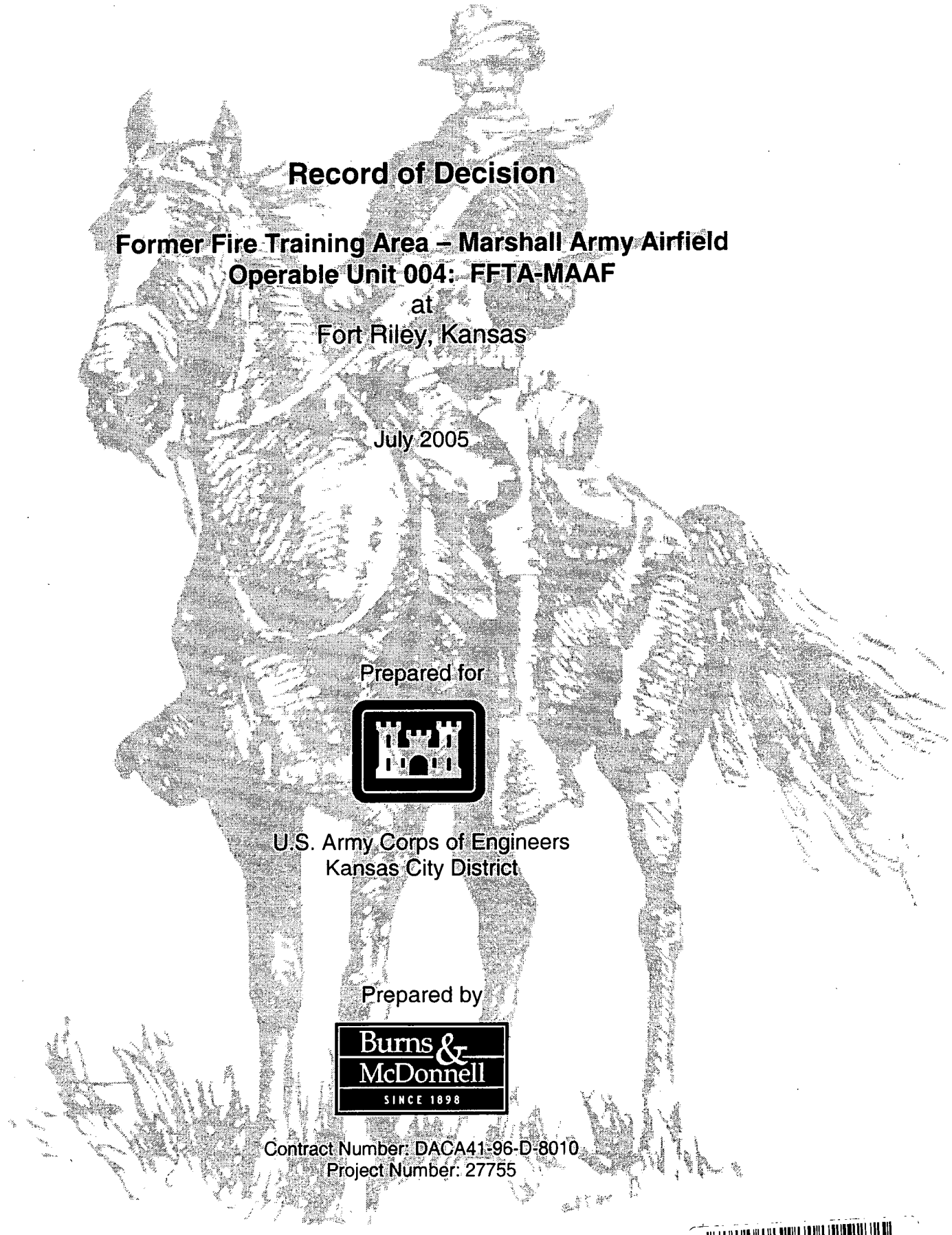

Record of Decision

Former Fire Training Area – Marshall Army Airfield
Operable Unit 004: FFTA-MAAF
at
Fort Riley, Kansas

July 2005

Prepared for

U.S. Army Corps of Engineers
Kansas City District

Prepared by

Burns & McDonnell
SINCE 1898

Contract Number: DACA41-96-D-8010
Project Number: 27755

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List of Acronyms and Abbreviations

APZ	Accident Potential Zones
AR	Army Regulation
ARAR	Applicable or Relevant and Appropriate Requirement
bgs	Below Ground Surface
BLRA	Baseline Risk Assessment
BMcD	Burns & McDonnell Engineering Company, Inc.
BNP	Bimetallic Nanoscale Particle
CENWK	U.S. Army Corps of Engineers, Kansas City District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Chemical of Concern
COPC	Chemical of Potential Concern
COPEC	Chemical of Potential Ecological Concern
CSM	Conceptual Site Model
DA	Department of the Army
DCE	Dichloroethene
DCFA	Dry Cleaning Facilities Area
DES	Directorate of Environment and Safety
DNAPL	Dense Non-Aqueous Phase Liquid
DO	Dissolved Oxygen
DoD	Department of Defense
DRO	Diesel Range Organics
DSR	Data Summary Report
EAB	Enhanced Anaerobic Bioremediation
EE/CA	Engineering Evaluation/Cost Analysis
ESD	Explanation of Significant Differences
EUC	Environmental Use Control
Fe^{+3}	Ferric Iron
Fe^{+2}	Ferrous Iron
Fe^{0}	Zero-Valent Iron
FFA	Federal Facility Agreement
FFTA	Former Fire Training Area
FS	Feasibility Study
ft	Foot/feet
GRO	Gasoline Range Organics
HEAST	USEPA Health Effects Assessment Summary Tables
HRS	Hazard Ranking System
IAG	Interagency Agreement
ICUZ	Installation Compatibility Use Zone Study
IDW	Investigative Derived Waste
IRIS	Integrated Risk Information System

List of Acronyms and Abbreviations

IRP	Installation Restoration Program
ISL	Identified Site List
ISRM	In-Situ Redox Manipulation
IWSA	Installation Wide Site Assessment
JLUS	Joint Land Use Study
JP-4	Jet Fuel
KDHE	Kansas Department of Health and Environment
LBA	Louis Berger & Associates
MAAF	Marshall Army Airfield
MCL	Maximum Contaminant Level
MNA	Monitored Natural Attenuation
MOGAS	Leaded Motor Gasoline
MPEO	Master Plan Environmental Overlay
msl	Mean Sea Level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
ORP	Oxidation Reduction Potential
OSHA	Occupation Health and Safety Administration
OU	Operable Unit
PCE	Tetrachloroethene
ppb	Parts per Billion
PRB	Permeable Reactive Barrier
PRG	Preliminary Remediation Goal
PWE	Directorate of Public Works – Environmental Division
RAB	Restoration Advisory Board
RACER	Remediation Action Cost Engineering and Requirements
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
RPMP	Real Property Master Plan
SARA	Superfund Amendments and Reauthorization Act
SI	Site Investigation
Site	Former Fire Training Area – Marshall Army Airfield
SVE	Soil Vapor Extraction
SVOC	Semivolatile Organic Compound
TCE	Trichloroethene

1.0 DECLARATION

1.1 SITE NAME AND LOCATION

SITE NAME:	Former Fire Training Area (FFTA)-Marshall Army Airfield (MAAF)
USEPA IDENTIFICATION NUMBER:	KS6214020756; Federal Facility Agreement Docket Number VII-90-F-0015
LOCATION:	Fort Riley, Kansas
SITE TYPE:	Federal Facility
LEAD AGENCY:	The United States Department of the Army (DA), Fort Riley
SUPPORTING AGENCIES:	The United States Environmental Protection Agency (USEPA), Region VII; the State of Kansas, Kansas Department of Health and Environment (KDHE), Bureau of Environmental Remediation (BER)
OPERABLE UNIT:	Operable Unit (OU) 004

1.2 STATEMENT OF BASIS AND PURPOSE

This document is published as a Record of Decision (ROD) for THE FFTA-MAAF SITE (OU 004) under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The remedy was chosen in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practical, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The remedy was selected based upon the Administrative Record file for the FFTA-MAAF Site (OU 004). This ROD is consistent with the other previous RODs for the overall Fort Riley Site discussed in Section 2.4 and is expected to be in agreement with the Final Comprehensive ROD for the entire Fort Riley Site. Documents supporting this ROD are identified in Section 4.0.

This remedy was selected by the DA, Fort Riley, in consultation with the USEPA, Region VII, and the KDHE. The State of Kansas and the USEPA concur with the selected remedy.

1.3 ASSESSMENT OF THE SITE

The response action selected in this ROD is necessary to protect the public health, welfare, and the environment from actual or threatened releases of hazardous substances into the environment. The principal threat pertains to potential future use of site-impacted groundwater. Groundwater is the primary

source of drinking water and water used for non-domestic purposes (e.g., livestock and irrigation) for Fort Riley and many of the surrounding communities. Alluvial sand and gravel deposits in the Kansas and Republican River valley areas are excellent aquifers. In the upland areas, bedrock is also tapped as a source of water (Burns & McDonnell [BMcD], 2001a).

1.4 DESCRIPTION OF THE SELECTED REMEDY

The selected remedy for the FFTA-MAAF Site (OU 004) at Fort Riley is Monitored Natural Attenuation (MNA) with Institutional Controls. This alternative relies on natural degradation processes already occurring at the FFTA-MAAF Site (OU 004) to further reduce contaminant concentrations to levels below the maximum contaminant levels (MCLs). With this alternative, progress at the FFTA-MAAF Site (OU 004) will be monitored through groundwater sampling, and institutional controls will be implemented to restrict groundwater usage until remediation is complete. The Remedial Design/Remedial Action Plan for the FFTA-MAAF Site (OU 004) will be completed upon ROD approval. The Remedial Design/Remedial Action Plan will include details of the monitoring to be conducted under the MNA approach. The primary form of institutional controls will be restricting the installation and use of groundwater supply wells at and downgradient of the FFTA-MAAF Site (OU 004). The primary control for the on-post portion of the FFTA-MAAF Site (OU 004) will be to restrict use through the environmental overlay of the Base Master Plan. The primary control for the off-post portion of the FFTA-MAAF Site (OU 004) will be implementation of institutional controls for property with environmental contamination above unrestricted land use standards.

The Proposed Plan discussed the implementation of institutional controls for property with contaminant concentrations above the MCLs or unrestricted land use standards as the primary control for the off-post portion of the FFTA-MAAF Site (OU 004) and recommended the implementation of the KDHE Environmental Use Control (EUC) Program. The EUC program requires the impacted landowners to make application to the KDHE for approval of an EUC program for their property. The KDHE then provides oversight to ensure that the conditions imposed are followed. The EUC program for this site would include restriction of future use to agricultural, industrial, or commercial use and prohibit installation of drinking water wells within the areas of the site with contaminant concentrations above MCLs. Although the Proposed Plan discussed the implementation of the KDHE EUC Program, the most recent groundwater sampling event results (February 2005) indicated contaminant levels are below MCLs; therefore the EUC

Program will not be utilized unless groundwater concentrations increase to levels greater than the MCLs.

The source of contamination in soil was reduced to concentrations below the levels determined by the KDHE that would prevent further leaching of contaminants to groundwater. The source reduction occurred through a source removal pilot study (using soil vapor extraction (SVE) and bioventing technologies) and was completed in May of 1995. Two new private water wells, which are included in the long-term monitoring plan, were installed in 2002 on private property outside of the contaminant plume. Five wells (M-1, R-1, R-2, R-3, and R-4) located in or near the contaminant plume were abandoned per the State of Kansas regulations in 2002 as well. These measures have assisted in the reduction of exposure of nearby residents and visitors to contaminated groundwater. Natural attenuation, combined with the source removal, has been responsible for the continuing decrease of contaminant levels in groundwater. In the final round of groundwater sampling for the Remedial Investigation (RI) in August of 1999, twelve monitoring wells of the 45 monitoring wells sampled, had contaminants at levels greater than MCLs. The number of monitoring wells with contaminants at levels greater than MCLs has decreased steadily since that time with only three wells of the 40 wells sampled having contaminants at levels greater than MCLs in February 2004. Contaminant levels within the monitoring wells are also decreasing (BMcD, 2004a and 2004b).

The following key elements of the selected remedy will be implemented:

- Monitoring the aquifer periodically in the zone of MNA,
- Restricting the installation and use of groundwater wells at and downgradient of the FFTA-MAAF Site (OU 004), and
- Providing sampling results to the affected off-site landowners until groundwater quality has been restored.
- Conducting a review no less often than every five years after initiation.

The remediation goal is to restore the groundwater to its beneficial use, which may include drinking water or non-domestic uses such as agricultural (livestock or irrigation). When groundwater cleanup levels (MCLs) have been achieved at all of the monitoring wells (on and off the FFTA-MAAF Site [OU 004]) and have not been exceeded for a period of three consecutive

years, the cleanup/remediation of the FFTA-MAAF Site (OU 004) and affected off-site areas will be considered complete, and the FFTA-MAAF Site (OU 004) will be recommended for close-out. A five-year will be conducted every five years for 20 years to evaluate the effectiveness of the remedy.

1.5 STATUTORY DETERMINATIONS

The DA, USEPA, and KDHE have determined that the selected remedy meets the requirements of CERCLA, and, to the extent practical, the NCP. The selected remedy was chosen over the other alternatives because it provides risk reduction through degradation of contaminants in the groundwater and provides measures to prevent future exposure to currently contaminated groundwater. Based on the information available at this time, the DA, USEPA, and KDHE believe the selected remedy will be protective of human health and the environment, will comply with applicable or relevant and appropriate requirements (ARARs), will be cost-effective, and will utilize permanent solutions to the maximum extent practicable (BMcD, 2004c). Although the selected remedy does not involve engineered treatment, it does rely on natural degradation processes already occurring at the FFTA-MAAF Site (OU 004) to further reduce contaminant concentrations to levels below the MCLs. Evidence of natural degradation processes at the Site, as per the USEPA MNA guidance document (USEPA, 1999a) included 1) decreasing contaminant concentration trend, and 2) supporting geochemical data measurements. The source of contamination in soil was successfully treated by SVE and bioventing in 1995. This treatment reduced concentrations of volatile organic compounds (VOCs) in soil to below levels that would continually leach to groundwater. As a result, the contamination was effectively removed, so no known source exists at the FFTA-MAAF Site (OU 004). In addition, natural attenuation/degradation of the VOCs plume(s) is effectively reducing the contamination based on available data. The selection of MNA as the selected remedy is based upon current and reasonably projected land use and exposures. However, hazardous substances, pollutants, or contaminants may remain at the FFTA-MAAF Site (OU 004) above levels that would allow for unlimited use and unrestricted exposure. The rationale for choosing this remedy is based on the fact that no source materials (such as liquids, areas contaminated with high concentrations of toxic compounds, or highly mobile materials) constituting principal threat wastes likely exist at the FFTA-MAAF Site (OU 004) that require further treatment.

Because this remedy will result in hazardous substances, pollutants or contaminants remaining at the FFTA-MAAF Site (OU 004) above levels that allow for unlimited use and unrestricted exposure, a review in accordance with the NCP will be conducted no less often than every five years after initiation of the

selected remedial action to ensure that the remedy is, or will be, protective of human health and the environment. The first five-year review of the selected remedy will include consideration of the following factors:

- the performance of MNA in achieving cleanup levels (MCLs),
- property above the groundwater plume to ensure that groundwater with contamination above cleanup levels (MCLs) is not used, and
- if no wells show groundwater cleanup levels at or below MCLs, a recommendation for discontinuing sampling and for closing the FFTA-MAAF Site (OU 004) will be made.

1.6 ROD DATA CERTIFICATION CHECKLIST

In accordance with *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents* (USEPA, 1999b), the following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record file for the FFTA-MAAF Site (OU 004).

- Chemicals of concern (COCs) and their respective concentrations (Page 2-16)
- Baseline risk represented by the COCs (Page 2-21)
- Cleanup levels established for COCs and the basis for these levels (Page 2-15)
- How source materials constituting principal threats are addressed (Page 2-46)
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater as defined in the baseline risk assessment (BLRA) and ROD (Pages 2-12 and 2-14, respectively)
- Potential land (Page 2-12) and groundwater (Page 2-14) use that will be available at the FFTA-MAAF Site (OU 004) as a result of the selected remedy
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (Pages 2-44 and Tables 2-32 through 2-34)
- Key factors that led to selecting the remedy (i.e., describe how the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (Page 2-47)

1.7 AUTHORIZING SIGNATURES

On the basis of the RI/Feasibility Study (FS) performed at the FFTA-MAAF Site (OU 004), the selected remedy, MNA with Institutional Controls, meets the requirements for remedial action set forth in CERCLA, as confirmed by the following signature pages.

Lead and Support Agency Acceptance of the ROD

Fort Riley Army Installation

FFTA-MAAF, OU 004

Signature sheet to the ROD for the FFTA-MAAF Site (OU 004) final action at the Fort Riley Installation between the United States Army, Fort Riley and the USEPA, Region VII, with concurrence by the State of Kansas acting through KDHE, BER.

Cecilia Tapia — 8/10/05

Cecilia Tapia — Date

Superfund Division Director, USEPA

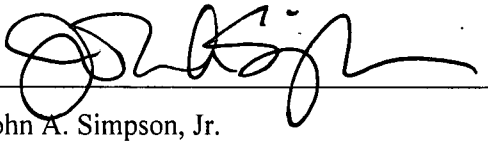
Lead and Support Agency Acceptance of the ROD

Fort Riley Army Installation

FFTA-MAAF, OU 004

Signature sheet to the ROD for the FFTA-MAAF

Site (OU 004) final action at the Fort Riley Installation between the United States Army, Fort Riley and the USEPA, Region VII, with concurrence by the State of Kansas acting through KDHE, BER.



7/21/05

John A. Simpson, Jr. Date

Colonel, United States Army

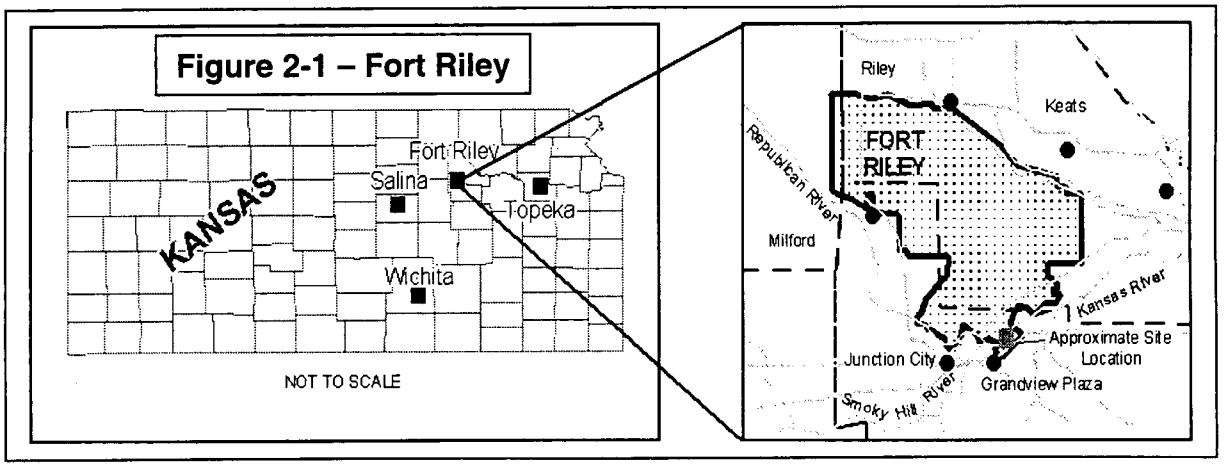
* * * * *

2.0 DECISION SUMMARY

This Decision Summary provides an overview of the problems posed by the groundwater conditions at the FFTA-MAAF Site (OU 004), the remedial alternatives, and the analysis of those options. In addition, this section explains the rationale for the remedy selection and describes how the selected remedy satisfies statutory requirements.

2.1 SITE NAME, LOCATION, AND DESCRIPTION

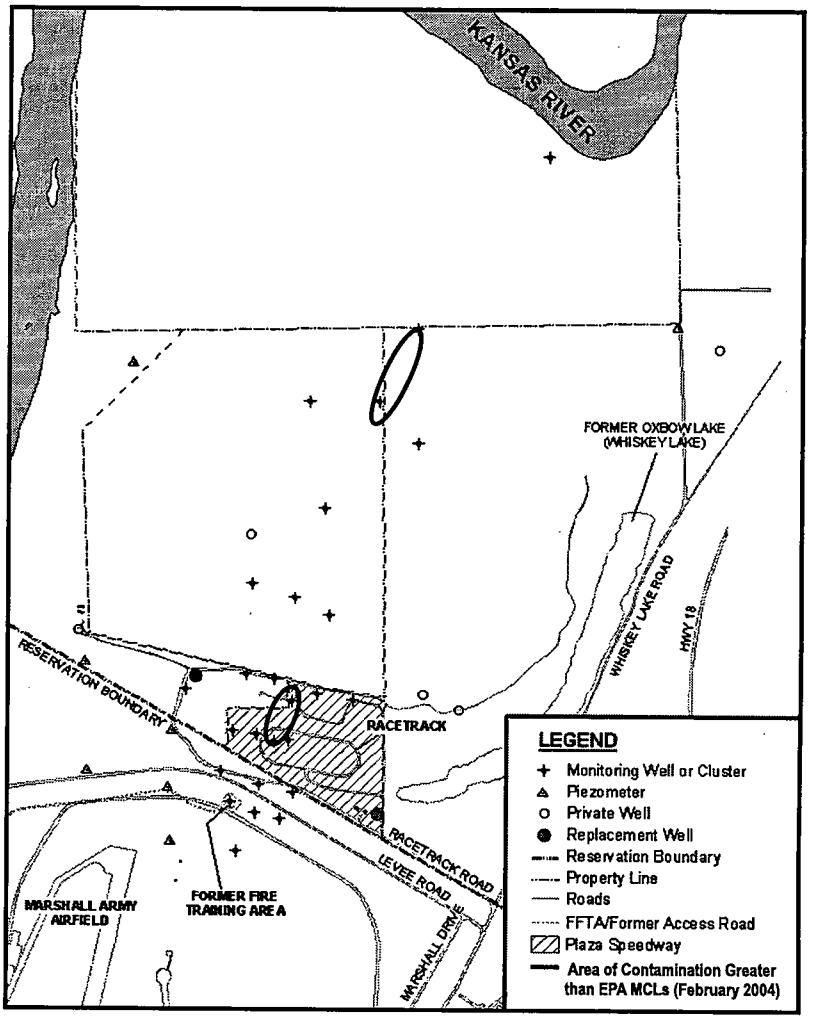
The FFTA-MAAF Site (OU 004) is located at the north end of the MAAF in the southern region of the Fort Riley Military Installation and extends to the Kansas River. MAAF is in the southern region of Fort Riley, south of the Kansas River (Figures 2-1 and 2-2). The term Site is used in this report to refer to the general area extending from the FFTA north to the Kansas River.



Fort Riley is identified by the USEPA as CERCLIS site KS6214020756. This document is issued by the DA, the lead agency for the activities at Fort Riley, with consultation with the USEPA and KDHE, the support agencies. Cleanup work at the FFTA-MAAF Site (OU 004) has been funded by the DA, Fort Riley through the Installation Restoration Program (IRP).

The FFTA-MAAF Site (OU 004) is located on the alluvial floodplain of the Kansas River. The material beneath the FFTA-MAAF Site (OU 004) consists primarily of unconsolidated alluvial sand and gravel deposits (with minor discontinuous lenses of silt and clay) that tend to coarsen downward to the bedrock surface. The top of bedrock is at a depth of approximately 60 to 70 feet (ft) below ground surface (bgs), and is composed of limestone and shale units that dip gently (less than ten degrees) to the west-northwest (BMcD, 2001a).

