DECISION DOCUMENT FOR THE FINAL REMEDIAL ACTION AT THE FORMER PUMPHOUSE #2 (HAA-13)

HUNTER ARMY AIRFIELD, GEORGIA

15 MAR 2001

PURPOSE

This decision document describes the selected Final Remedial Action (FRA) for the former Pumphouse #2 located at Hunter Army Airfield, Georgia, which consists of active remediation. Specifically, the selected remedial action for this site is Six-Phase Heating and all aspects of the proposed actions, which have been approved by the Georgia Environmental Protection Division (GA EPD), are described in detail in the *Final Corrective Action Plan –Part B for Former Pumphouse #2, Former Building 8065, Facility ID #9-025086,* dated May 2000. HAA-13, the Defense Site Environmental Restoration Tracking System (DSERTS) site which includes former Pumphouses #1, #2, and #6, is eligible for Environment, Restoration Account (E,RA) funds; therefore, the FRA for Pumphouse #2 will be funded using fiscal year (FY) 2001 E,RA funds.

This decision document presents the justification for the selected FRA and specifically provides details on the following:

- Site Location and History
- Nature and Extent of Contamination
- Remedial Response Objectives
- Conceptual Design and Implementation
- Public Notification
- Declaration

Site Location and History

The Former Pumphouse #2 site is located along the east-west taxiway of HAAF, within an average or higher groundwater pollution susceptibility area. According to the operational information provided by the HAAF Directorate of Public Works (DPW), Former Pumphouse #2 was an aviation gas fuel island that was used from about 1953 until the early 1970s and consisted of ten 25,000-gallon underground storage tanks (USTs). Pumphouse #2 was inactive from the 1970s to 1995.

In 1995, eight of the 25,000-gallon USTs were removed by Anderson Columbia Environmental, Inc. Two 25,000-gallon tanks remained in place, partially under the pumphouse structure. The 8-inch cast iron piping internal to the Former Pumphouse #2 facility was removed prior to tank removal. During UST closure activities, benzene, toluene, ethylbenzene, and xylenes (BTEX) and polynuclear aromatic hydrocarbons (PAHs) were not detected in the soil samples. However, concentrations of total petroleum hydrocarbon (TPH) were observed in the soil samples. Samples of the groundwater seeping into the excavation confirmed the presence of BTEX and PAH constituents in the groundwater at the site. Free product was not observed during tank removal activities.

In 1996, Metcalf & Eddy (M&E) conducted a Corrective Action Plan (CAP)-Part A investigation. The CAP-Part A Report for Pumphouse #2 (M&E 1997) was submitted to GA EPD in May 1997 and describes the results of the CAP-Part A site investigation (SI). As outlined in the CAP-Part A report, a CAP-Part B SI was determined to be necessary to:

- Delineate the horizontal and vertical extent of petroleum contamination in soil and groundwater to concentrations below the applicable soil threshold level (STL) or In-Stream Water Quality Standards (IWQS), and

- Assess the potential impact of petroleum contaminants to surface water and sediment in the drainage ditch located south (downgradient) of the site.

A CAP-Part B SI was conducted by M&E in May 1997 to determine the nature and extent of petroleum contamination. On January 27, 1999, representatives from GA EPD Underground Storage Tank Management Program (USTMP), U.S. Army Corps of Engineers (USACE), Fort Stewart DPW, and M&E met to discuss issues regarding the completion of the CAP-Part B report. Representatives of GA EPD USTMP confirmed that the surface water drainage feature located south of the Former Pumphouse #2 constitutes a surface water body regulated by the State of Georgia under the IWQS and, as such, should be considered as the most likely receptor. As a result of the meeting, additional surface water/sediment sampling locations were determined to be necessary downgradient of the groundwater plume. In addition, the installation of monitoring wells on the south and east sides of the drainage ditch were determined to be necessary prior to submitting the CAP-Part B report to GA EPD. M&E performed the additional work in February and November 1999.

