DEPARTMENT OF THE AIR FORCE
AIR FORCE CIVIL ENGINEER CENTER

AFCEC/CZRB-Griffiss
706 Brooks Road
Rome, NY 13441

3 April 2013

Ms. Carolyn d'Almeida
U.S. EPA Region IX
75 Hawthorne Street
San Francisco, CA 94105

and

Mr. Don Atkinson
Arizona Department of Environmental Quality
1110 West Washington Street, 4415B-1
Phoenix, Arizona 85007

Subject: Submission of "Final Amended Proposed Plan for Operable Unit 2, Former Williams Air Force Base"

The Air Force is pleased to submit the attached, *Amended Proposed Plan for Operable Unit 2* (OU-2), in final format for your records. The Proposed Plan provides background information about Williams and OU-2, describes the remedial alternatives considered at the site, identifies the preferred alternative, solicits public review and comment on the alternatives, and provides information on how the public can be involved in the remedy selection process. Comments from the USEPA and ADEQ have been addressed and responses will be transmitted under separate cover.

Please contact me at (315) 356-0810 or catherine.jerrard@us.af.mil if you have any questions regarding this report.

Sincerely,

CATHERINE JERRARD, PE
AFCEC/CZRB Program Manager

Attachments:

1. Final Amended Proposed Plan for Operable Unit 2, Former Williams Air Force Base, Mesa, Arizona.

c: Addressee (1 and 1 CD)
USEPA – Eva Davis (1 and 1CD)
ADEQ – Don Atkinson (2 and 2 CDs)
AFCEC –Catherine Jerrard (1 and 1 CD)
CNGS – Geoff Watkin (1 and 1 CD)
TechLaw – Bill Mabey (1 and 1 CD)
UXOPro – Steven Willis (1 CD)
Administrative Record – Terie Glaspey (1 and 1 CD)
File

Amended Proposed Plan
For Operable Unit 2
Former Williams Air Force Base

Final – April 3, 2013

Air Force Civil Engineer Center
3411 Olson Street
McClellan, CA 95652-1003

HOW YOU CAN BE INVOLVED

Public Comment Period: 10 April 2013 through 9 May 2013

Mail (or e-mail) your written comments by 9 May 2013 to:

Air Force Civil Engineer Center (AFCEC)
Western Region Public Affairs
3411 Olson Street
McClellan, CA 95652-1003
afrpa.west.pa@us.af.mil

Public Meeting: 18 April 2013, 7:00 p.m.
Arizona State University Polytechnic Campus
Peralta Hall
7171 E. Sonoran Arroyo Mall
Mesa, AZ 85212

The Air Force will conduct a presentation on the Proposed Plan. You will be able to ask questions and tell Air Force representatives what you think about the cleanup alternatives. The Air Force will accept written and oral comments and respond to comments in the final decision document.

For additional information or to obtain another copy of this Amended Proposed Plan, call Catherine Jerrard, AFCEC Program Manager, at (315) 356-0810.

Administrative Record Location:
http://afrpaar.lackland.af.mil/ar/

Information Repository:
Arizona State University (ASU) Library
Government Documents Section
300 East Orange Mall
Tempe, Arizona 85287
(480) 965-3417
7:00 a.m. - Midnight
(Open 24 Hours with ASU ID)

A. INTRODUCTION

The Air Force is issuing this Amended Proposed Plan for Operable Unit 2 (OU-2) (Proposed Plan) at the former Williams Air Force Base (AFB), Mesa, Arizona. The Proposed Plan provides background information about the former Williams AFB and OU-2, describes the remedial alternatives considered at the site, identifies the preferred alternative, solicits public review and comment on the alternatives, and provides information on how the public can be involved in the remedy selection process. The Air Force encourages public involvement in cleanup decisions at the former Williams AFB and is making this Proposed Plan and supporting documentation available for public review. The community is invited to ask questions about the Proposed Plan and to learn more during a public meeting scheduled for 18 April, at 7:00 p.m..

Information regarding the public comment period and the public meeting is provided to the left. You will have the opportunity to review and comment on the Proposed Plan during the comment period. The Air Force and U.S. Environmental Protection Agency (EPA) will co-select the final cleanup remedy, in consultation with the Arizona Department of Environmental Quality (ADEQ), after all comments have been considered. The Air Force, in consultation with the ADEQ and EPA, may modify the Preferred Alternative or select another response action presented in this Proposed Plan based on new information or public comments. Therefore, the public is encouraged to review and comment on all the alternatives in this Proposed Plan.

The Air Force is issuing this Proposed Plan as part of its public participation responsibilities under Section 117 (a) of the **Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)**[1], 42 USC § 9617(a) and Section 300.430 (f)(3) of the **National Oil and Hazardous Substances Pollution Contingency Plan (NCP)**.

[1] To assist the reader, as each key term is introduced, it appears in **bold type**. A glossary of key terms is provided on pages 14-15.

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The OU-2 Amended Proposed Plan highlights and summarizes key information from the Focused Feasibility Study (FFS), Remedial Alternatives for OU-2 (AMEC, 2012). This Proposed Plan and the reference documents listed in Section L are available during the public comment period in the Information Repository at the Arizona State University (ASU) Library or at the online Administrative Record maintained by the Air Force (see How You Can Be Involved box on page 1).

B. CERCLA PROCESS

The generalized CERCLA investigation and cleanup process is illustrated in Figure 1a. Although the process was previously completed to the remedial action step, the selected remedial action for **groundwater**, which included extraction, treatment, and reinjection or discharge, proved ineffective. Therefore, the Air Force is reevaluating groundwater remedial actions. The investigation and cleanup process for OU-2 is illustrated in Figure 1b. A timeline summarizing site investigations and actions throughout the history of ST012 is shown in Figure 1c. The Air Force is providing this Proposed Plan to solicit public comment on a new Preferred Alternative for ST012 groundwater. Based on public comments, or if new information becomes available, the Air Force may consider other cleanup actions if they are deemed necessary to provide protection to public health and the environment. This Proposed Plan will be followed by a **Record of Decision (ROD)** Amendment, which describes and documents the selection of the final cleanup decision. The ROD Amendment will also include a **Responsiveness Summary** to respond to comments received during the Proposed Plan comment period.

C. SITE BACKGROUND

C.1 Former Williams AFB

The former Williams AFB is located in Mesa, Arizona, approximately 30 miles southeast of Phoenix. Williams AFB was commissioned as a flight training school in 1941, and pilot training was the primary mission throughout the history of the base. Jet aircraft training started at the base as early as 1949. In 1991, Congress established a Base Realignment and Closure (BRAC) Commission that identified Williams AFB for closure.

On 21 November 1989, Williams AFB was added to the EPA National Priorities List (NPL), which serves primarily as an information tool for the EPA to identify sites that warrant priority investigation and remedial action under CERCLA, commonly known as Superfund. On 21 September 1990, in accordance with 42 United States Code (USC) 9620(e), a Williams AFB Federal Facility Agreement (FFA) was signed,

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which established a cooperative and participatory framework among the federal and state agencies, defined their roles and responsibilities, and established a process to resolve any disputes that may arise during the study and execution phases of the environmental cleanup. Parties to the FFA include the Air Force, EPA, ADEQ, and the Arizona Department of Water Resources (ADWR). The ADEQ has been functioning as the agency presenting positions on behalf of the state (ADEQ and ADWR). The Air Force and EPA co-select remedies, in consultation with the ADEQ.