The Fort Riley National Priorities List (NPL) site currently encompasses five OUs around the military installation. The OUs have been designated by the DA, Fort Riley based on the results of prior investigations. The five OUs include: the Southwest Funston Landfill site (OU 001); the Pesticides Storage Facility site (OU 002); the Dry Cleaning Facilities Area (DCFA) site (OU 003); the FFTA-MAAF Site (OU 004); and the 354 Area solvent Detections site (OU 005). Two of the OUs, the 354 Area Solvent Detections site and the DCFA site, are currently the subject of feasibility studies (FSs) for cleanup/remediation of chlorinated solvents in groundwater.



2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

The FFTA was operated from the mid-1960s through 1984 to conduct fire-training exercises. During these exercises, flammable liquids were poured into the FFTA, ignited, and then extinguished. The predominant fuels used for the fire training exercises were JP-4 (jet fuel), diesel, and MOGAS (a generic term for leaded motor gasoline). In August 1982, reportedly 55 gallons of tetrachloroethene (PCE) were inadvertently poured into a pit at the FFTA. The next day it was pumped out of the pit and into 55-gallon drums. Fire fighting training has not been conducted at the FFTA since 1984. Contaminants at the FFTA-MAAF Site (OU 004) are believed to have entered the environment through the FFTA and moved downward through the soil to the groundwater. Some of these contaminants have migrated in the groundwater northward from the FFTA and currently exist under private property (BMcD, 2003c).

Environmental investigations and sampling events were performed at Fort Riley during the 1970s and 1980s. These investigations identified activities and facilities where hazardous substances had been released or had the potential to be released to the environment. Potential sources of contamination included landfills; printing, dry cleaning, and furniture shops; and pesticide storage facilities (BMcD, 2001a).

Hazard Ranking System (HRS) ranking was performed in 1988 by the USEPA based on the aggregation of three individual sites, the Southwest Funcston Landfill, the Main Post Landfill, and the Pesticide Storage Facility. It was noted that other potentially contaminated areas exist at Fort Riley (e.g., burn pits, fire training areas, and dry cleaner operations). These sites received a comprehensive score of 33.79. As a result, on July 14, 1989, the USEPA proposed inclusion of Fort Riley on the NPL pursuant to CERCLA. The USEPA formally listed Fort Riley on the NPL in August 1990 (BMcD, 2001a). Effective June 1991, the DA entered into a Federal Facility Agreement (FFA) with KDHE and USEPA Region VII to address environmental pollution subject to the Resource Conservation and Recovery Act (RCRA) and/or CERCLA (USEPA, 1991). This agreement is also referred to as the Interagency Agreement (IAG). Pursuant to the IAG, Fort Riley conducted an Installation Wide Site Assessment (IWSA) in 1992 (Louis Berger & Associates [LBA], 1992) to identify sites having the potential to release hazardous substances to the environment. The IWSA identified the FFTA-MAAF as one of the sites where releases of hazardous substances to the environment either have occurred or were likely to have occurred. Subsequent to the IWSA, in March 1994, a site investigation (SI) was conducted for the FFTA-MAAF. The SI results indicated that concentrations of organic compounds had been released to groundwater at concentrations exceeding federal and state drinking water standards. Also, similar contaminants were found in off-site private wells at levels above drinking water standards (LBA, 1994a). These results indicated that additional investigation and study at the FFTA-MAAF Site (OU 004) were necessary.

A source removal pilot test study was performed at the FFTA from November 1994 through May 1995. This remediation effort was successful in removing from the soil an estimated 1,896 pounds of contaminants (primarily petroleum hydrocarbon compounds) from one area and an estimated 472 pounds of contaminants (primarily PCE) from a second area (BMcD, 2004c). Soil samples were collected following the pilot study to confirm source removal. A comparison between pre-pilot study analytical results and post-pilot study analytical results revealed an overall reduction in the number and levels of chemicals detected in soils near the treatment area. Post-pilot study results are described in the RI report and in the *Data Summary Report for Post-Pilot Study Expanded Soil Sampling for the Expanded Site*

Investigation, Former Fire Training Area, Marshall Army Airfield, Fort Riley, Kansas, and Nearby Off-Post Properties (LBA, 1996a).

Since July 1994 through February 2004, the monitoring wells associated with the FFTA-MAAF Site (OU 004) have been sampled by LBA (July 1994 through December 1996) and BMcD (May 1997 through February 2004) as part of the groundwater monitoring program at Fort Riley. The results of these sampling events are provided in the Data Summary Reports (DSRs) for each event (LBA, 1994a, 1994b, 1994c, 1995a, 1995b, 1995c, 1995d, 1995e, 1996b, 1997a, and 1997c and BMcD, 1998a, 1998b, 1998d, 1998e, 1999a, 1999b, 1999c, 1999d, 2000a, 2000b, 2001b, 2001c, 2002b, 2002c, 2003a, 2004a, and 2004b).

In 1996, the DA, Fort Riley, began an RI/FS, including a BLRA (human health and ecological), to identify the types, quantities, locations, and risk of the contaminants at the FFTA-MAAF Site (OU 004) and to develop a plan to address the contamination problem. The resulting *Exposure Control Action Engineering Evaluation/Cost Analysis for the Former Fire Training Area, Marshall Army Airfield, Fort Riley, Kansas and Nearby Off-Post Properties* (LBA, 1997b) recommended the installation of two new supply wells within the aquifer in areas that have not been influenced by the groundwater plume. Two alternate water supply wells were installed in August 2002 after a lawsuit settlement to replace private wells impacted by the contaminant plume at the FFTA-MAAF Site (OU 004). The impacted private wells (M-1, R-1, and R-2) and two additional unimpacted wells (R-3 and R-4) were then abandoned. With the removal of these wells, there are no longer any private wells impacted by the contaminant plume at the FFTA-MAAF Site (OU 004) (BMcD, 2004c).

Another engineering evaluation/cost analysis (EE/CA) was performed in 1997 to describe current conditions and to propose a groundwater removal action for remediating threats to human health and the environment associated with the FFTA-MAAF Site (OU 004). The results of the EE/CA are presented in the *Draft Groundwater Engineering Evaluation/Cost Analysis for the Former Fire Training Area at Marshall Army Airfield, Fort Riley, Kansas* (BMcD, 1998c). The EE/CA was never finalized because the plume characterization activities defined a larger plume than anticipated and addressing hot-spot contamination was no longer applicable. It was agreed by Fort Riley, the U.S. Army Corps of Engineers, Kansas City District (CENWK), and regulators to suspend the report and proceed with the RI report and the FS report (BMcD, 2003c).

In 1996, the Army began an RI/FS to identify the types, quantities, and locations of the contaminants at the FFTA-MAAF Site (OU 004) and to develop a plan to address the contamination problem. The RI report provided the basis for the FS report which presents the alternatives available to address potential risk identified in the RI report. The USEPA and KDHE approved of the RI and FS reports in 2001 and 2003, respectively (BMcD, 2004c). In August 2004, two monitoring wells (FP-04-33b and FP-04-33c) were installed on the north bank of the Kansas River adjacent to the Southwest Funston Landfill to provide additional monitoring points at KDHE's request as part of the 2001 approval of the RI report.

The *Proposed Plan, FFTA-MAAF at Fort Riley, Kansas* (BMcD, 2004c), was issued as a supplement to the RI and FS reports to inform the public of Fort Riley's, USEPA's, and KDHE's preferred remedy based on information included in the Administrative Record and to solicit public comments pertaining to the remedial alternatives evaluated, including the preferred alternative. The Proposed Plan described the remedial alternatives considered for the FFTA-MAAF Site (OU 004) and identified the preferred remedial alternative with the rationale for this preference. Submitted on May 12, 2004, the Draft Final Proposed Plan was accepted by KDHE and by USEPA with no comments, as presented in the Responsiveness Summary which is Section 3.0 of this document.

2.3 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The RI/FS process was conducted in accordance with CERCLA requirements to document the comprehensive remedial activities and proposed remedial plan for the FFTA-MAAF Site (OU 004). Primary documents developed during the RI/FS process included the RI report (with the BLRA), FS report, and Proposed Plan for the FFTA-MAAF Site (OU 004) (BMcD, 2001a, 2003c, and 2004c, respectively). These reports were released to the public between April 1998 through August 2004 and have been made available for public review as part of the Administrative Record file at the Fort Riley Directorate of Public Works – Environmental Division (PWE), formerly known as the Directorate of Environment and Safety (DES). The Administrative Record is the set of supporting information used to determine the preferred alternative and is made available to the public. These reports were also made available to potentially affected persons and the public in the Dorothy Bramlage Public Library (Junction City) and Manhattan Public Library. The Proposed Plan can be viewed electronically by conducting a search at the following website: http://www.riley.army.mil/Services.

Notices of availability of these documents and the notice for the public meeting to discuss the Proposed Plan were published in the *Manhattan Mercury* and the *Junction City Daily Union* on July 11, 2004.

Additionally, personal letters inviting the five adjacent landowners (Thompson, Boller, More, Strauss, and Wahle) to comment on the Proposed Plan and attend the public meeting were sent by Fort Riley on June 29, 2004 (Saulters, 2004a).

A public comment period for this remedial action was declared from July 13, 2004 through August 11, 2004 to provide a reasonable opportunity for comment and to disseminate information regarding the Proposed Plan. No comments were received from the public (Saulters, 2004a).

A public meeting was held at the PWE, Building 407 Pershing Court, Fort Riley, Kansas at 7:00 pm local time on July 20, 2004 in conjunction with the Restoration Advisory Board (RAB) meeting to discuss the Proposed Plan. At this meeting, representatives for the DA, KDHE, and USEPA were available to inform the public about the FFTA-MAAF Site (OU 004) and remedial options under consideration. The official transcript for the public meeting was recorded and transcribed verbatim by Ms. Jennifer L. Gibson, court reporter. There were no significant comments made by the public during the meeting (Saulters, 2004a).

2.4 SCOPE AND ROLE OF OPERABLE UNIT

This response action will be the final response action for the FFTA-MAAF Site (OU 004). Other actions will be implemented at the other OUs on the Fort Riley military installation which may include pilot studies, removal actions, and/or remedial actions under the investigation, removal, or remedial authorities of CERCLA. This response action will be conducted under the remedial authority of CERCLA. The FFTA-MAAF Site (OU 004) is part of the overall cleanup of the Fort Riley NPL site that currently includes five OUs. The FFTA-MAAF Site (OU 004) is a discrete area of contamination that does not affect or is not affected by the other OUs at the Fort Riley NPL site. OUs 001 and 002 are the first OUs that have progressed to the remedy selection phase and have approved RODs. Other OUs are being addressed in subsequent phases to their initial investigations. OUs 003 and 004 are in the FS phase.

The selected response action addresses the remedial action objectives (RAOs) established for the FFTA-MAAF Site (OU 004). Refer to Section 2.8 for more information on RAOs and PRGs.

2.5 SITE CHARACTERISTICS

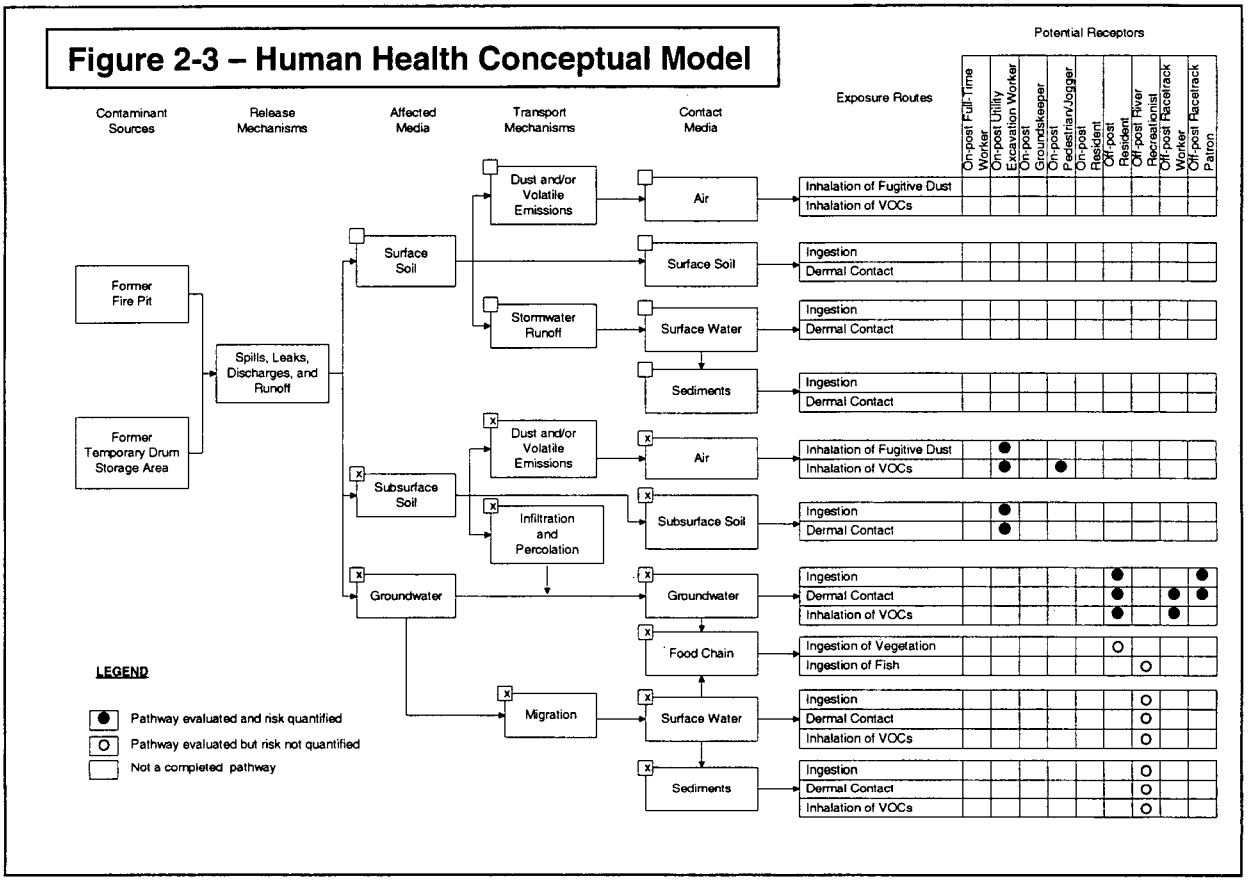
The conceptual site model (CSM); site overview; summary of surface and subsurface features; sampling strategy; known or suspected sources, types, and location of contamination; and nature and extent of

contamination are discussed below. Additional details regarding the FFTA-MAAF Site (OU 004) characteristics are provided in the RI report (BMcD, 2001a).

2.5.1 Conceptual Site Model

As presented in the CMS (Figure 2-3), the following pathways for current and future receptors were considered. Reasonable exposure scenarios were developed based on how the FFTA-MAAF Site (OU 004) is currently used and assumptions about its future use, physical site features, and zoning. In addition, exposure to contaminants migrating off the site into nearby residences was evaluated.

Figure 2-3 – Human Health Conceptual Model



2.5.2 Site Overview

MAAF is in the southern region of Fort Riley, south of the Kansas River. The FFTA is located at the north end of MAAF, approximately 300 ft southwest of the Fort Riley reservation boundary (Figures 2-1 [Page 2-1] and 2-2 [Page 2-2]). The source of contamination in soil, which was located in the former drum storage area and former burn pit area, was reduced to concentrations below the levels determined by KDHE that would prevent further leaching of contaminants to groundwater. For further information on the source removal, refer to the Pilot Study Report (LBA, 1999). The groundwater plume originated from the

fire training pit area at the FFTA, but has migrated from the FFTA in a northeasterly direction toward the Kansas River.

The FFTA-MAAF Site (OU 004) is located on the alluvial floodplain of the Kansas River. The material beneath the FFTA-MAAF Site (OU 004) consists primarily of unconsolidated alluvial sand and gravel deposits (with minor discontinuous lenses of silt and clay) that tend to coarsen downward to the bedrock surface. The top of bedrock is at a depth of approximately 60 to 70 ft bgs, and is composed of limestone and shale units that dip gently (less than ten degrees) to the west-northwest (BMcD, 2003c). A more detailed description of the geology of the FFTA-MAAF Site (OU 004) is presented in the RI report (BMcD, 2001a).

2.5.3 Surface and Subsurface Features

The FFTA-MAAF is covered with soil and has a well-established grass cover; its previous location is no longer discernible in the field. After use of the FFTA-MAAF was discontinued in 1984, a new road and associated drainage ditch were constructed along the northern edge of the airfield. A new road runs south of the boundary of the former FFTA-MAAF burn pit and the new drainage ditch transects the former burn pit. Surface soil was excavated from portions of the FFTA-MAAF during road construction to complete the project and improve surface drainage. As needed, soil was spread in nearby areas consistent with the natural topography. With the exception of the drainage ditch and a low area east of the former burn pit, the surrounding area is relatively flat with a gentle grade to the south.

The FFTA-MAAF Site (OU 004) is underlain by the alluvial aquifer of the Kansas River valley. This aquifer is unconfined and connected hydraulically to the Kansas River. Underlying the alluvial sediments is bedrock composed of limestone and shale units that are considered relatively impermeable, compared to the highly permeable alluvial sediments.

Water table elevations at the FFTA-MAAF Site (OU 004) generally have ranged between 1,036 and 1,043 ft above mean sea level (msl), or approximately 20 to 25 ft bgs. Groundwater flow within the alluvium is generally toward the north-northeast and parallel to the alluvial valley. For any one sampling event, the horizontal component of the hydraulic gradient has typically been in the range of 0.0006 to 0.0009 ft/ft.

Horizontal hydraulic conductivity ranges from 600 ft/day to 900 ft/day and increases with depth. Effective porosity (excluding shallow clay samples) ranges from 0.31 to 0.40, with a mean of 0.35. A more detailed

description of the hydrogeology of the FFTA-MAAF Site (OU 004) is presented in Section 2.5 of the RI report (BMcD, 2001).

2.5.4 Sampling Strategy

The FFTA-MAAF Site (OU 004) has been extensively investigated and monitored. Samples have been collected from soil and groundwater to define the extent of contamination. Only contaminated groundwater above MCLs remains on and off the site at the FFTA-MAAF Site (OU 004). Details regarding the historical sampling events are provided in the RI report (BMcD, 2001a) and DSRs (LBA, 1994a, 1994b, 1994c, 1995a, 1995b, 1995c, 1995d, 1995e, 1996b, 1997a, and 1997c and BMcD, 1998a, 1998b, 1998d, 1998e, 1999a, 1999b, 1999c, 1999d, 2000a, 2000b, 2001b, 2001c, 2002b, 2002c, 2003a, 2004a, and 2004b).

Metals above background levels (beryllium, cadmium, copper, lead, selenium, and zinc) and semi-volatile organic compounds (SVOCs), including naphthalene and 2-methylnaphthalene, were detected in a limited number of soil samples located at or near the FFTA-MAAF Site (OU 004) during the April 1996 post-pilot study soil sampling (LBA, 1996a). Chlorinated solvents, including PCE, trichloroethene (TCE), and cis-1,2-dichloroethene (DCE), have been detected in soil samples located at or near the former drum storage area. Vinyl chloride (VC) was not detected in soil samples at the FFTA. Petroleum products, including total volatile petroleum hydrocarbons (TVPH), total petroleum hydrocarbon (TPH) as diesel fuel, and TPH in the $C_{19} - C_{40}$ range (Note: This range is typically referred to as motor oil) were detected in soil samples located at or near the FFTA in June 1999 (BMcD, 2001a). Petroleum VOCs including ethylbenzene, toluene, and xylenes were also detected in soil samples located at or near the FFTA in June 1999 (BMcD, 2001a). Tables 2-1 and 2-2 present the positive VOC and TPH detections in the pre-pilot study soil borings, respectively. Tables 2-3, 2-4, and 2-5 present the positive VOC, TPH, metals detections in the post-pilot study soil borings, respectively.

Groundwater samples were analyzed for metals at the FFTA-MAAF Site (OU 004) as a screen for determining COPCs, which is further detailed in Section 2.7.1. Metals were all detected at levels below the MCLs in diverse locations and are not known to be associated with activities conducted at the FFTA-MAAF Site (OU 004). Chlorinated solvents including PCE, TCE, cis-1,2-DCE, and VC were detected in groundwater samples at the FFTA-MAAF Site (OU 004) in 2002. Petroleum products including benzene, ethylbenzene, xylene (total), and naphthalene were detected in groundwater samples at the FFTA-MAAF Site (OU 004) in 2002. TPH-Diesel Range Organics (DRO) and TPH-Gasoline Range Organics (GRO)

were also detected in groundwater samples at the FFTA-MAAF Site (OU 004) in 2002 (BMcD, 2003c). Table 2-6 presents the positive VOC, SVOC, TPH, metal, natural attenuation parameter, and general water quality parameter detections at the FFTA-MAAF Site (OU 004) from May 1997 through March 2005. Table 2-6 also presents the associated MCLs, the highest and lowest concentrations reported, and the most recent concentrations reported (March 2005).

Fifty-five surface water samples were collected along five cross-sections of the Kansas River in July 1999 (BMcD, 1999a) and twenty samples were collected along two cross-sections in March 2000 by the United States Geological Survey (USGS) (BMcD, 2000b). These samples were collected both upstream and downstream of the point where the groundwater plume enters the river. The samples were analyzed for VOCs. VOCs were not detected in any samples (BMcD, 2003c).

2.5.5 Known or Suspected Sources, Types, and Location of Contamination / Nature and Extent of Contamination

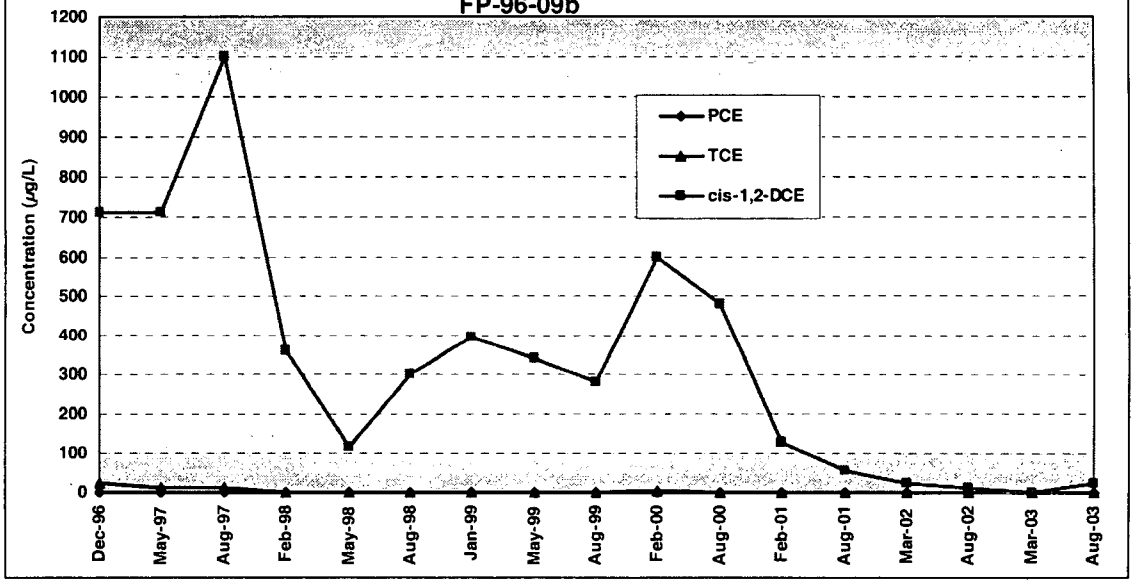
The known or suspected sources, types, and location (nature and extent) of contamination are presented in the RI report (BMcD, 2001a); however, major findings of the RI report are as follows:

- Soil contamination was detected over a 120-ft by 240-ft area to a depth of 15 ft in the FFTA. The levels of the soil contaminants, including chlorinated solvents and petroleum hydrocarbons, were reduced at the FFTA through a source removal pilot study in 1995 (BMcD, 2001a). Soil data following treatment in 1995 confirms that there is no source material remaining that would make the soil classified as a principal threat waste. The concentrations of VOCs remaining in the soil do not contribute to or drive the risk at the FFTA-MAAF Site (OU 004) (See Table 2-5).
- As an alternative water supply/interim removal action, two private water supply wells were installed and five existing wells were abandoned in 2002. The two new wells are located outside of the contaminated groundwater plume, thus further reducing the potential human health risk.
- The two COCs (TCE and cis-1,2-DCE) present in the dissolved phase in groundwater drive the need for remedial action at the FFTA-MAAF Site (OU 004) (See Table 2-2). Data have not indicated that there is source material (e.g., liquids, areas of contamination with high concentrations of toxic compounds, highly mobile materials, or dense non-aqueous phase liquids [DNAPLs]) in the soil or groundwater at the FFTA-MAAF Site (OU 004).