In 1998, Earth Tech, Inc., removed the remaining two USTs and the pumphouse structure. The piping from the boundary of the pumphouse to the bulk fuel farm was also drained, pigged, and grouted in-place. Soil and groundwater samples were not collected during the 1998 tank removal since the tanks were being removed from an area of known soil contamination as determined during the CAP-Part A investigation (approved by GA EPD in correspondence dated June 17, 1998, White to Brown).

Science Applications International Corporation (SAIC) utilized the data collected by M&E in 1997 and 1999 to prepare the Final CAP-Part B report for Fort Stewart. In addition, in early 2000, SAIC performed selected sampling to fill data gaps and the USACE delineated the free product plume.

Nature and Extent of Contamination

The results of chemical analyses performed during the CAP-Part A and CAP-Part B investigations indicated that soil, groundwater, surface water and sediment contain greater than their appropriate regulatory standards (i.e., threshold levels for soil and IWQS for groundwater).

SOIL Specifically, petroleum-related contaminants detected in soil at the Former Pumphouse #2 site during the UST closure, CAP-Part A SI, and CAP-Part B SI included benzene, ethylbenzene, toluene, xylenes, TPH-DRO, TPH-GRO, and numerous PAH compounds. The analytical results from the various investigations indicate that there are two separate areas of soil contamination. These areas consist of the area in the vicinity of the former tank pits near the former Pumphouse #2 (size: ~300 feet x 200 feet) and in the area around Former Fuel Pit 2E (size: ~150 feet x 50 feet). Twenty soil samples exceeded the Georgia Underground Storage Tank (GUST) STL (i.e., Table B, Column 1) for benzene and 4 soil samples exceeded the GUST STL for ethylbenzene. The ethylbenzene concentrations were below the risk-based screening level of 204,400 mg/kg that is protective of soil exposure during industrial land use and below the GA EPD approved Alternate Threshold Level (ATL) for ethylbenzene of 389 mg/kg that was developed based on fate and transport modeling. The benzene concentrations

are below the risk-based screening level of 197.4 mg/kg that is protective of soil exposure during industrial land use.

GROUNDWATER Petroleum-related contaminants detected in groundwater at the Former Pumphouse #2 site during the previous investigations included benzene, ethylbenzene, toluene, xylenes, and numerous PAH compounds. In order to fully delineate (i.e., horizontally and vertically) the dissolved benzene contamination plume, thirteen wells were installed at the site. Benzene was identified in twelve groundwater samples during the CAP-Part B SI. Benzene concentrations ranged from 2.6 ug/L to 2700 ug/L. The concentrations in five samples exceeded the Georgia IWQS of 71.28 ug/L, the concentrations in eleven samples exceed the federal maximum contaminant level (MCL) of 5 ug/L, and the concentrations in all twelve samples exceed the risk-based screening level of 0.36 ug/L. The concentrations in five samples were above the GA EPD approved site Alternate Concentration Level (ACL) for benzene of 469 ug/L.

The investigations conducted have demonstrated that the horizontal and vertical extent of petroleum contaminants in groundwater has been delineated to the appropriate analytical detection. Petroleum contaminants identified in groundwater at the Former Pumphouse #2 site include BTEX constituents as well as PAH constituents. The results of the CAP-Part B SI indicated that there are two separate plumes related to the operation of the Former Pumphouse #2. The primary plume of groundwater contamination is located in the vicinity of the former tank pits and is approximately 450 feet x 250 feet. The contaminated groundwater is migrating towards the drainage ditch located to the east and south of the site; however, the dissolved plume does not migrate beyond the drainage ditch to the south and east. Benzene was the only contaminant to exceed its IWQS and ACL. A smaller plume (i.e., 200 feet x 175 feet) of groundwater contamination is located in the vicinity of Former Fuel Pit 2E.

