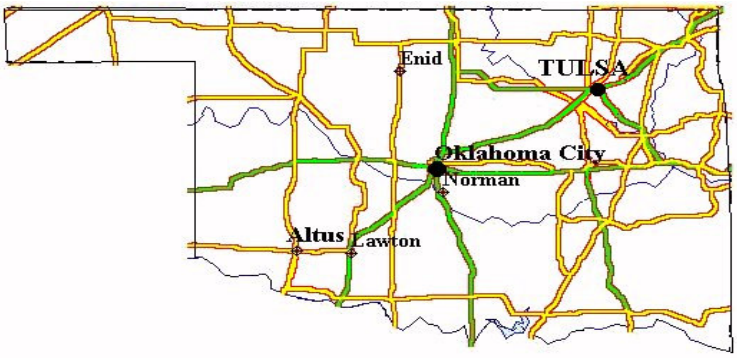
STATEMENT OF BASIS
RCRA CORRECTIVE ACTION

ALTUS AIR FORCE BASE
ALTUS, OKLAHOMA
OK9571824045

THE PURPOSE OF THE STATEMENT OF BASIS IS TO:

- Identify the proposed remedy for addressing contamination at the site and explain the reasons for the preference;
- Describe remedial options considered in the Corrective Measures Study;
- Solicit public review and comment on the alternatives and information contained in the Administrative Record;
- Provide information on how the public can be involved in the remedy selection process; and
- Provide history and background about the facility and surrounding site.



EPA ANNOUNCES STATEMENT OF BASIS

This Statement of Basis issued by the U.S. Environmental Protection Agency (EPA) describes the proposed remedies to address ground water and soil contamination at the Altus Air Force Base (Altus AFB) in Altus, Oklahoma as required in the RCRA 3008(h) Unilateral Administrative Order (Order) issued on November 6, 1996. In addition, the Statement of Basis includes summaries of other alternative remedies evaluated for the facility and the rationale for EPA's preference. EPA, the lead agency for remedial activities at the site, in consultation with the Oklahoma Department of Environmental Quality (ODEQ), will select a final remedy for the Altus facility only after the public comment period has ended and the information submitted during this time is reviewed and considered in the decision-making process.

This Statement of Basis is issued by EPA as part of its public participation responsibilities under the **Resource Conservation and Recovery Act (RCRA)**. Addressing stakeholders concerns are critical to the success of the final remedy. Words in **boldface type** are defined in the glossary at the end of this Statement of Basis. The Statement of Basis summarizes information that can be found in greater detail in the **Administrative Record**. The **conceptual site model** and summation of the current status of solid waste management units are provided in the **Corrective Measures Study** (CMS) report.

COMMUNITY PARTICIPATION

EPA invites the public to review the Administrative Record in order to gain a more comprehensive understanding of the RCRA investigation and corrective measures activities that have been conducted at the Facility. The Administrative Record is available for review at EPA Region 6 offices in Dallas, and at the following location:

Altus Public Library
421 North Hudson
Altus, Oklahoma
(580) 477-2890
Toll Free number 1-888-302-9053
Mon., Fri & Sat - 10:00 a.m. to 6:00 p.m.
Tue & Thur. - 10:00 p.m. to 9:00 p.m.

EPA welcomes public review and comment on all of the remedial alternatives described in this document and on any additional options not previously identified and/or studied. Public input on all potential remedial alternatives, and on the information that supports the alternatives, is an important contribution to the remedy selection process. EPA may modify the proposed remedy or select another remedy based on new and/or substantive information presented to EPA through public comments. Therefore, the public is encouraged to review and comment on all alternatives. For viewing the administrative record at the EPA office in Dallas, please contact Nancy Fagan at the email address below, or 214.665.8385.

The public comment period for the Statement of Basis begins September 6, 2007, and ends on October 22, 2007. During the public comment period, written comments must be postmarked or emailed by October 22, 2007, submitted to fagan.nancy@epa.gov or:

U.S. Environmental Protection Agency
Multimedia Planning and Permitting Division,
State Oversight Section (6PD-O)
Attention: Nancy Fagan
1445 Ross Avenue
Dallas, Texas 75202-2733

EPA will also hold a public meeting beginning at 7 pm on September 6, 2007, to inform the community about the proposed remedy. The public meeting will be held at the following location:

South West Technology Center
711 West Tamarack Road
Altus, Oklahoma 73521
(580) 477-2250

EPA will address all comments received during the public comment period in the Response to Comments/ Final Decision document (RTC). The **RTC** will explain EPA's rationale for the remedy selected to address contamination at Altus AFB. The preferred remedy in the Statement of Basis is a preliminary determination. Should another option be selected as the remedy based upon public comment, new information, or a re-evaluation of existing information, any significant differences from this Statement of Basis will be explained in the RTC. The RTC will be incorporated into the Administrative Record and made available to the public in the information repositories.

The final remedy selected by EPA will be implemented through the Corrective Measure Implementation (CMI) phase in the corrective action process, as outlined in the EPA Order

issued to Altus AFB in November 1996. The ODEQ is interested in issuing a State Consent Order for oversight of the remedy implementation. The State Consent Order will be reviewed by EPA before terminating the EPA Order.

FACILITY BACKGROUND

A. Site Description and Geology

Altus Air Force Base (AFB) is located in Altus, Oklahoma within the City of Altus in Jackson County in southwestern Oklahoma. The AFB occupies about 5,983 acres, and is bordered by the City of Altus on the west, Highway 62 on the south, and agricultural land on the north and east **(Figure 1).**

Altus AFB is underlain almost entirely by the Hennessey Group, which is of Permian age, except the northern portion of the Base where unconsolidated terrace deposits are present. The Hennessey Group in southwestern Oklahoma ranges in thickness from 200 to 1,000 feet, and consists of reddish-brown shale with thin interbeds of siltstone and sandstone. The weathered shale becomes more competent with depth, exhibiting zones of red clay interbedded with highly weathered shale. Throughout much of this weathered zone, gypsum mineralization occurs in what were presumably fractures and bedding planes in the original rock matrix. Surface soils overlying the Hennessey Group at Altus AFB consist of three major types: Tillman/Hollister, Miles and Altus. Tillman/Hollister soils consist of clay loams and are the most extensive unit in Jackson County. The Miles soil type is characterized by a fine, sandy loam surface soil and reddish-brown sandy clay loam subsoil. The Altus soils consist of dark grayish-brown, fine sandy loam. The thickness of the surface soils generally ranges from 10 to 25 feet.

The upper 35 to 40 feet of the subsurface is characterized as one **hydrologic zone** (water-bearing unit). To characterize the extent of groundwater contamination, a series of “upper” monitoring wells were installed with screens across the water table interface, and “lower” monitoring wells were screened near what was believed to be the base of the hydrologic zone. Subsequent groundwater investigations revealed the need to further characterize flow rates near the base of the zone because of preferential pathways in the fractures of the Hennessey Group shale (**transmissive zone**).