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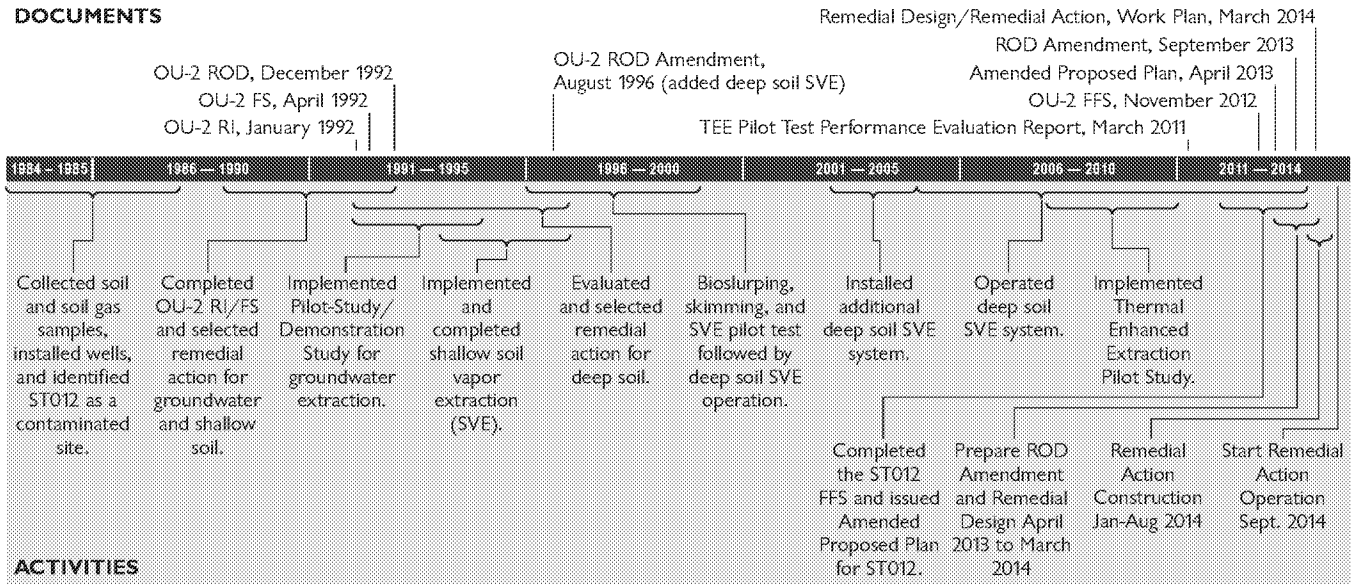
Figure 1a. General CERCLA Investigation and Cleanup Process

Site Discovery and Preliminary Investigation	*Remedial Investigation (RI) and Feasibility Study (FS)*	*Proposed Plan/Public Comment Period*	*Responsiveness Summary/Record of Decision (ROD)*	*Remedial Action*
A Preliminary Assessment/Site Inspection evaluates the potential for a release of hazardous substances from a site.	The RI identifies areas of contamination and evaluates potential risks. The FS identifies and evaluates remedial alternatives to address contamination.	The public has the opportunity to comment on the Proposed Plan.	After review of all comments, decisions are documented in the ROD.	Remedial action, if needed as documented in the ROD, is implemented.

Figure 1b. OU-2 Groundwater Investigation and Cleanup Process

Site Discovery and Preliminary Investigation	*Remedial Investigation (RI) and Feasibility Study (FS)*	*Proposed Plan/Public Comment Period*	*Responsiveness Summary/Record of Decision Amendment*	*Remedial Action*
Done		**We are Here**	**To Be Done**	
The Liquid Fuels Storage Area (ST012) was identified as a site where past hazardous material handling may have resulted in contamination during Phase I of the Installation Restoration Program developed for Williams AFB, performed in 1984.	The OU-2 RI (IT, 1992a) and FS (IT, 1992b) identified the sources and areas of contamination, assessed potential risks, and evaluated remedial alternatives for OU-2. The OU-2 ROD (IT, 1992c) selected groundwater extraction and soil vapor extraction as the remedial actions. Groundwater extraction was not effective at the site, so a Focused Feasibility Study (FFS) was performed to evaluate additional groundwater alternatives in 2012 (AMEC, 2012).	This Amended Proposed Plan is being published to present a new preferred remedial alternative for ST012 groundwater. The public now has the opportunity to comment on this Amended Proposed Plan.	After review of comments, the Air Force will document the decisions for OU-2 groundwater in the ROD Amendment. The Air Force will respond to comments received in the Responsiveness Summary.	The preferred alternative includes Steam Enhanced Extraction, Enhanced Bioremediation, and Monitored Natural Attenuation for ST012. Soil vapor extraction will continue to treat soil above the water table.