- Groundwater is a medium of concern at the FFTA-MAAF Site (OU 004). The COCs (TCE and cis-1,2-DCE) were detected in groundwater at concentrations exceeding MCLs (See Table 2-2). TCE and cis-1,2-DCE are the degradation products of the PCE spilled at the FFTA-MAAF Site (OU 004) (BMcD, 2001a).

- The groundwater contamination at the FFTA-MAAF Site (OU 004) extends from the FFTA to the Kansas River and generally increases in depth with distance from the FFTA. Analytical samples from the Kansas River were nondetect for the COCs. Current conditions (as of February 2004) show contamination reduction from amounts that existed at the time of the RI and FS reports (BMcD, 2001a, 2003c, and 2004b). As shown on Figure 2-4, the contaminants in Monitoring Well FP-96-09b have decreased significantly since the start of monitoring in 1996. This well is located approximately 300 yards down the groundwater flow path from the FFTA and displays contaminant concentration trends representative of the monitoring wells within the plume.

Figure 2-4 - Monitoring Well FP-96-09b



- Based on the groundwater monitoring conducted in February 2004, the overall concentration trend of chlorinated solvents at the FFTA-MAAF Site (OU 004) continues to decrease, with only one chlorinated solvent (cis-1,2-DCE) remaining at concentrations slightly above the MCL, as discussed below:

- In February 2004, PCE was detected in two monitoring wells at concentrations below the MCL. PCE has remained below the MCL in all wells since March 2002. PCE is anticipated to remain below the MCL based on modeling and the trend over the past two years (BMcD, 2004b).
- In February 2004, TCE was detected in eleven monitoring wells at concentrations below the MCL. TCE has remained below the MCL in all wells since August 2003 when only one well contained TCE above the MCL. TCE concentrations have been consistently decreasing since August 2002 and are anticipated to remain below the MCL at the FFTA-MAAF Site (OU 004) based on modeling and the trend over the past two years (BMcD, 2004b).
- cis-1,2-DCE was detected in 22 monitoring wells in February 2004; however, only three of these detections exceeded the MCL at concentrations of 90.5 micrograms per liter (µg/L), 91.8 µg/L, and 106 µg/L. cis-1,2-DCE concentrations in 30 of the 35 wells at FFTA-MAAF have been consistently decreasing. The exception to this is shallow Monitoring Wells FP-93-02 (increasing), FP-96-25 (increasing), and FP-96-26 (increasing); and intermediate Monitoring Wells FP-96-26b (fluctuating) and FP-98-31b (steady state). These few well locations where cis-1,2-DCE concentrations have increased, fluctuated, or held at a steady state are likely the result of the varying amount of degradation of the parent compound, TCE (BMcD, 2004b).

- Natural attenuation of contaminants is the dominant mechanism for the decrease in contaminant levels in groundwater at the FFTA-MAAF Site (OU 004). Natural attenuation was determined to be occurring at the FFTA-MAAF Site (OU 004) due to the presence of degradation products of PCE and favorable natural attenuation parameters (temperature, pH, methane, alkalinity, nitrate as nitrogen, sulfate, chloride, total organic carbon [TOC], dissolved oxygen [DO], oxidation-reduction potential [ORP], and ferrous iron [Fe^{+2}]) (BMcD, 2001a).

2.6 CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

2.6.1 Land Uses

The FFTA is part of the Fort Riley reservation and, as such, is not zoned by the county. The FFTA is at the northern edge of MAAF, just beyond the airport perimeter road (BMcD, 2001a). Land uses at MAAF must be in compliance with Executive Order 11988 -- Floodplain Management. This Order restricts and places requirements on actions that occur within a floodplain (www.fema.gov/library/eo11988.shtm, 2005).

Land use on MAAF is related to the operation of an active military airfield. The level of activity at MAAF has decreased significantly over the past few years due to reassignment of aviation units to other bases. However, land use for MAAF in the short and long term is expected to continue to be active military (BMcD, 2001a).

The Department of Defense (DoD) requires the establishment of aircraft safety zones near military airfields. According to the Installation Compatibility Use Zone Study (ICUZ), prepared for Fort Riley by Robert and Company, the FFTA-MAAF lies west of aircraft accident potential zones (APZ), APZ-I and APZ-II. APZ-I is designated as an approach safety zone and APZ-II an accident potential zone (Robert & Company, 1993) [Updated in 2000].

DoD guidelines, as stated in ICUZ, prevent uses in aircraft zones which have a high residential density, large numbers of workers, concentrate (sic) of people not able to respond well to emergencies, among other restrictions. ICUZ also states DoD policy that structures should be located toward the edges of this zone wherever possible. Although there is currently little aircraft activity at MAAF, ICUZ points out that development should still be limited (Robert & Company, 1993).

A small triangular tract of property north of the levee and the racetrack road is owned by the Fort Riley reservation, but is leased as a safety zone to Plaza Speedway (referred to as Junction City Raceway on the property lease). The lease agreement restricts construction of any permanent structure on the subject property (BMcD, 2001a).

The actual racetrack north of the FFTA is zoned commercial by Geary County. Commercial zoning allows the use of a mobile home for sales, but not for residence (BMcD, 2001a).

Property west of the racetrack is zoned by Geary County for agricultural use. Residential and other public institutions could be permitted by the county in agricultural districts, as defined in the *Geary County Zoning Regulations* prepared by Bucher Willis & Ratliff for the county (Bucher, et. al., 1986). However, because the location of this land is within the Kansas River 100-year floodplain, development of this kind is not likely to occur in the future (BMcD, 2001a).

In addition, the Flint Hills Joint Land Use Study (JLUS) is currently underway. The JLUS is a cooperative land use planning initiative between Fort Riley and surrounding cities and counties. The purpose of the

JLUS is to increase cooperation between the military and the community and promote awareness of the strong economic and physical relationship between Fort Riley and its neighbors. The study will evaluate both the impacts of current and future Fort Riley operations on surrounding cities and counties, as well as the potential impacts of community growth on the long-term viability of Fort Riley's mission (www.edaw.com/flinthillsjlus, 2005).

The ultimate goal of the JLUS is to reduce potential land use conflicts, while accommodating necessary growth and sustaining the area's economy. The JLUS will identify measures that can reduce existing impacts and prevent future conflicts from developing. After the JLUS process is over, Fort Riley and the surrounding cities and counties will consider which of the recommended measures may be adopted and implemented (www.edaw.com/flinthillsjlus, 2005).

2.6.2 Water Uses

The Fort Riley water supply wells are located approximately four miles upgradient (west) of the FFTA-MAAF Site (OU 004) near Camp Forsyth. The nearest water supply well (used as a backup well) is in Building 801 at MAAF, within one mile of the FFTA-MAAF Site (OU 004). This well is south and upgradient of the FFTA-MAAF Site (OU 004). The purpose of the well at Building 801 is to service the airfield in the event of an emergency affecting the Fort Riley water distribution system (BMcD, 2001a).

There are seven remaining private wells north of the FFTA. Six of these wells (identified as Wells F-1, F-2, I-1, N-1, M02-02, and R02-02) are located within the Kansas River valley and one well (identified as Well B-1) appears to be near the margin of the valley and the upland terrace. None of these wells fall within the plume based on the available data collected through February 2004. Of the six wells located in the river valley, two presently supply water for domestic use (Wells M02-02 and R02-02). Wells F-1 and F-2 are located at an abandoned trailer house; one of these wells is reported to supply water for livestock. Well R02-02 is located at the racetrack, and Well M02-02 us located at a residence approximately 400 ft north of the FFTA-MAAF Site (OU 004). Well I-1 is an irrigation well approximately 2,400 ft north (downgradient) of the FFTA. During calendar years 1997 and 1998, water use from this well was reported to be 25.1 million gallons and 15.6 million gallons, respectively. The seventh well (identified as Well B-1) is located at a residence approximately 6,000 ft northeast of the FFTA-MAAF Site (OU 004) near the edge of the river valley. This well supplies water to a residence for domestic use (BMcD, 2001a).

The major river in the area is the Kansas River, which runs along the southern portion of Fort Riley. None of the surface waters are used as a direct source for drinking water, but are used for recreational purposes, such as for swimming and fishing.

There are no reasonably anticipated changes in the future water uses at the Site.

For more information regarding water uses and hydrogeology at the FFTA-MAAF Site (OU 004), refer to the RI report (BMcD, 2001a).

2.7 SUMMARY OF SITE RISKS

The BLRA (human health and ecological) that was completed for the FFTA-MAAF Site (OU 004) in 2001 found that the estimated risks to human health and the environment were within or below the USEPA acceptable levels. However, the DA Fort Riley's remedy decision is based primarily on the presence of site-related contaminants present off the site in the alluvial aquifer at levels exceeding drinking water standards (MCLs), identified as an ARAR. The off-site contamination has affected nearby wells at the racetrack and adjacent farms along the Kansas River. Installation of alternate water supply wells has addressed the off-site contamination, and there is currently no human use of groundwater at the FFTA-MAAF Site (OU 004). The source of contamination in soil was reduced to concentrations below the KDHE soil to groundwater protection pathway that would prevent further leaching of contaminants to groundwater. The source reduction occurred through a source removal pilot study (using SVE and bioventing technologies) and was completed in May of 1995. The levels of VOCs remaining in the soil do not contribute to or drive the risk at the FFTA-MAAF Site (OU 004). Natural attenuation, combined with the source removal, has been responsible for the continuing decrease of contaminant levels in groundwater. However, future use of the groundwater at the FFTA-MAAF Site (OU 004) and off the site would be affected if current concentrations of contamination do not decrease to below the MCLs and development allows for use of the groundwater for drinking water. For this reason, despite the absence of current human health or ecological risks, the exceedance of MCLs provides the basis for remedial action at the FFTA-MAAF Site (OU 004).

Although additional sampling of groundwater has occurred since 2001 and an alternative water supply interim remedial action was successfully completed in 2002, the BLRA presented in the RI was not updated for this ROD. The RI (BLRA), the FS, and the FFTA-MAAF Site (OU 004) Proposed Plan may be found in the Administrative Record file for the FFTA-MAAF Site (OU 004). Although the results of the BLRA are not the basis for remedial action at the FFTA-MAAF Site (OU 004), a brief discussion of

the contaminants and exposures that were evaluated is appropriate. The following subsections of the ROD summarize the human health and ecological risk assessments that were conducted as part of the RI at the FFTA-MAAF Site (OU 004).

2.7.1 Summary of Human Health Risk Assessment

This subsection provides a brief summary of the four primary components of the human health risk assessment: identification of chemicals of potential concern (COPCs), the exposure assessment, the toxicity assessment, and the risk characterization. Details regarding each of these areas can be found in Section 7 of the RI report (BMcD, 2001a).

Identification of Chemicals of Potential Concern

The COPCs selection process considered detection frequency, impacted media, chemical mobility and toxicity, availability of toxicological information, and chemical family. The chemicals selected as COPCs generally were detected at more than 5 percent frequency, could reasonably be expected to be present based on history of the FFTA-MAAF Site (OU 004), were degradation products of positively detected compounds, and/or were identified as known human carcinogens.

The following chemicals were selected as COPCs in subsurface soil: benzene, ethylbenzene, 2-methylnaphthalene, naphthalene, toluene, xylenes, cis-1,2-DCE, PCE, and TCE. Of these COPCs, only xylenes and PCE were detected above 5 percent frequency during the RI (BMcD, 2001a). The remaining chemicals in the list were retained as COPCs since the FFTA-MAAF soil is believed to be the originating source of contamination in groundwater. Benzene was not detected in soil during either the Post-Pilot Study or during the RI (BMcD, 2001a). Benzene is highly mobile in soil and has probably all leached to the groundwater, but because it is considered a Class A carcinogen (i.e., a known human carcinogen) and it may be present at concentrations below the detection limit, it was retained as a COPC (BMcD, 2001a). A summary of the COPCs, including the range and frequency of detections in soil is presented in Table 2-7.

For groundwater, the following were selected as COPCs: benzene, ethylbenzene, toluene, xylenes, naphthalene, 1,1-DCE, cis and trans-1,2-DCE, PCE, TCE, and VC. 1,1-DCE and VC were not detected in on-post wells, but were detected at 2 percent frequency in off-post wells. Because they are considered daughter products of PCE degradation, 1,1-DCE and VC were retained as COPCs, as per RAGS Part A guidance (USEPA, 1989). Further, VC is considered a Class A carcinogen. Although detected in on-post wells, naphthalene and xylenes were not detected in off-post wells during the RI (BMcD, 2001a). The

only historical detection of xylene was in Monitoring Well FP-94-11, located at the racetrack. Naphthalene has never been detected in off-post groundwater samples. This indicates that xylenes and naphthalene are not migrating significantly, if at all. However, to be conservative, xylenes and naphthalene were retained as COPCs in groundwater (BMcD, 2001a). A summary of the COPCs, including the range and frequency of detections in on-post and off-post groundwater is presented in Tables 2-8 and 2-9, respectively. Table 2-10 summarizes the COPCs included in the human health risk assessment.

Exposure Assessment

In the exposure assessment, potentially exposed populations and potential pathways of exposure are identified. A Human Health CSM showing potentially completed pathways is presented as Figure 2-3 (Page 2-7).

The risk assessment evaluated potential exposures to both on-post and off-post populations. The on-post populations (those within the Fort Riley Army Reservation) included pedestrians/joggers and utility excavation workers. The off-post populations included racetrack workers and racetrack patrons (adults and children), current residents (adults and children), and future residents (adult farmers and children).

Based on the Human Health CSM, the potentially completed exposure pathways evaluated for each population are as follows:

- On-Post Pedestrians/Joggers – Inhalation of vapor phase chemicals from soil.
- On-Post Utility Excavation Workers – Ingestion of chemicals in soil, dermal contact with chemicals in soil, inhalation of dust, and inhalation of vapor phase chemicals from soil.
- Off-Post Racetrack Workers – Ingestion of chemicals in water, dermal contact with chemicals while showering, and inhalation of vapor phase chemicals in water.
- Off-Post Child and Adult Racetrack Patrons – Ingestion and dermal contact with chemicals in water.
- Current Off-Post Child and Adult Residents – Ingestion of chemicals in water, dermal contact with chemicals while showering, and inhalation of vapor phase chemicals while showering.
- Future Off-Post Child and Adult Farmer Residents – Ingestion of chemicals in water, dermal contact with chemicals while showering, and inhalation of vapor phase chemicals while showering, and inhalation of vapor phase chemicals while irrigating crops (adult farmer only).

The potential for human health risk due to exposure to chemicals at the Site was considered for soil, water, and air media. Based on observed Site conditions at the time of the RI report, it was concluded that chemical exposure was possible to off-post populations through contact with groundwater (BMcD, 2001a). USEPA's *Supplemental Guidance to RAGS, Calculating the Concentration Term* (USEPA, 1992c) specifies that the reasonable maximum exposure (RME) concentration for a receptor population be calculated using the 95 percent upper confidence limit (UCL) of the arithmetic mean of chemical concentrations. These values were calculated assuming a lognormal distribution of the data. However, there are instances where the 95 percent UCL can be greater that the maximum detected value, such as when there are elevated detection limits or small sample sizes with great variability. In these situations, USEPA recommends that the maximum detected concentration be used.

The maximum detected concentrations and the 95 percent UCLs are shown in Tables 2-5 through 2-8, with the values used in calculations specified. Table 2-11 presents the subsurface soil data (1-8 feet bgs) that were used in the on-post pedestrian/jogger scenario. Table 2-12 presents Well R-2 groundwater data that were used in the racetrack worker scenario. Table 2-13 presents Well R-1 groundwater data that were used in the adult and child racetrack patron scenarios. Table 2-14 presents Well M-1 groundwater data that were used in the adult and child resident scenarios.

Except for the future child and adult farmer residential scenario, exposure concentrations were based on actual data from the FFTA-MAAF Site (OU 004). Groundwater fate and transport modeling was conducted to estimate future maximum concentrations off the Post, which were used as the exposure concentrations for the future residential scenario. Intake assumptions were based on USEPA guidance and are described in detail in the RI report (BMcD, 2001a). Major assumptions used to calculate intake are presented below:

- On-Post Pedestrians/Joggers – Inhalation of vapor phase chemicals from soil.
  - Weight – 70 kilograms (kg)
  - Inhalation Intake – 3.2 cubic meters of air per hour ($m^3$of air/hr)
  - Exposure Time, Frequency, and Duration - Considered either an on-post resident or regular full-time worker who is in the FFTA-MAAF area for 15 minutes a day, 350 days per year, for 30 years

- On-Post Utility Excavation Workers – Ingestion of chemicals in soil, dermal contact with chemicals in soil, inhalation of dust, and inhalation of vapor phase chemicals from soil.

- Weight – 70 kilograms (kg)
- Exposed Skin Area – 3,160 square centimeters (cm^2)
- Soil to Skin Adherence Factor – 0.21 milligrams (mg)/cm^2
- Inhalation Intake – 2.5 m^3 of air/hr)
- Soil Ingestion Intake – 100 mg/day
- Variable Fraction of Soil Ingested from Contaminated Source - 1
- Exposure Time, Frequency, and Duration – Workers conduct excavation work in the FFTA-MAAF area for 8 hours a day, 6 days per year, for 25 years

- Off-Post Racetrack Workers – Ingestion of chemicals in water, dermal contact with chemicals while showering, and inhalation of vapor phase chemicals in water.
  - Weight – 70 kilograms (kg)
  - Contaminated Water Ingestion Intake – 1 liter (L) per workday
  - Inhalation Intake – 2.5 m^3 of air/hr)
  - Exposure Time, Frequency, and Duration – Workers spend 8 hours (working) and 15 minutes (showering) a day, 1 day per week, for 18 weeks per year, for 25 years

- Off-Post Child and Adult Racetrack Patrons – Ingestion and dermal contact with chemicals in water.
  - Adult Weight – 70 kilograms (kg)
  - Adult Exposed Skin Area (while washing hands) – 1,980 cm^2
  - Adult Contaminated Water Ingestion Intake (for 3 hours at the Racetrack) – 0.4 L per day
  - Adult Exposure Time, Frequency, and Duration – Patrons attend races 1day each weekend, spend 15 minutes washing their hands each day at the racetrack, for 18 weeks per year, for 30 years
  - Child (3 – 9 years old) Weight – 21 kilograms (kg)
  - Child Exposed Skin Area (while washing hands) – 990 cm^2
  - Child Contaminated Water Ingestion Intake (for 3 hours at the Racetrack) – 0.2 L per day
  - Child Exposure Time, Frequency, and Duration – Patrons attend races 1day each weekend, spend 15 minutes washing their hands each day at the racetrack, for 18 weeks per year, for 6 years

- Current Off-Post Child and Adult Residents – Ingestion of chemicals in water, dermal contact with chemicals while showering, and inhalation of vapor phase chemicals while showering.
  - Adult Weight – 70 kilograms (kg)

- Adult Exposed Skin Area (while showering) – 19,400 cm^2
- Adult Inhalation Intake – 1 m^3/hr (while showering)
- Adult Contaminated Water Ingestion Intake – 2 L per day
- Adult Exposure Time, Frequency, and Duration – Residents spend 15 minutes showering (for dermal exposure) each day for 350 days per year, for 30 years.
- Adult Exposure Time, Frequency, and Duration – Residents spend 20 minutes in the bathroom (15 minutes showering and 5 minutes following their shower/bath) each day for 350 days per year, for 30 years (for inhalation exposure)
- Note that the exposure duration for carcinogenic risk characterization was assumed to be 30 years, 6 of which were as a child.
- Child (1 – 6 years old) Weight – 15 kg
- Child Exposed Skin Area (while showering) – 8,023 cm^2
- Child Inhalation Intake (while showering) – 1.2 m^3/hr
- Child Contaminated Water Ingestion Intake – 1 L/day
- Child Exposure Time, Frequency, and Duration – Residents spend 20 minutes showering (for dermal exposure) each day for 350 days per year, for 6 years.
- Child Exposure Time, Frequency, and Duration – Residents spend 25 minutes in the bathroom (20 minutes showering and 5 minutes following their shower/bath) (for inhalation exposure) each day for 350 days per year, for 6 years.

• Future Off-Post Child and Adult Farmer Residents – Ingestion of chemicals in water, dermal contact with chemicals while showering, and inhalation of vapor phase chemicals while showering, and inhalation of vapor phase chemicals while irrigating crops (adult farmer only).
- Adult Weight – 70 kilograms (kg)
- Adult Exposed Skin Area (while showering) – 19,400 cm^2
- Adult Inhalation Intake – 1 m^3/hr (while showering) and 2.5 m^3/hr (while tending to crops)
- Adult Contaminated Water Ingestion Intake – 2 L per day
- Adult Exposure Time, Frequency, and Duration – Residents spend 15 minutes showering (for dermal exposure) each day for 350 days per year, for 30 years.
- Adult Exposure Time, Frequency, and Duration – Residents spend 20 minutes in the bathroom (15 minutes showering and 5 minutes following their shower/bath) each day for 350 days per year, for 30 years (for inhalation exposure) and spend 1 hour per day, for 45 days per year, for 25 years (tending to crops in the downwind vicinity of a sprinkler irrigation system).

- Note that the exposure duration for carcinogenic risk characterization was assumed to be 30 years, 6 of which were as a child.
- Child (1 – 6 years old) Weight – 15 kg
- Child Exposed Skin Area (while showering) – 8,023 cm^2
- Child Inhalation Intake (while showering) – 1.2 m^3/hr
- Child Contaminated Water Ingestion Intake – 1 L/day
- Child Exposure Time, Frequency, and Duration – Residents spend 20 minutes showering (for dermal exposure) each day for 350 days per year, for 6 years.
- Child Exposure Time, Frequency, and Duration – Residents spend 25 minutes in the bathroom (20 minutes showering and 5 minutes following their shower/bath) (for inhalation exposure) each day for 350 days per year, for 6 years.

Toxicity Assessment

In a risk assessment, toxicity of COPCs is evaluated for both carcinogenic potential and noncarcinogenic adverse health effects. Data regarding health effects are then used to derive numerical toxicity values. Toxicity values used in the risk assessment were obtained from the following sources (listed in order of preference):

- Integrated Risk Information System (IRIS) (USEPA, 2000a),
- Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997a), and
- The USEPA National Center for Environmental Assessment Superfund Technical Support Center (USEPA, 1999c).

Risk Characterization

The noncarcinogenic risk value, the hazard quotient, represents the ratio of the chemical-specific intake rate to the toxicity value for that chemical. Hazard quotients are summed within each pathway and then for all pathways for a total hazard index. If the total hazard index is one or less, it is unlikely for even sensitive populations to experience adverse health effects within the described scenario. Tables 2-15, 2-16, 2-17, 2-18, 2-19, 2-20, 2-21, 2-22, and 2-23 show the intakes, reference values, and hazard quotients (HQs) for the on-post pedestrian jogger, the future on-post utility excavation worker, the current racetrack worker, the child racetrack patron, the adult racetrack patron, the current off-post child resident, the current off-post adult resident, the future off-post child resident, and the future off-post adult resident farmer, respectively. Please note that the values presented in Tables 2-15, 2-16, 2-17, 2-18, 2-19, 2-20, 2-21, 2-22, and 2-23 are in scientific notation (i.e., 2E-03 instead of 0.002). Also note that the tables show that the

noncarcinogenic hazard indices did not exceed the USEPA acceptable level for the exposure scenarios evaluated.

