Cost	Quantity (#)	Units	Total Cost
1	**O&M**					
1.1	Annual O&M for Subgrade Biogeochemical Reactor	Annual O&M for subgrade biogeochemical reactor for 2016 through 2020 (including groundwater monitoring)	$21,700	5	Year	$108,500
1.2	O&M for Passive Operation of Subgrade Biogeochemical Reactor and Eastern Landfill 1 Biobarrier	Substrate injection every five years from 2021 through 2115	$44,000	20	Each	$880,000
1.3	Annual O&M/Landfill Cap Inspection	Annual O&M for landfill cap inspection and source area groundwater monitoring for 2016 through 2215	$15,450	200	Year	$3,090,000
	Line Item Total					**$4,078,500**

C. PRESENT WORTH FOR O&M ACTIVITIES

O&M Present Worth = (O&M) x (P/A), 1.5% for 200 years $1,515,704

D. COST SUMMARY

Cost Element	Present Value Cost ($)
Capital Costs	$1,515,000
O&M/Monitoring (through 2215)	$1,516,000
Total 200-Year Present Worth Costs	**$3,031,000**

NOTES:
A = Annual amount.
i = 2016 Real Discount Rate from OMB-094A (http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c/).
n = Discount periods.
O&M = Operation and maintenance.
P = Present worth.

$(P/A, i\%, n) = A\,[((1 + i)^n - 1) / (i\,(1+i)^n)]$
Total present worth costs have been rounded to the nearest $1,000.
Present worth costs are an estimate for planning purposes only. Actual costs will vary.

TABLE B-3
Source Area – Expanded Remedy Cost Estimate
Capital Cost Planning-Level Estimate
Operable Unit 4 Record of Decision Amendment, Hill Air Force Base, Utah

Item/Activity	Quantity	Unit	Unit Cost	Cost	Subtotals	Comments and References
Subgrade Biogeochemical Reactor Installation (associated costs)						
Mobilization/Demobilization (Drill Rig)	1	LS	$20,000	$20,000		Unit cost is engineering estimate
Utility Locating Services	1	each	$1,000	$1,000		
Subgrade Biogeochemical Reactor Column Installation	660	feet	$92	$60,720		Assumes 12, 12-inch borings with injection wells to 55 ft bgs; unit cost based on bids for Travis AFB Site SD031
Subgrade Biogeochemical Reactor Column Backfill	19	CY	$1,400	$26,600		Unit cost based on bids for Travis AFB Site SD031
Well Installation	330	feet	$67	$22,272		Assumes 1 monitoring well and 5 extraction wells to approximately 55 ft bgs; unit cost based on quote
Extraction Well and Subgrade Biogeochemical Reactor Column Vaults	17	each	$5,625	$95,625		Assumes 4' x 4' x 4' pre-cast concrete; includes delivery and placement; unit cost based on OU 9 Golf Course Area work in 2015
Recirculation System Installation	1	LS	$51,300	$51,300		Assumes solar power installation, 1 pump in each of 5 extraction wells, meters, transducers, controls, trenching/piping, and miscellaneous parts
Survey Services	18	each	$46	$828		Assumes survey of 18 wells or columns; unit rate based on 2015 rate for OU 4 surveys
Sampling and Analysis	1	LS	$5,500	$5,500		
T&D Non-Hazardous Waste	85	ton	$67	$5,713		Assumes drill cuttings contain detectable VOCs and are sent to off-Base Subtitle D landfill
				Bioreactor/Mulch Wall Installation (associated costs) Subtotal:	*$289,558*	
Landfill Cap Installation (associated costs)						
Mobilization/Demobilization	1	LS	$40,000	$40,000		Unit cost based on 2016 estimate for Utah County site
Clear/Grub	2.0	Acre	$3,500	$7,000		Unit cost based on 2016 estimate for Utah County site
Drainage Swales and Revegetation	2.0	Acre	$8,000	$16,000		Unit cost based on 2016 estimate for Utah County site
Multi-layer Landfill Cap	1.5	Acre	$300,000	$450,000		Unit cost based on 2016 estimate for Utah County site
Settlement Monuments	3	each	$1,500	$4,500		Unit cost based on 2016 estimate for Utah County site
Install Fencing	1200	LF	$14.40	$17,280		Unit cost from OU 9 Pond 1 work in 2016
Survey Services	1	each	$3,250	$3,250		
				Landfill Cap Installation (associated costs) Subtotal:	*$538,030*	
Additional Monitoring Well and Biobarrier Installation (associated costs)						
Mobilization/Demobilization (Drill Rig)	1	LS	$4,311	$4,311		Based on drilling company quote (1 sonic rig and crew)
Mobilization/Demobilization (Development Rig)	1	LS	$3,292	$3,292		Based on drilling company quote (1 development rig and crew)
Utility Locating Services	1	each	$1,000	$1,000		
Drilling/Well Installation	450	feet	$67	$30,371		Assumes 10 monitoring/injection wells to approximately 45 ft bgs; unit cost based on quote
Well Completions	10	each	$1,200	$12,000		Assumes 10 monitoring/injection wells
Sampling and Analysis	1	LS	$1,500	$1,500		
T&D to C&D landfill	14	ton	$67	$945		Assumes drill cuttings contain detectable VOCs and are sent to off-Base Subtitle D landfill
Survey Services	10	each	$46	$460		Assumes survey of 10 wells; unit rate based on 2015 rate for OU 4 surveys
				Well Installation (associated costs) Subtotal:	*$53,879*	
				Direct Cost Subtotal:	***$881,467***	
	Fee:	15%	of	$881,467	*$132,220*	
				Subcontractor Subtotal:	*$1,013,687*	
Professional Services	15%	of	$1,013,687	$152,053		Includes project management, construction oversight, injection performance, design, and reporting
				Professional Services Subtotal:	*$152,053*	
				Expanded Source Remedy Subtotal:	*$1,165,740*	
Contingency	30%	of	$1,165,740	$349,722		
				Contingency Subtotal:	*$349,722*	
Expanded Source Remedy Total Capital Cost					**$1,515,462**	