B. Facility History

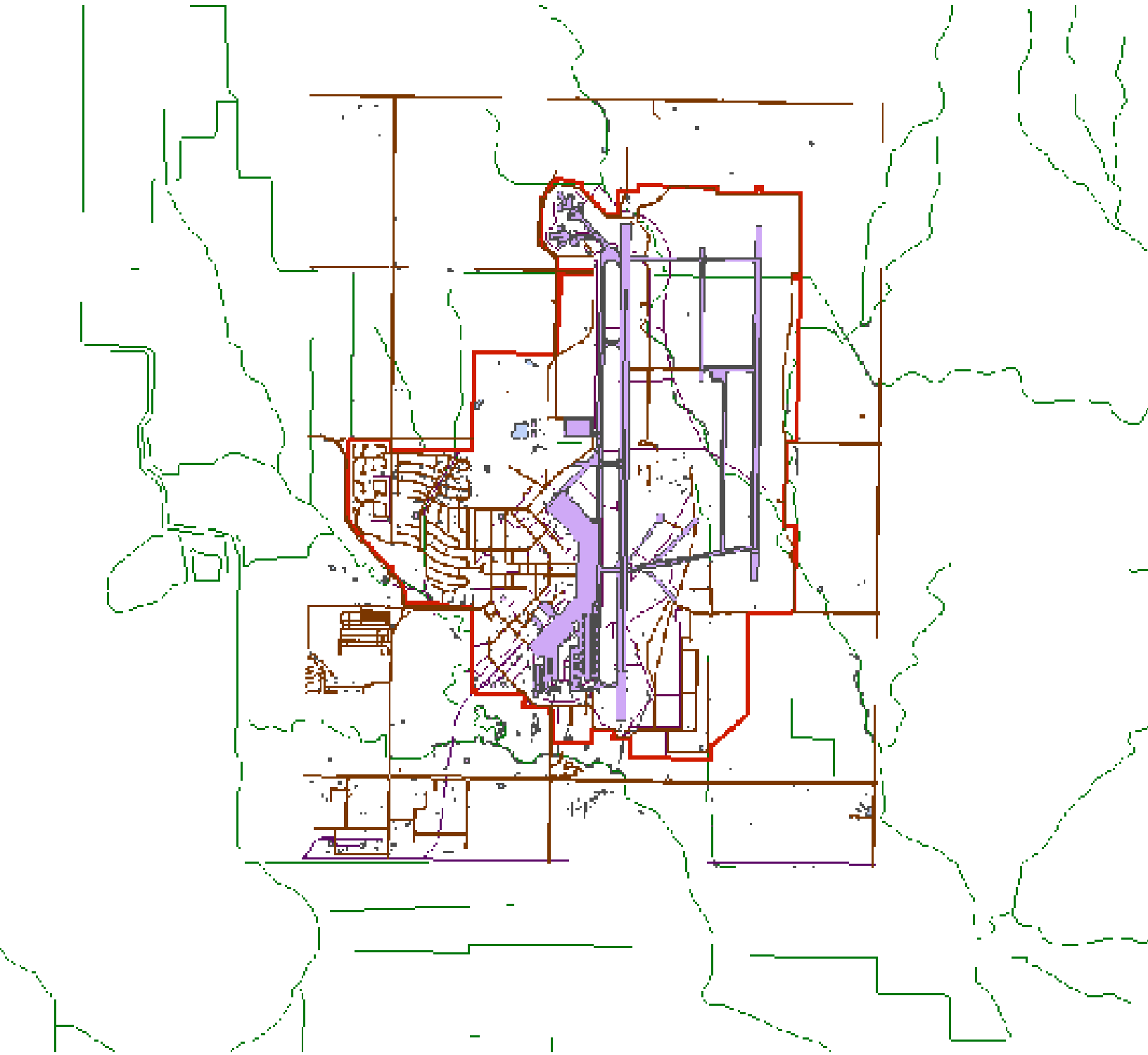
Altus AFB began operating as a flight-training base in 1942. In 1968, control of Altus AFB was transferred to the Military Airlift Command (MAC) and the base became the training center for the C-5A transport aircraft. Since 1968, the primary mission of Altus AFB has been training aircraft crews for the Strategic Air Command (SAC) and MAC operations.

Equipment cleaning, aircraft cleaning and fire training activities resulted in the release to soil and groundwater of chemicals from cleaning solutions, solvents, oil and grease and JP-4 fuel. **Chemicals of concern (COCs)** related to this material include **trichloroethene (TCE)**, **1,2-dichloroethene (1,2-DCE**), **perchloroethylene (PCE**), **carbon tetrachloride**, **benzene**, **xylene** and **toluene**. The TCE, 1,2-DCE , and PCE chemicals are also called chlorinated **volatile organic compounds** (VOCs), or chlorinated solvents. These chemicals can degrade or break down to form other chemicals such as **cis-1,2 DCE**, and **vinyl chloride**.

C. Regulatory History

On November 6, 1996, the EPA issued a Final Administrative Order (Order), Docket No. RCRA-VI-002(h)-95-H, pursuant to Section

Figure 1 Altus Air Force Base



3008(h) of the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §6928(h). The Order specified the legal and technical requirements for Altus AFB to follow in performing corrective action.

In response to the Order, Altus AFB has completed activities under the Interim Measures phase of work to be performed, as described in Section VI of the Order. The work performed as part of the RFI and corrective measures study (CMS) phase has been conducted from 1999 to the present.

FACILITY INVESTIGATION

Under the terms of the Order, Altus AFB is required to complete the following actions: 1) conduct interim measures, as necessary to control offsite migration of contaminated groundwater, 2) conduct an RFI to determine the nature and extent of contamination resulting from past facility operations; and 3) perform a CMS to evaluate the various clean-up alternatives, and 4) within 150 days upon receipt of EPA's selection of the corrective measure (documented in the RTC), submit to EPA a Corrective Measures Implementation (CMI) Program Plan. At EPA's direction, Altus AFB performed the requirements of the CMS, originally submitted in November 2002 with the RFI report (*RFI/IA/CMS* report). A description of **remedial alternatives** can be found in the RFI/IA/CMS report. The final CMS report was submitted in August 2007. This Statement of Basis document proposes for public comment; (1) the **corrective action objectives** (CAO's), (2) the EPA-preferred alternative for corrective measures to meet the CAO's, and (3) performance-based measures to ensure protectiveness.

A. Interim Measures

Altus AFB installed a pump and treat system as an interim measure in 1999 that consisted of 24 extraction wells along the southern Base boundary (average depth of extraction wells was 39 feet bgs). In 2001, six more extraction wells were installed further downgradient and outside the Base boundary to address the groundwater plume to the south. These extraction wells average 25-feet in depth. From 1999 to 2004 greater than 100 million gallons of contaminated groundwater was extracted and treated to meet the appropriate standards for discharge via a **granular activated carbon (GAC)**, then discharged through the base sanitary sewer system to the City of Altus publically-owned treatment works (**POTW)**. Over 1200 pounds of TCE was removed from groundwater with this system. In 2005, the pump and treat system was replaced by the installation of a below-grade **bark mulch wall (biowall)** pilot study (see Section C below) along the southern Base boundary.

B. RCRA Facility Investigation (RFI)

Under the Order, Altus AFB performed an RFI to determine the nature and extent of releases to the ground water associated with past operations.

The RFI Work Plan called for the investigation of 26 sites that included four areas of concern (AOCs), one Installation Restoration Program (IRP) site, and 21 **solid waste management units (SWMUs)**. One SWMU (SWMU 18) included 33 Oil-Water Separators (OWSs) located throughout the Base. Certain sites were evaluated together because of their close proximity. As a result, the actual initial number of sites being investigated pursuant to the Order was 51. The RFI Report documenting this investigation was originally scheduled for submission in December 2000.

RFI fieldwork conducted in 1999–2000 detected contamination not associated with the sites named in the Order. After the EPA reviewed data from this fieldwork, a time extension to January 2002 for submitting the Draft RFI Report to was allowed to investigate the new sites. As part of this time extension, the EPA requested the Air Force to complete and concurrently submit the CMS with the RFI in one RFI/IA/CMS Report. Altus AFB agreed with the conditions for the time extension. The

subsequent fieldwork in 2000–2001 identified four new sites, Spill Site (SS) 18, SS-22, SS-23, and SS-24. The data from the fieldwork conducted in 2000-2001 was reviewed by the EPA, resulting in a request for additional fieldwork at 10 of the sites. The EPA approved a second time extension to July 2002 for submitting the draft report to allow for additional fieldwork at the 10 sites. The fieldwork conducted in 2001–2002 completed investigation of the four new sites and six previously existing sites. As a result, a total of 55 sites are addressed in the *Draft RFI/IA/CMS*.

The existing site history and historical sampling data were reviewed and additional field screening data (e.g., surface **geophysical surveys**, direct-push sampling and temporary lower well groundwater sampling) were collected to optimize the locations for subsequent RFI sampling. After reviewing historical and field screening data, Altus AFB collected soil, groundwater, sediment, and surface water samples, typically for analysis of **volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs)**, and metals.

Altus AFB conducted a risk assessment to evaluate potential threats to human and ecological receptors from site- and non site-related chemicals detected above **risk-based screening criteria**. Site-related chemicals were those constituents that have been released from a site. Non site-related chemicals were those constituents that were interpreted to be either background or related to other nearby industrial activities (e.g., storm water runoff from paved roads or runways), and not releases from a specific site. Data for more than one site were sometimes combined based on similar chemical constituents, or common human health and ecological **exposure scenarios**. However, most sites were evaluated individually.

The evaluation process for groundwater changed during preparation of the *RFI/IA/CMS* report. In a letter dated November 8, 2001, the Oklahoma Water Resources Board (OWRB) concurred with an Altus AFB request to consider groundwater as a **non-potable** water source. The request was based on the concentration of total dissolved solids (TDS) in groundwater at Altus AFB. The TDS concentration is high enough that groundwater at Altus AFB is categorized as “salt water” by the Oklahoma Administrative Code and the OWRB considers that the groundwater is “not considered treatable or usable for human consumption.” Although the same groundwater **aquifer** exists in and around Altus AFB, the Air Force only requested consideration for that portion of the aquifer inside the Base boundary in 2001.