Carcinogenic risk represents the probability of developing cancer as a result of exposure to a given chemical. The chemical-specific risks are summed within each pathway and then for all pathways to yield total excess cancer risk posed by a site. This represents the probability of developing cancer that is solely attributable to exposure from the site and is in excess of the general background risk. USEPA has established the risk range of one in 10,000 to one in a million (1E-04 to 1E-06 in scientific notation) as a commonly accepted remediation goal. An excess lifetime cancer risk greater than one in 10,000 would generally be considered unacceptably high, while risks within the range would be acceptable depending upon site use. Risks of one in a million or less are generally considered insignificant. Tables 2-24, 2-25, 2-26, 2-27, 2-28, and 2-29 show the intakes, slope factors, and the excess lifetime cancer risk associated with chemical exposure for the on-post pedestrian jogger, the future on-post utility excavation worker, the current racetrack worker, the adult racetrack patron, the current off-post adult resident, and the future off-post adult resident farmer, respectively. Please note that the values presented in Tables 2-24, 2-25, 2-26, 2-27, 2-28, and 2-29 are in scientific notation (i.e., 2E-03 instead of 0.002). Also note that the tables show that the carcinogenic risk values did not exceed the USEPA acceptable range for the scenarios evaluated.

Uncertainties

Conducting a risk assessment requires making a number of assumptions that serve to introduce degrees of uncertainty in the final result. Uncertainties are inherent in the chemical identification, toxicity assessment, and exposure assessment processes. However, the cumulative effect is generally that risk has been overestimated, not underestimated. Section 7.6 of the RI report (BMcD, 2001a) provides a detailed discussion of the uncertainties and their potential effect on the risk assessment.

2.7.2 Summary of Ecological Risk Assessment

The purpose of the ecological evaluation was to assess possible adverse effects to ecological receptors that may come in contact with contaminated media. Qualitative observations, calculated exposure estimates, and best professional judgement were used to determine whether further evaluation of ecological risk is necessary (BMcD, 2001a).

Chemicals that may elicit adverse effects to ecological receptors are considered chemicals of potential ecological concern (COPECs). The following chemicals were selected as preliminary COPECs: cis-1,2-

DCE, ethylbenzene, PCE, toluene, xylene, acenaphthene, bis(2-ethylhexyl)phthalate, fluorene, 2-methylnaphthalene, naphthalene, phenanthrene, and pyrene.

The FFTA-MAAF Site (OU 004) was evaluated for the presence of ecological receptors (plants, animals, and soil organisms) and completed ecological exposure pathways. The potential presence of sensitive receptors, including threatened or endangered species, wetlands, streams, lakes, etc., was evaluated, and it was concluded that none were present within the FFTA-MAAF Site (OU 004). Although a completed exposure pathway from soil to small mammals may be present, the habitat provided by the FFTA-MAAF Site (OU 004) was marginal for these receptors. All other receptors, including plants and soil organisms, were qualitatively determined to have no observable adverse effects. Table 2-30 presents the results of the preliminary wildlife benchmark screening.

Contaminant migration in groundwater was modeled to evaluate ecological risk to aquatic species in the Kansas River. The estimated maximum present and future concentrations for each chemical were below all available aquatic life toxicity benchmarks, thus indicating minimal risk to the environment. The results of the macroinvertebrate benchmark screening for surface water is presented in Table 2-31.

2.7.3 Basis for Action

The BLRA (human health and ecological) that was completed for FFTA-MAAF Site (OU 004) found that the estimated risks to human health and the environment were within or below the USEPA acceptable levels. The presence of site-related contaminants off the site in the alluvial aquifer at levels exceeding drinking water standards (MCLs, identified as an ARAR) provides the basis for remedial action.

2.8 REMEDIAL ACTION OBJECTIVES

As identified in the EPA guidance Rules of Thumb for Superfund Remedy Selection (EPA, 1997b), a remedial action is generally warranted if one or more of the following conditions apply:

1) Cumulative excess carcinogenic risk to an individual exceeds 10^{-4}.

2) Non-carcinogenic hazard index is greater than one.

3) Site contaminants cause adverse environmental impacts.

4) Chemical-specific standards (i.e., ARARs) or other measures that define acceptable levels are exceeded and exposure to contaminants above these levels is predicted for the reasonable maximum exposure (RME) identified in the risk assessment.

For this Site, only item number (4) above applies. Item (4) is applicable at this Site because there are exceedances of chemical-specific standards. For example, drinking water standards (i.e., MCLs) are exceeded in the groundwater, which could potentially be used as a future drinking water source.

The RAOs for the FFTA-MAAF Site (OU 004) are to: 1) prevent use of groundwater with contaminant levels exceeding the MCLs as a drinking water source and 2) reduce contaminant levels, to the extent practicable and appropriate, through natural attenuation processes. The ultimate goal is for the groundwater to meet unrestricted use requirements. The Preliminary Remediation Goals (PRGs) for groundwater at the FFTA-MAAF Site (OU 004) are levels determined safe for drinking water (MCLs). The MCLs for COCs that drive the risk at the FFTA-MAAF Site (OU 004) are as follows:

- TCE: 5 parts per billion (ppb)
- cis-1,2-DCE: 70 ppb (BMcD, 2004c).

There are no reasonably anticipated changes in the future water uses at the Site.

2.9 DESCRIPTION OF REMEDIATION ALTERNATIVES

Following the initial screening of alternatives, the DA, Fort Riley evaluated and selected a range of alternatives to consider for the FFTA-MAAF Site (OU 004). The alternatives are listed below.

- Alternative 1 – No Action
- Alternative 2 – MNA with Institutional Controls
- Alternative 3 – Enhanced Anaerobic Bioremediation (EAB) with Institutional Controls, and MNA
- Alternative 4 – Zero-Valent Iron (Fe^0) Permeable Reactive Barrier (PRB) with Institutional Controls and Monitoring
- Alternative 5 – In-Situ Redox Manipulation (ISRM) with Institutional Controls and Monitoring
- Alternative 6 – Bimetallic Nanoscale Particles (BNP) with Institutional Controls, and MNA
- Alternative 7 – Air Sparge/Soil Vapor Extraction with Institutional Controls and Monitoring
- Alternative 8 – Groundwater Extraction and Ex-Situ Treatment with Institutional Controls and Monitoring

Note that the discussion below was excerpted from the FS report, so only data that were available at the time of the preparation of the FS were used.

2.9.1 Description Of Remedy Components

Following the initial screening of potential alternatives, the DA, Fort Riley evaluated and determined a range of alternatives to consider for the FFTA-MAAF Site (OU 004). The alternatives are discussed in the following paragraphs.

2.9.1.1 Alternative 1 – No Action

This alternative is the "no action" alternative, a requirement of the NCP, which provides a baseline for comparison of active remedial alternatives developed for the FFTA-MAAF Site (OU 004). Under the no action alternative, institutional controls are not implemented and remediation and monitoring of the groundwater contamination are not conducted. Biodegradation is the dominant natural attenuation process at the FFTA-MAAF Site (OU 004) acting to destroy contaminant mass in groundwater. In addition to biological processes, dispersion and diffusion processes also serve to reduce contaminant concentrations.

By definition, this alternative requires that the current monitoring program be discontinued. At a minimum, CERCLA requires administrative reassessments every five years, if the site is not open for unrestricted use, whenever contaminants are left in place. Therefore, with no institutional controls in place with this alternative, the possibility for the public's use of the affected aquifer for a drinking water source remains.

Groundwater sampling results, up to and including the March 2002 sampling round, indicate that chemical-specific ARARs (i.e., MCLs) were exceeded for both of the COCs at the Site (TCE and cis-1,2-DCE). Based on the natural attenuation modeling performed in the RI report (BMcD, 2001a), all COCs at the Site are predicted to be reduced below MCLs, thus meeting the chemical-specific ARARs for this Site. VC has only been detected in six of over 700 groundwater samples collected at this Site. There is no trend to these detections, they are low level and sporadic. This provides strong evidence that it is not accumulating in the aquifer as a result of dechlorination of cis-1,2-DCE. For this alternative, there are no location- or action-specific ARARs.

2.9.1.2 Alternative 2 – MNA with Institutional Controls

The term MNA refers to the reliance on natural attenuation processes (within the context of a controlled and monitored site cleanup approach) to achieve site-specific remediation objectives within a time frame that is reasonable compared to those time frames offered by other more active methods (KDHE, 2001). MNA relies on natural subsurface processes to reduce contaminant concentrations. Some of these natural

processes that appear to be occurring at the FFTA-MAAF Site (OU 004) are dilution, dispersion, volatilization, biodegradation, and sorption (BMcD, 2003c).

Natural attenuation is sometimes perceived as equivalent to "no action". However, MNA differs from the "no action" alternative in that the site is actively monitored and evaluated to reduce the risk of exposure and to evaluate potential further degradation of the aquifer. Typical performance parameters monitored for natural attenuation include: temperature, pH, methane, ethene/ethane, alkalinity, nitrate, sulfate/sulfide, chloride, total organic carbon (TOC), dissolved oxygen (DO), oxidation-reduction potential (ORP), iron, and contaminant concentrations. System components of MNA are usually groundwater wells, soil borings, and/or soil vapor probes (BMcD, 2003c). Contaminant concentrations and natural attenuation parameters will be monitored per USEPA MNA guidance (USEPA, 1998) periodically to evaluate if the natural attenuation processes are reducing contaminant concentrations to below chemical-specific ARARs (MCLs). Details regarding the system components of MNA at the FFTA-MAAF Site (OU 004) will be included in the Remedial Design/Remedial Action Plan for the FFTA-MAAF Site (OU 004).

Selection of this option as a sole remedy required the collection of groundwater quality information and evaluation of contaminant degradation rates and pathways. Evidence of natural degradation processes at the Site, as per the USEPA MNA guidance document (USEPA, 1999a) included 1) decreasing contaminant concentration trend, and 2) supporting geochemical data measurements. Modeling was used to demonstrate that natural processes may reduce contaminant concentrations below regulatory standards before potential exposure pathways are completed. A risk assessment was used to evaluate whether MNA is likely to be protective of human health and the environment (BMcD, 2003c).

For MNA to be a considered a stand-alone remedial alternative for the FFTA-MAAF Site (OU 004), the criteria outlined in the following guidance documents must be met: *Monitored Natural Attenuation*, Bureau of Environmental Remediation/Remedial Section Policy, BER Policy # BER RS 042 (KDHE, 2001); and *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites* (USEPA, 1999a).

Site geochemical and contaminant concentrations, results from contaminant fate and transport modeling, and results from USEPA reductive dechlorination screening protocol (USEPA, 1998) performed in the RI, indicated there is strong evidence for reductive dechlorination (and thus natural attenuation) of chlorinated solvents at the FFTA-MAAF Site (OU 004) (BMcD, 2003c). Samples are collected, analyzed, and

evaluated on a periodic basis. If the groundwater MCLs are not exceeded for three consecutive years, the FFTA-MAAF Site (OU 004) will be recommended for the discontinuance of sampling and for site closeout during the next periodic review. At a minimum, CERCLA requires administrative reassessments every five years, if the Site is not open for unrestricted use, whenever contaminants are left in place.

The inclusion of institutional controls, such as groundwater restrictions, will reduce the potential for human ingestion, inhalation, or dermal contact with contaminated groundwater at the FFTA-MAAF Site (OU 004). Because the contamination impacts both private and Federal property, there are significant differences in the way institutional controls will be applied.

Off-Post Institutional Controls

The primary control for the off-Post portion of the FFTA-MAAF Site (OU 004) will be implementation of institutional controls for property with environmental contamination above unrestricted land use standards. The institutional controls will restrict future use to agricultural, industrial, or commercial use and prohibit installation of drinking water wells within the impacted areas. These restrictions will limit the exposure at the FFTA-MAAF Site (OU 004) by:

- Providing access for DA to continue monitoring
- Providing access for the USEPA and KDHE to conduct site inspections to confirm land and water use
- Prohibiting installation of groundwater wells within the impacted area
- Ensuring future owners and tenants are aware of contamination at the FFTA-MAAF Site (OU 004)

These institutional controls will be in the form of proprietary controls such as deed restrictions to limit land and water use; however, the USEPA guidance on institutional controls suggests that controls should be "layered" to enhance the effectiveness and protectiveness of the remedy (USEPA, 2000b). Layering refers to using different types of institutional controls together or in series to enhance their effect on other institutional controls. Layering of institutional controls at the FFTA-MAAF Site (OU 004) will include the following:

- The KDHE EUC Program restricts future use to agricultural, industrial, or commercial use and prohibits installation of drinking water wells within the areas of the site with contaminant

concentrations above MCLs. The EUC program requires the impacted landowners to make application to the KDHE for approval of an EUC program for their property. The KDHE then provides oversight to ensure that the conditions imposed are followed. Although the Proposed Plan discussed the implementation of the KDHE EUC Program, the most recent groundwater sampling event results (February 2005) indicated contaminant levels are below MCLs, therefore the EUC Program will not be utilized unless groundwater concentrations increase to levels greater than the MCLs.

- Lease Agreements are currently in place between Fort Riley and adjacent landowners whose land has been impacted by the contaminant plume. The agreements allow for groundwater monitoring, monitoring well maintenance, well installation, and access for Fort Riley and the regulators. The landowners are provided with results of monitoring and other information on the contaminants at the FFTA-MAAF Site (OU 004).
- KDHE ISL is accessible through the Internet and provides basic information about the site, including site location, contaminants at the site, a narrative of activities, and a point of contact at the KDHE. The ISL database is not used for enforcement and does not place restrictions on site usage. The ISL database allows the public to conduct a web-based search to find contaminated sites within a specific community or area. State registries like this KDHE ISL are useful in providing information to the public.
- Deed Notices will be filed for impacted adjacent properties with landowner permission. Deed notices are non-enforceable, informational provisions that alert and inform anyone performing a title search that the property is located within a CERCLA site. Information in the notice will include types of contaminants and the risks they create.
- Zoning for the FFTA-MAAF Site (OU 004) is agricultural which allows construction of residential dwellings; however, the FFTA-MAAF Site (OU 004) is located in the floodplain where new construction is limited by a zoning ordinance. This zoning restriction will decrease the chance of a new drinking water well being installed. Monitoring of this zoning requirement will help ensure that new residential dwellings are not constructed.

Other controls, including alternate supply (replacement) wells, community awareness, and groundwater monitoring, are also components of this alternative. Details of the institutional controls for the FFTA-MAAF Site (OU 004) will be included in the Remedial Design/Remedial Action Plan for the FFTA-MAAF Site (OU 004). Two alternate water supply wells (M02-02 and R02-02) were installed in August

2002 to replace Private Wells R-1, R-2, R-3, R-4, and M-1. Groundwater monitoring is intended to provide a level of protection to ensure that risk levels are adequate at the FFTA-MAAF Site (OU 004) during the remediation period.

On-Post Institutional Controls

The proprietary and governmental controls discussed above cannot be applied at active military bases. USEPA guidance for institutional controls states that the local authority for regulating and enforcing institutional controls at an active military base is the Commanding Officer and that the regulators should work through the installation personnel to incorporate restrictions (USEPA, 2000b). The primary control for the on-Post portion of the FFTA-MAAF Site (OU 004) will be to restrict use through the environmental overlay of the Real Property Master Plan (RPMP). Master planning for Army installations is required by Army Regulation (AR) 210-20 which establishes a relationship between environmental planning and real property master planning in order to ensure that the environmental factors are included in planning decisions and land use. The long-range component of the RPMP consists of narratives and supporting graphics that include a Master Plan Environmental Overlay (MPEO) to reflect operational and environmental constraints. The FFTA-MAAF Site (OU 004) will be designated as restricted land use in the RPMP. The category directs the RPMP user to the MPEO that subsequently identifies the restrictions. Restrictions will limit exposure at the FFTA-MAAF Site (OU 004) by:

- Restricting use to non-residential
- Limiting public access
- Prohibiting installation of drinking water wells and groundwater use in the area
- Involving PWE personnel in proposed future plans for the FFTA-MAAF Site (OU 004)

The Federal ownership of an active military base limits the layering of other proprietary or government controls. The only additional controls that will be implemented at the FFTA-MAAF Site (OU 004) are informational controls (KDHE Identified Site List and community awareness through the RAB).

This alternative is anticipated to control exposure to the contaminated groundwater through governmental controls, proprietary controls, and alternate water supply. Therefore, the use of groundwater during the time when levels are decreasing to MCLs is restricted by this alternative. This alternative is anticipated to meet chemical-specific ARARs (i.e., MCLs), as predicted by natural attenuation modeling (see Appendix B of the FS report [BMcD, 2003c]). Since there are no major construction activities associated with this

alternative, there are no anticipated issues with location- or action-specific ARARs. Compliance with endangered and/or threatened species ARARs are anticipated to be achieved because disruption of critical habitat is not anticipated with this alternative. Compliance with floodplain-related ARARs are anticipated to be met because remedial activities will not result in any permanent structures or surface improvements. Before implementing a remedy, the need for an archeological investigation for compliance with archeological/historical-related ARARs should be determined. All location-specific, RCRA-related ARARs are anticipated to be met.

In addition to ARARs, this alternative is anticipated to comply with the TBCs Monitored Natural Attenuation, Bureau of Environmental Remediation/Remedial Section Policy, BER Policy # BER RS 042 (KDHE, 2001); and Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites (USEPA, 1999a). VC has only been detected in six of over 700 groundwater samples collected at this Site. There is no trend to these detections, they are low level and sporadic. This provides strong evidence that it is not accumulating in the aquifer as a result of dechlorination of cis-1,2-DCE.

As with Alternative 1, a review will be conducted no less often than every five years after initiation.

2.9.1.3 Alternative 3 – Enhanced Anaerobic Bioremediation (EAB) with Institutional Controls, and MNA

This alternative consists of installing an in-situ treatment system in the higher concentration areas within all the aquifer zones of the plume to remediate the most contaminated area(s) of the plume. Carbon sources such as lactate, vegetable oil, molasses, and others can be added to aquifer materials to enhance anaerobic bioremediation via reductive dechlorination. Various combinations of methane, nitrogen, and phosphorous have also been used to promote increased biodegradation. A system of vertical or horizontal wells could deliver these nutrients to selected aquifer zones. To remediate the chlorinated solvent plume at the FFTA-MAAF Site (OU 004), the conceptual design of this alternative uses nine curtains spaced approximately 500 ft apart. A lactate configuration is often selected because typically lactate is designed to remain active for approximately one year. Any contaminants remaining above MCLs following the lactate treatment are anticipated to be remediated through MNA.

This alternative is anticipated to control exposure to the contaminated groundwater through governmental controls, proprietary controls, and alternate water supply. Therefore, the use of groundwater during the

time when levels are decreasing to MCLs is restricted by this alternative. This alternative is anticipated to meet chemical-specific ARARs (i.e., MCLs), as predicted by contaminant transport modeling of this alternative. Location-specific ARARs are anticipated to be adequately met by this alternative as follows. Compliance with endangered and/or threatened species ARARs are anticipated to be achieved because disruption of critical habitat is not anticipated with this alternative. Compliance with floodplain-related ARARs is anticipated to be met because remedial construction activities will not result in any permanent structures or surface improvements. Before implementing this remedy, the need for an archeological investigation for compliance with archeological/historical-related ARARs should be determined. Action-specific ARARs are anticipated to be adequately met by this alternative as follows. An underground injection permit will not likely be required to inject lactate into the subsurface, since CERCLA sites are exempt. Occupational Safety and Health Administration (OSHA) requirements will need to be met during implementation of this alternative. All action-specific RCRA-related ARARs are anticipated to be met.

The inclusion of institutional controls, monitoring, and alternate water supply wells with this alternative is discussed in Section 2.9.1.2. As with Alternative 1, a review will be conducted no less often than every five years after initiation.

2.9.1.4 Alternative 4 – Zero-Valent Iron (Fe^0) Permeable Reactive Barrier with Institutional Controls and Monitoring

This alternative consists of installing a Fe^0 permeable reactive barrier (PRB) downgradient of the higher concentration area (under current conditions this would be slightly downgradient of Monitoring Well FP-98-31) to remediate the most contaminated area(s) of the plume. In this process, iron and chlorinated organics undergo an abiotic oxidation/reduction reaction. Reduction in contaminant volume is anticipated to be achieved with this alternative primarily through reductive elimination of chlorinated solvents, which does not result in accumulation of intermediate daughter products such as VC. Natural attenuation processes will also act to further reduce contaminant concentrations. Conceptual design of this reactive barrier uses a 250-ft linear Fe^0 PRB to intercept and treat chlorinated solvents at the FFTA-MAAF Site (OU 004). Installation of the Fe^0 PRB could be performed using modified excavation equipment and a biodegradable guar-based slurry to support the excavation during installation. The Fe^0 would be emplaced into the open excavation through the guar slurry (ETI, 2000). Proper management of any soil, guar, or groundwater removed from the trench during excavation may be required during construction. If elevated contaminant levels are present, special care is needed to minimize risk to human health and the environment during implementation of Fe^0 PRB.

This alternative is anticipated to control exposure to the contaminated groundwater through governmental controls, proprietary controls, and alternate water supply. Therefore, the use of groundwater during the time when levels are decreasing to MCLs is restricted by this alternative. This alternative is anticipated to meet chemical-specific ARARs (i.e., MCLs), as predicted by contaminant transport modeling of this alternative. Location-specific ARARs are anticipated to be adequately met by this alternative as follows. Compliance with endangered and/or threatened species ARARs are anticipated to be achieved because disruption of critical habitat is not anticipated with this alternative. Compliance with floodplain-related ARARs are anticipated to be met because remedial construction activities will not result in any permanent structures or surface improvements. Before implementing a remedy, the need for an archeological investigation for compliance with archeological/historical-related ARARs should be determined. Action-specific ARARs are anticipated to be adequately met by this alternative as follows. OSHA requirements will need to be met during implementation of this alternative. All action-specific RCRA-related ARARs are anticipated to be met.

The inclusion of institutional controls, monitoring, and alternate water supply wells with this alternative is discussed in Section 2.9.1.2. As with Alternative 1, a review will be conducted no less often than every five years after initiation.

2.9.1.5 Alternative 5 – In-Situ Redox Manipulation (ISRM) with Institutional Controls and Monitoring

This alternative consists of creating an in-situ ferrous iron (Fe^{+2}) passive treatment zone downgradient of the higher concentration area (under current conditions this would be slightly downgradient of Monitoring Well FP-98-31) to remediate the most contaminated area(s) of the plume. In-Situ Redox Manipulation (ISRM) is a technology based upon the in-situ manipulation of natural processes to destroy contaminants in the subsurface. ISRM creates a permeable treatment zone by injection of chemical reagents into the subsurface. This concept requires the presence of natural iron, which can be reduced from its oxidized state in the aquifer sediments to serve as a long-term reducing agent (DoE, 2000). The ISRM technology has been used at five groundwater remediation sites (Pacific Northwest National Laboratory [PNNL], 2002).

A chemical reducing agent, such as sodium dithionite, is injected into the aquifer through a groundwater injection well. The reducing agent reacts with the ferric iron (Fe^{+3}) naturally present in the aquifer sediments in the form of various minerals (clays, oxides, etc.) during the residence phase. Buffers are

added to balance the groundwater pH, which decreases with the addition of sodium dithionite. Once the residence phase is complete, unreacted reagent, buffers, and reaction products are withdrawn through the same wells used for injection and disposed. Once Fe^{+3} in the aquifer has been reduced to Fe^{+2}, reductive elimination of chlorinated solvents is initiated, which does not result in accumulation of intermediate daughter products such as VC. Redox-sensitive contaminants that migrate through the reduced zone in the aquifer undergo degradation. Natural attenuation processes will also act to further reduce contaminant concentrations. Conceptual design of the ISRM treatment zone uses a 250-ft long barrier placed slightly downgradient of Monitoring Well FP-98-31 to intercept and treat chlorinated solvents at the FFTA-MAAF Site (OU 004).