NOTES:
bgs = Below ground surface.
C&D = Construction and demolition.
CY = Cubic yard.
ft = Feet(foot).
LS = Lump sum.
OU = Operable Unit.
T&D = Transportation and disposal.
VOC = Volatile organic compound.

TABLE B-4
Non-Source Area – Existing Remedy Cost Estimate
Operable Unit 4 Record of Decision Amendment, Hill Air Force Base, Utah

A. CAPITAL COSTS

Item No.	Cost Categories and Items	Description	Unit Cost	Quantity (#)	Units	Total Cost
1	**No Action**					
	Not applicable	Not applicable				$0
	Total Capital Cost					**$0**

B. OPERATION AND MAINTENANCE (O&M) COSTS

Item No.	Cost Categories and Items	Description	Unit Cost	Quantity (#)	Units	Total Cost
1	**O&M**					
1.1	Annual O&M	Annual O&M on HDUS 2016 through 2215	$32,000	200	Year	$6,400,000
1.2	RA-O performance monitoring	RA-O performance monitoring for 2016 through 2215	$12,000	200	Year	$2,400,000
	Line Item Total					**$8,800,000**

C. PRESENT WORTH FOR O&M ACTIVITIES

O&M Present Worth = (O&M) x (P/A), 1.5% for 200 years $2,784,001

D. COST SUMMARY

Cost Element	Present Value Cost ($)
Capital Costs	$0
O&M/Monitoring (through 2214)	$2,784,000
Total 200-Year Present Worth Costs	**$2,784,000**

NOTES:
A = Annual amount.
HDUS = Horizontal drain upgrade system.
i = 2016 Real Discount Rate from OMB-094A (http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c/).
n = Discount periods.
O&M = Operation and maintenance.
P = Present worth.
RA-O = Remedial action-operations.