To implement changes in the *Draft RFI/IA/CMS* brought about by the November 8, 2001 letter from the OWRB, the EPA approved a third time extension for submitting the draft report to November 2002.

Altus AFB continued to pursue the re-classification of groundwater for on-Base and off-Base and held a public meeting on April 14, 2005 to solicit input for the final evaluation. The *Final Groundwater Classification Monitoring Report* (September 2006) summarizes the results of the groundwater study.

C. Pilot Study and Full-Scale Study

Since the major contaminants of concern are TCE and the break-down products of TCE in groundwater, Altus focused resources in addressing the TCE plumes on site and the TCE plume that has already migrated off site (SS-17 plume denoted in **Figure 2)**.

The Operating Unit (OU) 1 located in the northeast corner of Altus AFB (also known as Landfill 3) was chosen for the location of the first pilot study. A TCE and cis-1,2-DCE plume extending 3000 feet down-gradient of Landfill 3 has potential exposures from the groundwater to surface water pathway to Stinking Creek. In June 2002, Altus AFB installed a bark-mulch

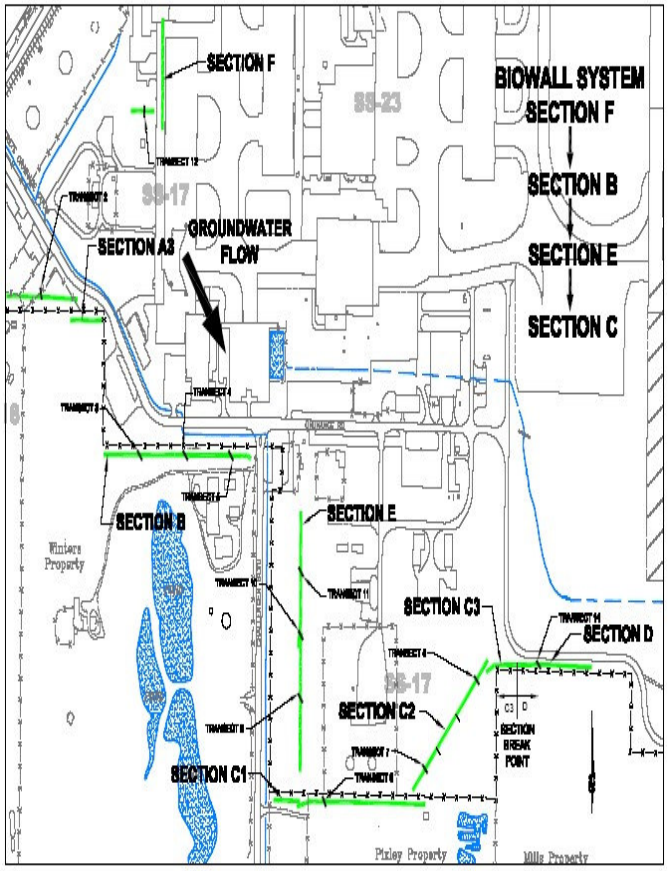
Figure 2 Approximate Location of the TCE plume along the southern Base Boundary

(Bldg 506 at top of Figure 2; Hwy 62 at bottom.)

wall (biowall) to a depth of 24 feet and 455 feet long as a pilot study. The biowall was 18 inches wide. The purpose of the biowall is to intercept groundwater flow and reduce the concentration of contaminants as groundwater passes through the wall. The technology is known as **enhanced reductive dechlorination (ERD)** which is a form of **bioremediation**. The installation of the biowall at Altus AFB was also part of a field-based testing program of the Technology Transfer Office of the Air Force Center of Environmental Excellence (AFCEE).

Performance monitoring was conducted at the pilot study during a 34-month period, including 6 rounds of sampling. TCE in groundwater passing through the biowall was reduced from 92 to 99 percent. Because of the effectiveness of the pilot study, Altus proposed a Full Scale biowall installation for the southern Base boundary (**Figure 3**). EPA approved the workplan for the biowall installation in January 2005, and the biowall was installed in March – June 2005. Monitoring wells upgradient and downgradient were also installed prior to the biowall construction. A continuous trencher installed the full-scale biowall covering about 5,800 linear feet of the southern Base boundary to a depth of 35 feet. Monitoring results indicate that the full-scale biowall pilot has effectively reduced concentrations of TCE in groundwater passing through the biowall; however, TCE-contaminated groundwater in deeper zones is still migrating offsite untreated. Due to this concern, a substrate injection test was performed in September 2006 which involved the injection of an oil/lactate solution into the piping system at the bottom of the biowall. The results of this test indicated that the injections only minimally stimulated biodegradation below the 35-foot depth.

Figure 3 Biowalls at Southern Base Boundary



D. Activities and Reports Subsequent to the RFI

The first round of post-RFI groundwater monitoring was conducted in 2002 and summarized in the *Final 2002 Long-Term Monitoring Report*. This report includes sampling and analysis of 330 monitoring wells at 24 sites and confirmation of RFI results to evaluate plume stability. This report has been followed by the *Draft 2004 Long-Term Monitoring Report*.

In June 2003, Altus submitted the *Draft RFI/IA/CMS Addendum Report* which refined groundwater modeling results at nine sites and evaluated the bark mulch wall as a viable addition to the CMS, and changed the recommended CMS at nine sites to NFA (no further action).

In September 2004, Altus submitted *the Draft Groundwater Classification Report*. Data in this report was used by the OWRB to reclassify the upper aquifer using the OWRB criteria to a Class III aquifer with agricultural and municipal/industrial cooling beneficial uses. *The Final Groundwater Classification Monitoring Report* (September 2006) summarizes the results of their study.

In October 2004, Altus AFB submitted the *Final Work Plan for the Bark Mulch Trench Interim Corrective Action for In-Situ Anaerobic Bioremediation of Chlorinated Solvents in Groundwater at Altus Air Force Base*. This report, approved in January 2005, outlines the pilot interim corrective action for installing six sections of biowalls for the **in-situ** (in-place) bioremediation of chlorinated hydrocarbons as groundwater passes through the biowall. The project design included 5,375 feet of biowall to be installed as a means of boundary containment and/or mass reduction of TCE. To confirm the effectiveness of the biowall, a groundwater monitoring well network was installed for quarterly sampling during the first twelve months of operation. In February 2005, Altus submitted the *Draft Risk-Based Evaluation for the Off-Base Portion of the Spill Site 17 Groundwater Plume*. This report proposed **risk-based concentrations (RBC's**) as cleanup levels for several contaminants in groundwater which were not approved by EPA.

As part of the bark mulch trench interim corrective actions, Altus AFB has submitted quarterly monitoring reports to evaluate the effectiveness of the reduction of TCE and TCE breakdown products in groundwater. To document the biowall construction activities that took place from April 2004 to November 2005, Altus AFB submitted a *Construction Closeout Report* in February 2006.

An Addendum to the *Draft Ecological Risk Assessment* report was submitted in February 2006. This report included evaluations of sediment and surface water with relation to ecological impacts. After an EPA review and site visit, EPA determined that corrective measures, based solely on ecological risk, were not required at Altus AFB.

In September 2006, Altus AFB submitted the *Final Borehole Geophysics Report* which documented the installation of the "intermediate" monitoring wells during three separate field mobilizations.

On January 19, 2007 EPA approved the Work Plan for the excavation and removal of contaminated soils at the Building 506 area which is considered a major source area for TCE in groundwater for Spill site 17. The size of the excavation was about 75 feet by 110 feet and about 35 feet in depth.

In February 2007, Altus AFB submitted *a Draft Evaluation of **Vapor-Intrusion** Potential in Off-Base* properties. The objective of this study was to evaluate the potential exposure to soil gas vapors from underlying TCE-contaminated groundwater that might intrude into hypothetical off-site residential buildings.

In March 2007, Altus AFB submitted a draft *Intermediate Monitoring Well Report* documenting sampling results from

intermediate wells and results of a 48-hour aquifer test conducted on intermediate monitoring well WL803, located in the off-base SS-17 plume.

In June 2007, Altus AFB submitted the *Project Completion Report for the Technology Demonstration for In-Situ Anaerobic Bioremediation of Chlorinated Solvents in Groundwater Using a Permeable Mulch Biowall at Operable Unit 1*, which summarizes results of the first pilot study.

In June 2007, Altus AFB submitted a *Plume Stability Report* to assess the plume stability of the SS-17 spill site and the SWMU 7 site from the 1999 – 2007 groundwater sampling data.