This alternative will control exposure to the contaminated groundwater through governmental controls, proprietary controls, and alternate water supply. Therefore, the use of groundwater during the time when levels are decreasing to MCLs is restricted by this alternative. This alternative is anticipated to meet chemical-specific ARARs (i.e., MCLs), as predicted by contaminant transport modeling. Location-specific ARARs are anticipated to be adequately met by this alternative as follows. Compliance with endangered and/or threatened species ARARs are anticipated to be achieved because disruption of critical habitat is not anticipated with this alternative. Compliance with floodplain-related ARARs are anticipated to be met because remedial construction activities are not anticipated to result in any permanent structures or surface improvements. Before implementing a remedy, the need for an archeological investigation for compliance with archeological/historical-related ARARs should be determined. Action-specific ARARs are anticipated to be adequately met by this alternative as follows. A permit will not likely be required to inject chemicals into the subsurface, since CERCLA sites are exempt. OSHA requirements would need to be met during implementation of this alternative. All action-specific RCRA-related ARARs are anticipated to be met.

The inclusion of institutional controls, monitoring, and alternate water supply wells with this alternative is discussed in Section 2.9.1.2. As with Alternative 1, a review will be conducted no less often than every five years after initiation.

2.9.1.6 Alternative 6 – Bimetallic Nanoscale Particles (BNP) with Institutional Controls and MNA

This alternative consists of installing an in-situ treatment system in the higher concentration areas within all the aquifer zones of the plume to remediate the most contaminated area(s) of the plume. Bimetallic

nanoscale particles (BNP) are submicron ($<10^{-6}$ meters) particles of Fe^0 that are small enough to migrate along with the groundwater flow. When injected, the BNP and chlorinated organics undergo an abiotic oxidation/reduction reaction, which results in the reductive elimination of the contaminants and not in accumulation of intermediate daughter products such as VC. Fe^0 acts as an electron donor being oxidized into Fe^{+2}/Fe^{+3}, while carbon atoms act as electron acceptors being reduced to lower valance states. In this reduction process, the carbon atoms release chlorine atoms which are replaced by hydrogen. Natural attenuation processes will also act to further reduce contaminant concentrations.

To remediate the chlorinated solvent plume at the FFTA-MAAF Site (OU 004), a multi-curtain approach is anticipated to provide an effective and efficient design. Conceptual design of this alternative uses nine curtains spaced approximately 500 ft apart and extending 250 ft across the plume. This design is consistent with the horizontal and vertical extent of the contaminant plume at the FFTA-MAAF Site (OU 004).

This alternative is anticipated to control exposure to the contaminated groundwater through governmental controls, proprietary controls, and alternate water supply. Therefore, the use of groundwater during the time when levels are decreasing to MCLs is restricted by this alternative. This alternative is anticipated to meet chemical-specific ARARs (i.e., MCLs), as predicted by contaminant transport modeling of this alternative. Location-specific ARARs are anticipated to be adequately met by this alternative as follows. Compliance with endangered and/or threatened species ARARs is anticipated to be achieved because disruption of critical habitat is not anticipated with this alternative. Compliance with floodplain-related ARARs are anticipated to be met because remedial construction activities will not result in any permanent structures or surface improvements. Before implementing a remedy, the need for an archeological investigation for compliance with archeological/historical-related ARARs should be determined. Action-specific ARARs are anticipated to be adequately met by this alternative as follows. An underground injection permit will not likely be required to inject BNP into the subsurface, since CERCLA sites are exempt. OSHA requirements would need to be met during implementation of this alternative. All action-specific RCRA-related ARARs are anticipated to be met.

The inclusion of institutional controls, monitoring, and alternate water supply wells with this alternative is discussed in Section 2.9.1.2. As with Alternative 1, a review will be conducted no less often than every five years after initiation.

2.9.1.7 Alternative 7 – Air Sparge/Soil Vapor Extraction with Institutional Controls and Monitoring

This alternative consists of installing an in-situ treatment system in the higher concentration areas within all the aquifer zones of the plume to remediate the most contaminated area(s) of the plume. Gas (e.g., air or nitrogen) is injected under pressure into a well installed into the saturated zone. Gas injected below the water table volatilizes contaminants that are dissolved in groundwater, exist as a separate aqueous phase, and/or are sorbed onto saturated soil particles. The volatilized contaminants migrate upward into the vadose zone, where they are removed using SVE techniques. The conceptual design of this alternative uses nine curtains spaced approximately 500 ft apart and extending 250 ft across the plume.

A system of horizontal SVE wells will be installed in the soil above each treatment curtain to collect vapors resulting from the air sparging. Due to the low concentrations of contaminants in the plume, it is anticipated that an off-gas treatment system will not be needed. Reduction in contaminant volume is anticipated to be achieved with this alternative primarily through volatilization of chlorinated solvents. Natural attenuation processes will also act to further reduce contaminant concentrations. This design is consistent with the horizontal and vertical extent of the contaminant plume at the Site (for addition information, refer to the RI report, BMcD, 2001a and/or the February 2004 DSR, BMcD, 2004b).

This alternative is anticipated to control exposure to the contaminated groundwater through governmental controls, proprietary controls, and alternate water supply. Therefore, the use of groundwater during the time when levels are decreasing to MCLs is restricted by this alternative. This alternative is anticipated to meet chemical-specific ARARs (i.e., MCLs), as predicted by contaminant transport modeling of this alternative. Location-specific ARARs are anticipated to be adequately met by this alternative as follows. Compliance with endangered and/or threatened species ARARs are anticipated to be achieved because disruption of critical habitat is not anticipated with this alternative. Compliance with floodplain-related ARARs are anticipated to be met because any structures or surface improvements built as part of the remedial action will be temporary and are not anticipated to be occupied. Before implementing a remedy, the need for an archeological investigation for compliance with archeological/historical-related ARARs should be determined. Action-specific ARARs are anticipated to be adequately met by this alternative as follows. OSHA requirements would need to be met during implementation of this alternative. All action-specific RCRA-related ARARs are anticipated to be met. Confirmation air samples may be required for the SVE system to meet the Ambient Air Quality Standards and Air Pollution Control ARAR (BMcD, 2002a).

The inclusion of institutional controls, monitoring, and alternate water supply wells with this alternative is discussed in Section 2.9.1.2. As with Alternative 1, a review will be conducted no less often than every five years after initiation.

2.9.1.8 Alternative 8 – Groundwater Extraction and Ex-Situ Treatment with Institutional Controls and Monitoring

This alternative consists of installing a groundwater extraction system downgradient of the higher concentration area (under current conditions this would be slightly downgradient of Monitoring Well FP-98-31). Following extraction, the groundwater is treated by one of several methods, such as air stripping. In the air stripping process, VOCs are partitioned from groundwater by significantly increasing the surface area of the water exposed to air. Groundwater extraction and treatment (pump and treat) is designed to provide containment of concentrations above MCLs while natural attenuation processes work to reduce contaminant levels.

This alternative is anticipated to control exposure to the contaminated groundwater through governmental controls, proprietary controls, and alternate water supply. Therefore, the use of groundwater during the time when levels are decreasing to MCLs is restricted by this alternative. This alternative is anticipated to meet chemical-specific ARARs (i.e., MCLs), as predicted by contaminant transport modeling of this alternative. Location-specific ARARs are anticipated to be adequately met by this alternative as follows. Compliance with endangered and/or threatened species ARARs is anticipated to be achieved because disruption of critical habitat is not anticipated with this alternative. Compliance with floodplain-related ARARs is anticipated to be met because any structures or surface improvements built as part of the remedial action will be temporary and are not anticipated to be occupied. Before implementing a remedy, the need for an archeological investigation for compliance with archeological/historical-related ARARs should be determined. Action-specific ARARs are anticipated to be adequately met by this alternative as follows. OSHA requirements would need to be met during implementation of this alternative. The Kansas Ambient Air Quality Standards and Air Pollution Control Regulations are anticipated to be met because the mass of VOCs discharged to the atmosphere is anticipated to be far below the 25 tons per year limit for a single HAP. A National Pollutant Discharge Elimination System (NPDES) permit is not anticipated to be required to discharge treated groundwater into the Kansas River, since CERCLA sites are exempt. The Kansas Water Well Construction Regulations are anticipated to be followed when installing the groundwater extraction well as part of this alternative. All action-specific RCRA-related ARARs are anticipated to be met.

The inclusion of institutional controls, monitoring, and alternate water supply wells with this alternative is discussed in Section 2.9.1.2. As with Alternative 1, a review will be conducted no less often than every five years after initiation.

2.9.2 Common Elements and Distinguishing Features of Each Alternative

Many of the alternatives evaluated for the FFTA-MAAF Site (OU 004) include common components, while certain characteristics of some of the alternatives clearly distinguish them from the others. Following are lists of many of these common elements and distinguishing features.

Common Elements

Common elements among the alternatives include:

- Alternatives 2 through 8 include some of the same institutional controls which will be detailed in the Remedial Design/Remedial Action Plan. See Section 2.9.1.2.
- Alternatives 1, 2, and 3 involve biodegradation as the primary means of contaminant reduction.
- Alternatives 1, 2, and 3 result in the generation of intermediate daughter products.
- Alternatives 1, 2, 3, 4, 5, and 6 involve the destruction of contaminants in-situ, so no transfer of contaminants to other media.
- Alternatives 2 through 8 involve periodic or confirmational groundwater sampling, which will be detailed in the Remedial Design/Remedial Action Plan.
- Alternatives 3 through 8 involve the installation of treatment or extraction systems.
- Alternatives 3, 4, 5, 6, and 7 involve the injection of foreign material into or downgradient of the plume.
- Alternatives 4, 5, and 8 involve downgradient treatment.
- Alternatives 3, 6, and 7 involve treatment in the higher concentration areas within all contaminated aquifer zones.
- All alternatives are anticipated to eventually meet the same chemical-specific ARAR (MCLs).
- All alternatives are anticipated to be in compliance with the same location-specific ARARs.
- Alternatives 3 through 8 may require an archeological investigation for compliance with the archeological/historical-related ARARs.
- Alternatives 3 through 8 require compliance with OSHA requirements (action-specific ARAR).
- Alternatives 7 through 8 require compliance with the Ambient Air Quality Standards and Air Pollution Control ARAR (action-specific ARAR).
- Alternatives 2, 3, and 6 are comparable in regard to cost.

- Alternatives 4, 5, 7, and 8 are comparable in regard to cost.
- All alternatives require at least one five-year review and a closure report.

Distinguishing Features

Distinguishing features among the alternatives include:

- Alternative 1 does not include periodic groundwater sampling or institutional controls.
- According to groundwater modeling conducted for the FFTA-MAAF Site (OU 004) and not considering the potential for rebound effect, Alternative 7 is anticipated to ultimately achieve cleanup levels the soonest followed by Alternative 8, then Alternatives 3 and 6, then Alternatives 4 and 5, and lastly, Alternatives 1 and 2.
- Alternative 1 is considerably less expensive than the other alternatives.
- Alternative 4 is the most expensive alternative.

2.10 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

Nine criteria are used to evaluate the different remediation alternatives individually and against each other in order to select a remedy. This section of the ROD profiles the relative performance of each alternative against the nine criteria, noting how it compares to the other options under consideration. The nine evaluation criteria are defined below in Section 2.10.1. The evaluation methodology is described in Section 2.10.2, and a comparison of the alternatives to each criterion is provided in Section 2.10.3. Table 2-24 summarizes the comparative evaluation.

2.10.1 Evaluation Criteria for CERCLA Remedial Alternatives

The first two criteria are the "threshold" factors. Any alternative that does not satisfy both of the following criteria is dropped from further consideration in the remedy selection process:

- Overall Protectiveness of Human Health and the Environment
- Compliance with ARARs

Five "primary balancing" criteria are then used to make comparisons and to identify the major trade-offs between the remedial alternatives. Alternatives that satisfy the threshold criteria are therefore evaluated using the following balancing criteria:

- Long-term Effectiveness and Permanence

- Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment
- Short-term Effectiveness
- Implementability
- Cost

The remaining two criteria are "modifying" factors and are to be evaluated in the ROD. The evaluation of these two factors can only be complete after the Proposed Plan is published for comment and the public comment period is completed. These modifying factors are:

- State/Support Agency Acceptance
- Community Acceptance

2.10.2 Evaluation Method

The alternatives were scored on a pass/fail basis for the two threshold criteria (protection of human health and environment, and compliance with ARARs). Those alternatives passing the threshold criteria were then evaluated for the five balancing criteria on the basis of incremental differences between alternatives (BMcD, 2003c). The final two modifying criteria were then evaluated for the selected remedy only. Since no public comments were received and KDHE and the USEPA approved the Proposed Plan, both of these criteria were met.

An evaluation and semi-quantitative comparison was performed to facilitate a rating of the alternatives evaluated in the detailed analysis. Evaluations were based on vendor information, published reports, past experiences, and professional judgment (see Section 4.0 for references). Equal rating was given if it was not possible to differentiate performance for the given criteria. The range was on a scale of 1 to 10. Any alternative that completely fails the criteria was given a 10. Other alternatives were placed appropriately within the range based on their expected performance relative to the other alternatives and in accordance with the following further justification for specific ratings (BMcD, 2003c).

1	Most favorable alternative
3	Good, generally favorable
5	Fair, potentially unfavorable
7	Poor, unfavorable

10 Completely fails the criteria

Ratings of 2, 4, 6, 8, and 9 were used to differentiate between alternatives with similar qualifications where one slightly outperformed the other (e.g., two alternatives were considered "fair" but one was slightly more favorable). This method was employed for each of the five balancing criteria (see Sections 2.10.3.3 through 2-10.3.7, BMcD, 2003c).

2.10.3 Comparative Analysis

This section of the ROD compares the alternatives against the nine criteria, noting how each compares to the other alternatives. Note that all alternatives are evaluated against the initial seven criteria, but only the selected remedy is evaluated against the final two criteria. Table 2-3 (Page 2-25) summarizes the comparative evaluation.

2.10.3.1 Overall Protection of Human Health and the Environment

Overall protectiveness of human health and the environment determines whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment. This is a pass/fail criterion. Based on the BLRA (human health and ecological) performed in the RI report (BMcD, 2001a), all of the alternatives are protective of human health and the environment because the risk estimates for current and future RME scenarios do not exceed the USEPA accepted risk levels (BMcD, 2003c).

2.10.3.2 Compliance with ARARs

Compliance with ARARs evaluates whether the alternative meets Federal and State environmental statutes, regulations, and other requirements that pertain to a site, or whether a waiver is justified. This is a pass/fail criterion. All of the remedial alternatives, except Alternative 1 (No Action), are anticipated to comply with preliminary chemical-, potential location-, and potential action-specific ARARs. Alternative 1 does not comply with chemical-specific ARARs (i.e., MCLs) because contaminant levels are currently above MCLs, and this alternative takes no action to address the ARAR (e.g., no institutional controls to limit current use). Therefore, Alternative 1 was dropped from further consideration because it does not meet one of the threshold criteria (i.e., either Overall Protection of Human Health and the Environment or Compliance with ARARs) (BMcD, 2003c). Compliance with specific ARARs for the selected remedy is further discussed in Section 2.13.2.

2.10.3.3 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence considers the ability of an alternative to maintain protection of human health and the environment over time. Since there is not an ongoing source at the FFTA-MAAF Site (OU 004), once RAOs are met, Alternatives 2 through 8 are anticipated to provide similar long-term effectiveness and permanence at the FFTA-MAAF Site (OU 004). Alternatives 2 through 6 destroy the contaminant through dechlorination so that it is no longer a risk. For example, once the contaminant passes through a Fe^0 PRB, the contaminant reacts with the Fe^0 and a reduction of the chlorinated contaminant occurs. However, Alternatives 7 and 8 are removal-type remedies that do not destroy the contamination, but instead transfer it to another media. This makes these alternatives less favorable in terms of long-term effectiveness and permanence than Alternatives 2 through 6 (USEPA, 1996). The ratings for long-term effectiveness and permanence are assigned as follows:

Alternative 2 (MNA)	1
Alternative 3 (EAB)	1
Alternative 4 (Fe^0 PRB)	1
Alternative 5 (ISRM)	1
Alternative 6 (BNP)	1
Alternative 7 (Air Sparge)	3
Alternative 8 (Pump & Treat)	4

2.10.3.4 Reduction of Toxicity, Mobility, or Volume

Reduction of toxicity, mobility, or volume of contaminants through treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present. Alternatives 2 through 8 are anticipated to provide similar levels of reduction in toxicity, mobility, and volume of contaminants in the plume. However, Alternatives 7 and 8 are removal-type remedies that do not destroy the contamination, but instead transfer it to another media. This, coupled with the known rebounding effects associated with Alternatives 7 (Air Sparge) and 8 (Pump & Treat), make these alternatives less favorable in terms of reducing the toxicity, mobility, and volume of contaminants in the plume than Alternatives 2 through 6 (BMcD, 2003c).

Alternatives 2 through 6 destroy the contaminant through dechlorination so that it is no longer a risk. The ratings for reduction in toxicity, mobility, and volume are assigned as follows:

Alternative 2 (MNA)	1
Alternative 3 (EAB)	1
Alternative 4 (Fe^0 PRB)	1
Alternative 5 (ISRM)	1
Alternative 6 (BNP)	1
Alternative 7 (Air Sparge)	5
Alternative 8 (Pump & Treat)	5

2.10.3.5 Short-Term Effectiveness

Short-term effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation. Construction activities during implementation of Alternative 7 (Air Sparge) are intensive due to the large number of sparge wells, trenching to install air lines, construction of building(s), and start up (BMcD, 2003c).

Construction activities during implementation of Alternative 8 (Pump & Treat) are anticipated to be moderate and include installation of an extraction well, construction of a treatment building, installation of discharge piping to the Kansas River, and start up (BMcD, 2003c).

Construction activities during implementation of Alternatives 3 (EAB) and 6 (BNP) are anticipated to be minimal, because both technologies inject treatment fluids into the aquifer using direct-push equipment, resulting in very little impact to the surface (BMcD, 2003c). However, the effectiveness of BNP is less certain due to the infancy of this technology.

Alternative 4 (Fe^0 PRB) has the advantage over Alternative 5 (ISRM) due to the proven effectiveness of this technology versus the fairly new technology of Alternative 5. In addition, Fe^{+2} (Alternative 5) is not as reactive (i.e., efficient) as Fe^0 (Alternative 4). Construction activities during implementation of these alternatives are fairly intensive, especially for Alternative 4. To implement Alternative 4, a 67-ft deep trench is required to place the Fe^0 in the aquifer. This alternative would have the highest risk to workers during implementation. Alternative 5 uses injection wells to inject chemicals into the aquifer (BMcD, 2003c).

Alternative 2 (MNA) relies on natural processes to remediate the plume and will have low impact to the surface, low risk to workers during implementation of the alternative, and has been demonstrated to be actively reducing contaminant concentrations at the FFTA-MAAF Site (OU 004) (BMcD, 2003c). The ratings for short-term effectiveness are assigned as follows:

Alternative 7 (Air Sparge)	3
Alternative 3 (EAB)	4
Alternative 8 (Pump & Treat)	4
Alternative 5 (ISRM)	5
Alternative 6 (BNP)	5
Alternative 2 (MNA)	6
Alternative 4 (Fe^0 PRB)	7

2.10.3.6 Implementability

Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services. Alternative 2 (MNA) would be the simplest alternative to implement because there are no construction activities associated with this alternative. Administrative implementability of the institutional controls associated with this alternative would be the same as the other alternatives (BMcD, 2003c).

Alternatives 3 (EAB) and 6 (BNP) would be fairly simple to implement because both technologies inject treatment fluids into the aquifer using direct-push equipment; however, the availability of BNP in the quantities required for this project may be a concern. Preferential pathways for the injected materials to move during injection may be an implementability issue with these alternatives. Administrative implementability of the institutional controls associated with these alternatives would be the same as other alternatives (BMcD, 2003c).

Alternatives 5 (ISRM) and 8 (Pump & Treat) would be more intensive to implement (intensive permanent off-Post well installation on adjacent agricultural land) and will likely require more time and more equipment than Alternatives 3 (EAB) and 6 (BNP). Administrative implementability of the institutional controls associated with these alternatives would be the same as other alternatives (BMcD, 2003c).

Alternatives 4 (Fe^0 PRB) and 7 (Air Sparge) would be the most difficult to implement due to the complexity of installing the Fe^0 PRB to a depth of 67 ft, and the difficulties associated with assembling all of the air sparge/SVE piping, equipment, and structures for housing the equipment. The potential of unforeseeable problems during implementation is highest with these alternatives. Administrative implementability of the institutional controls associated with these alternatives would be the same as other alternatives (BMcD, 2003c). The ratings for implementability are assigned as follows:

Alternative 2 (MNA)	1
Alternative 3 (EAB)	2
Alternative 6 (BNP)	4
Alternative 5 (ISRM)	5
Alternative 8 (Pump & Treat)	5
Alternative 4 (Fe^0 PRB)	7
Alternative 7 (Air Sparge)	7

2.10.3.7 Cost Evaluation

Cost includes estimated capital, periodic, and annual O&M costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent. Details of the cost estimates for all of the alternatives are provided in Appendix A of the FS (BMcD, 2003c). The ratings for cost and the total project costs are assigned as follows (BMcD, 2003c):

Alternative 2 (MNA)	1	$2,300,000
Alternative 3 (EAB)	2	$2,500.000
Alternative 6 (BNP)	3	$2,700,000
Alternative 5 (ISRM)	5	$4,100,000
Alternative 7 (Air Sparge)	5	$4,000,000
Alternative 8 (Pump & Treat)	5	$4,200,000
Alternative 4 (Fe^0 PRB)	6	$4,400,000

2.10.3.8 State/Support Agency Acceptance

State/support agency acceptance considers whether the State agrees with DA's analyses and recommendations, as described in the RI and FS reports (BMcD, 2001a and 2003c) and Proposed Plan (BMcD, 2004c). The KDHE supports the selected remedy presented in the Proposed Plan for the FFTA-MAAF Site (OU 004).

2.10.3.9 Community Acceptance

Community acceptance considers whether the local community agrees with DA's analyses and preferred alternative. No comments were received on the Proposed Plan (BMcD, 2004c) which is an important indicator of community acceptance. Only the selected remedy was evaluated for this criterion. Based on the lack of comments from the public on the Proposed Plan (BMcD, 2004c), the selected remedy for the FFTA-MAAF Site (OU 004) is acceptable to the community.

2.10.4 Summary of Comparative Analysis

The alternatives were first evaluated as either compliant or non-compliant with the threshold criteria (Protection of Human Health and the Environment, and Compliance with ARARs). The no action alternative was the only alternative that does not comply with the threshold criteria (non-compliant with ARARs), and, therefore, it was removed from further consideration in the ranking of alternatives. Each alternative that met the threshold criteria was then comparatively evaluated using the five balancing criteria. Following the comparative evaluation of alternatives using the five balancing criteria, the two alternatives with the most favorable rankings were Alternative 3 (EAB) and Alternative 2 (MNA). Discussions of the results are presented below, and a semi-quantitative summary of the rankings is presented in Table 2-3 (Page 2-25) (BMcD, 2003c).

The favorable EAB rating was due to the ease of implementability (direct-push application), favorable cleanup time, no permanent structures, reliability, and cost effectiveness. EAB provides similar or greater levels of long-term effectiveness and reduction of toxicity, mobility, and volume as the other alternatives.

The favorable MNA rating was due to the ease of implementation (no physical systems required except for monitoring), effectiveness of the process (reduces contaminants at the FFTA-MAAF Site [OU 004]), and low costs (monitoring and evaluation costs). This Alternative has the longest cleanup time frame, but is still in the range of the other alternatives, with the exception of SVE (BMcD, 2003c).

Alternative 6 (BNP) appears to be adequate for the FFTA-MAAF Site (OU 004) and similar to EAB and MNA for many of the criteria; however, concerns with the availability of BNP, potential dispersion problems, and limited full-scale implementation decreased the overall rating when compared to MNA and EAB (BMcD, 2003c).

While Alternative 5 (ISRM) appears to be acceptable for the FFTA-MAAF Site (OU 004), the mid-level ranking was due to short-term effectiveness issues (intensive permanent off-Post well installation on adjacent agricultural land) and the possibility of implementability problems, since this is an innovative technology with limited full-scale information available. The cost for this alternative was higher than MNA, EAB, and BNP and was a factor in the ranking (BMcD, 2003c).