$(P/A, i\%, n) = A [((1 + i)^n - 1) / (i (1+i)^n)]$
Total Present Worth Costs have been rounded to the nearest $1,000.
Present worth costs are an estimate for planning purposes only. Actual costs will vary.

TABLE B-5
Non-Source Area – Expanded Remedy Cost Estimate
Operable Unit 4 Record of Decision Amendment, Hill Air Force Base, Utah

A. CAPITAL COSTS

Item No.	Cost Categories and Items	Description	Unit Cost	Quantity (#)	Units	Total Cost
1	**ERD Treatment**					
1.1	Total Capital Cost	Total capital cost for ERD treatment (refer to Table B-6 for line items)	$284,809	1	LS	$284,809
2	**Allowances, Services, and Contingency**					
2.1	Fee	15%	$ 42,721	1	LS	$42,721
2.2	Professional Services (project management, design, and oversight)	15%	$ 49,130	1	LS	$49,130
2.3	Contingency	30%	$ 112,998	1	LS	$112,998
	Total Capital Cost					**$490,000**

B. OPERATION AND MAINTENANCE (O&M) COSTS

Item No.	Cost Categories and Items	Description	Unit Cost	Quantity (#)	Units	Total Cost
1	**O&M**					
1.1	Annual O&M	Annual O&M on HDUS 2016 through 2085	$32,000	70	Year	$2,240,000
1.2	O&M for Biobarriers	Substrate re-injection events for Biobarriers between 2016 and 2025	$91,600	2	Each	$183,200
1.3	RA-O performance monitoring	Optimized RA-O performance monitoring for non-source area from 2016 through 2085	$12,000	70	Year	$840,000
	Line Item Total					**$3,263,000**

C. PRESENT WORTH FOR O&M ACTIVITIES

O&M Present Worth = (O&M) x (P/A), 1.5% for 70 years $2,073,891

D. COST SUMMARY

Cost Element	Present Value Cost ($)
Capital Costs	$490,000
O&M/Monitoring (70 years)	$2,074,000
Total 200-Year Present Worth Costs	**$2,564,000**

NOTES:
A = Annual amount.
ERD = Enhanced reductive dechlorination.
HDUS = Horizontal drain upgrade system.
i = 2016 Real Discount Rate from OMB-094A (http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c/).
n = Discount periods.
O&M - Operation and maintenance.
P = Present worth.
RA-O = Remedial action-operations.

$(P/A, i\%, n) = A [((1 + i)^n - 1) / (i (1+i)^n)]$
Total Present Worth Costs have been rounded to the nearest $1,000.
Present worth costs are an estimate for planning purposes only. Actual costs will vary.

TABLE B-6
Non-Source Area – Expanded Remedy Cost Estimate
Capital Cost Planning-Level Estimate
Operable Unit 4 Record of Decision Amendment, Hill Air Force Base, Utah

Item/Activity	Quantity	Unit	Unit Cost	Cost	Subtotals	Comments and References
ERD Treatment						
Mobilization/Demobilization (Drill Rig)	1	LS	$4,311	$4,311		Based on drilling company quote (1 sonic rig and crew)
Mobilization/Demobilization (Development)	1	LS	$3,292	$3,292		Based on drilling company quote (1 development rig and crew)
Utility Locating Services	1	each	$1,000	$1,000		
Injection Equipment	1	event	$4,360	$4,360		Engineer estimate
EVO Substrate	46,600	lbs/event	$1.05	$48,930		Assumes 46,600 lbs of EVO per event; unit price based on 2016 Terra Systems quote
Drilling/Well Installation	2,250	feet	$67	$151,853		Approximately 50 wells to average of 45 ft bgs, based on drilling company quote
Well Completions	50	each	$1,200	$60,000		Assumes 50 monitoring/injection wells
Survey Services	50	each	$46	$2,300		Assumes survey of 50 injection wells; unit rate based on 2015 rate for OU 4 surveys
Sampling and Analysis	1	LS	$6,000	$6,000		
T&D to C&D Landfill	71	ton	$25	$1,764		Assumes drill cuttings do not contain detectable VOCs and are sent to on-Base landfill
Utility Locating Services	1	each	$1,000	$1,000		Engineer estimate
			Direct Cost Subtotal:		***$284,809***	
	Fee:	15%	of	$284,809	*$42,721*	
			Subcontractor Subtotal:		*$327,531*	
Professional Services	15%	of	$327,531	$49,130		
			Professional Services Subtotal:		*$49,130*	
			Expanded Non-Source Remedy Subtotal:		*$376,660*	
Contingency	30%	of	$376,660	$112,998		
			Contingency Subtotal:		*$112,998*	
Expanded Non-Source Remedy Total Capital Cost					**$489,658**	