Also in June 2007, Altus AFB submitted a draft *Workplan for Oil Water Separator (OWS) Interim Corrective Measures at Buildings 296, 343, and 392* to remove contaminated soils associated with past waste management practices. The final report was submitted in July 2007. This workplan has been approved by EPA and removal activities will be completed by December 2007.

In August 2007, Altus AFB submitted the *Final Corrective Measures Study*. This report has been reviewed and approved by EPA.

CORRECTIVE ACTION OBJECTIVES and SUMMARY OF SITE RISKS

The **corrective action objectives (CAO's**) are developed by the EPA and are based on current and reasonably anticipated land and groundwater uses. It is EPA's policy to determine protective media cleanup objectives for groundwater remedies considering the use, value, and vulnerability of the groundwater resource, and all potential pathways that could result in human or ecological exposure to contaminants (Final Comprehensive State Ground Water Protection Program Guidance, December 1992). Typically, the groundwater use designation is the starting point for determining the appropriate reasonable expected uses and exposures to evaluate risks and identify groundwater cleanup levels. Shallow groundwater resources in the area of Altus AFB have been classified by the OWRB as Class III having a beneficial use as agricultural and municipal/industrial cooling water.

To determine the value of an aquifer, EPA reviews the potential impact on the underlying aquifer, the potential discharge to surface water, and potential exposures to indoor air. Groundwater studies conducted by Altus AFB and reviewed by EPA reveal that shallow groundwater in the area is not hydraulically connected to the deeper aquifer (due to the thickness of the Hennessey Shale). There is some evidence that shallow groundwater discharges to surface water; however, because of the volatile nature of contaminants, the human and ecological exposure risk is low. Potential for contaminated indoor air from the affected groundwater at Altus AFB is high due to the volatile nature of the contaminants and the shallow depth to groundwater. Altus AFB will mitigate potential indoor air exposures, as described in the institutional controls section below.

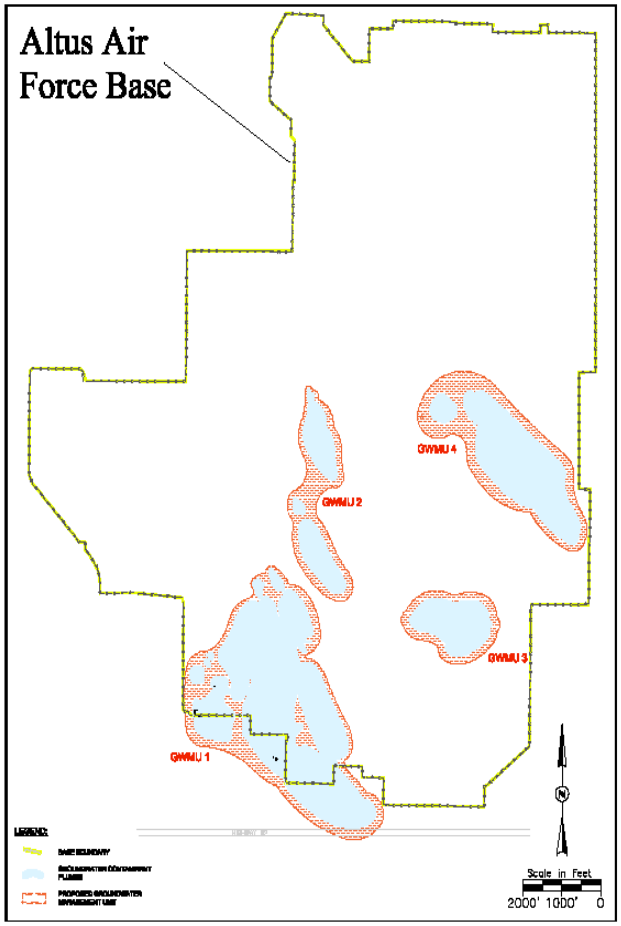
GROUNDWATER

Corrective Action Objective 1: Complete restoration of groundwater at the Altus AFB site is not practicable given the nature of the contaminants of concern (dense non-aqueous phase liquids (DNAPLs), and the hydrogeology of the site. In addition, EPA has reviewed the value and vulnerability as described above; therefore the final groundwater cleanup objective is to contain the plume, rather than to return the groundwater to its maximum beneficial use. EPA is proposing the use of four groundwater management units (GWMUs) at Altus AFB, as identified in **Figure 4**. The GWMUs have been delineated by monitoring wells. (In the development of the *Final Groundwater Monitoring Plan* for Altus AFB, EPA and ODEQ will review and approve the locations of sentinel

monitoring wells that delineate each GWMU). The sentinel monitoring wells will serve as compliance wells to demonstrate that each GWMU is stable. The sentinel well system will be designed to monitor the upper, lower and "intermediate" flow zones of the aquifer.

A description of each SWMU can be found in the Final Corrective Measures Study (August 2007). Each description includes the SWMUs associated with each GWMU. Many SWMUs reviewed for "no further action" were situated above the GWMUs, so that groundwater monitoring will continue and CAO's will be met.

Figure 4 – Ground Water Management Units



<u>Corrective Action Objective 2</u>:
To support the final groundwater cleanup objective, Altus must <u>remove</u> or <u>treat</u> source material in subsurface soils and/or groundwater to the extent practicable. Removal or treatment of source material that could subsequently migrate into groundwater will enhance the attainment of the performance metrics. Chlorinated VOC's which make up the source material at Altus AFB have higher specific gravities than water, and as a result, have the potential to sink in groundwater. Source removal activities must target the removal of chlorinated VOC's in soils at concentrations that exceed their corresponding solubility constants in water.

<u>Performance metrics</u>: Sentinel monitoring wells will serve as compliance wells for each GWMU. Statistical analysis of sentinel monitoring well data must demonstrate that the groundwater plumes delineated in each GWMU are shrinking or stable. EPA and ODEQ will approve the calculation of protective concentrations for COCs for sentinel monitoring wells within each GWMU. Statistical analysis of the protective concentrations will serve as a measure to determine that each GWMU is stable or shrinking.

The point of compliance (POC) for Altus AFB will be at the Base boundary, where concentrations of chemicals of concern must be a maximum contaminant levels (MCLs) for drinking water.

If Altus is successful in eliminating the human health exposure via the groundwater pathway (including vapor intrusion) for offsite properties through controls on groundwater use, as agreed by the property owners and memorialized in the form of **institutional controls**, the POC will move to the boundary of the area under the control.

<u>Contingency plans</u>: Altus AFB must develop contingency plans for corrective measures if statistical analysis of sentinel monitoring well data demonstrates that a plume within a GWMU is expanding. If source material has been removed and groundwater treated to the

extent practicable, then a third alternative of engineered containment must be implemented within a reasonable time frame.

Institutional Controls/Engineering Controls
Altus AFB will implement institutional controls in the form of a base-wide *Site Management Plan* to protect construction workers from exposure to contaminants in groundwater and saturated soils during any excavation activity.

To protect on-base personnel in administrative buildings situated above a GWMU from indoor air exposure from COCs that could migrate from the groundwater through the soil profile and accumulate under a building foundation, an engineered mitigation measure (such as construction of proper ventilation) must be constructed for each building. In addition, for any future building of administrative or office building above a GWMU, engineered measures to mitigate indoor air exposures must be part of the initial design of the new building and implemented according to design plans. If groundwater sampling data or iso-concentration maps predict low levels of COCs in groundwater directly below the administrative building, EPA and ODEQ will review the results to determine if engineering controls are necessary on a site-specific basis.

Altus AFB will develop a *Land Use Control (LUC Plan)* to document the land use on Base and for all off-Base portions of land above GWMU's. Institutional controls in the *LUC Plan* will be subject to performance reviews in the *Performance Review Plan*.

SURFACE SOILS

Corrective Action Objective 3: **For the protection of human health from exposures of residual COCs in surface soils, EPA is proposing a media-specific cleanup level for the Altus AFB to attain at any identified SWMU or AOC area.**

Performance metric: Carcinogenic COCs in surface soils (0 to 2 feet bgs) must be remediated to levels that do not exceed a cumulative **human health risk level of 1E-05** (1 in 100,000 risk of getting cancer) for an industrial outdoor worker exposure scenario. Non-carcinogenic COCs must be remediated to levels that do not exceed a hazard index (HI) of 1 for an industrial outdoor worker. Confirmation sampling data from corrective actions at sites will confirm attainment of appropriate cleanup levels.

SUBSURFACE SOILS

Corrective Action Objective 4: As stated in CAO 2 for groundwater, Altus AFB must remove or treat source material in subsurface soils that could subsequently migrate to groundwater, and attain a media-specific cleanup goal protective of groundwater.