Figure 1c: ST012 Completed and Anticipated Investigation and Cleanup Actions



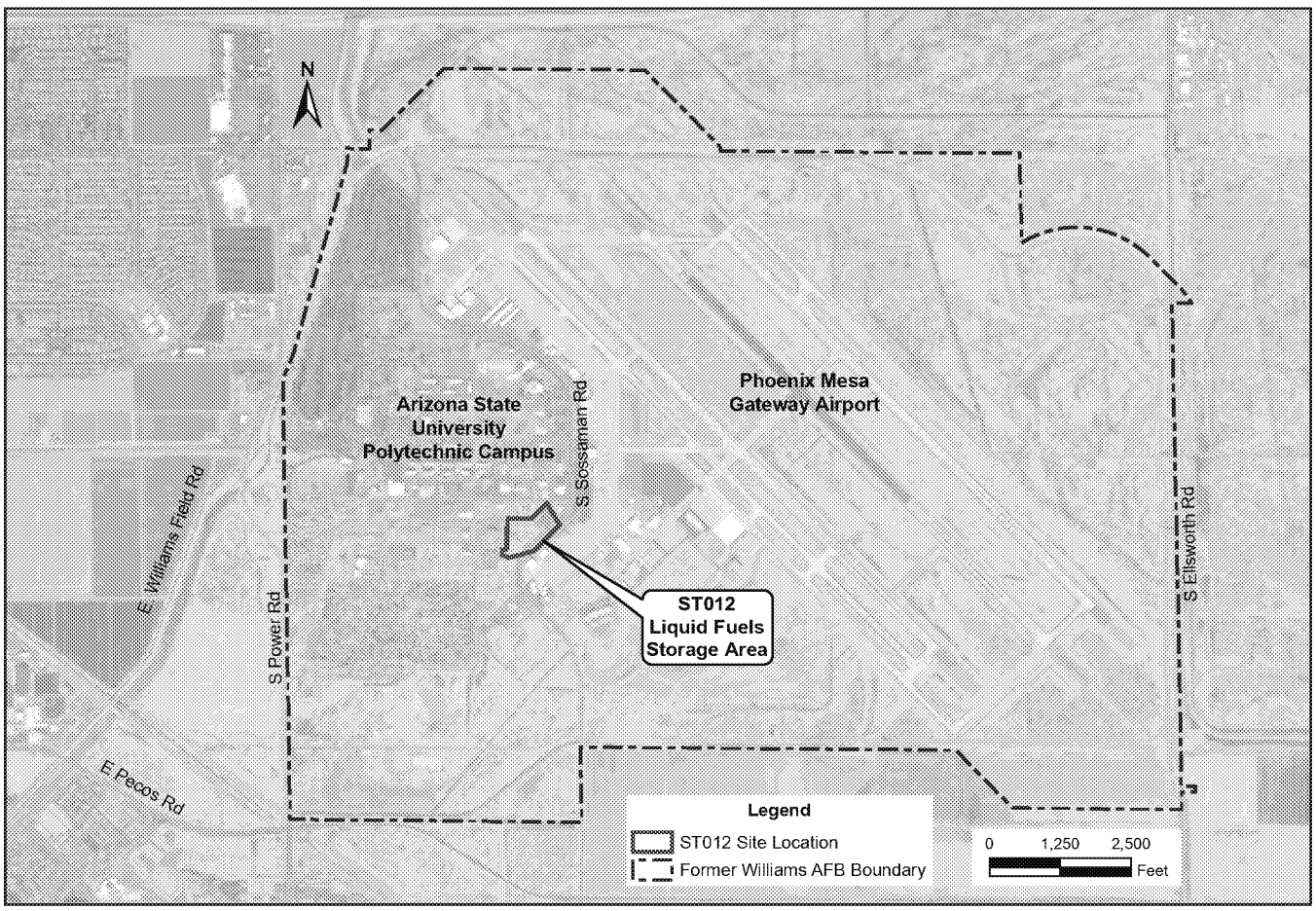
C.2 Liquid Fuels Storage Area ST012

OU-2 includes soil and groundwater of Site ST012, the former Liquid Fuels Storage Area (LFSA). Site ST012 is located at the intersection of Sossaman Road and Ulysses Avenue (Figure 2). Fuel storage and distribution operations involving aboveground and underground tanks and lines were conducted at ST012 from 1941 until the fuel storage and distribution system was decommissioned in 1991. The Air Force-owned aboveground and underground equipment and structures relating to the fuel storage and transmission operations within ST012 were removed in 1990 and 1991. Soil and groundwater at ST012 have been affected by releases of **jet propellant (JP-4)** and **aviation gasoline (AVGAS)** from the former fuel facilities, as documented during the drilling and sampling of numerous investigation boreholes and **monitoring** wells at ST012. The fuel releases are attributed to multiple documented and undocumented releases during the 50-year LFSA operations period. The volume of **light non-aqueous phase liquid (LNAPL)** (i.e., non-dissolved contaminant) in the saturated zone was estimated by the Air Force to be 2.2 million gallons (BEM, 2011).

Groundwater in the area of the **contaminant plume** is not currently used as drinking water or for irrigation, so there is no immediate threat posed to human health. Treatment is being pursued in order to bring concentrations in groundwater down to drinking water standards and to prevent contaminant migration. Remaining source material is in the form of LNAPL floating on top of the **water table** and retained as residual in soil both above and below the water table.

The 1992 OU-2 ROD specified installation of a **soil vapor extraction (SVE)** system as the remedy for **shallow soil** and installation of extraction wells to perform groundwater **pump and treat** remediation and LNAPL recovery. A subsequent ROD Amendment in 1996 added another SVE system as the remedy for **deep soil**. The SVE systems proved to be effective at remediating soils above the water table, completing the remediation of the shallow soil and continuing remediation in the deep soil. LNAPL recovery also proved to be effective and has been continued as part of the site cleanup strategy. Between the LNAPL recovery, SVE activities, and natural attenu-

Figure 2. Location of OU-2 Site



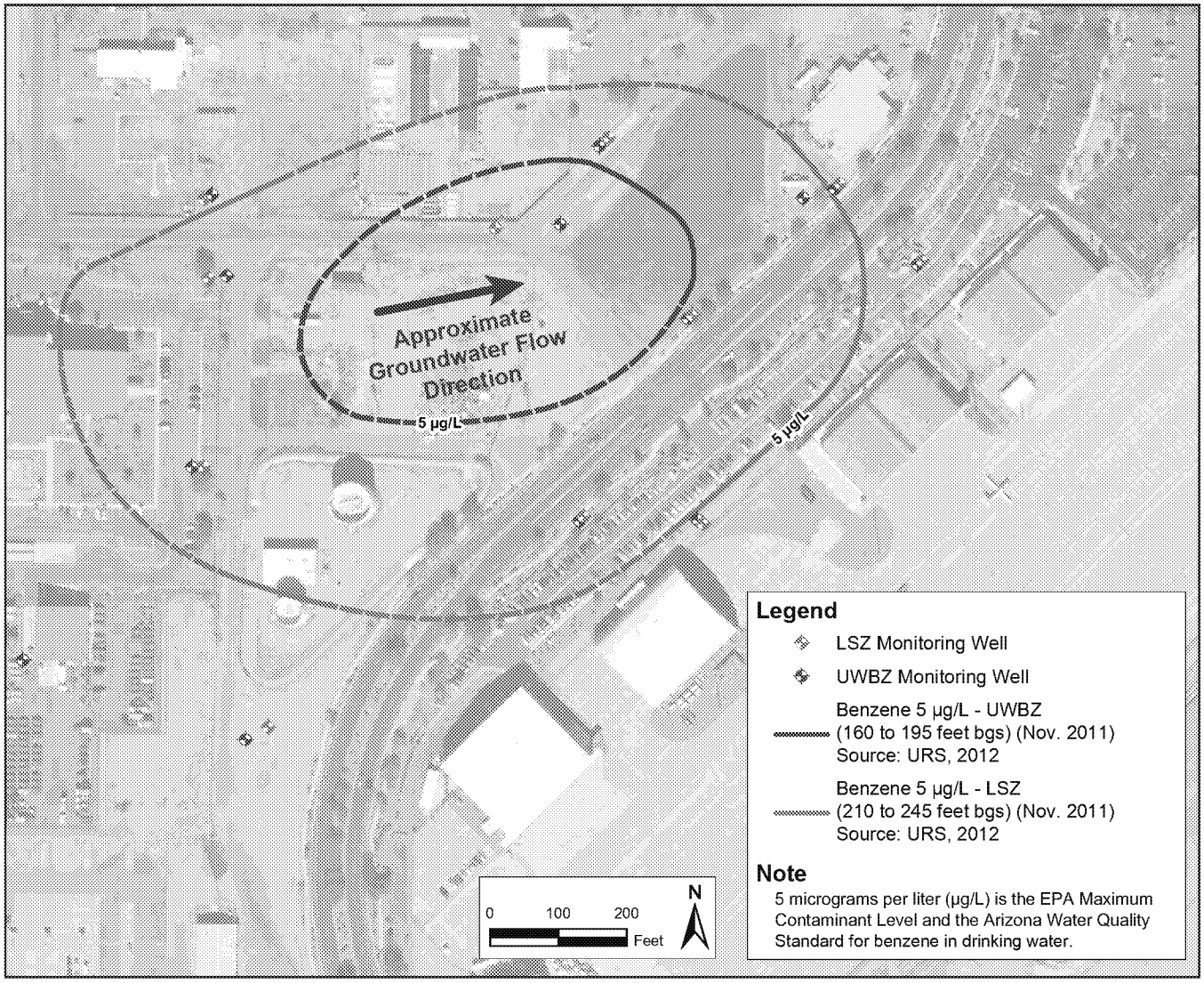
ation, an estimated 670,000 gallons of fuel have been removed. However, the groundwater extraction remedy had limited influence on the groundwater contaminant plume and was abandoned. The Air Force conducted a **Thermal Enhanced Extraction (TEE)** pilot test in 2008 and 2009 to evaluate the effectiveness of the technology. The TEE pilot test successfully demonstrated that the technology, using steam injection and liquid/vapor extraction, was safe and effective at removing LNAPL and treating the **dissolved phase** plume.