Free product was identified at the Former Pumphouse #2 site during the CAP-Part B SI. On May 14, 1997, M&E discovered free product in well P2-MW27 at a thickness of 0.04 feet. Later measurements by M&E detected 0.97 feet on May 29, 1997. Interim corrective action consisted of free product recovery in P2-MW27 via absorbent socks; however, in order to delineate the extent of the product at the site, the USACE Savannah District installed a total of 52 piezometers around the P2-MW27 location between July 1999 and March 2000. Between August 1999 and December 1999, the piezometers contained less than 0.02 feet of free product, except for PZ-10, which averaged about 0.35 feet of product. During free product measurements in February 2000, 1.28 feet and 0.75 feet of free product was observed in P2-MW27 and P2-MW41, respectively. Free product was also identified in 15 of 24 piezometers that had been installed by February 2000, with eight of the piezometers showing over two feet of free product. Twenty-eight additional piezometers were installed in March 2000 to delineate the extent of the product that appeared to be released from the pore space in the soil in January/February 2000. On April 12, 2000, 30 of the 52 piezometers contained free product. The product plume is estimated to be 85 feet x 50 feet in size.

SURFACE WATER AND SEDIMENT Surface water and sediment samples were collected from eight locations around the Former Pumphouse #2 site. BTEX constituents were detected in three of the eight surface water samples while no PAH constituents were detected in any of the surface water samples. No BTEX constituents were detected in any of the sediment samples. As a result of the surface water and sediment sampling, it appears that the dissolved groundwater plume emanating from Former Pumphouse #2 is impacting the drainage ditch, but at concentrations below the respective IWQS.

Remedial Response Objectives

Based on the findings of the site characterization at the former Pumphouse #2 site, the primary goal and purpose for implementing corrective measures at the site is not only protection of human health and safety, but removal/remediation of the extensive free product plume which exists. To achieve this goal, the following remedial response objectives (described by media) have been established for the site:

FREE PRODUCT During the CAP-Part B investigations in 1997 and 1999, free product was present in well P2-MW27 at the Former Pumphouse #2 site. Results of additional free product delineation activities conducted in February/ March 2000 indicate that the area of free product has increased in size. Therefore, active removal/remediation of the free product to less than 0.10 foot across the site is required by GA EPD.

GROUNDWATER CONTAMINATION The investigations documented groundwater contamination that exceeded the IWQS. In November 1999, the benzene concentration at the site was 2700 µg/L in well P2-MW05, located south of the former tank pit area. This concentration was the maximum concentration observed during the CAP-Part A and CAP-Part B investigations. The dissolved benzene appears to be impacting a man-made drainage ditch, which is located approximately 160 feet southeast of the former tank pits. This is evidenced by low concentrations of benzene in the drainage ditch surface water and a lack of benzene in the monitoring wells located on the south and southeast side (i.e., downgradient) of the drainage ditch.

Groundwater in the vicinity of the former tank pits is generally flowing to the southwest with a man-made drainage ditch affecting the localized flow. Conservative fate and transport modeling using the Analytical Transient 1-, 2-, 3-Dimensional Model (AT123D) predicts that benzene (the most conservative representative compound) should be exceeding its IWQS at the drainage ditch located 160 feet southeast of the site. The model results for this compound indicates that there is minimal groundwater impact at a distance of 1,000 feet from the former tank pits. Concentrations of benzene in the vicinity of the former tank pit exceed the benzene ACL of 469 µg/L. Therefore, active remediation of the groundwater plume in the vicinity of the former tank pits is required.

In the vicinity of Former Fuel Pit 2E, the groundwater contamination did not exceed IWQS during the CAP-Part B investigation. Therefore, no further action is required for the groundwater plume in the vicinity of Former Fuel Pit 2E.