The aforementioned Base-wide *Site Management Plan* will provide institutional controls to protect construction workers from exposure to contaminants in subsurface soils.

Performance Metric: If subsurface soils are being addressed through a removal action, then confirmation sampling will confirm the attainment of an appropriate cleanup level, so that source material has been removed from subsurface soils that may leach to groundwater. Source removal activities must target the removal of concentrations of the chlorinated VOC's in soils. For source removal activities, EPA has set the excavation cleanup goal for TCE at 8 mg/kg. Any residual contamination left in place above cleanup levels must be treated or contained.

Confirmation sampling data from corrective action at sites will confirm that appropriate cleanup levels are attained. Confirmation sampling will be documented in the appropriate source removal close-out reports.

SURFACE WATER

Corrective Action Objective 5: **The corrective action objective for surface water is to monitor contaminant levels in surface water features associated with groundwater management zones to assure protection of human and ecological receptors.**

Performance Metric: Surface water sampling results must confirm that concentrations in surface water are protective of human health and the environment. Surface water sampling results will be compared to risk-derived screening numbers calculated from the Region 6 medium-specific screening levels (**MSSL**'s). Because of the volatile nature of chlorinated VOC's at Altus AFB, elevated levels are not expected. The sampling plan for surface water will be developed in the *Performance Monitoring Plan*.

Ecological Risk

An *Addendum to the Draft Ecological Risk Assessment Report* was submitted in February 2006. This report included evaluations of sediment and surface water with relation to ecological impacts. After an EPA review and site visit, EPA determined that corrective measures, based solely on ecological risk, were not required at Altus AFB based upon current base activities (March 23, 2006 EPA memorandum from Cheryl Overstreet to Sue Westbrook).

SUMMARY OF REMEDIAL ALTERNATIVES

EPA and ODEQ reviewed soil and groundwater data from all 55 SWMU's addressed during the RFI in the June 24 – 28, 2007 meeting at Altus AFB. Individual SWMU's recommended for "no further action" (NFA) were reviewed and approved as documented in the July 5, 2007 letter from EPA to Altus AFB. In this letter, EPA approved the NFA status for 40 SWMU's. This Statement of Basis document therefore addresses only the SWMUS that needed further corrective measures for cleanup, as described in the *Final CMS Report.*

For the Statement of Basis, individual corrective measure alternatives are described and evaluated against criteria outlined in the Guidance on RCRA Corrective Action Decision Documents, Office of Solid Waste and Emergency Response (OSWER) Directive 9902.6. This guidance document outlines the four general standards for remedy selection of 1) overall protection of human health and the environment, 2) attainment of cleanup standards, 3) control of the sources of releases, and 4) compliance with regulatory standards for hazardous waste management. There are five criteria used for remedy selection and they are: 1) long-term reliability and effectiveness, 2) reduction of toxicity, mobility and volume of wastes, 3) short-term effectiveness, 4) implementability, and 5) cost.

Altus AFB conducted a preliminary screening of technologies for final remediation, documented in the *Draft RFI/IA/CMS* report dated November 4, 2002. A complete review of all technologies can be found in Appendix M of this report. EPA has selected the following seven alternatives for a viable comparison of available technologies for remediation at Altus AFB.

Except for the "No Further Action" alternative, all of the alternatives being considered for the site include a comparison of the **net present value** and capital costs. In addition, annual operation and maintenance costs are included for sampling and analyses of monitoring wells to evaluate the design and performance of the alternatives. A brief discussion on the technical implementability of each alternative as it applies to the Altus AFB site is included in each description.

Alternative 1: No Further Action

Cost

Net Present Value	$0
Capital Cost:	$0
Operation & Maintenance:	$0

Time of Implementation
Design/Remedial Action: 0 months
Operation & Maintenance: 0 months

Description
The "No Further Action" alternative is often evaluated to establish a baseline for the comparison with other alternatives. Under this alternative, no further remedial actions are undertaken to address the existing ground water and soil contamination. Ground water monitoring of the contaminant plume would also be discontinued. This alternative would not meet any of the CAO's for Altus AFB.

Alternative 2: Monitored Natural Attenuation (MNA)

Cost Comparison
Net Present Value: $19,613,195
Capital Cost: $ 2,640,000
Operation & Maintenance: $840,000/Year

Time of Implementation
Design/Remedial Action: 1 year
Operation & Maintenance: 30 years

Description
MNA is a potential option for containment and reduction of the mass and concentration of contaminants in the environment. Remediation by natural attenuation depends upon natural processes such as dispersion, dilution, biodegradation, volatilization, hydrolysis, and sorption to attenuate contaminants to meet CAO's. Choosing MNA as the means for remediation first requires modeling to predict when CAO's will be attained. A groundwater monitoring program must be in place as part of the *Performance Monitoring Plan*. The success of MNA alone would depend on the natural tendency for COC's to degrade at Altus AFB. Groundwater modeling reports that some degradation occurs, but not at a rate that will meet the CAO's. The existing biowalls would be maintained.

Alternative 3: On-Site Ground Water Extraction (Pump and Treat) and MNA

Cost
Net Present Value: $ 30,645,859
Capital Cost: $ 5,814,612
Operation & Maintenance: $1,221,252/Year

Time of Implementation
Design/Remedial Action: 2 years
Operation & Maintenance: 30 years

Description
In Alternative 3, operation of the existing on-site ground water recovery and treatment system would be re-started. The existing on-site system was installed in 1999 during the Interim Measures activities to mitigate potential risks to human health and the environment. The system consists of 30 recovery wells which extract contaminated ground water from the upper aquifer at Altus AFB. Contaminated groundwater extracted would be treated via the granular activated carbon (GAC), then discharged through the Base sanitary sewer system to the City of Altus POTW. The existing on-site system is not capable of preventing further migration of the contaminant plume. Instead, this alternative would rely on **natural attenuation** to reduce contaminant concentrations during continued plume migration. This alternative only addresses on-site groundwater contamination, and contaminated groundwater at the Altus AFB site has already migrated offsite. The current groundwater extraction wells do not address the transmissive zone at the base of the alluvial sediments (35 – 45 feet bgs), and therefore does not meet the CAO's. Locations of groundwater extraction wells would need to be reconfigured to maximize reduction of COC's.

Alternative 4: Physical Containment using Slurry Walls

Cost
Net Present Value: $ 28,913,245
Capital Cost: $ 7,572,449
Operation & Maintenance: $1,041,459/year

Time of Implementation
Design/Remedial Action: 2 years
Operation & Maintenance: 30 years

Description
In Alternative 4, the corrective measure for contaminated groundwater would rely solely on the physical containment of source areas with installation of slurry walls to contain contaminated soils and groundwater. **Slurry walls** are commonly used to contain or divert contaminated groundwater at hazardous waste sites. These subsurface barriers consist of a vertically excavated trench filled with a slurry (usually a soil, bentonite and water mixture). The slurry hydraulically shores the trench to prevent collapse of the sidewalls and forms a filter cake that reduces groundwater flow. Slurry walls are often used where the waste mass is too large for treatment and where soluble and mobile constituents pose an imminent threat to a source of drinking water. To be effective, the slurry wall has to be keyed into the underlying resistant bedrock material as much as 20 feet. At Altus AFB, keying into the bedrock material is problematic because of the extensive weathered zone at the top of the shale which could allow for continued migrations of COC's. An overlying cover would need to be installed, such as a low-permeability clay, to minimize the infiltration of water and provide a physical barrier to prevent direct contact with contaminated soils. Continuous cover would be difficult at Altus because of the structures on site.