Alternative 4 (Fe^0 PRB) was acceptable for long-term effectiveness and reduction of toxicity, mobility, and volume. The alternative's low ranking was primarily due to possible implementability issues related to the installation of a 67-ft deep PRB in the Kansas River alluvium and high cost. These issues range from the impact on the landowner to the possible collapse of the trench which leads to possible breakthrough or bypass of contaminants (decreasing the short-term effectiveness of the alternative). The short-term effectiveness was also lower because of the cleanup time, reliability issues, and higher risk to workers during installation (BMcD, 2003c).

Low rankings of Alternatives 7 (Air Sparge) and 8 (Pump & Treat) were primarily due to their less favorable rating for reduction of toxicity, effectiveness, and permanence based on the fact that Alternatives 7 and 8 are removal-type remedies that do not destroy the contamination, but instead transfer it to another. While the short-term effectiveness ratings for these alternatives were relatively high, these ratings do not overcome surface implementability issues off the site, and potential for increased costs (BMcD, 2003c).

2.11 PRINCIPAL THREAT WASTES

The NCP establishes an expectation that treatment will be used to address the principal threats posed by a site wherever practicable. Identifying principal threat wastes combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Contaminated groundwater is not considered to be a source material and is, therefore, not generally considered to be a principal threat waste (USEPA, 199b).

The source of contamination in soil was reduced to concentrations below the levels determined by the KDHE that would prevent further leaching of contaminants to groundwater. The source reduction occurred through a source removal pilot study (using soil vapor extraction (SVE) and bioventing technologies) and was completed in May of 1995. Therefore, there are no known principal threat wastes at the FFTA-MAAF Site (OU 004). Only the groundwater remains contaminated with VOCs above MCLs. Since there are no known principal threat wastes at the FFTA-MAAF Site (OU 004), the selected remedy will rely on natural processes to address the groundwater plume(s).

2.12 SELECTED REMEDY

Alternative 2: MNA with Institutional Controls, the selected remedy for the FFTA-MAAF Site (OU 004), will address the contaminated groundwater. Alternative 2 will use institutional controls to prevent exposure of receptors to contaminated groundwater. MNA relies on natural degradation processes already demonstrated to be occurring at the FFTA-MAAF Site (OU 004) and off the site (downgradient) to further reduce contaminant concentrations to or below the MCLs. Monitoring will be conducted to follow the effectiveness and progress of natural attenuation.

2.12.1 Summary of the Rationale for the Selected Remedy

The key factors influencing the DA, Fort Riley in its selection of Alternative 2 are:

- Soil contamination was reduced to below levels determined by KDHE to prevent further leaching to groundwater through a source removal pilot study (using SVE and bioventing technologies).
- As an alternative water supply/interim removal action, two private water supply wells were installed and five existing wells were abandoned in 2002. The two new wells are located outside of the contaminated groundwater plume. This reduced the potential exposure of human health receptors to contaminated groundwater, and thus the overall risk; further supporting MNA.
- Current monitoring data indicate no evidence of principal threat waste.
- Natural attenuation combined with source removal has resulted in a continuing decrease in contaminant concentrations in groundwater.
- The selected remedy is expected to continue to provide risk reduction through degradation of contaminants in the groundwater.
- The selected remedy provides measures to prevent future exposure to currently contaminated groundwater.

- DA, USEPA, KDHE, and the public believe the selected remedy would be protective of human health and the environment, would comply with ARARs, would be cost-effective, and would utilize permanent solutions and alternative treatment technologies to the maximum extent practicable.

2.12.2 Description of the Selected Remedy

The selected remedy for remediation of the groundwater contamination at the FFTA-MAAF Site (OU 004) is Alternative 2: MNA with Institutional Controls. This alternative relies on natural degradation processes already occurring at the FFTA-MAAF Site (OU 004) to further reduce contaminant concentrations to levels below the MCLs. With this alternative, the FFTA-MAAF Site (OU 004) will undergo groundwater sampling to monitor progress, and institutional controls will be put in place to prevent exposure of receptors. MNA and institutional controls are detailed in Section 2.9.1.2.

2.12.3 Summary of the Estimated Remedy Costs

The costs for the selected remedy of MNA with Institutional Controls are summarized below:

Present Worth Cost:	$2,000,000
Capital Cost:	$ 48,000
Total O&M Cost:	$2,200,000
Periodic Costs:	$ 108,000
Total Project Cost:	$2,400,000

Detailed cost analysis tables are presented in Tables 2-33 and 2-34. For the cost estimation process, data were gathered from cost estimation software (Remediation Action Cost Engineering and Requirements [RACER], 2000), vendor quotations, prior expenses, and professional judgement. Details regarding the costs for the selected remedy are presented in the FS report (BMcD, 2003c).

The information in the cost estimate summary tables is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the design and implementation of the MNA remedy. Major changes may be documented in the form of a memorandum in the Administrative Record file, an Explanation of Significant Differences (ESD), or a ROD amendment.

2.12.4 Expected Outcomes of the Selected Remedy

The selected remedy relies on natural degradation processes already occurring at the FFTA-MAAF Site (OU 004) to further reduce contaminant concentrations to levels below the MCLs. With this alternative, the FFTA-MAAF Site (OU 004) will undergo groundwater sampling to monitor progress, and institutional controls will be put in place to prevent exposure of receptors where MCLs are exceeded. The USEPA and KDHE will provide oversight and will have the opportunity to collect split samples to confirm the results that will be used to evaluate the effectiveness of the selected remedy.

Currently there is no human exposure to the contaminated groundwater and concentrations of contaminants in groundwater are below MCLs based on the most recent groundwater sampling results (February 2005). The selected remedy will be considered complete when the following COCs are below their respective MCLs for three consecutive years:

- TCE (MCL is 5 μg/L)
- cis-1,2-DCE (MCL is 70 μg/L)

If the groundwater MCLs are not exceeded for three consecutive years, the FFTA-MAAF Site (OU 004) will be recommended for the discontinuance of sampling and for site closeout during the next periodic review. CERCLA requires administrative reassessments every five years if the Site is not open for unrestricted use whenever contaminants are left in place. Upon completion of the selected remedy, the land use at the FFTA-MAAF Site (OU 004) and off the site will be changed to unrestricted.

2.13 STATUTORY DETERMINATIONS

The selected remedy must meet the statutory requirements of CERCLA, which are itemized in Section 1.5 of this ROD and described below.

2.13.1 Protection of Human Health and the Environment

The selected remedy will prevent future exposure to contaminated groundwater. Currently there is no exposure to contaminated groundwater. The selected remedy includes monitoring of groundwater and restriction of groundwater use through the use of institutional controls to ensure receptors are not exposed to contaminant levels above MCLs. There is no evidence of ecological risk to the Kansas River from the contaminated groundwater plume based on the evaluations performed. The monitoring ensures that contaminant levels that could cause risk will be detected in time to take remedial action. The selected

remedy relies on natural degradation processes already occurring at the FFTA-MAAF Site (OU 004) to further reduce contaminant concentrations to levels below the MCLs.

2.13.2 Compliance with Applicable or Relevant and Appropriate Requirements

The selected remedy must meet the Federal and State environmental statutes, regulations, and other requirements that regulate the FFTA-MAAF Site (OU 004) and the actions in the MNA with Institutional Controls alternative. These criteria are known as ARARs and are placed into three categories: chemical-specific, location-specific, and action-specific.

The KDHE list of potential ARARs was evaluated according to each statutory program and the regulations specific to each program. The ARAR evaluation was conducted in accordance with the CERCLA Compliance with Other Laws Manual, Parts I and II (USEPA, 1989a and USEPA, 1989b). Following the ARAR evaluation process, chemical-, location-, and action-specific ARARs for the MAAF Site were identified and are summarized below.

The chemical-specific ARARs for the MAAF Site are:

- Kansas Surface Water Quality Standards (Kansas Administrative Record [KAR] § 28.16.28b)
- Kansas Water Pollution Control, Antidegradation Policy (KAR § 28.16.28c(a))
- Safe Drinking Water Act (SDWA), National Primary Drinking Water Regulations (40 CFR § 141 and 142)
- Kansas Drinking Water Standards (KAR § 28.15)

The location-specific ARARs for the MAAF Site are:

- Archaeological and Historic Preservation Act of 1974 (16 USC § 469 et seq.)
- Endangered Species Act of 1973 (7 USC § 136 and 16 USC § 460 et seq.)
- Fish and Wildlife Conservation Act (16 USC § 2901 and 2911)
- Flood Control Act of 1944 (16 USC § 460)
- National Historic Preservation Act of 1966 (16 USC § 470 et seq.)
- Kansas Historic Preservations Act (KAR § 118-3)
- Non-Game, Threatened or Endangered Species (KAR § 115-15)

The action-specific ARARs for the MAAF Site are:

- Clean Water Act (33 USC § 1251 et seq.)
- CERCLA of 1980 (42 USC § 9601 et seq. as amended by the SARA of 1986)
- Occupational Safety and Health Act (OSHA) of 1970 (29 USC § 651 et seq.). Includes both workplace standards (29 CFR 1910) and construction standards (29 CFR 1926)
- Water Well Contractor's License; Water Well Construction and Abandonment (KAR § 28-30)
- Emergency Planning and Right-to-Know (KAR § 28-65)
- Kansas Board of Technical Professions (KAR § 66-6 through 66-14)

Based on the RI report, groundwater is the only environmental medium at the FFTA-MAAF Site (OU 004) that has constituent levels above their corresponding chemical-specific ARARs (MCLs). The selected remedy will eventually achieve compliance with the chemical-specific ARAR (MCLs) through the natural attenuation process. Institutional controls will prevent exposure to groundwater with contamination levels in excess of MCLs until groundwater quality for unrestricted use is achieved. The selected remedy is in compliance with both action- and location-specific ARARs, including endangered and/or threatened species, floodplain, historical, or RCRA ARARs because there are no major construction activities associated with the selected remedy and no hazardous wastes produced by the remediation.

2.13.3 Cost Effectiveness

The selected remedy meets the NCP's definition that a cost-effective remedy is one whose costs are proportional to its overall effectiveness.

2.13.4 Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

With this alternative, the FFTA-MAAF Site (OU 004) will undergo groundwater sampling to monitor progress, and institutional controls will be put in place to eliminate or minimize the chance of a receptor being exposed to the contaminated groundwater below and downgradient of the FFTA-MAAF Site (OU 004). Once RAOs are achieved at the FFTA-MAAF Site (OU 004), groundwater contaminant levels are anticipated to remain below MCLs because there is likely no ongoing source at the FFTA-MAAF Site (OU 004). Therefore, the magnitude of risk to human health and the environment is anticipated to be less than current risk conditions, which are already within the USEPA accepted limits at the FFTA-MAAF Site (OU 004). An alternate water supply and institutional controls are anticipated to limit exposure to present and future users of the groundwater, if necessary.

The selected remedy did not lend itself to the use of alternative treatment technologies.

2.13.5 Preference for Treatment as a Principal Element

The selected remedy does not involve engineered treatment, but instead relies on natural degradation processes already occurring at the FFTA-MAAF Site (OU 004) to further reduce contaminant concentrations to levels below the MCLs.

The source of contamination in soil was reduced to concentrations below the levels determined by KDHE to prevent further leaching of contaminants to groundwater through the completion of a source removal pilot study (using SVE and bioventing technologies) in May of 1995. As an alternative water supply/interim removal action, two private water supply wells were installed and five existing wells were abandoned in 2002. The two new wells are located outside of the contaminated groundwater plume, thus further reducing the potential human health risk. Natural attenuation combined with the source removal has been responsible for the continuing decrease of contaminant levels in groundwater. The selected remedy was selected over the other alternatives because it is expected to continue to provide risk reduction through degradation of contaminants in the groundwater and provides measures to prevent future exposure to currently contaminated groundwater. The selected remedy did not lend itself to the use of treatment as the principal element. The relative rank of the selected remedy for the evaluation criteria is presented in Table 2-3 (Page 2-25).

2.13.6 Five-Year Review Requirements

Once PRGs are achieved at the FFTA-MAAF Site (OU 004), groundwater contaminant levels are anticipated to remain below MCLs because there is no ongoing source at the FFTA-MAAF Site (OU 004). Therefore, the magnitude of risk to human health and the environment is anticipated to be less than current risk conditions, which are already within the USEPA accepted limits at the FFTA-MAAF Site (OU 004). However, contaminants sorbed to the aquifer matrix may serve as a low-level source after remediation is completed, but natural attenuation will continue. An alternate water supply and institutional controls are anticipated to limit exposure to present and future users of the groundwater, if necessary.

Because this remedy will result in hazardous substances, pollutants or contaminants remaining at the FFTA-MAAF Site (OU 004) above levels that allow for unlimited use and unrestricted exposure, a review in accordance with the NCP will be conducted no less often than every five years after initiation of the selected remedial action to ensure that the remedy is, or will be, protective of human health and the

environment. The first five-year review of the selected remedy will include consideration of the following factors:

- the performance of MNA in achieving cleanup levels (MCLs),
- property above the groundwater plume to ensure that groundwater with contamination above cleanup levels (MCLs) is not used, and
- if no wells exceed groundwater cleanup levels (MCLs) for three consecutive years, a recommendation for discontinuing sampling and site closeout will be made.

2.14 DOCUMENTATION OF SIGNIFICANT CHANGES

The revised (Draft Final) Proposed Plan was submitted to the USEPA and KDHE on May 12, 2004 and was available to the public (via the Fort Riley IRP administrative library located at 407 Pershing Court, Fort Riley, Kansas, the Dorothy Bramlage Public Library located at 230 West Seventh Street, Junction City, Kansas, and the Manhattan Public Library in Manhattan, Kansas). The Proposed Plan was released to the public during the July 13, 2004 through August 11, 2004 public comment period, which included the July 20, 2004 public meeting held concurrently with the public RAB meeting. Announcements regarding the Site are published in the *Junction City Daily Union* and the *Manhattan Mercury* newspapers. The Proposed Plan identified Alternative 2 (MNA with Institutional Controls) as the preferred remedy. Fort Riley received no public comments on the Proposed Plan during the designated public comment period. No significant changes to the remedy as it was originally identified in the Proposed Plan are necessary.

* * * * *

3.0 RESPONSIVENESS SUMMARY

3.1 STAKEHOLDER COMMENTS AND LEAD AGENCY RESPONSES

During the public comment period from July 13, 2004 through August 11, 2004 for the Proposed Plan (BMcD, 2004c), no specific public comments regarding the selected remedy for the FFTA-MAAF Site (OU 004) were received. No significant comments were conveyed at the public meeting held on July 20, 2004. Because there was no public response to the selected remedy of the Proposed Plan, this Responsiveness Summary contains no comments.

3.2 TECHNICAL AND LEGAL ISSUES

3.2.1 Technical Issues

There are no outstanding technical issues at the FFTA-MAAF Site (OU 004).

3.2.2 Legal Issues

There are no outstanding legal issues at the FFTA-MAAF Site (OU 004). The DA, Fort Riley will continue to coordinate with the USEPA and the State of Kansas acting through KDHE and the land owners of the property (off-site land) adjacent to the FFTA-MAAF Site (OU 004) regarding implementation of appropriate institutional controls to prevent use of the groundwater until concentrations decrease to at or below the MCLs for a consecutive period of three years. At this point, the cleanup/remediation of the FFRA-MAAF Site (OU 004) and off the site will be considered complete.

* * * * *

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TABLES

Table 2-1
Positive VOC Detections in Pre-Pilot Study Soil Borings
July 1994
FFTA-MAAF Record of Decision

Site ID	Sample ID	Depth From (ft)	Depth To (ft)	Concentration	Units
Benzene					
SB-4	MAAFSB4-2	4.0	7.0	550	µg/kg
SB-4	MAAFSB4A-2	4.0	7.0	1400	µg/kg
Ethylbenzene					
SB-4	MAAFSB4-2	4.0	7.0	15000 r,J	µg/kg
SB-4	MAAFSB4A-2	4.0	7.0	19000 r,J	µg/kg
SB-4	MAAFSB4-3	10.0	12.0	9600 r,J	µg/kg
SB-4	MAAFSB4-4	12.5	13.0	1300	µg/kg
Meta &/or Para-Xylene					
SB-4	MAAFSB4-1	1.0	3.0	850	µg/kg
SB-4	MAAFSB4-2	4.0	7.0	160000 r,J	µg/kg
SB-4	MAAFSB4A-2	4.0	7.0	160000 r,J	µg/kg
SB-4	MAAFSB4-3	10.0	12.0	94000 r,J	µg/kg
SB-4	MAAFSB4-4	12.5	13.0	22000 r,J	µg/kg
SB-5	MAAFSB5-3	10.0	12.0	170000 r,J	µg/kg
SB-5	MAAFSB5-4	12.0	13.0	18000	µg/kg
Ortho-Xylene					
SB-4	MAAFSB4-2	4.0	7.0	33000 r,J	µg/kg
SB-4	MAAFSB4A-2	4.0	7.0	29000 r,J	µg/kg
SB-4	MAAFSB4-3	10.0	12.0	18000 r,J	µg/kg
SB-4	MAAFSB4-4	12.5	13.0	2900	µg/kg
SB-5	MAAFSB5-3	10.0	12.0	24000 r,J	µg/kg
SB-5	MAAFSB5-4	12.0	13.0	4000	µg/kg
Toluene					
SB-4	MAAFSB4-1	1.0	3.0	710	µg/kg
SB-4	MAAFSB4-2	4.0	7.0	130000 r,J	µg/kg
SB-4	MAAFSB4A-2	4.0	7.0	180000 r,J	µg/kg
SB-4	MAAFSB4-3	10.0	12.0	70000 r,J	µg/kg
SB-4	MAAFSB4-4	12.5	13.0	8600 r,J	µg/kg
SB-5	MAAFSB5-3	10.0	12.0	26000 r,J	µg/kg
SB-5	MAAFSB5-4	12.0	13.0	4100	µg/kg

Table 2-1 (continued)
Positive VOC Detections in Pre-Pilot Study Soil Borings
July 1994
FFTA-MAAF Record of Decision

Site ID	Sample ID	Depth From (ft)	Depth To (ft)	Concentration	Units
Tetrachloroethene					
SB-4	MAAFSB4A-1	1.0	3.0	170	µg/kg
SB-7	MAAFSB7-2	1.0	3.0	250	µg/kg
SB-7	MAAFSB7-3	5.0	7.0	130	µg/kg
SB-8	MAAFSB8-2	1.0	3.0	35	µg/kg
SB-8	MAAFSB8B-1	1.0	3.0	21	µg/kg
SB-8	MAAFSB8B-2	4.0	6.0	260	µg/kg
SB-8	MAAFSB8-3	4.0	6.0	560	µg/kg
SB-9	MAAFSB9-1	1.0	3.0	220	µg/kg
SB-9	MAAFSB9B-1	1.0	3.0	103	µg/kg
SB-9	MAAFSB9-2	4.0	6.0	650	µg/kg
SB-9	MAAFSB9B-2	4.0	6.0	240	µg/kg
SB-9	MAAFSB9-3	10.0	12.0	15	µg/kg
SB-9	MAAFSB9B-3	4.0	6.0	93	µg/kg
SB-10	MAAFSB10-1	1.0	3.0	170	µg/kg
SB-10	MAAFSB10-2	5.0	7.5	19	µg/kg
SB-10	MAAFSB10-4	10.1	12.0	26	µg/kg
SB-11	MAAFSB11-1	1.0	3.0	26	µg/kg
SB-11	MAAFSB11-2	4.0	6.0	18	µg/kg
SB-12	MAAFSB12-1	1.0	3.0	38	µg/kg
Trichloroethene					
SB-4	MAAFSB4A-1	1.0	3.0	8.6	µg/kg
1,2-Dichloroethene					
SB-4	MAAFSB4A-1	1.0	3.0	160	µg/kg
SB-4	MAAFSB4-2	4.0	7.0	13000 r,J	µg/kg
SB-4	MAAFSB4A-2	4.0	7.0	23000 r,J	µg/kg
SB-4	MAAFSB4-3	10.0	12.0	310	µg/kg

Notes:

r - Laboratory Reanalysis

J - Sample quantitative value estimated

µg/kg - micrograms per kilogram

Source:

Post-Pilot Soils (LBA, 1996a)

Table 2-2
Positive TPH Detections in Pre-Pilot Study Soil Borings
July 1994
FFTA-MAAF Record of Decision

Site ID	Sample ID	Depth From (ft)	Depth To (ft)	Concentration	Units
TPH-DRO					
SB-1	MAAFSB1-1	1.0	3.0	150000	µg/kg
SB-1	MAAFSB1-4	12.3	12.8	1400000	µg/kg
SB-3	MAAFSB3B-1	1.0	3.0	40000	µg/kg
SB-4	MAAFSB4-1	1.0	3.0	15000000	µg/kg
SB-4	MAAFSB4A-1	1.0	3.0	7000000	µg/kg
SB-4	MAAFSB4-2	4.0	7.0	23000000	µg/kg
SB-4	MAAFSB4A-2	4.0	7.0	980000	µg/kg
SB-4	MAAFSB4-3	10.0	12.0	6000000	µg/kg
SB-4	MAAFSB4-4	12.5	13.0	3300000	µg/kg
SB-5	MAAFSB5-3	10.0	12.0	4000000	µg/kg
SB-5	MAAFSB5-4	12.0	13.0	6000000	µg/kg
TPH-GRO					
SB-1	MAAFSB1-1	1.0	3.0	190	µg/kg
SB-1	MAAFSB1-2	4.0	7.0	270	µg/kg
SB-1	MAAFSB1-3	10.0	12.0	200	µg/kg
SB-1	MAAFSB1-4	12.3	12.8	21000	µg/kg
SB-4	MAAFSB4-1	1.0	3.0	350000	µg/kg
SB-4	MAAFSB4A-1	1.0	3.0	1800000	µg/kg
SB-4	MAAFSB4-2	4.0	7.0	2600000	µg/kg
SB-4	MAAFSB4A-2	4.0	7.0	2200000	µg/kg
SB-4	MAAFSB4-3	10.0	12.0	2200000	µg/kg
SB-4	MAAFSB4-4	12.5	13.0	600000	µg/kg
SB-5	MAAFSB5A-2	4.0	6.0	130	µg/kg
SB-5	MAAFSB5-3	10.0	12.0	1800000	µg/kg
SB-5	MAAFSB5-4	12.0	13.0	1500000	µg/kg
SB-7	MAAFSB7-2	1.0	3.0	430	µg/kg
SB-7	MAAFSB7-3	5.0	7.0	320	µg/kg
SB-7	MAAFSB7-4	5.0	7.0	210	µg/kg
SB-7	MAAFSB7-5	10.0	12.0	450	µg/kg
SB-7	MAAFSB7-6	14.0	15.5	170	µg/kg

Notes:

µg/kg - micrograms per kilogram

TPH-DRO - Total Petroleum Hydrocarbons - Diesel Range Organics

TPH-GRO - Total Petroleum Hydrocarbons - Gasoline Range Organics

Source:

Post-Pilot Soils (LBA, 1996a)

Table 2-3
Positive VOC Detections in Post-Pilot Study Soil Borings
March/April 1996
FFTA-MAAF Record of Decision