D. SITE CHARACTERISTICS

Various characterization efforts have taken place over the lifespan of the site. Remedial investigations defined the nature and extent of contamination, pilot studies evaluated the feasibility of proposed remedies, and remedial actions have been implemented (and are ongoing) to address contamination in soil and groundwater. A more thorough review of the investigation results can be found in the OU-2 FFS (AMEC, 2012) or in the respective investigation reports available through the Administrative Record (see sidebar page 1). The following section summarizes pertinent findings from those investigations.

The primary contaminants on site are fuel and fuel-related compounds. Although fuels contain many hydrocarbons, some that are typically observed in higher concentrations and may pose a threat to human health are benzene, toluene, ethylbenzene, and xylene. These are commonly referred to as BTEX compounds. Benzene in particular has been used at this site as an indicator for the location and extent of the dissolved phase contaminant plume because it is the most widely detected contaminant and has been observed at the highest concentrations dur-

Figure 3. Estimated Extent and Concentration of the Benzene Plume at Site ST012 in 2011



ing groundwater monitoring. An estimated 67.5 million gallons of water is believed to contain concentrations of benzene above the drinking water standard of 5 micrograms per liter, based on 2011 monitoring data.

The extent and concentration of benzene in groundwater, based on 2011 monitoring information, is presented in Figure 3. The conceptual understanding of the site suggests that the JP-4/AVGAS trickled down through the soil after release until it encountered the water table. Being less dense than water, the fuels floated on the water table and began to spread and diffuse into the groundwater over time. This suggests that little LNAPL contamination exists in areas that are below the historic low of the water table, which was observed at 232 feet below ground surface (bgs). The water table has risen by about 75 feet since 1978 and currently sits at roughly 150 to 155 feet bgs. A low permeability layer of clay commonly referred to as an **aquitard** is located about 10 to 15 feet below the historic low of the groundwater table. The aquitard layer tends to impede deeper migration of contaminants.

Groundwater is not currently used as drinking water or for irrigation, so there is no threat posed to human health. Treatment is being pursued in order to reduce concentrations of contaminants of concern in groundwater to meet remedial action objectives. Remaining source material is in the form of LNAPL floating on top of the water table and retained as residual in soil both above and below the water table.

Lateral contamination extent varies across two higher permeability zones of groundwater referred to as the Upper Water Bearing Zone, or UWBZ, (160 to 195 feet bgs) and the Lower Saturated Zone, or LSZ, (210 to 245 feet bgs) as shown in Figure 3. The groundwater remedy at OU-2 will involve treating dissolved phase contamination, LNAPL, and residual contaminant in saturated soil. These source materials constitute the principle threat wastes at the site.

E. ROLE AND SCOPE OF THE OPERABLE UNIT

As a result of findings from ongoing investigations of contaminated soil and groundwater, the Air Force has organized the former Williams AFB sites into six Operable Units (OUs). OUs are used to group sites having similar contaminants and site conditions, and are anticipated to have similar remedies. Organizing similar sites into OUs simplifies the FS portion of the CERCLA process. When performing technology screening, considering OUs reduces the number of times the process needs to be completed by reducing the number of sites being evaluated and eliminates the need to consider the effects of a variety of different site conditions on the appropriateness of remedial technologies. OU-2 consists entirely of Site ST012, the former Liquid Fuels Storage Area.

F. SUMMARY OF SITE RISKS

A risk assessment was performed as part of the OU-2 RI completed in 1992 (IT, 1992a) and is summarized in the OU-2 FFS (AMEC, 2012), available through the Administrative Record.

There are currently no exposure pathways to contaminants of concern at the site, and the depth of the contamination eliminates environmental risk associated with groundwater and soil. However, future exposure pathways could include ingestion of contaminated groundwater and inhalation of chemicals volatilized from groundwater during household use, should the aquifer be accessed in the future development of the site.

A future residential scenario was evaluated to provide an upper bound estimate of potential risks associated with exposure to groundwater. The quantitative assessment included calculation of **incremental lifetime cancer risk (ILCR)** to evaluate carcinogenic effects and **hazard index (HI)** to evaluate non-carcinogenic effects. The ILCR is a probability value representing the odds of an incident of cancer in a community given 30 years of exposure. For humans, the likelihood of any kind of cancer resulting from exposure is generally expressed as a probability; for example, "1-in-1,000,000" or "one-in-one million". In other words, for every 1,000,000 people who are exposed over a period of 30 years, one extra cancer case could occur as a result of exposure to a carcinogenic contaminant. The EPA risk management range of carcinogenic risk is between 1-in-1,000,000 (10^{-6}) and 1-in-10,000 (10^{-4}) (EPA, 1991).

The greatest ILCR (6×10^{-5}) associated with the future residential scenario is from benzene in drinking water. The total ILCR from all contaminants of concern associated with domestic use of groundwater (i.e. ingestion via

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drinking water and inhalation during showering) from OU-2 by a residential population is 6×10^{-5} (IT, 1992a). Benzene contributes greater than 99% of the total ILCR.

The HI is a measure of the risk of non-cancer health effects from exposure to a chemical, calculated by dividing an assumed daily exposure value (dependant on the concentration of contaminant at the site and the proposed use scenario) to a reference dose that is derived from toxicological testing determining the highest dose that does not produce an observable adverse effect. If the daily dose is greater than the reference dose, the HI will be greater than 1, indicating that there is some possibility that an adverse non-cancer effect may occur. If the daily dose is less than the reference dose, the HI will be less than 1, indicating that there is no appreciable risk that adverse non-cancer health effects will occur. The individual HIs associated with domestic use of groundwater from OU-2 by a residential population are greater than one for three chemicals: naphthalene (1.8), antimony (1.8) and chromium (7.8). As mentioned previously, the metals are attributable to well construction materials; however, naphthalene is a contaminant related to fuel releases at ST012. The total groundwater HI associated with future land use is 12. Because this value exceeds one, the risk to human health due to non-carcinogens in groundwater is considered significant under a future residential land use scenario.

These potential risks would only exist if a well is completed within the unremediated plume at OU-2, a resident uses the groundwater at the levels assumed for 30 years, and there are no institutional controls such as deed restrictions. Based on the results of site characterization and the risk assessment, a basis for action was established to address risks associated with potential future site uses and to address the continuing source of groundwater contamination at concentrations exceeding drinking water standards.

During remediation, there will be additional potential for exposure; precautions will be taken to protect workers and the public from exposure to contaminated soil, LNAPL, or groundwater resulting from drilling and other remedial activities. The goal of the remedy will be to reduce site risks and achieve unrestricted use of the site. It is the Air Force's current judgment that the Preferred Alternative identified in this Proposed Plan, or one of the other active measures considered in the Proposed Plan, is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

G. REMEDIAL ACTION OBJECTIVES

The Remedial Action Objectives (RAOs) for OU-2 are:

- to prevent exposure to contaminants in water exceeding drinking water standards.
- to prevent exposure to contaminants in water at concentrations exceeding 10^{-6} to 10^{-4} ILCR or an HI greater than 1 when a drinking water standard is not established.
- to restore the aquifer to drinking water and aquifer water quality standards.

Drinking water standards and other risk based levels are presented in Appendix B of the OU-2 FFS (AMEC, 2012).

H. SUMMARY OF REMEDIAL ALTERNATIVES

This section briefly describes the unique components of each of the alternatives developed for groundwater in the OU-2 FFS (AMEC, 2012), as well as the components that are common among all alternatives. The preferred alternative is ST012-3: Steam Enhanced Extraction and Enhanced Bioremediation. A discussion of the justification for this preference is presented in Section D.7.