SOIL CONTAMINATION The benzene concentration in two of the soil samples from the Former Fuel Pit 2E area were above the ATL for benzene of 0.44 mg/kg. However, the soil samples were located at the soil/water interface and groundwater data indicates that remediation of this area is not warranted. Also this area of the site is located beneath 12 inches of concrete, which prevents incidental contact with the soil and minimizes infiltration of groundwater. The benzene contamination in the soil at the Former Fuel Pit 2E area will continue to degrade naturally and does not require active remediation.

The benzene concentrations in four of the soil samples from the vicinity of the former tank pits were above the ATL for benzene of 0.44 mg/kg, which was developed based on fate and transport modeling. These soil samples are located near the soil/water interface near the area of free product; thus, active remediation of the soil in this area is required.

Conceptual Design and Implementation

This section presents a conceptual design and plan for implementation of the selected corrective action alternative for the former Pumphouse #2. Based on the level and type of soil contamination, groundwater contamination, and free product, a cost-effective corrective action was selected that will adequately protect human health and safety, while remediating the site to GA EPD requirements. Specifically, Six-Phase Heating has been chosen as the Final Remedial Action for the site based on a number of site factors. The theory of this technology is described below:

THEORY Since, residual soil contamination has been identified only in the area directly above the water table, this indicates that the soil contamination is being spread through the seasonal fluctuation of the water table. The aromatic hydrocarbon constituents of concern (BTEX) are volatile and can be readily volatilized by heating the impacted soil and free-phase hydrocarbons and causing residual moisture content to vaporize, resulting in steam stripping and volatilization of the contamination. This situation will allow the volatile compounds to be extracted to the surface through soil vapor extraction wells where they can be sorbed onto activated carbon or incinerated by a catalytic oxidizer. This remediation technique is the basis of the six-phase heating technology. Six-phase heating splits conventional three-phase electricity into six separate phases, producing an improved subsurface heat distribution. Each phase is delivered to a single electrode, each of which is placed in a hexagonal pattern. Because each electrode is at a separate phase, each one conducts to all the others. The phases are connected so that adjacent electrodes, which are spaced 60 degrees apart in the hexagonal pattern, are also electrically 60 degrees out of phase. The vapor extraction well, which removes the contaminants, air, and steam from the subsurface, is electrically neutral and located in the center of the hexagon. Six-phase heating delivers significantly more power to the bulk soil and less at the electrodes than other resistive heating techniques. This remediation technology is gaining wide acceptance for the rapid and effective removal of all types of hydrocarbons. The addition of a solution of water and salt may be required at the electrodes to maintain soil moisture and promote electrical heating.

In addition, dissolved phase hydrocarbons exist in the groundwater beneath the site. Again, the BTEX compounds are volatile and can be readily volatilized by heating and in-situ steam stripping; therefore, groundwater is heated to and maintained at its boiling point. As the heat and steam moves through the groundwater, the volatile compounds will partition from the dissolved phase to the vapor phase. Once the vapor phase contaminants rise to the vadose zone, they will release the VOC laden air and steam into the soil pores where it will be collected by the soil vapor extraction (SVE) wells.

CONCEPTUAL DESIGN The Former Pumphouse #2 site is now an empty grass area between an active runway and taxiway at HAAF. The proposed remediation system consisting of six-phase heating, vapor extraction, and treatment of the off-gas and condensate can be installed in such a manner that will not interfere with continued operation of the airfield while the system is operational, which was a critical factor in selecting the FRA.

In order to install the proposed remediation system, several permits may be required by GA EPD. These permits include an underground injection permit, air emissions permit, and a National Pollutant Discharge Elimination System (NPDES) permit to discharge the effluent to the drainage ditch.