Alternative 5: A "treatment" train of **source removal**; **source treatment and containment** with Enhanced Reductive Dechlorination (ERD) technology using multiple applications (bioreactors, biowalls and well circulation systems)

Cost
Net Present Value: $ 28,690,118
Capital Cost: $ 5,400,000
Operation & Maintenance: $1,140,000

Time of Implementation
Design/Remedial Action: 2 years
Operation & Maintenance: 30 years

Description
In Alternative 5, the excavation of contaminated soil is the first step towards controlling the sources of contamination. Excavation and disposal will take place in accordance with agency-approved workplans. The second phase is treatment of source material through the use of **bioreactors** that create source treatment zones to effectively **enhance reductive dechlorination** (ERD) of the residual chlorinated solvents. ERD will also be implemented downgradient as treatment and containment of the plume by the ongoing operation of the biowalls at the facility boundary. In the remedial design, implementation for additional biowalls upgradient may be necessary to meet the corrective action objectives. The third phase in the treatment train addresses the chlorinated solvents that are migrating offsite via the deeper transmissive zone. Through the use of a transmissive zone well injection circulation system, the residual chlorinated VOC's will be subjected to nutrient enhancements plus an enhancement of mass transfer from the nonaqueous phase to the aqueous phase. The conceptual site model for Altus AFB describes the natural chemistry of the aquifer as a hydrologic zone which has background conditions ranging from anaerobic (less than 0.5 mg/L **DO** [dissolved oxygen]) to slightly aerobic (more than 2.0 mg/L DO). This environment is conducive to the breakdown of the lesser chlorinated VOCs (cis-1,2 DCE and vinyl chloride). The mulch biowalls and vegetable oil injections create an anaerobic reaction zone (DO<0.5 mg/L) which is conducive to the breakdown of the higher chlorinated VOC's (PCE and TCE), and in many cases complete dechlorination has been observed in these zones. At Altus, the pilot projects have also shown a reduction in concentrations of COCs in the anaerobic treatment zone and a reduction of the lesser

chlorinated daughter products downgradient in the natural aerobic zone.

Alternative 6: In-situ Thermal Treatment of Soil and Groundwater

Cost
Net Present Value: $ 37,163,124
Capital Cost: $ 18,863,984
Operation & Maintenance: $1,132,265/year

Time of Implementation
Design/Remedial Action: 3 years
Operation & Maintenance: 30 years

Description
The **in-situ** thermal treatment of contaminated soil and groundwater involves the installation of a system to heat the soil and groundwater to remove TCE contamination. The heat can destroy or volatilize organic chemicals. As the chemicals change into gases, their mobility increases, and the gases can be extracted via collection wells for capture and cleanup in an **exsitu** treatment unit. Thermal methods can be particularly useful for dense or light nonaqueous phase liquids (DNAPLs or LNAPLs). Heat can be introduced to the subsurface by electrical resistance heating, radio frequency heating, dynamic underground stripping, thermal conduction, or injection of hot water, hot air, or steam. Clay soils at Altus AFB are not amenable to the collection of gases created by in-situ thermal treatment. The carbonate in soil and bedrock might also decompose when heated, producing excessive gas and potentially causing a subsidence, or sinking problems which could be problematic for existing building structures.

Alternative 7: In-situ thermal treatment of Soil and In-situ Chemical Oxidation

Cost
Net Present Value: $ 29,283,598
Capital Cost: $ 10,515,732
Operation & Maintenance: $ 1,203,298/year

Time of Implementation
Design/Remedial Action: 6 years
Operation & Maintenance: 30 years

Description
This combination of in-situ thermal treatment of soils and in-situ chemical oxidation of soil and groundwater in the source areas includes the installation of a thermal treatment system to treat the TCE in soil above the water. Following soil treatment, a series of injection wells would be installed in source areas to conduct the in-situ chemical oxidation of groundwater. The likely oxidant would be potassium permanganate; however, the exact spacing of the injection wells, the oxidant and the number of injections of the oxidant would be determined through a **treatability study**. In-situ chemical oxidation has been reported as having "rebound" effects after the oxidation process. This technology also may not prove effective in the sulfate-rich groundwater at Altus AFB and would not meet the CAO's.

SUMMARY OF THE PROPOSED REMEDY

The preferred alternative for addressing the ground water and soil contamination at the Altus AFB facility is Alternative 5. EPA's proposed remedy consists of:

- Soil excavation at source areas for **source removal.**
- Enhanced reductive dechlorination (ERD) for source zone treatment using **bioreactors**.
- Enhanced reductive dechlorination (ERD) for source containment using **mulch biowalls** at the facility boundary and additional upgradient biowalls or enhancements of the biowalls, if necessary to meet the CAO's.
- Enhanced reductive dechlorination (ERD) using a **well injection circulation system** enhancing mass transfer from the nonaqueous phase to the aqueous phase (to address dissolved phase and residual DNAPL in the transmissive zone).

- Optimization of selected ground water recovery wells to monitor the GWMU's for compliance with the corrective action objectives, as proposed in the *Performance Monitoring Plan* to be developed in the CMI.

Source Removal

To attain the CAO's outlined for Altus AFB, EPA is confident that a combination of activities using the ERD technology should be implemented, as outlined in Alternative 5. First, removal of contaminated soils at source areas where concentrations of contaminants are elevated will advance the attainment of groundwater cleanup goals. Source removal through excavation of contaminated soil will also enable long-term cleanup goals to be reached in a shorter amount of time.

Source Treatment and Containment using Enhanced Reductive Dechlorination (ERD) Technology

Pilot studies conducted at Altus AFB have shown the effectiveness of the use of bioreactors for the treatment of source zones. The introduction of a continuing carbon source from the bioreactor enhances the reductive dechlorination process needed to break down contaminants to final daughter products that have less toxicity. The use of bark-mulch biowalls along the boundaries have proven effective for containment of shallow groundwater contaminants. The long-term effectiveness has not been proven; therefore additional measures, such as additional biowalls installed upgradient and the addition of carbon substrates are needed to ensure continued effectiveness. Also, there is a concern that the deeper transmissive zone is not affected by the biowall treatment, since the walls were constructed to a depth of 35 feet, and the deeper transmissive zone may extend to depths of greater than 45 feet in some areas. To address the deeper contamination, EPA is proposing that Altus install a well injection circulation system to enhance treatment and containment of contaminants in the deeper transmissive zone.

Advantages of ERD Technology

- Destruction of contaminants in-situ: Chlorinated VOC's that are treated have the potential of being completely mineralized or destroyed. The benefits of in-situ treatment include; no secondary waste stream to treat, potential risks related to exposure during remediation are limited, and there is minimal impact to infrastructure.

- Interphase mass transfer: Data has shown that the enhancement of the anaerobic process may increase the rate of DNAPL source zone dissolution, thus speeding up the removal of sources that are contributing to groundwater contamination.

- Potential application to a variety of COCs: ERD technology may be applicable to a variety of contaminants.

- Other degradation processes: Other chemical reactions, both biological and abiological can be induced and/or enhanced to facilitate the destruction of chlorinated VOCs, which means there are many ways to enhance the system to produce results.

The following discussion profiles the performance of EPA's proposed remedy against the four general standards for corrective measures and the five remedy decision factors, noting how the proposed alternative compares to the other options under consideration.

1. Overall Protection of Human Health and the Environment

Alternative 1, "No Further Action", will not be considered further as a remedial alternative because, although the performance of the biowall in the treatment of the shallow groundwater is promising; DNAPLs are denser than water and very mobile in the subsurface. A large DNAPL spill can sink below the water table, spreading laterally as it encounters finer-grained sands and clays extending to the base of an aquifer. DNAPL can migrate along the top of downward sloping geologic layers or

along fractures thus extending source areas for groundwater contamination. For the protection of human health and the environment, the DNAPL source zones must be addressed through removal, treatment and containment. Each of the remaining alternatives provide some protection to human health and the environment by reducing or controlling the risk of exposure to the contaminants. Alternative 5 provides the application of a technology (ERD) in an environment that is conducive to attaining results (as noted in the pilot studies).

2. Attainment of Media Cleanup Standards
Alternative 3, and 5 through 7 would each provide for extraction and/or treatment of hazardous waste in achieving the media cleanup standards. Alternative 2, 3 and 4 would continue to address only contaminants in the upper part of the aquifer at the Altus AFB and would rely on natural attenuation to meet the media cleanup standards for the remaining on-site and off-site contaminant plume. Alternative 5, 6 or 7 has the potential to meet the media cleanup standards for ground water through long-term operation; however the long-term effectiveness has not been proven. Alternatives 3, 5, 6 and 7 would each reduce the quantity of source material available for migration to the surrounding ground water and assist in containment of contaminated groundwater.

3. Controlling the Sources of Releases
Alternative 3, and 5 through 7 would provide the most effective source control by including additional technologies for removal and treatment of the source material in the on-site soil and ground water. Alternative 3 would rely solely on ground water extraction from the shallow groundwater zones for source control.

4. Compliance with Waste Management Standards
Alternatives 2 through 7 would comply with all applicable waste management standards. In Alternatives 3, 6 and 7, recovered ground water would be treated through a granular activated carbon unit to remove volatile organic contaminants prior to discharge to the atmosphere. The granular activated carbon and any chemical precipitate generated from the treatment process would be disposed or treated off-site at a permitted facility. The groundwater treatment will be designed to attain the chemical-specific discharge requirements for the treated ground water and air emissions.