Site ID	Sample ID	Depth From (ft)	Depth To (ft)	Concentration	Units
Ethylbenzene					
PSB-4	MAAFPSB-4-1	1.0	3.0	450	µg/kg
PSB-4	MAAFPSB-4-2	4.2	6.0	15000	µg/kg
PSB-44	MAAFPSB-44-5	15.7	16.7	40	µg/kg
Meta &/or Para-Xylene					
PSB-16	MAAFPSB-16-5	16.5	17.5	210	µg/kg
PSB-29	MAAFPSB-29-5	15.8	17.0	520	µg/kg
PSB-30	MAAFPSB-30-5	15.5	16.5	470	µg/kg
PSB-30	MAAFPSB-30-4	13.0	14.5	130	µg/kg
PSB-31	MAAFPSB-31-5	14.8	15.7	3100	µg/kg
PSB-32	MAAFPSB-32-5	16.0	16.8	340	µg/kg
PSB-4	MAAFPSB-4-5	14.8	15.8	610	µg/kg
PSB-4	MAAFPSB-4-1	1.0	3.0	2200	µg/kg
PSB-4	MAAFPSB-4-3	10.0	11.8	240	µg/kg
PSB-4	MAAFPSB-4-4	12.6	13.1	210	µg/kg
PSB-4	MAAFPSB-4-2	4.2	6.0	37000	µg/kg
PSB-44	MAAFPSB-44-5	15.7	16.7	260	µg/kg
PSB-5	MAAFPSB-5-3	10.0	12.0	1700	µg/kg
PSB-5	MAAFPSB-5-4	12.5	13.0	170	µg/kg
PSB-5	MAAFPSB-5-5	15.3	16.3	830	µg/kg
Ortho-Xylene					
PSB-29	MAAFPSB-29-5	15.8	17.0	850	µg/kg
PSB-30	MAAFPSB-30-4	13.0	14.5	260	µg/kg
PSB-30	MAAFPSB-30-5	15.5	16.5	330	µg/kg
PSB-31	MAAFPSB-31-5	14.8	15.7	420	µg/kg
PSB-32	MAAFPSB-32-5	16.0	16.8	150	µg/kg
PSB-4	MAAFPSB-4-5	14.8	15.8	550	µg/kg
PSB-4	MAAFPSB-4-4	12.6	13.1	180	µg/kg
PSB-4	MAAFPSB-4-1	1.0	3.0	950	µg/kg
PSB-4	MAAFPSB-4-3	10.0	11.8	490	µg/kg
PSB-4	MAAFPSB-4-2	4.2	6.0	27000	µg/kg
PSB-44	MAAFPSB-44-5	15.7	16.7	140	µg/kg
PSB-44	MAAFPSB-44-4	12.8	14.8	17	µg/kg
PSB-5	MAAFPSB-5-4	12.5	13.0	550	µg/kg
PSB-5	MAAFPSB-5-3	10.0	12.0	1500	µg/kg
PSB-5	MAAFPSB-5-5	15.3	16.3	450	µg/kg

Table 2-3 (continued)
Positive VOC Detections in Post-Pilot Study Soil Borings
March/April 1996
FFTA-MAAF Record of Decision

Site ID	Sample ID	Depth From (ft)	Depth To (ft)	Concentration	Units
Tetrachloroethene					
PSB-17	MAAFPSB-17-5	15.1	16.0	35	µg/kg
PSB-17	MAAFPSB-17-1	0.5	1.0	290	µg/kg
PSB-24	MAAFPSB-24-6	4.2	7.0	11	µg/kg
PSB-24	MAAFPSB-24-2	4.2	7.0	21	µg/kg
PSB-25	MAAFPSB-25-2	4.8	7.0	28	µg/kg
PSB-4	MAAFPSB-4-1	1.0	3.0	100	µg/kg
PSB-7	MAAFPSB-7-1	1.0	3.0	8.8	µg/kg
PSB-8	MAAFPSB-8-6	3.9	6.1	63	µg/kg
PSB-8	MAAFPSB-8-2	3.9	6.1	41	µg/kg
PSB-9	MAAFPSB-9-1	1.0	3.0	47	µg/kg
PSB-9	MAAFPSB-9-2	4.0	6.0	74	µg/kg
PSB-9	MAAFPSB-9-6	4.0	6.0	29	µg/kg
Toluene					
PSB-4	MAAFPSB-4-1	1.0	3.0	760	µg/kg
PSB-4	MAAFPSB-4-2	4.2	6.0	63000	µg/kg
PSB-5	MAAFPSB-5-3	10.0	12.0	370	µg/kg
Trichloroethene					
PSB-13	MAAFPSB-13-2	4.7	7.0	7.5	µg/kg
PSB-14	MAAFPSB-14-2	4.0	7.0	37	µg/kg
PSB-14	MAAFPSB-14-1	0.5	1.3	51	µg/kg
PSB-14	MAAFPSB-14-6	4.0	7.0	21	µg/kg

Notes:
µg/kg - micrograms per kilogram
Source:
Post-Pilot Soils (LBA, 1996a)

Table 2-4
Positive TPH Detections in Post-Pilot Study Soil Borings
March/April 1996
FFTA-MAAF Record of Decision

Site ID	Sample ID	Depth From (ft)	Depth To (ft)	Concentration	Units
TPH-DRO					
PSB-13	MAAFPSB-13-5	15.0	15.5	500000	µg/kg
PSB-13	MAAFPSB-13-4	13.0	14.5	160000	µg/kg
PSB-14	MAAFPSB-14-1	0.5	1.3	16000	µg/kg
PSB-15	MAAFPSB-15-4	12.7	13.3	750000	µg/kg
PSB-15	MAAFPSB-15-3	10.0	11.2	180000	µg/kg
PSB-16	MAAFPSB-16-5	16.5	17.5	1400000	µg/kg
PSB-16	MAAFPSB-16-4	13.0	14.6	84000	µg/kg
PSB-16	MAAFPSB-16-3	10.0	12.0	11000	µg/kg
PSB-17	MAAFPSB-17-1	0.5	1.0	13000	µg/kg
PSB-2	MAAFPSB-2-5	14.8	15.6	33000	µg/kg
PSB-22	MAAFPSB-22-1	0.5	1.0	13000	µg/kg
PSB-23	MAAFPSB-23-1	0.6	1.0	11000	µg/kg
PSB-24	MAAFPSB-24-1	0.5	1.0	16000	µg/kg
PSB-25	MAAFPSB-25-1	0.5	1.0	27000	µg/kg
PSB-27	MAAFPSB-27-1	0.5	1.0	10000	µg/kg
PSB-29	MAAFPSB-29-5	15.8	17.0	1500000	µg/kg
PSB-3	MAAFPSB-3-5	15.4	16.4	5900	µg/kg
PSB-30	MAAFPSB-30-5	15.5	16.5	700000	µg/kg
PSB-30	MAAFPSB-30-1	0.5	1.0	8700	µg/kg
PSB-30	MAAFPSB-30-4	13.0	14.5	1200000	µg/kg
PSB-30	MAAFPSB-30-3	10.5	12.0	77000	µg/kg
PSB-31	MAAFPSB-31-4	13.0	14.8	15000	µg/kg
PSB-31	MAAFPSB-31-1	0.5	1.0	14000	µg/kg
SB-31+A	MAAFPSB-31-5	14.8	15.7	2900000	µg/kg
PSB-32	MAAFPSB-32-4	13.0	14.6	190000	µg/kg
PSB-32	MAAFPSB-32-5	16.0	16.8	1000000	µg/kg
PSB-34	MAAFPSB-34-1	0.9	1.4	8700	µg/kg
PSB-36	MAAFPSB-36-2	4.0	7.0	9200	µg/kg
PSB-38	MAAFPSB-38-2	4.0	7.0	6100	µg/kg
PSB-39	MAAFPSB-39-4	14.2	15.0	40000	µg/kg
PSB-4	MAAFPSB-4-5	14.8	15.8	2600000	µg/kg
PSB-4	MAAFPSB-4-4	12.6	13.1	2700000	µg/kg
PSB-4	MAAFPSB-4-1	1.0	3.0	6200000	µg/kg
PSB-4	MAAFPSB-4-2	4.2	6.0	21000000	µg/kg
PSB-4	MAAFPSB-4-3	10.0	11.8	5300000	µg/kg
PSB-40	MAAFPSB-40-1	0.5	1.0	6200	µg/kg
PSB-41	MAAFPSB-41-1	0.5	1.0	10000	µg/kg
PSB-42	MAAFPSB-42-1	0.5	1.0	13000	µg/kg
PSB-43	MAAFPSB-43-1	0.5	1.0	7300	µg/kg

Table 2-4 (continued)
Positive TPH Detections in Post-Pilot Study Soil Borings
March/April 1996
FFTA-MAAF Record of Decision

Site ID	Sample ID	Depth From (ft)	Depth To (ft)	Concentration	Units
TPH-DRO					
PSB-44	MAAFPSB-44-4	12.8	14.8	1100000	µg/kg
PSB-44	MAAFPSB-44-1	0.5	1.0	130000	µg/kg
PSB-44	MAAFPSB-44-5	15.7	16.7	1800000	µg/kg
PSB-47	MAAFPSB-47-1	0.5	1.0	1100000	µg/kg
PSB-5	MAAFPSB-5-5	15.3	16.3	1200000	µg/kg
PSB-5	MAAFPSB-5-4	12.5	13.0	2300000	µg/kg
PSB-5	MAAFPSB-5-3	10.0	12.0	11000000	µg/kg
PSB-5	MAAFPSB-5-2	4.1	6.0	7700	µg/kg
PSB-5	MAAFPSB-5-1	1.0	3.0	15000	µg/kg
PSB-7	MAAFPSB-7-4	12.5	14.0	5300	µg/kg
PSB-7	MAAFPSB-7-5	15.3	16.3	850000	µg/kg
PSB-8	MAAFPSB-8-6	3.9	6.1	10000	µg/kg
TPH-GRO					
PSB-13	MAAFPSB-13-5	15.0	15.5	37000	µg/kg
PSB-14	MAAFPSB-14-5	15.7	16.4	140	µg/kg
PSB-15	MAAFPSB-15-3	10.0	11.2	4900	µg/kg
PSB-15	MAAFPSB-15-4	12.7	13.3	89000	µg/kg
PSB-16	MAAFPSB-16-5	16.5	17.5	96000	µg/kg
PSB-16	MAAFPSB-16-4	13.0	14.6	410	µg/kg
PSB-28	MAAFPSB-28-2	4.4	7.0	116	µg/kg
PSB-29	MAAFPSB-29-5	15.8	17.0	92000	µg/kg
PSB-30	MAAFPSB-30-5	15.5	16.5	73000	µg/kg
PSB-30	MAAFPSB-30-4	13.0	14.5	87000	µg/kg
PSB-31	MAAFPSB-31-5	14.8	15.7	70000	µg/kg
PSB-32	MAAFPSB-32-5	16.0	16.8	19000	µg/kg
PSB-4	MAAFPSB-4-3	10.0	11.8	340000	µg/kg
PSB-4	MAAFPSB-4-2	4.2	6.0	2500000	µg/kg
PSB-4	MAAFPSB-4-4	12.6	13.1	100000	µg/kg
PSB-4	MAAFPSB-4-1	1.0	3.0	240000	µg/kg
PSB-4	MAAFPSB-4-5	14.8	15.8	97000	µg/kg
PSB-44	MAAFPSB-44-5	15.7	16.7	55000	µg/kg
PSB-44	MAAFPSB-44-4	12.8	14.8	34000	µg/kg
PSB-5	MAAFPSB-5-5	15.3	16.3	740000	µg/kg
PSB-5	MAAFPSB-5-4	12.5	13.0	210000	µg/kg
PSB-5	MAAFPSB-5-3	10.0	12.0	2800000	µg/kg
PSB-7	MAAFPSB-7-5	15.3	16.3	230000	µg/kg

Notes:

µg/kg - micrograms per kilogram

TPH-DRO - Total Petroleum Hydrocarbons - Diesel Range Organics

TPH-GRO - Total Petroleum Hydrocarbons - Gasoline Range Organics

Source:

Post-Pilot Soils (LBA, 1996a)

Table 2-5
Metals Detections Above Background in Post-Pilot Study Soil Borings
FFTA-MAAF Record of Decision

Metal	Background Value (mg/kg)	Detection Above Background (mg/kg)	Sample Point	Sample Depth
Beryllium	**1.10**	1.20	PSB-21	0.5-1.0
		1.30	PSB-36	4-7
Cadmium	**1.00**	1.20	PSB-4	1-3
		1.30	PSB-8	3.9-6.1
		1.30	PSB-10	1-3
		1.40	PSB-12	1-3
		1.20	PSB-17	0.5-1.0
		1.60	PSB-21	0.5-1.0
		1.30	PSB-34	4-7
		1.50	PSB-36	4-7
Copper	**17.68**	32.00	PSB-22	0.5-1.0
		21.00	PSB-36	4-7
Lead	**32.31**	507.00	PSB-4	1-3
		101.00	PSB-4	4.2-6
		36.40	PSB-4	14.8-15.8
Selenium	**0.60**	0.70	PSB-24	0.5-1.0
Zinc	**72.86**	89.00	PSB-4	1-3
		78.00	PSB-8	3.9-6.1
		84.00	PSB-21	0.5-1.0
		74.00	PSB-24	4.2-7
		86.00	PSB-36	4-7
		74.00	PSB-46	0.5-1.0

Notes:
mg/L = milligrams per kilogram
Data from *Pilot Study Report* (LBA, 1999)

Table 2-6
Positive Detections in Groundwater
May 1997 through March 2005
FFTA-MAAF Record of Decision

Parameter	Units	MCL	Highest Result	Lowest Result	Highest Detection in March 2005 Sampling Event
Volatile Organic Compounds					
1,1-Dichloroethylene	µg/l	7	1.2	0.6 U	0.06 U
1,4-Dichlorobenzene	µg/l	NA	2.7	1 U	1 U
Acetone	µg/l	NA	220	100 U	100 U
Benzene	µg/l	5	**12**	0.4 U	2.6
Bromodichloromethane	µg/l	NA	0.6	0.5 U	0.5 U
Carbon Disulfide	µg/l	NA	6.7	5 U	5 U
Chlorobenzene	µg/l	100	1.1 J	0.4 U	0.4 U
cis-1,2-Dichloroethylene	µg/l	70	**1100**	0.5 U	34.3
Dichloromethane	µg/l	5	**51.2 J***	0.9 U	0.9 U
Ethylbenzene	µg/l	700	103	0.7 U	0.7 U
m,p-Xylene	µg/l	10000	328	0.6 U	0.6 U
Naphthalene	µg/l	NA	70.8	5 U	5 U
o-Xylene	µg/l	10000	128	0.6 U	0.6 U
Tetrachloroethylene	µg/l	5	**56**	1.1 U	2
Toluene	µg/l	1000	6.6	0.4 U	0.4 U
trans-1,2-Dichloroethylene	µg/l	100	4	0.5 U	0.5 U
Trichloroethylene	µg/l	5	**190**	0.6 U	0.9
Trichloromethane	µg/l	NA	14	0.5 U	0.5 U
Vinyl Chloride	µg/l	2	**2.8**	0.8 U	0.8 U
Semivolatile Organic Compounds					
4-Methylphenol	µg/l	NA	140	10 U	Not Sampled
Naphthalene	µg/l	NA	25	10 U	Not Sampled
Phenol	µg/l	NA	17	10 U	Not Sampled
Total Petroleum Hydrocarbons					
Calculated as Diesel	µg/l	NA	3900	100 U	Not Sampled
Calculated as Kerosene	µg/l	NA	340 J	100 U	Not Sampled
Calculated as Motor Oil	µg/l	NA	890	100 U	Not Sampled
Total Purgeable Hydrocarbons	µg/l	NA	2500	100 U	Not Sampled
Miscellaneous Analyses					
Ethane	µg/l	NA	9	4 U	Not Sampled
Methane	µg/l	NA	2640	2 U	Not Sampled

Table 2-6
Positive Detections in Groundwater
May 1997 through March 2005
FFTA-MAAF Record of Decision

Parameter	Units	MCL	Highest Result	Lowest Result	Highest Detection in March 2005 Sampling Event
Total Metals					
Arsenic, Total	mg/l	0.05	0.04	0.005 U	Not Sampled
Chromium, Total	mg/l	0.1	**0.207**	0.002 U	Not Sampled
Copper, Total	mg/l	1*/**	0.025	0.01 U	Not Sampled
Lead, Total	mg/l	0.015*	0.013	0.003 U	Not Sampled
Mercury, Total	mg/l	0.002	0.0003	0.0002 U	Not Sampled
Nickel, Total	mg/l	NA	0.091	0.01 U	Not Sampled
Selenium, Total	mg/l	0.05	0.024	0.005 U	Not Sampled
Zinc, Total	mg/l	5**	0.144	0.01 U	Not Sampled
Inorganics					
Total Chloride	mg/l	250**	80	1 U	Not Sampled
Total Nitrate	mg/l	10	**29**	0.1 U	Not Sampled
Total Sulfate	mg/l	250**	241	1 U	Not Sampled
Total Sulfide	mg/l	NA	0.4	0.1 U	Not Sampled
Water Quality					
Alkalinity	mg/l	NA	670	20 U	Not Sampled
Total Organic Carbon	mg/l	NA	96	0.5 U	Not Sampled

Note: Some of the results reported were the result of a diluted analysis. In particular, the total purgeable hydrocarbon and methane results were the higher result, however, other results for these parameters had a higher dilution factor and when accounting for this, for this, the result may be higher than noted above.

*Action level regulated by Treatment Technique (TT8)
**Secondary Standard

Bold text indicates result exceeded MCL.
J = Estimated value
J* = Qualified as estimated during QC evaluation
MCL = Maximum Contaminant Level
mg/l = milligrams per liter
NA = Not Applicable
U = Compound was not detected
µg/l = micrograms per liter

Table 2-7
Exposure Area Soil Data Summary
FFTA-MAAF Record of Decision

Chemical	Number of Detections / Number of Samples	Frequency of Positive Detections	Range of Detected Concentrations (ug/kg)	Sample with Maximum Detection
Petroleum Constituents				
Benzene	0 / 138	0%		
Ethylbenzene	4 / 138	3%	690 - 14000	FP99-SB13 b
2-Methylnaphthalene	15 / 170	9%	740- - 46,000	PSB 4-2
Naphthalene	10 / 170	6%	680 - 18000	PSB 4-2
Toluene	3 / 138	2%	3700 - 39000	FP99-SB13 b
Xylenes	10 / 138	7%	2380 - 77000	FP99-SB13 b
Chlorinated Solvents				
1,1-DCE	0 / 138	0%		
cis 1,2-DCE	4 / 138	3%	55 - 580	FP99-SB13 b
trans 1,2-DCE	0 / 138	0%		
PCE	16 / 138	12%	15 - 150	FP99-SB59a (31a)
TCE	3 / 138	2%	14 JM - 19 J	FP99-SB01 d
Vinyl Chloride	0 / 138	0%		

Note:
Population includes RI samples collected from 1 to 17 ft bgs. Samples collected from 0 to 0.5 ft bgs were nondetect.

Napthalene and 2-methylnaphthalene data were taken from the RI Work Plan since these constituents were not analytes for the RI.

Table 2-8
On-Post Groundwater Data Summary
FFTA-MAAF Record of Decision

Chemical	Number of Detections / Number of Samples	Frequency of Positive Detections	Range of Detected Concentrations (ug/L)	Monitoring Well with Maximum Detection	Sample Date of Maximum Detection
Petroleum Constituents					
Benzene	3 / 71	4%	0.6 - 1	FP-93-04	5/20/1999
Ethylbenzene	9 / 71	13%	52 - 95.5	FP-93-04	9/1/1998
Naphthalene	8 / 71	11%	7.7 - 70.8	FP-93-04	9/1/1998
Toluene	14 / 71	20%	0.5 - 6.6	FP-93-04	5/20/1999
Xylenes	9 / 71	13%	1.3 - 418	FP-93-04	9/1/1998
Chlorinated Solvents					
1,1-DCE	0 / 71	0%			
cis 1,2-DCE	22 / 71	31%	0.6 - 95.9	FP-93-04	5/20/1999
trans 1,2-DCE	2 / 71	3%	0.8 - 1.2	FP-93-02b	2/3/1999
PCE	9 / 71	13%	3.9 - 18.8	FP-93-02	9/7/1998
TCE	17 / 71	24%	0.6 - 39.6	FP-93-02b	2/3/1999
Vinyl Chloride	0 / 71	0%			
Other Chemicals					
Acetone	0 / 71	0%			
Methylene Chloride	0 / 71	0%			
Chloroform (Trichloromethane)	0 / 71	0%			
Phenols	0 / 18	0%			
4-Methylphenol	0 / 18	0%			

Note:
Population includes samples from all on-post wells with positive detections measured during the eight quarterly sampling events from 2/97 through 8/99: FP-93-01, FP-93-02, FP-93-02b, FP-93-02c, FP-93-03, FP-93-04, FP-93-04b, and FP-93-05.

Table 2-9
Off-Post Groundwater Data Summary
FFTA-MAAF Record of Decision

Chemical	Number of Detections / Number of Samples	Frequency of Positive Detections	Range of Detected Concentrations (ug/L)	Monitoring Well with Maximum Detection	Sample Date of Maximum Detection
Petroleum Constituents					
Benzene	61 / 244	25%	0.4 - 12	FP-94-09b	8/30/1997
Ethylbenzene	4 / 244	2%	0.8 - 2.4	FP-96-23b	8/29/1997
Naphthalene	0 / 244	0%			
Toluene	7 / 244	3%	0.4 - 0.6	R-3	5/20/1999
Xylenes	0 / 244	0%			
Chlorinated Solvents					
1,1-DCE	5 / 244	2%	0.8 - 1.2	FP-94-09	5/14/1999
cis 1,2-DCE	157 / 244	64%	0.5 - 1100	FP-94-09b	8/30/1997
trans 1,2-DCE	55 / 244	23%	0.5 - 4	FP-94-09	8/30/1999
PCE	73 / 244	30%	1.1 - 56	FP-96-25	5/28/1997
TCE	112 / 244	46%	0.7 - 190	FP-96-25	5/28/1997
Vinyl Chloride	6 / 244	2%	1.1 - 2.8	FP-94-11	8/30/1999
Other Chemicals					
Acetone	2 / 244	1%	160 - 220	I-1	3/3/1998
Methylene Chloride	4 / 244	2%	1 - 27.5	R-3	5/20/1999
Chloroform (Trichloromethane)	5 / 244	2%	0.7 - 14	R-1	5/29/1997
Phenols	1 / 52	2%	- 17	R-3	9/2/1997
4-Methylphenol	1 / 52	2%	- 140	R-3	9/2/1997

Note:
Population includes samples from all wells with positive detections measured in at least one of the eight quarterly sampling events from 2/97 through 8/99: I-1, M-1, R-1, R-2, R-3, R-4, FP-94-09, FP-94-09b, FP-94-11, FP-96-20b, FP-96-23, FP-96-23b, FP-96-23c, FP-96-24, FP-96-25, FP-96-25b, FP-96-25c, FP-96-26, FP-96-26b, FP-96-26c, FP-98-27, FP-98-27b, FP-98-27c, FP-98-28b, FP-98-28c, FP-98-29b, FP-98-29c, FP-98-31, FP-98-31b, FP-98-31c, FP-99-32b, FP-99-32c.

Table 2-10
Summary of Chemicals of Potential Concern
Evaluated in Risk Assessment
FFTA-MAAF Record of Decision

SOIL
Petroleum Constituents
Benzene
Ethylbenzene
2-Methylnaphthalene
Naphthalene
Toluene
Xylenes
Chlorinated Solvents
cis-1,2-DCE
PCE
TCE

GROUNDWATER
Petroleum Constituents
Benzene
Ethylbenzene
Toluene
Xylenes
Naphthalene
Chlorinated Solvents
1,1-DCE
cis-1,2-DCE
trans-1,2-DCE
PCE
TCE
Vinyl Chloride

Table 2-11
Concentrations in Subsurface Soil (1-8 feet bgs)
On-Post Scenarios
FFTA-MAAF Record of Decision

Chemical	Maximum Detected Concentration or Detection Limit (ug/kg)	95% Upper Confidence Limit (UCL) (ug/kg)	Concentration Used in HHBRA (ug/kg)
Petroleum Constituents			
Benzene	320 U	8.9	8.9
Ethylbenzene	14,000	28	28
2-Methylnaphthalene	4,900	940	940
Naphthalene	25,000	690	690
Toluene	39,000	40	40
Xylenes	77,000	103	103
Chlorinated Solvents			
1,2-DCE (cis)	800	11	11
PCE	150	15	15
TCE	16	6.5	6.5

Notes:

RI sampling population from 1-8 ft bgs was 66 for all chemicals except for naphthalene and 2-methylnaphthalene. The post-pilot study data sets were used for these two COPCs and included 13 samples each.