NOTES:
bgs = Below ground surface.
C&D = Construction and demolition.
ERD = Enhanced reductive dechlorination.
EVO = Emulsified vegetable oil.
ft = Feet(foot).
lbs = Pounds.
LS = Lump sum.

Appendix C
Notice of Availability and Public Meeting Sign-in Sheet

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Public Comment Opportunity
June 17 - July 16, 2016

The U.S. Air Force is accepting comments on the Updated Revised Proposed Plan for changes to the existing cleanup plan at Hill Air Force Base (Hill AFB) Operable Unit 4 (OU 4).

OU 4 is located along the northern boundary of Hill AFB and consists of:

- Landfills 1 and 2 - contaminated with trichloroethene (TCE), a degreasing solvent used historically on the base.
- A shallow TCE-contaminated groundwater plume that underlies portions of Hill AFB, Riverdale City and South Weber City.

In 1994, the Air Force, the U.S. Environmental Protection Agency and the Utah Department of Environmental Quality signed an agreement for cleanup of OU 4. The OU 4 Updated Revised Proposed Plan recommends expanding that agreement. The plan proposes:

- Maintaining the current cleanup remedies in place
- Installing a bioreactor downgradient of Western Landfill 1 cap to treat TCE-contaminated groundwater
- Installing enhanced reductive dechlorination biobarriers on Hill AFB to treat TCE-contaminated groundwater
- Installing low-permeability cap on Eastern Landfill 1 to prevent surface water from infiltrating landfill
- Conducting soil vapor extraction (SVE) treatabilty study in Landfill 2 to determine if SVE is a viable option

The public is invited to attend the

OU 4 Proposed Plan Public Meeting

Wednesday, June 22
7-8 p.m.

Riverdale Community Center
4360 S. Parker Drive
Riverdale, Utah

Comment in person at the public meeting, or write to:

Mr. Mark Loucks
Department of the Air Force
AFCEC/CZOM
7290 Weiner Street,
Building 383
Hill AFB, UT 84056-5003

Or via email:
mark.loucks@us.af.mil

All comments must be postmarked or received by midnight, July 16, 2016.

For more information, contact Barbara Fisher, Hill AFB's environmental public affairs representative, at (801) 775-3652.

Review the OU 4 Updated Revised Proposed Plan online: http://AFCEC.public.admin-record.us.af.mil
Under Hill AFB, search "Operable Unit 4 Updated Revised Proposed Plan"

Fri, Day 6-17-16 STANDARD EXAMINER

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Operable Unit 4
Revised Proposed Plan
Public Meeting
Riverdale Community Center
June 22, 2016
Please Sign In

Name (Please print)	**Address**	**Phone**
Jarrod Case	Hill AFB	801-777-3943
Sandra Staigerwald	EA ENG	412-215-6142
ANDREW CASTOR	CH2M	801-385-8411
Doug Johnson	4142 S. 600 W Riverdale	801 776 6920
Mark Loucks	Hill AFB	801 777-6299
Sandra Bourgeois	US EPA Region 8	303-312-6606
David Harris	Hill AFB	801 645 0409
Norm Searle	Riverdale City	801-397-2128
JAN UKENA	South Weber	801-479-8749
Carly Brown	Hill AFB	801-721-8448
Tammy Long	South Weber	801-510-1368

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