5. Long-Term Reliability and Effectiveness
Alternative 3 would recover contaminants from the upper flow zone of the aquifer at Altus AFB but would be unable to reduce the long-term risk of further exposure to the off-site contaminant plume because of ongoing releases from source areas. Alternative 3 would provide a reduction in long-term risk by reducing concentrations throughout the contaminant plume. However, contaminants would remain in the deeper transmissive zone and provide a long-term source of additional contamination to the ground water. Alternatives 5 through 7 have the potential to remove a long-term source of contaminants to the surrounding ground water and reduce the long-term risk of exposure to the contaminant plume in the ground water.

6. Reduction of Toxicity, Mobility, or Volume of Wastes
Alternative 3 and 5 through 7 would remove the contaminants from the ground water and/or soil thus reducing their toxicity, mobility, and volume. Alternative 3 would achieve the least reduction by addressing only the on-site contaminated shallow ground water. Since existing technologies cannot ensure a 100% removal efficiency rate, there may be some concentration of contaminants remaining above the media cleanup standards for Alternatives 3 through 7. Alternative 5 would involve biological processes that have the potential to permanently reduce or destroy the organic contaminants, thus achieving the maximum reduction in toxicity, mobility, and volume through treatment. Alternatives 6 and 7 would involve physical and chemical processes that have the potential to permanently reduce or

destroy the organic contaminants, also achieving the maximum reduction in toxicity, mobility and volume through treatment, but recent studies have shown that these processes tend to show "rebound" effects.

7. Short-Term Effectiveness
Alternatives 4 through 7 demonstrates viability for short-term effectiveness, and alternatives 5 through 7 have the potential to address the deeper transmissive zones which could continue as a source for offsite contamination. Alternatives 6 and 7 have potential to show short term effectiveness, but also has the potential for rebound effects.

8. Implementability
Alternatives 3 through 7 utilize existing technology with no technical obstacles to prevent implementation, operation, performance monitoring and future modifications to the system design. For Alternatives 5, 6 and 7, obstacles may exist in the form of permits and/or administrative approvals required for installation of off-site structures in public easements, the discharge of recovered vapors to the atmosphere, the pumping of additional ground water from the aquifer, and the possibility for re-injection of ground water back into the aquifer. Alternatives 6 and 7 would also require the performance of additional testing with varying degrees of uncertainty regarding actual implementation.

9. Cost
Due to the uncertainty in predicting the time necessary for restoration of the ground water to its beneficial use, costs were based on a thirty year operational period where applicable, for comparison purposes. Some comparative costs are outlined below:

In-situ Bioremediation	$ 16/cubic yard
Thermal treatment	$ 61/cubic yard
In-situ Chemical oxidation	$ 26/cubic yard

The preferred alternative 5 which utilizes multiple ERD (in-situ bioremediation) technologies is the most cost-effective approach for addressing the contaminants present in both groundwater and soil.

10. State Acceptance
The State of Oklahoma, through the Oklahoma Department of Environmental Quality (ODEQ) has been provided the opportunity to review and comment on a draft of the Statement of Basis. Their support for the preferred alternative will be evaluated prior to and during the public comment period.

11. Community Acceptance
Comments from the community will be an important consideration in the final evaluation of remedial alternatives. All comments received during the 45-day public comment period and at the public meeting scheduled for September 6, 2007, will be addressed in the Response to Comments/Final Decision document (RTC).

PERFORMANCE-BASED MEASURES TO ENSURE PROTECTIVENESS

A. Performance Monitoring Plan

As part of the *Corrective Measures Implementation Plan*, Altus AFB will be required to submit, for agency approval a *Performance Monitoring Plan* which outlines periodic sampling of groundwater to measure the effectiveness of the remedy in achieving the corrective action objectives. EPA is proposing an optimization of the monitoring well system already in place to ensure effective compliance monitoring. This may include additional well installations to effectively monitor compliance at the POC. The optimization program will also make sure that the monitoring wells are screened in proper intervals for detection of contaminants of concern. The *Performance Monitoring Plan* will also measure the effectiveness of the preferred remedy (alternative 4) and will outline a clear definition of the monitoring frequency, sampling locations and data interpretation.

B. Performance Review Plan

As part of the *Corrective Measures Implementation Plan*, Altus AFB will be required to submit, for agency review and approval a *Performance Review Plan*. This plan is a 3-year assessment of progress towards achieving the corrective action objectives, including a summary of the effectiveness and efficiency of the preferred alternative for the remedy. It will also include recommendations for any needed changes in performance monitoring and the adequacy and effectiveness of land use controls. The *Performance Review Plan* needs a clear decision logic that defines either 1) contingency plan to implement when CAO's are not being met, or 2) a plan for phase-out of performance monitoring as risk is reduced.

C. Land Use Control (LUC) Plan

EPA also proposes the use of land use controls (LUCs) to ensure that exposures to residual contaminants in soil or groundwater are not incurred. Altus AFB will be required to adopt a *LUC Plan* which specifies the implementation and maintenance of land use controls. The land use control commitments will be part of the *Corrective Measures Implementation Plan* for the final phase of corrective action. The effectiveness and adequacy of land use controls will be reviewed and documented as part of the 3-year *Performance Review Plan*. If land use should change so that the proposed remedy does not address exposures to new receptors, the agency performing oversight of the remedy will submit a new Statement of Basis to re-visit the viable remedies for the new land use that are protective of human health and the environment.

D. Contingency Plan

As part of the *Corrective Measures Implementation Plan*, Altus AFB is required to submit, for agency review and approval a ***Contingency Plan*** which provides response actions to address any new releases or poor performance of the selected remedy. Failure to achieve the CAO's will trigger a contingency plan to correct the course of the remedy or to re-assess performance measures.

E. Community Relations Plan

As part of the *Corrective Measures Implementation Plan*, Altus AFB is required to submit, for agency review and approval a *Community Relations Plan* which will outline various ways that Altus AFB will communicate to the public and keep the public informed about the overall effectiveness of the preferred remedy, and of any needed changes or modifications to the preferred remedy to meet the CAO's.

ALTUS AIR FORCE BASE RCRA CORRECTIVE ACTION PUBLIC MEETING Public meeting held: Thursday, September 6, 2007 at 7:00 PM in the South West Technology Center 711 West Tamarack Altus, Oklahoma	**FOR MORE INFORMATION:** For more information about the public involvement process, or if you have questions about site activities at Altus AFB, please contact: **Ms. Nancy Fagan,** Project Manager U.S. EPA (6PD-O) 1445 Ross Avenue Dallas, Texas 75202-2733 (214) 665-8385

U.S. Environmental Protection Agency
Multimedia Planning and Permitting Division
State Oversight Section (6PD-O)
1445 Ross Avenue
Dallas, TX 75202-2733

GLOSSARY OF TERMS

Administrative Record - A collection of documents that form the basis for the remedy selection.

Aerobic environment – term used to describe the hydrogeologic environment that is rich in oxygen with dissolved oxygen at greater than 1 milligrams per liter (mg/L).

Anaerobic environment – term used to describe the hydrogeologic environment that has dissolved oxygen at less than 1.0 mg/L.

Aquifer - A layer of permeable rock, sand, or gravel below the ground's surface that can supply usable quantities of ground water to wells and springs. An aquifer can be a source of drinking water.

Bioremediation (enhanced)– a process of adding nutrients to groundwater to speed up the natural biological breakdown process .

Benzene – a colorless, liquid, flammable aromatic hydrocarbon associated with fuels.

Bark mulch wall (biowall) –application of mulch material (tree bark, etc.) in narrow, but deep trenches to form a below-grade "wall" that groundwater will pass through and receive treatment as it passes through the wall. This adds a carbon source to the groundwater in an effort to speed up the natural breakdown process of chemicals.

Bioreactor – term used to describe a "plug" of mulch material or other carbon source that serves as a continual treatment of groundwater as water is percolated through the system. Bioreactors may provide an effective approach to treating residual DNAPL at depth.

Carbon tetrachloride – a compound consisting of one carbon and four chlorine atoms commonly used in solvents.

Cis-1,2 DCE – a chemical that is one of the breakdown products of trichloroethane (TCE).

Conceptual site model (CSM) – a three dimensional "picture" of site conditions at a facility that describes physical site conditions, general site history, releases, release mechanisms, contaminant fate and transport, exposure pathways, potential receptors, and risks.

Contaminant (chemical) of Concern (COC) - a term used for chemicals that are viewed as potentially causing the most harm to human health.

Corrective Measures Study (CMS) - An evaluation of the alternatives for cleanup of sites contaminated with hazardous waste.