All alternatives continue the operation of the existing SVE system to remediate deep unsaturated soils. All alternatives also include long-term groundwater monitoring to observe the effectiveness of the remedy and determine when remediation is complete. SVE and groundwater monitoring are included in the cost estimates. Institutional controls to prevent groundwater use are already in effect for ST012 and will remain in effect as part of each alternative until cleanup levels in soil and groundwater are achieved.

Alternative ST012-1: No Action

Alternative ST012-1 is the No Action alternative. As part of the CERCLA Feasibility Study process, a "no action" alternative is carried through the evaluation process to serve as a baseline comparison for the considered remedial technologies. This alternative does not include any groundwater remedial action. SVE and groundwater monitoring would continue.

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- Estimated Capital Cost: $0
- Estimated Annual Operation and Maintenance (O&M) Cost: $41,000
- Estimated **Present Worth** Cost (30 years): $1,400,000
- Estimated Construction Timeframe: 0 Months
- Estimated Time to Achieve RAOs: 100+ years

Alternative ST012-2: Monitored Natural Attenuation with Free Product Removal and Treatment

Alternative ST012-2 consists of monitored natural attenuation (MNA) of the contaminant plume and LNAPL (free product) removal to remove the contaminant source responsible for the groundwater contamination. MNA is a program of groundwater monitoring in combination with the natural degradation of a contaminant plume by physical, chemical, and biological processes that verifies that contamination is contained and poses no threat while it naturally decreases in concentration until remediation goals are reached. LNAPL (free product) removal involves extracting LNAPL when it is observed in monitoring wells at sufficient thicknesses to allow pumping, bailing, or other means of removal for treatment or disposal.

- Estimated Capital Cost: $0
- Estimated Annual O&M Cost: $185,000
- Estimated Present Worth Cost (30 years): $4,600,000
- Estimated Construction Timeframe: 0 months
- Estimated Time to Achieve RAOs: 100+ years

Alternative ST012-3: Steam Enhanced Extraction and Enhanced Bioremediation

Alternative 3 includes **Steam Enhanced Extraction**

Figure 4. Sketch of Steam Enhanced Extraction Process

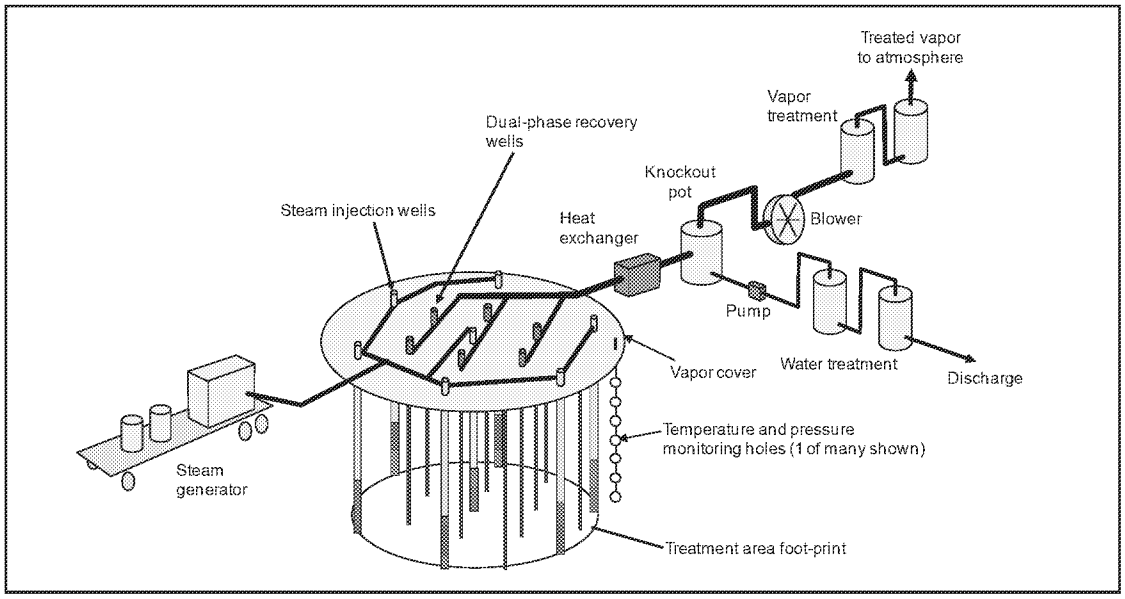
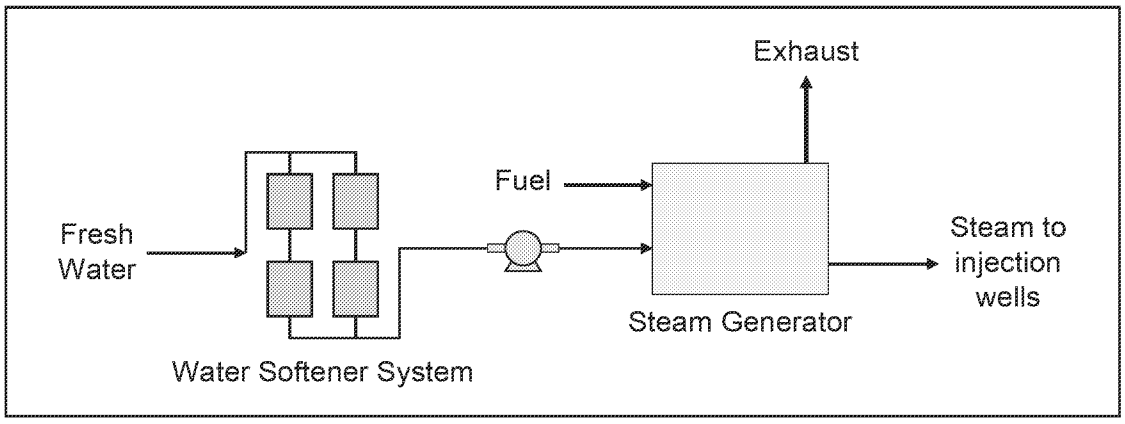


Figure 5. Steam Generation System Schematic



(SEE) and Enhanced **Bioremediation**. SEE involves the installation of a network of steam injection and liquid extraction wells, installation of temperature monitoring equipment, injection of steam into the wells, and extraction of hot fluids (LNAPL and groundwater) for on-site separation and treatment. The vapors produced are drawn from the soil by extraction wells that are installed as part of the SEE remedy. Implementation of SEE would be similar to the technology successfully demonstrated by the TEE pilot test. A generic sketch of the SEE process is presented in Figure 4. Figure 5 shows a simple schematic of a steam generation system. The fuel source can be natural gas, propane, diesel, or recovered hydrocarbon product. For ST012, two steam generation systems would be utilized, with one using natural gas for fuel and the other using recovered hydrocarbon product supplemented by natural gas. It is estimated that SEE would be operated for 9 to 18 months.

When the effectiveness of contaminant mass removal by SEE has diminished, the remedial action will transition to enhanced bioremediation. Enhanced bioremediation is the process of modifying existing conditions to promote biological activity among bacteria that feed off of contamination present at the site. This can be achieved by introducing strains of bacteria that are more effective at degrading contaminants than those that are present at the site, introducing food sources to promote activity, or modifying physical or chemical characteristics (pH, temperature) to create an environment that is more hospitable to bacterial growth. The specific methods will depend on the biological and contaminant conditions at ST012 after SEE implementation and may include a variety of enhancements. The residual increase in temperature at the site after the cessation of SEE is anticipated to increase biological activity.

After enhanced bioremediation, a period of MNA may be necessary until RAOs are achieved.