Six-Phase Heating The six-phase array is made up of six electrodes equally spaced around a center 7th "Neutral" electrode, which serves as the soil vapor extraction well. Typical array diameters range from 30 – 80 feet. The heated zone is 40% larger than the array diameter; resulting in treatment zone diameters ranging from 42 – 112 feet. An array diameter of 40 feet was assumed based on present site knowledge. This array diameter results in an effective treatment diameter of 56 feet. The six-phase system will consist of approximately 20 arrays with 6 electrodes and one vapor extraction well per array. The exact number of arrays will be determined through a baseline screening phase. The electrodes will extend up to 15 feet BGS. The electrode boreholes will be constructed with 2-inch stainless steel casing and backfilled with graphite or steel shot added to assist in maintaining soil conduction. If necessary, water containing an electrolyte, sodium chloride, will be continuously added to the electrodes through a drip system to assist in maintaining moisture and soil conduction.

Three-phase power from the electrical manhole that used to supply power to Former Pumphouse #2 will be connected to a six-phase power transformer. A remote computer will control the output voltages for each electrode. Electrodes will be connected to the transformer via buried insulated power cables to minimize damage from aircraft operations.

Soil Vapor Extraction A total of approximately 20 SVE wells will be installed across the site, one within the center of each heating array, consisting of 2-inch stainless steel casing similar to the electrode wells. A bentonite and/or cement grout will extend along the riser pipe to approximately 5 feet below grade. At that point the casing will be slotted and have a sand pack. The SVE wells will extend to the same depth as the electrodes. The estimated radius of influence in silty sands in conjunction with the six-phase heating is approximately 23 feet. The estimated flow rate per well is 10 cubic feet per minute (cfm). Actual flow rates and corresponding vacuums will be measured during a pre-design field test. The estimated total SVE system flow rate is approximately 200 cfm.

This subsurface flow will be induced by a vacuum pump/blower. Soil vapor will go through a SVE condensate tank, which will remove any moisture in the vapor phase before the vapor reaches the blower. Once on the positive pressure side of the pump, the vapor will be pushed through a catalytic oxidizer or activated carbon prior to discharge to the atmosphere. Each SVE well will have its own dedicated pipe leading to a header manifold near the treatment unit. Valves at the manifold will regulate flow rates from each well.

Condensate Treatment Condensate water from the SVE system will be routed through an oil/water separator. The oil/water separator will be sized to handle the condensate. Free product will be containerized into a 500 gallon double walled aboveground storage tank (AST) with an overfill shut-off. Water from the separator will then pass through a shallow tray aeration system with the off-gas going to the catalytic oxidizer or activated carbon system prior to discharge to the atmosphere. Based on current site information, free product will probably be encountered, thus an oil/water separator will be required. The treated condensate will be discharged to the drainage ditch along the southeastern edge of the site in accordance with the NPDES permit.

Implementability Very few factors limit implementability of the FRA (i.e., Six-Phase Heating) under evaluation. A contract will be awarded either through the COE or DOE to perform the entire FRA (installation, operation, required sampling, report preparation, system shut-down, and confirmatory sampling).

Cost The estimated total life-cycle cost of performing the FRA to include O&M activities and management and oversight is approximately $750,000 (E,RA funds). This alternative will provide adequate protection of human health and the environment, and achieve the GA EPD required ACLs and ATLs.

Public Notification

The CAP-Part B describes the FRA and final publication of the document was announced in the Savannah Morning News on two consecutive Sundays (i.e., classified section), as required by GA EPD. To date, a public request for review of the document has not occurred; however, if a request is made, Fort Stewart will comply with all applicable State and Federal regulations.

Declaration

The selected Final Remedial Action for the former Pumphouse #2 is protective of human health and the environment, attains Federal and State requirements that are applicable or relevant and appropriate to the FRA, and will be cost-effective.

As the selected course of action for former Pumphouse #2 was presented in the May 2000 CAP-Part B and was approved by GA EPD, the five-year review will not apply to the proposed FRA. Fort Stewart will submit a certificate of completion to GA EPD, upon achieving all the required ATLs and ACLs.

This decision document was developed by the Fort Stewart Directorate of Public Works, with support from the U.S. Army Corps of Engineers and SAIC.