1,2-dichloroethane (1,2-DCE) - a chemical that is one of the breakdown products of trichloroethane (TCE).

DO – Dissolved oxygen

Exposure scenarios- a term used to describe various cases of potential exposures to contaminants given the various pathways for exposure such as ingestion, inhalation and dermal contact.

Ex-situ – a term used to describe treatments that take place outside and above-ground from the actual contaminated area.

Geophysical survey – a survey using sound-penetrating radar used to delineate subsurface features.

Granular Activated Carbon (GAC) - Carbon used to treat ground water that is usually crushed to produce a large surface-to-volume ratio that exposes a large number of carbon atoms for adsorption of hazardous constituents.

Hydrologic zones – geologic layers in the subsurface that have large enough pore spaces to contain water. The shallow zones are usually above a confining layer and recharged through an upgradient exposure to precipitation.

Human health cancer risk of 1E-05 - Incremental probability of an individual's developing cancer over a lifetime as a result of exposure to a potential carcinogen.

The 10 -5 refers to the incremental probability of one in a 100,000 developing cancer over a lifetime as a result of exposure to a potential carcinogen.

In-situ – a term used to describe treatments that take place in (below-ground) the actual contaminated area.

Institutional Controls – a land or deed notice recorded with the appropriate regulatory agency (or agencies) to memorialize current land use. Examples of different types of institutional controls are: Structure-use restrictions, land-use restrictions, natural resource-use restrictions, well restriction areas, deed restrictions, deed notices, declaration of environmental restrictions, access controls, monitoring requirements, site posting requirements, information distribution, notification in closure letter, restrictive covenants, and Federal/State/county/local registries.

Maximum Contaminant Level (MCL) - Maximum permissible level of a contaminant in water which is delivered to any user of a public water system.

Monitoring Wells - Special wells drilled at specific locations on or off a site where ground water can be sampled at selected depths and studied to determine such things as the direction in which ground water flows and the types and amounts of contaminants present.

MSSL – Medium-Specific Screening Levels. EPA Region 6 publishes screening values for common human health exposure pathways. The MSSL table can be found on our internet site at: http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm

Natural attenuation or Monitored natural attenuation (MNA) – a process whereby only monitoring of the natural breakdown process takes place. MNA is an accepted remedy only in circumstances where sources of contamination have been removed to the extent practicable, and the environment is conducive to natural chemical breakdown.

Net Present Value – a calculation for present value that takes inflation into account. Used to compare costs of applications of various remedial alternatives.
No Further Action (NFA) - no further remedial actions are undertaken to address the existing ground water and soil contamination. NFA determinations can be made when the site no longer poses a risk to human health or the environment.

Nonaqueous phase liquid (NAPL) - The term NAPL refers to the undissolved liquid phase of a chemical, such as trichloroethylene (TCE), and not to the aqueous phase dissolved in water. Virtually all NAPLs are organic compounds that are immiscible (resistant to mixing) with water. The distinct interface resulting from the water-NAPL contact does allow some NAPL to dissolve, with the degree of aqueous solubility varying dramatically among NAPL compounds. As NAPL moves through the soil and aquifer, a portion becomes trapped and a portion may continue to migrate. The "free-phase NAPL" is the migrating portion, which can flow into a well. "Residual NAPL" is that portion trapped in the soil or aquifer and no longer migrates as a separate phase. Both residual and free-phase NAPLs are sources of vapors and dissolved contaminants.
DNAPL – dense non-aqueous phase liquids that have densities greater than water and have a tendency to sink.
LNAPL - light non-aqueous phase liquids that have densities less than water and have a tendency to "float" on the water table.

Non-potable – water that has been deemed unsafe or unpalatable to drink because it contains pollutants, chemicals or minerals.

Parts Per Million (ppm)/Parts Per Billion (ppb) - Units of measure used to express concentrations of contaminants. 1 ppm is equal to 1,000 ppb and 1 ppb is equal to 0.001 ppm. Also, 1 ppm is equal to 1 mg/kg or 1 mg/l; 1 ppb is equal to 1 ug/kg or 1 ug/l. As an example, 1 ounce of trichloroethylene in 1 million ounces of water is 1 ppm.

Perchloroethylene (PCE) – stable colorless liquid,nonflammable and nonexplosive with low toxicity; used as an industrial solvent and in metal cleaning. Another name for this chemical is tetrachloroethylene, also sometimes called "perc".

Point of Compliance (POC) – a three-dimensional point in space where regulatory compliance cleanup values must be met.

POTW – Publicly owned treatment works – a wastewater treatment facility owned by a state or municipality.

Reductive Dechlorination (enhanced) – biodegradation or abiodegradation of chlorinated solvents in natural groundwater environments.

Remedial alternatives – viable choices in the selection of technologies that can be used to remove, treat or contain contaminants for the protection of human health and the environment.

Resource Conservation and Recovery Act (RCRA) - This law authorizes the federal government to respond

directly to releases of hazardous waste which may be a threat, or potential threat, to public health and the environment. EPA is responsible for implementing Section 3008(h) of RCRA in the State of New Mexico.

RCRA Facility Investigation (RFI) - An investigation to determine the nature and extent of contamination at a facility.

RFI/IA/CMS Report – RCRA Facility Investigation/ Investigation Analysis/Corrective Measures Study report that summarizes all investigations of soils and groundwater and proposes corrective measures to achieve cleanup goals.

Risk-based concentrations (RBCs) – concentrations of contaminants that can be left in environmental media (e.g, soils, groundwater) that do not pose a risk to human health.

Risk-based screening criteria - Region 6 derived screening-level concentrations for addressing human health exposure pathways. The comparison of preliminary investigation data against risk-based media concentrations provides for an initial evaluation for the relative environmental concern for a site or set of environmental data.

Semivolatile organic compounds (SVOCs) – an organic compound that has a boiling point higher than water which may vaporize at room temperature.

Solid waste management units (SWMUs) – units that have managed solid or hazardous waste that have been identified to have had a routine or systematic release to the environment.

Source removal – process of removing contaminants in soil and/or groundwater

Slurry walls – a mixture of bentonite clay and native soil and water in a vertically excavated trench; used to contain or divert contaminated groundwater.

Toluene - also known as methylbenzene or phenylmethane, is a clear, water-insoluble liquid with the typical smell of paint thinners.

Transmissive zone – a term used in this document to describe the groundwater zone with higher groundwater velocities located below the alluvial section and within the fractured system of the Hennessey Shale.

Treatability Study - A treatability study (40 CFR 260.10) is a study in which a hazardous waste is subjected to a physical, chemical, biological, or thermal treatment process to determine the effectiveness of a treatment process.

Trichloroethene (TCE) - a colorless liquid used as a solvent for cleaning metal parts.

Vapor intrusion - Vapor intrusion is the migration of volatile chemicals from the subsurface into overlying buildings. Volatile chemicals in contaminated groundwater can emit vapors that may migrate through subsurface solid and into air spaces of overlying buildings.

Vinyl chloride - a colorless organic gas with a sweet odor. Vinyl chloride released to soil will either quickly evaporate, be broken down by microbes or may leach to the groundwater. It also rapidly evaporates from water, but does not degrade there. It will not accumulate in aquatic life.

Volatile organic compounds (VOCs) – organic compounds that have a boiling point higher than water which may vaporize at room temperatures.

Water Table - The upper surface of ground water in an aquifer. The water table marks the boundary between the unsaturated soil and the saturated aquifer.

Xylene - Xylene is a colorless, sweet-smelling liquid that catches on fire easily. It occurs naturally in petroleum and coal tar. Chemical industries produce xylene from petroleum.

ALTUS AIR FORCE BASE - PUBLIC COMMENT PERIOD

The 45-day public comment period for the Altus Air Force Base will begin on September 6, 2007**,** and end on October 22, 2007. Your written comments must be postmarked or e-mailed by October 22, 2007. EPA would like your comments on the Statement of Basis for the Altus Air Force Base. Please write your comments below, then fold, tape, stamp, and mail this form. EPA will address all comments received during the public comment period in the Response to Comments/Final Decision document (RTC). If you would like to receive a copy of the RTC, please state in your comments that you would like to receive the RTC and include your full name and address on the return address form.

ALTUS AIR FORCE BASE
RCRA CORRECTIVE ACTION
PUBLIC COMMENT PERIOD

The public comment period for the Altus Air Force Base begins September 6, 2007. Your comments must be post marked by October 22, 2007.

Name _____

Address _____

City _____

State _____Zip_____

U.S. EPA
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Dallas, TX 75202-2733