- Estimated Capital Cost: $19,100,000
- Estimated Annual O&M Cost: $98,000
- Estimated Present Worth Cost: $21,000,000
- Estimated Construction Timeframe: 1 year
- Estimated Time to Achieve RAOs: 20 years

Alternative ST012-4: Enhanced Bioremediation and Ozonation

Alternative 4 includes enhanced bioremediation and ozonation of the contaminant plume. Ozonation is the injection of gaseous ozone beneath the water table. Ozone is a strong chemical oxidant that degrades large organic molecules. As the ozone bubbles through the contaminant plume, degrading contaminants, the dissolved oxygen content of the water is increased. The same injection equipment could be used to inject air beneath the water table in a process known as air sparging, also increasing the dissolved oxygen content.

Dissolved oxygen is used by certain bacteria in their metabolic processes, and their population and biological activity would potentially increase during and after treatment. However, the activity of other bacteria that thrive in low dissolved oxygen conditions would decrease.

A period of MNA may be necessary as a final step until RAOs are achieved.

- Estimated Capital Cost: $5,300,000
- Estimated Annual O&M Cost: $77,000
- Estimated Present Worth Cost (30 years): $11,000,000
- Estimated Construction Timeframe: 1 year
- Estimated Time to Achieve RAOs: 60 years

I. EVALUATION OF ALTERNATIVES

Nine criteria are used to evaluate the different remediation alternatives individually and against each other. This section of the Proposed Plan profiles the relative performance of each alternative against the nine criteria, noting how each compares to the other options under consideration. The nine criteria are:

- Overall Protection of Human Health and the Environment – The assessment against this criterion describes how the alternative, as a whole, achieves and maintains protection of human health and the environment.
- Compliance with **Applicable or Relevant and Appropriate Requirements (ARARs)** – The assessment against this criterion describes how the alternative complies with ARARs, or if a waiver is required and how it is justified. The assessment also addresses other information from advisories, criteria, and guidance that the lead and support agencies have agreed is "to be considered."

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- Long-Term Effectiveness and Permanence – The assessment of alternatives against this criterion evaluates the long-term effectiveness of alternatives in maintaining protection of human health and the environment after response objectives have been met.
- Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment – The assessment against this criterion evaluates the anticipated performance of the specific treatment technologies an alternative may employ.
- Short-Term Effectiveness – The assessment against this criterion examines the effectiveness of alternatives in protecting human health and the environment during the construction and implementation of a remedy until response objectives have been met.
- Implementability – This assessment evaluates the technical and administrative feasibility of alternatives and the availability of required goods and services.
- Cost – This assessment evaluates the capital and operation and maintenance costs of each alternative.
- State/Support Agency Acceptance – This assessment reflects the state's (or support agency's) apparent preferences among or concerns about alternatives.
- Community Acceptance – This assessment reflects the community's apparent preferences among or concerns about alternatives.

The nine criteria fall into three groups: threshold criteria, balancing criteria, and modifying criteria. A description of the purposes of the three groups follows:

- Threshold criteria are requirements that an alternative must meet in order to be eligible for selection.
- Balancing criteria are used to weigh major trade-offs among alternatives.
- Modifying criteria may be considered to the extent that information is available during the FS, but can be fully considered only after public comment is received on the Proposed Plan.

The nine evaluation criteria are discussed below with the criteria group indicated. The "Detailed Analysis of Alternatives" can be found in the OU-2 FFS (AMEC, 2012). Figure 6 also provides a comparison of the alternatives using the nine criteria; alternatives are ranked as unfavorable, neutral, or favorable in relation to each other.

1. Overall Protection of Human Health and the Environment (Threshold Criterion)

Through existing **institutional controls (ICs)** preventing the use of groundwater, no exposure pathways exist and human health is protected in Alternatives ST012-1 and -4. Alternatives ST012-2 and -3 also include ICs to restrict groundwater use and are protective of human health; however, the free product removal portion of Alternative ST012-2 and the SEE portion of Alternative ST012-3 create a new potential exposure pathway to workers by extracting contaminated groundwater, soil vapor, or LNAPL to the surface for treatment. The additional exposure pathway could pose a risk to human health, but that risk is easily managed by adherence to standard safety procedures. Both Alternative ST012-3 and -4 include active remediation of site contaminants and rely on ICs for shorter time periods than Alternatives ST012-1 and ST012-2.

2. Compliance with Applicable or Relevant and Appropriate Requirements (Threshold Criterion)

Alternative ST012-1 does not address contaminant levels that exceed drinking water standards and does not comply with ARARs. Alternative ST012-2 uses a combination of ICs and MNA of the contaminant plume to eventually achieve compliance with ARARs. Alternatives ST012-3 and -4 use a combination of ICs, MNA, and active remediation to achieve compliance with ARARs.

3. Long-Term Effectiveness and Permanence (Balancing Criterion)

Alternatives ST012-1 and ST012-2 are not permanent solutions; they rely on ongoing support of and compliance with ICs preventing exposure to groundwater. Alternatives ST012-3 and ST012-4 represent permanent solutions through contaminant removal. The TEE pilot test demonstrated that SEE is an effective technology for Alternative ST012-3. The exact degree of effectiveness of Alternative ST012-4 requires a pilot study to determine.

4. Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment (Balancing Criterion)

Alternative ST012-1 does not include any treatment and does not establish that the toxicity, mobility, or volume of contaminants are being reduced. Alternative ST012-2 does not include any treatment but does provide moni-

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toring to establish that the toxicity, mobility, or volume of contaminants are being reduced. Both Alternatives ST012-3 and -4 reduce toxicity, mobility, and volume of contaminants through active **in-situ remediation.**

5. Short-Term Effectiveness (Balancing Criterion)

Alternatives ST012-1 and -2 pose nominal short-term risks to workers during monitoring and LNAPL extraction events, but pose no risk to the community or environment. Due to the use of steam (high pressure and temperature) and its associated safety hazards in the immediate vicinity of the treatment system, Alternative ST012-3 poses a risk to workers and neighboring properties. The risk will be managed via on site safety procedures, restricted access to the site and, to the extent necessary, restricted access to neighboring roadways or properties (temporary road or area closures). Alternative ST012-4 poses some risk to workers and the community during air and ozone injection activities, which could continue for decades. Risks in all alternatives can be managed by following safety procedures put forward in a site-specific health and safety plan.

The timeframe in which compliance is achieved is very different between alternatives. The large mass of LNAPL would likely delay MNA effectiveness for decades or longer. Alternatives ST012-1 and -2 may take hundreds of years, whereas Alternative ST012-3 is anticipated to take about 20 years and Alternative ST012-4 is anticipated to take up to 60 years.

6. Implementability (Balancing Criterion)

Alternatives ST012-1 and -2 are easily implementable; all of the on-site infrastructure is in place to support monitoring and LNAPL extraction. Alternative ST012-3 is complex to implement, but feasible. Alternative ST012-4 is moderately complex, and requires a pilot study to determine the large-scale design and implementability. Injection of ozone beneath the water table for Alternative ST012-4 would be complicated by subsurface heterogeneity (variations in soil type). Significant coordination with regulatory agencies will be required for alternatives ST012-3 and ST012-4.

Figure 6: Comparative Analysis of Alternatives Summary

Criteria	Alternative 1 No Action	Alternative 2 MNA and Free Product Removal	Alternative 3 SEE and Bioremediation	Alternative 4 Bioremediation and Ozonation
Overall Protection of Human Health and the Environment	●	✓	✓	✓
Compliance with ARARs	●	○	✓	✓
Long-Term Effectiveness and Permanence	●	●	✓	○
Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment	●	N/A	✓	✓
Short-Term Effectiveness	●	●	✓	○
Implementability	✓	✓	○	○
Cost (in millions)	$1.4	$4.6	$21	$11
State/Support Agency Acceptance	●	○	✓	○
Community Acceptance	TBD	TBD	TBD	TBD

Notes ● Unfavorable ○ Neutral ✓ Favorable

TBD – To be determined (will be evaluated following Public Comment Period)

N/A – Not applicable (alternative does not include active treatment)

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7. Cost (Balancing Criterion)

Costs are presented in the "Summary of Remedial Alternatives" section of this Proposed Plan and the OU-2 FFS (AMEC, 2012); the present worth cost of each alternative is summarized below:

- ST012-1: $1,400,000
- ST012-2: $4,600,000
- ST012-3: $21,000,000
- ST012-4: $11,000,000

8. State/Support Agency Acceptance (Modifying Criterion)

The long timeframe required to reach ARARs for alternatives ST012-1 and -2 makes them unlikely to be acceptable to the regulatory bodies. The EPA and ADEQ have expressed support for SEE (Alternative ST012-3) since it was established during the TEE pilot test as an effective technology to address source materials (LNAPL) at the site.

9. Community Acceptance (Modifying Criterion)

Information on the community acceptance of these alternatives is limited; this is the first formal presentation of the alternatives to the public and is intended as a tool to solicit feedback on their acceptability. When community feedback has been gathered and reviewed, this criterion will be evaluated more thoroughly and discussed in the Responsiveness Summary in the ROD Amendment.

J. PREFERRED ALTERNATIVE

Alternative ST012-3: Steam Enhanced Extraction and Enhanced Bioremediation is the Air Force's Preferred Alternative. This alternative is recommended because, although it is the most expensive, it will achieve ARARs in the shortest amount of time and uses the technology with the highest likelihood of achieving the predicted results at the site. It is implementable and poses easily managed risks to workers and visitors to the site for the shortest period of time. It is a permanent solution that allows unrestricted use of the site in the future, and the technology is the most suited to the scale and conditions of the site.

Based on information currently available, the Air Force believes the Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. The Air Force expects the Preferred Alternative to satisfy the following statutory requirements of CERCLA §121(b): (1) be protective of human health and the environment; (2) comply with ARARs; (3) be cost-effective; (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and (5) satisfy the preference for treatment as a principal element.

K. COMMUNITY PARTICIPATION

The public is invited to review and comment on this Proposed Plan for OU-2 from 10 April 2013 through 9 May 2013. For information on how to comment, see Page 1 of this Proposed Plan. A Comment Form with a mailing address is provided in the back of this Proposed Plan for your use. A public meeting will also be held on 18 April 2013, during which the Air Force will present this Proposed Plan and be available to answer questions.

The Air Force will prepare written responses to comments pertaining to this Proposed Plan. Responses to the public comments will be included in the Responsiveness Summary of the ROD Amendment for OU-2. The ROD Amendment will be available in the Administrative Record upon publication.

To facilitate communication between the Air Force and the neighboring community, the former Williams AFB has an active Restoration Advisory Board (RAB). The RAB consists of stakeholders from the community, regulatory agencies, and the Air Force. For more information about the RAB, contact Linda Geissinger at AFCEC Western Region Community Relations at (916) 643-6420, ext. 109, or email linda.geissinger@us.af.mil.

The Air Force provides cleanup information through public meetings, the Administrative Record online at http://afrpaar.lackland.af.mil/ar/, the Administrative Record at the ASU library, and announcements or articles published in newsletters, fact sheets, or community newspapers. In addition, the Air Force conducts public outreach meetings and speaking engagements with local organizations. The Air Force, along with the federal and state regulatory agencies, encourages the public to gain a better understanding of the ongoing cleanup at the former Williams AFB.

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L. REFERENCES

References listed below with an Administrative Record number [AR#] can be accessed from the online Administrative Record discussed in Section K and listed in the How You Can Be Involved box on page 1.

AMEC, 2012, Final Focused Feasibility Study, Remedial Alternatives for Operable Unit 2, Site ST012, Former Williams Air Force Base, Mesa, Arizona, prepared for the Air Force Civil Engineer Center (AFCEC), Lackland Air Force Base, Texas, November 2012. [AR# 1535]

EPA, 1991. "Role of Baseline Risk Assessment in Superfund Remedy Selections". Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-30. http://www.epa.gov/oswer/riskassessment/baseline.htm

IT, 1992a, Final Remedial Investigation Report, Liquid Fuels Storage Area – Operable Unit 2, Williams Air Force Base, Arizona, prepared for the USAF Air Training Command, Randolph Air Force Base, Texas, January 1992. [AR# 227, 228.1, and 228.2]

IT, 1992b, Final Feasibility Study Report, Operable Unit 2, Williams Air Force Base, Arizona, prepared for the USAF Air Training Command, Randolph Air Force Base, Texas, April 1992. [AR# 258]

IT, 1992c Final Record of Decision, Operable Unit 2, Williams Air Force Base, Phoenix, Arizona. Prepared for the USAF Air Training Command, Randolph Air Force Base, Texas, December 1992. [AR# 316]

URS, 2012, Site ST012 Former Liquid Fuels Storage Area Annual 2011 Groundwater Monitoring Report, Former Williams Air Force Base, Mesa, Arizona, prepared for Air Force Real Property Agency and Air Force Center for Engineering and the Environment, June 2012. [AR# 1510]

BEM, 2011, Final Phase I Thermal Enhanced Extraction (TEE) Pilot Test Performance Evaluation Report, Former Williams Air Force Base, Mesa, Arizona, prepared for Air Force Center for Engineering and the Environment, March 2011.

For further information on OU-2, please contact:

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GLOSSARY

Applicable or Relevant and Appropriate Requirements (ARARs) – The Federal and State environmental cleanup standards and other substantive requirements that a selected remedy will meet. These requirements may vary among sites and alternatives.

Aquitard – A bed of low permeability material in an aquifer that slows or inhibits water flow.

Aviation Gasoline (AVGAS) – Aviation fuel used to power aircraft. Unlike jet propellant, AVGAS is not kerosene based; its primary petroleum component is alkylate.

Bioremediation – Any process that uses microorganisms, fungi, green plants, or their enzymes to remediate contaminated environmental media. Bioremediation may be used to clean up specific soil or groundwater contaminants, such as degradation of fuel hydrocarbons by bacteria.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) – Legislation passed in 1980 designed to respond to the past releases of hazardous substances. The act was extensively amended in 1986 by the Superfund Amendments and Reauthorization Act, which added many provisions and clarified unclear areas in the original law.

Contaminant Plume – A body of contamination with measurable horizontal and vertical dimensions that is suspended in and moves with groundwater.

Deep Soil – At the ST012 site, "deep soils" are classified as any soil greater than 25 feet beneath the ground surface.

Dissolved Phase – The state of matter that has been dissolved into a liquid medium (typically water).

Ex-situ remediation – The removal of a medium (for example, water or soil) from its original place, as through excavation, to perform the remedial action.

Groundwater – Underground water that fills pores in soil or openings in rocks to the point of saturation. Groundwater is often used as a source of drinking water via municipal or domestic wells.

Hazard Index (HI) – A measure of the risk of non-cancer health effects. It is calculated by dividing the projected daily exposure by a reference value believed to represent the greatest dose resulting in no observable adverse health effects (based on toxicological testing). An HI greater than 1 indicates a possibility that an adverse non-cancer effect may occur.

In-situ remediation – Performing remediation activities on a medium while leaving it relatively undisturbed (for example, treating groundwater without extracting it from the ground, or treating soil without excavating it).

Incremental Lifetime Cancer Risk (ILCR) – The probability of a population exposed to a particular concentration of a carcinogen over 30 years to develop cases of cancer as a result. For example, an ILCR of 1×10^{-6} denotes that a population of 1,000,000 (10^6) exposed to a concentration of carcinogen resulting in an ILCR of 1×10^{-6} for 30 years would be expected to result in one case of cancer.

Installation Restoration Program – The Department of Defense (DoD) program designed to identify, investigate, and cleanup contamination associated with past activities at active DoD installations; government-owned, contractor-operated facilities; off-site locations where contamination may have migrated; third party sites; and sites that the DoD formerly owned or used. IRP activities are conducted in accordance with the requirements of either the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or the Resource Conservation and Recovery Act (RCRA) corrective action process, as appropriate.

Institutional Controls (ICs) – Administrative or legal mechanisms that protect property users and the public from existing contamination that continues to be present during use of a site (e.g., permits, zoning, and/or deed restrictions).

Jet Propellant (JP-4) – JP-4 is a jet fuel specified by the government in 1951 that is a 50-50 blend of kerosene and gasoline.

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Light Non-Aqueous Phase Liquid (LNAPL) – A contaminant that is insoluble, or present in quantities that exceed the capacity of a water body to dissolve them, and is also less dense than water, causing the contaminant to float on the surface of the water. LNAPL is sometimes referred to as free product.

Monitoring – Ongoing collection of information about the environment that helps gauge the effectiveness of a clean-up action. For example, collecting samples of groundwater and soil to be sent to a lab for analysis for concentration of contaminants to determine to what extent the remedy has reduced concentrations at the site.

National Contingency Plan (NCP) – Abbreviated name of the National Oil and Hazardous Substances Pollution Contingency Plan. First published in 1968, the NCP is the federal government's blueprint for responding to both oil spills and hazardous substance releases. The NCP implements CERCLA, and it is a regulation found at 40 Code of Federal Regulations (CFR) Part 300.

Present Worth – A method of evaluation of expenditures that occur over different time periods. By discounting all costs to a common base year, the costs for different remedial actions can be compared on the basis of a single figure for each alternative. When calculating present worth cost for Superfund sites, total operations & maintenance costs are to be included.

Pump and Treat – A remediation approach that removes contaminated groundwater from the ground, performs **ex-situ treatment**, and discharges the treated water (typically into a municipal wastewater treatment system, but depending on the situation, potentially to surface water bodies or back into the aquifer).

Record of Decision (ROD) – A document explaining and legally committing the lead agency to the cleanup alternative(s) that will be used at a site. The ROD is based on information and technical analyses generated during the Remedial Investigation (RI), Feasibility Study (FS), and consideration of public comments and community concerns.

Responsiveness Summary – The Responsiveness Summary is issued as part of the ROD. It summarizes information about views of the public and support agency regarding both the remedial alternatives and general concerns about the site submitted during the public comment period. It also documents how public comments were integrated into the decision-making process.

Shallow Soil – At the ST012 site, "shallow soils" are classified as any soil less than 25 feet beneath the ground surface.

Steam Enhanced Extraction (SEE) – A remediation approach that injects steam into the ground to heat the target media, mobilize and capture LNAPL, and volatilize (evaporate) contaminants. Contaminants are captured as liquids and vapors and processed by a treatment system.

Soil Vapor Extraction (SVE) – A remediation approach that draws contaminated soil vapor up from the ground to be treated, if necessary, by an ex-situ treatment system. Soil vapor extraction is only effective on unsaturated soils, as soil vapors are not present beneath the water table, where voids in the soil are filled with groundwater.

Thermal Enhanced Extraction (TEE) – A remediation approach that uses heat to increase the mobility of contaminants, allowing for more efficient extraction of contaminants by groundwater extraction or soil gas extraction. The TEE Pilot test at the former Williams AFB used steam as the source of heat (see Steam Enhanced Extraction).

Water Table – The depth below the surface where groundwater is encountered.

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ACRONYMS

ADEQ — Arizona Department of Environmental Quality

ADWR — Arizona Department of Water Resources

AFB — Air Force Base

AFCEC — Air Force Civil Engineer Center

ARARs — Applicable or Relevant and Appropriate Requirements

ASU — Arizona State University

AVGAS — aviation gasoline

bgs — below ground surface

BRAC — Base Realignment and Closure

BTEX — Benzene, toluene, ethylbenzene, and xylenes

CERCLA — Comprehensive Environmental Response, Compensation, and Liability Act

CFR — Code of Federal Regulations

DoD — Department of Defense

EPA — U.S. Environmental Protection Agency

FFA — Federal Facility Agreement

FFS — Focused Feasibility Study

FS — Feasibility Study

HI — hazard index

ICs — institutional controls

ILCR — Incremental lifetime cancer risk

JP-4 — jet propellant grade 4

LFSA — Liquid Fuels Storage Area

LNAPL — light non-aqueous phase liquid

LSZ — Lower Saturated Zone

MNA — monitored natural attenuation

N/A — not applicable

NCP — National Oil and Hazardous Substances Pollution Contingency Plan

NPL — National Priorities List

O&M — operation and maintenance

OU — Operable Unit

OU-2 — Operable Unit 2

Proposed Plan — Amended Proposed Plan for Operable Unit 2

RAB — Restoration Advisory Board

RAO — Remedial Action Objective

RCRA — Resource Conservation and Recovery Act

RI — Remedial Investigation

ROD — Record of Decision

SEE — steam enhanced extraction

ST012 — Site Designation for the Operable Unit 2 and the former Liquid Fuels Storage Facility

SVE — soil vapor extraction

TBD — to be determined

TEE — thermal enhanced extraction

µg/L — micrograms per liter

USC — United States Code

UWBZ — Upper Water Bearing Zone

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USE THIS SPACE TO WRITE YOUR COMMENTS

Your input on this Proposed Plan for OU-2 at the former Williams Air Force Base is important to the Air Force. Comments provided by the public help the Air Force select a final cleanup remedy. Comments received by the deadline will be responded to in writing in the Responsiveness Summary section of the Record of Decision.

You may use the space below to write your comments. Use additional pages, if needed. Comments must be received by May 9, 2013. Send your comments to AFCEC, 3411 Olson Street, McClellan, CA 95652 or email at afrpa.west.pa@us.af.mil.

PRIVACY ACT STATEMENT

Your comments on this Amended Proposed Plan for Operable Unit 2 are requested. Letters or other written or oral comments provided may be published in the Operable Unit 2 Record of Decision (ROD) Amendment. As required by law, comments will be addressed in the Responsiveness Summary of the Operable Unit ROD Amendment and made available to the public. Personal home addresses and phone numbers will not be published in the Operable Unit 2 ROD Amendment or any other documents. Any personal information you provide will only be used to facilitate your ability to make a statement during the public comment portion of any public meeting or hearings, or to fulfill requests for copies of the Operable Unit 2 Amended Proposed Plan, ROD Amendment, or associated documents. Private addresses will be compiled to develop a mailing list for those requesting copies of these documents. However, only the names of the individuals and their comments will be disclosed.

If you have any questions about the comment period, contact Linda Geissinger at (916) 643-6420 x 109.
If you would like to be on the mailing list to receive information about environmental restoration activities at the former Williams Air Force Base, complete the Name and Address section below.

Name _____ ____ Yes, add me to the mailing list.

Address _____ e-Mail Address _____
(optional)

City _____ State ____ Zip _____

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