The 95% UCL value was used in the risk assessment except when the 95% UCL value was greater than the maximum concentration detected. In those instances the maximum concentration was used (USEPA, 1992c).

Half the detection limit was used as a proxy concentration in calculating the 95% UCL for samples that were nondetect.

Table 2-12
Groundwater Concentrations at Well R-2
Racetrack Worker Scenario
FFTA-MAAF Record of Decision

Chemical	Maximum Detected Concentration or Detection Limit (mg/L)	95% Upper Confidence Limit (UCL) (mg/L)	Concentration Used in HHBRA (mg/L)
Petroleum Constituents			
Benzene	0.0004 U	-	0.0002
Ethylbenzene	0.0007 U	-	0.00035
Toluene	0.0006	0.0004	0.0004
Xylenes	0.0006 U	-	0.0003
Naphthalene	0.005 U	-	0.0025
Chlorinated Solvents			
1,1-DCE	0.0006 U	-	0.0003
1,2-DCE (cis)	0.12	7.6	0.12
1,2-DCE (trans)	0.0023	0.0053	0.0023
PCE	0.0081	0.15	0.0081
TCE	0.0572	173	0.0572
Vinyl Chloride	0.0008 U	-	0.0004

Notes:

RI sample population for Well R-2 was 7.

The 95% UCL value was used for assessing current conditions except when the 95% UCL value was greater than the maximum concentration detected. In those instances, the maximum concentration was used (USEPA, 1992c).

Half the detection limit was used as a proxy concentration in calculating the 95% UCL for samples that were nondetect.

Table 2-13
Groundwater Concentrations at Well R-1
Racetrack Patron Scenario
FFTA-MAAF Record of Decision

Chemical	Maximum Detected Concentration or Detection Limit (mg/L)	95% Upper Confidence Limit (UCL) (mg/L)	Concentration Used in HHBRA (mg/L)
Petroleum Constituents			
Benzene	0.0005	0.0003	0.0005
Ethylbenzene	0.0014 U	-	0.0007
Toluene	0.0008 U	-	0.0004
Xylenes	0.0006 U	-	0.0003
Naphthalene	0.005 U	-	0.0025
Chlorinated Solvents			
1,1-DCE	0.0009	0.0006	0.0006
1,2-DCE (cis)	0.264	0.562	0.2640
1,2-DCE (trans)	0.002	0.0019	0.0019
PCE	0.039	0.167	0.0390
TCE	0.017	0.023	0.0170
Vinyl Chloride	0.0008 U	-	0.0004

Notes:

RI sample population for Well R-1 was 7.

The 95% UCL value was used for assessing current conditions except when the 95% UCL value was greater than the maximum concentration detected. In those instances, the maximum concentration was used (USEPA, 1992c).

Half the detection limit was used as a proxy concentration in calculating the 95% UCL for samples that were nondetect.

Table 2-14
Groundwater Concentrations at Well M-1
Current Off-Post Resident Scenario
FFTA-MAAF Record of Decision

Chemical	Maximum Detected Concentration or Detection Limit (mg/L)	95% Upper Confidence Limit (UCL) (mg/L)	Concentration Used in HHBRA (mg/L)
Petroleum Constituents			
Benzene	0.0004 U	-	0.0002
Ethylbenzene	0.0007 U	-	0.00035
Toluene	0.0004 U	-	0.0002
Xylenes	0.0006 U	-	0.0003
Naphthalene	0.005 U	-	0.0025
Chlorinated Solvents			
1,1-DCE	0.0006 U	-	0.0003
1,2-DCE (cis)	0.0098	0.0098	0.0098
1,2-DCE (trans)	0.0005 U	-	0.00025
PCE	0.0011 U	-	0.00055
TCE	0.0006 U	-	0.0003
Vinyl Chloride	0.0008 U	-	0.0004

Notes:

RI sample population for Well M-1 was 7.

The 95% UCL value was used for assessing current conditions except when the 95% UCL value was greater than the maximum concentration detected. In those instances, the maximum concentration was used (USEPA, 1992c).

Half the detection limit was used as a proxy concentration in calculating the 95% UCL for samples that were nondetect.

Table 2-15
Hazard Index Estimates for
On-Post Pedestrian/Jogger Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	RfD (mg/kg/day)	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Exposure Pathway: Inhalation of vapor phase chemicals from soil					
Petroleum Constituents					
Benzene	2.9E-06	3E-03	1E-03		
Ethylbenzene	1.9E-06	3E-01	6E-06		
2-Methylnaphthalene	1.1E-07	9E-04	1E-04		
Naphthalene	8.2E-07	9E-04	9E-04		
Toluene	6.1E-06	1E-01	6E-05		
Xylenes	6.7E-06	NAv	NAp		
Chlorinated Solvents					
1,2-DCE (cis)	2.1E-06	Nav	NAp		
PCE	2.7E-07	Nav	NAp		
TCE	1.4E-06	NAv	NAp		
				2E-03	
					2E-03

Notes:
Nav = Not available
Nap = Not applicable

Table 2-16
Hazard Index Estimates for
On-Post Utility Excavation Worker Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	RfD (mg/kg/day)	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Exposure Pathway: Incidental ingestion of chemicals in soil					
Petroleum Constituents					
Benzene	2.1E-10	1E-03	2E-07		
Ethylbenzene	6.6E-10	1E-01	7E-09		
2-Methylnaphthalene	2.2E-08	2E-02	1E-06		
Naphthalene	1.6E-08	2E-02	8E-07		
Toluene	9.4E-10	2E-01	5E-09		
Xylenes	2.4E-09	2E+00	1E-09		
Chlorinated Solvents					
1,2-DCE (cis)	2.6E-10	1E-02	3E-08		
PCE	3.5E-10	1E-02	3E-08		
TCE	1.5E-10	Nav	NAp		
				2E-06	
Exposure Pathway: Dermal contact with chemicals in soil					
Petroleum Constituents					
Benzene	1.4E-11	8E-04	2E-08		
Ethylbenzene	4.4E-11	8E-02	5E-10		
2-Methylnaphthalene	1.5E-09	2E-02	9E-08		
Naphthalene	1.1E-09	2E-02	7E-08		
Toluene	6.2E-11	2E-01	4E-10		
Xylenes	1.6E-10	2E+00	1E-10		
Chlorinated Solvents					
1,2-DCE (cis)	1.7E-11	8E-03	2E-09		
PCE	2.3E-11	8E-03	3E-09		
TCE	1.0E-11	NAv	NAp		
				2E-07	
Exposure Pathway: Inhalation of chemicals in fugitive dust					
Petroleum Constituents					
Benzene	2.1E-10	3E-03	7E-08		
Ethylbenzene	6.6E-10	3E-01	2E-09		
2-Methylnaphthalene	2.2E-08	9E-04	2E-05		
Naphthalene	1.6E-08	9E-04	2E-05		
Toluene	9.4E-10	1E-01	8E-09		
Xylenes	2.4E-09	NAv	NAp		
Chlorinated Solvents					
1,2-DCE (cis)	2.6E-10	Nav	NAp		
PCE	3.5E-10	Nav	NAp		
TCE	1.5E-10	NAv	NAp		
				4E-05	

Table 2-16 (continued)
Hazard Index Estimates for
On-Post Utility Excavation Worker Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	RfD (mg/kg/day)	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Exposure Pathway: Inhalation of vapor phase chemicals from soil					
Petroleum Constituents					
Benzene	1.2E-06	3E-03	4E-04		
Ethylbenzene	8.0E-07	3E-01	3E-06		
2-Methylnaphthalene	4.8E-08	9E-04	5E-05		
Naphthalene	3.5E-07	9E-04	4E-04		
Toluene	2.6E-06	1E-01	2E-05		
Xylenes	2.9E-06	NAv	NAp		
Chlorinated Solvents					
1,2-DCE (cis)	9.2E-07	Nav	NAp		
PCE	1.1E-07	Nav	NAp		
TCE	6.2E-07	NAv	NAp		
				9E-04	
					9E-04

Notes:
Nav = Not available
Nap = Not applicable

Table 2-17
Hazard Index Estimates for
Racetrack Worker Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	RfD (mg/kg/day)	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Exposure Pathway: Ingestion of chemicals in water					
Petroleum Constituents					
Benzene	1.4E-07	1E-03	1E-04		
Ethylbenzene	2.5E-07	1E-01	2E-06		
Toluene	3.1E-07	2E-01	2E-06		
Xylenes	2.1E-07	2E+00	1E-07		
Naphthalene	1.8E-06	2E-02	9E-05		
Chlorinated Solvents					
1,1-DCE	2.1E-07	9E-03	2E-05		
1,2-DCE (cis)	8.5E-05	1E-02	8E-03		
1,2-DCE (trans)	1.6E-06	2E-02	8E-05		
PCE	5.7E-06	1E-02	6E-04		
TCE	4.0E-05	NAv	NAp		
Vinyl Chloride	2.8E-07	5E-03	6E-05		
				9E-03	
Exposure Pathway: Dermal contact with chemicals while showering					
Petroleum Constituents					
Benzene	1.4E-08	8E-04	2E-05		
Ethylbenzene	8.8E-08	8E-02	1E-06		
Toluene	6.8E-08	2E-01	4E-07		
Xylenes	8.2E-08	2E+00	5E-08		
Naphthalene	5.9E-07	2E-02	4E-05		
Chlorinated Solvents					
1,1-DCE	1.6E-08	7E-03	2E-06		
1,2-DCE (cis)	4.1E-06	8E-03	5E-04		
1,2-DCE (trans)	7.9E-08	2E-02	5E-06		
PCE	1.5E-05	8E-03	2E-04		
TCE	4.0E-06	NAv	NAp		
Vinyl Chloride	4.0E-06	4E-03	2E-06		
				7E-04	
Exposure Pathway: Inhalation of vapor phase chemicals from water					
Petroleum Constituents					
Benzene	4.3E-08	3E-03	1E-05		
Ethylbenzene	7.5E-08	3E-01	2E-07		
Toluene	9.4E-08	1E-01	9E-07		
Xylenes	6.4E-08	Nav	NAp		
Naphthalene	5.3E-07	9E-04	6E-04		

Table 2-17 (continued)
Hazard Index Estimates for
Racetrack Worker Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	RfD (mg/kg/day)	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Exposure Pathway: Inhalation of vapor phase chemicals from water (cont.)					
Chlorinated Solvents					
1,1-DCE	6.4E-08	NAv	NAp		
1,2-DCE (cis)	2.6E-05	NAv	NAp		
1,2-DCE (trans)	4.9E-07	NAv	NAp		
PCE	1.7E-06	NAv	NAp		
TCE	1.2E-05	NAv	NAp		
Vinyl Chloride	8.5E-08	3E-02	3E-06		
				6E-04	
					1E-02

Notes:
Nav = Not available
Nap = Not applicable

Table 2-18
Hazard Index Estimates for
Child Racetrack Patron Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	RfD (mg/kg/day)	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Exposure Pathway: Ingestion of chemicals in tap water					
Petroleum Constituents					
Benzene	2.3E-07	1E-03	2E-04		
Ethylbenzene	3.3E-07	1E-01	3E-06		
Toluene	1.9E-07	2E-01	9E-07		
Xylenes	1.4E-07	2E+00	7E-08		
Naphthalene	1.2E-06	2E-02	6E-05		
Chlorinated Solvents					
1,1-DCE	2.7E-07	9E-03	3E-05		
1,2-DCE (cis)	1.2E-04	1E-02	1E-02		
1,2-DCE (trans)	9.1E-07	2E-02	5E-05		
PCE	1.8E-05	1E-02	2E-03		
TCE	8.0E-06	NAv	NAp		
Vinyl Chloride	1.9E-07	5E-03	4E-05		
				1E-02	
Exposure Pathway: Dermal contact with chemicals in tap water					
Petroleum Constituents					
Benzene	6.1E-09	8E-04	8E-06		
Ethylbenzene	3.0E-08	8E-02	4E-07		
Toluene	1.0E-08	2E-01	7E-08		
Xylenes	7.8E-09	2E+00	5E-09		
Naphthalene	6.5E-08	2E-02	4E-06		
Chlorinated Solvents					
1,1-DCE	5.3E-09	7E-03	7E-07		
1,2-DCE (cis)	1.5E-06	8E-03	2E-04		
1,2-DCE (trans)	1.1E-08	2E-02	7E-07		
PCE	1.5E-05	8E-03	1E-04		
TCE	4.0E-06	NAv	NAp		
Vinyl Chloride	4.0E-06	4E-03	4E-07		
				3E-04	
					1E-02

Notes:
Nav = Not available
Nap = Not applicable

Table 2-19
Hazard Index Estimates for
Adult Racetrack Patron Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	RfD (mg/kg/day)	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Exposure Pathway: Ingestion of chemicals in tap water					
Petroleum Constituents					
Benzene	1.4E-07	1E-03	1E-04		
Ethylbenzene	2.0E-07	1E-01	2E-06		
Toluene	1.1E-07	2E-01	6E-07		
Xylenes	8.5E-08	2E+00	4E-08		
Naphthalene	7.0E-07	2E-02	4E-05		
Chlorinated Solvents					
1,1-DCE	1.6E-07	9E-03	2E-05		
1,2-DCE (cis)	7.4E-05	1E-02	7E-03		
1,2-DCE (trans)	5.4E-07	2E-02	3E-05		
PCE	1.1E-05	1E-02	1E-03		
TCE	4.8E-06	NAv	NAp		
Vinyl Chloride	1.1E-07	5E-03	2E-05		
				8E-03	
Exposure Pathway: Dermal contact with chemicals in tap water					
Petroleum Constituents					
Benzene	3.7E-09	2E-02	2E-07		
Ethylbenzene	1.8E-08	6E-02	3E-07		
Toluene	6.3E-09	4E-02	2E-07		
Xylenes	8.4E-09	6E-02	1E-07		
Naphthalene	6.0E-08	6E-02	1E-06		
Chlorinated Solvents					
1,1-DCE	3.2E-09	1E-02	2E-07		
1,2-DCE (cis)	9.2E-07	8E-03	1E-04		
1,2-DCE (trans)	6.7E-09	8E-03	8E-07		
PCE	1.5E-05	4E-02	2E-05		
TCE	4.0E-06	NAv	NAp		
Vinyl Chloride	4.0E-06	6E-03	2E-07		
				1E-04	
					8E-03

Notes:
Nav = Not available
Nap = Not applicable

Table 2-20
Hazard Index Estimates for
Current Child Resident Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	RfD (mg/kg/day)	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Exposure Pathway: Ingestion of chemicals in tap water					
Petroleum Constituents					
Benzene	1.3E-05	1E-03	1E-02		
Ethylbenzene	2.2E-05	1E-01	2E-04		
Toluene	1.3E-05	2E-01	6E-05		
Xylenes	1.9E-05	2E+00	1E-05		
Naphthalene	1.6E-04	2E-02	8E-03		
Chlorinated Solvents					
1,1-DCE	1.9E-05	9E-03	2E-03		
1,2-DCE (cis)	6.3E-04	1E-02	6E-02		
1,2-DCE (trans)	1.6E-05	2E-02	8E-04		
PCE	3.5E-05	1E-02	4E-03		
TCE	1.9E-05	NAv	NAp		
Vinyl Chloride	2.6E-05	5E-03	5E-03		
				9E-02	
Exposure Pathway: Dermal contact with chemicals while showering					
Petroleum Constituents					
Benzene	6.5E-07	8E-04	8E-04		
Ethylbenzene	4.0E-06	8E-02	5E-05		
Toluene	1.4E-06	2E-01	9E-06		
Xylenes	3.7E-06	2E+00	2E-06		
Naphthalene	2.7E-05	2E-02	2E-03		
Chlorinated Solvents					
1,1-DCE	7.4E-07	7E-03	1E-04		
1,2-DCE (cis)	1.5E-05	8E-03	2E-03		
1,2-DCE (trans)	3.8E-07	2E-02	2E-05		
PCE	1.5E-05	8E-03	5E-04		
TCE	4.0E-06	NAv	NAp		
Vinyl Chloride	4.0E-06	4E-03	1E-04		
				6E-03	
Exposure Pathway: Inhalation of vapor phase chemicals while showering					
Petroleum Constituents					
Benzene	6.4E-06	3E-03	2E-03		
Ethylbenzene	1.1E-05	3E-01	4E-05		
Toluene	6.4E-06	1E-01	6E-05		
Xylenes	9.7E-06	Nav	NAp		
Naphthalene	8.1E-05	9E-04	9E-02		

Table 2-20 (continued)
Hazard Index Estimates for
Current Child Resident Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	RfD (mg/kg/day)	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Exposure Pathway: Inhalation of vapor phase chemicals while showering (cont.)					
Chlorinated Solvents					
1,1-DCE	9.7E-06	NAv	NAp		
1,2-DCE (cis)	3.2E-04	NAv	NAp		
1,2-DCE (trans)	8.1E-06	NAv	NAp		
PCE	1.8E-05	NAv	NAp		
TCE	9.7E-06	NAv	NAp		
Vinyl Chloride	1.3E-05	3E-02	4E-04		
				9E-02	
					2E-01

Notes:
Nav = Not available
Nap = Not applicable

Table 2-21
Hazard Index Estimates for
Current Adult Resident Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	RfD (mg/kg/day)	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Exposure Pathway: Ingestion of chemicals in tap water					
Petroleum Constituents					
Benzene	5.5E-06	1E-03	5E-03		
Ethylbenzene	9.6E-06	1E-01	1E-04		
Toluene	5.5E-06	2E-01	3E-05		
Xylenes	8.2E-06	2E+00	4E-06		
Naphthalene	6.8E-05	2E-02	3E-03		
Chlorinated Solvents					
1,1-DCE	8.2E-06	9E-03	9E-04		
1,2-DCE (cis)	2.7E-04	1E-02	3E-02		
1,2-DCE (trans)	6.8E-06	2E-02	3E-04		
PCE	1.5E-05	1E-02	2E-03		
TCE	8.2E-06	NAv	NAp		
Vinyl Chloride	1.1E-05	5E-03	2E-03		
				4E-02	
Exposure Pathway: Dermal contact with chemicals while showering					
Petroleum Constituents					
Benzene	2.8E-07	2E-02	2E-05		
Ethylbenzene	1.7E-06	6E-02	3E-05		
Toluene	6.0E-07	4E-02	2E-05		
Xylenes	1.6E-06	6E-02	2E-05		
Naphthalene	1.1E-05	6E-02	2E-04		
Chlorinated Solvents					
1,1-DCE	3.2E-07	1E-02	2E-05		
1,2-DCE (cis)	6.5E-06	8E-03	8E-04		
1,2-DCE (trans)	1.7E-07	8E-03	2E-05		
PCE	1.8E-06	4E-02	5E-05		
TCE	3.2E-07	NAv	NAp		
Vinyl Chloride	1.9E-07	6E-03	3E-05		
				1E-03	
Exposure Pathway: Inhalation of vapor phase chemicals while showering					
Petroleum Constituents					
Benzene	1.1E-05	3E-03	4E-03		
Ethylbenzene	1.8E-05	3E-01	6E-05		
Toluene	1.1E-05	1E-01	1E-04		
Xylenes	1.6E-05	Nav	NAp		
Naphthalene	1.3E-04	9E-04	1E-01		

Table 2-21 (continued)
Hazard Index Estimates for
Current Adult Resident Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	RfD (mg/kg/day)	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Exposure Pathway: Inhalation of vapor phase chemicals while showering (cont.)					
Chlorinated Solvents					
1,1-DCE	1.6E-05	NAv	NAp		
1,2-DCE (cis)	5.2E-04	NAv	NAp		
1,2-DCE (trans)	1.3E-05	NAv	NAp		
PCE	2.9E-05	NAv	NAp		
TCE	1.6E-05	NAv	NAp		
Vinyl Chloride	2.1E-05	3E-02	7E-04		
				1E-01	
					1E-01

Notes:
Nav = Not available
Nap = Not applicable

Table 2-22
Hazard Index Estimates for
Future Child Resident Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	RfD (mg/kg/day)	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Exposure Pathway: Ingestion of chemicals in drinking water					
Petroleum Constituents					
Benzene	2.6E-04	1E-03	3E-01		
Ethylbenzene	4.8E-05	1E-01	5E-04		
Toluene	1.2E-05	2E-01	6E-05		
Xylenes	1.1E-04	2E+00	6E-05		
Chlorinated Solvents					
1,1-DCE	7.7E-05	9E-03	9E-03		
1,2-DCE (cis)	1.4E-02	1E-02	1E+00		
1,2-DCE (trans)	1.6E-04	2E-02	8E-03		
PCE	1.4E-04	1E-02	1E-02		
TCE	4.4E-04	NAv	NAp		
Vinyl Chloride	6.6E-05	5E-03	1E-02		
				1E+00	
Exposure Pathway: Dermal contact with chemicals while showering					
Petroleum Constituents					
Benzene	1.3E-05	8E-04	2E-02		
Ethylbenzene	8.6E-06	8E-02	1E-04		
Toluene	1.3E-06	2E-01	8E-06		
Xylenes	2.2E-05	2E+00	1E-05		
Chlorinated Solvents					
1,1-DCE	3.0E-06	7E-03	4E-04		
1,2-DCE (cis)	3.4E-04	8E-03	4E-02		
1,2-DCE (trans)	3.8E-06	2E-02	2E-04		
PCE	1.5E-05	8E-03	2E-03		
TCE	4.0E-06	NAv	NAp		
Vinyl Chloride	4.0E-06	4E-03	3E-04		
				6E-02	
Exposure Pathway: Inhalation of vapor phase chemicals while showering					
Petroleum Constituents					
Benzene	9.3E-05	3E-03	3E-02		
Ethylbenzene	1.7E-05	3E-01	6E-05		
Toluene	4.3E-06	1E-01	4E-05		
Xylenes	4.1E-05	Nav	NAp		
Chlorinated Solvents					
1,1-DCE	2.8E-05	NAv	NAp		
1,2-DCE (cis)	5.1E-03	NAv	NAp		
1,2-DCE (trans)	5.8E-05	NAv	NAp		
PCE	5.1E-05	NAv	NAp		
TCE	1.6E-04	NAv	NAp		
Vinyl Chloride	2.4E-05	3E-02	8E-04		
				3E-02	
					1E+00

Notes:
Nav = Not available
Nap = Not applicable

Table 2-23
Hazard Index Estimates for
Future Resident Farmer Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	RfD (mg/kg/day)	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Exposure Pathway: Ingestion of chemicals in tap water					
Petroleum Constituents					
Benzene	2.6E-05	1E-03	3E-02		
Ethylbenzene	4.7E-06	1E-01	5E-05		
Toluene	1.2E-06	2E-01	6E-06		
Xylenes	1.1E-05	2E+00	5E-06		
Chlorinated Solvents					
1,1-DCE	3.3E-05	9E-03	4E-03		
1,2-DCE (cis)	2.0E-03	1E-02	2E-01		
1,2-DCE (trans)	6.8E-05	2E-02	3E-03		
PCE	1.4E-05	1E-02	1E-03		
TCE	4.4E-05	NAv	NAp		
Vinyl Chloride	1.4E-05	5E-03	3E-03		
				2E-01	
Exposure Pathway: Dermal contact with chemicals while showering					
Petroleum Constituents					
Benzene	1.3E-06	8E-04	2E-03		
Ethylbenzene	8.5E-07	8E-02	1E-05		
Toluene	1.3E-07	2E-01	8E-07		
Xylenes	2.1E-06	2E+00	1E-06		
Chlorinated Solvents					
1,1-DCE	1.3E-06	7E-03	2E-04		
1,2-DCE (cis)	4.9E-05	8E-03	6E-03		
1,2-DCE (trans)	1.7E-06	2E-02	1E-04		
PCE	1.5E-05	8E-03	2E-04		
TCE	4.0E-06	NAv	NAp		
Vinyl Chloride	4.0E-06	4E-03	6E-05		
				9E-03	
Exposure Pathway: Inhalation of vapor phase chemicals while showering					
Petroleum Constituents					
Benzene	4.9E-05	3E-03	2E-02		
Ethylbenzene	9.1E-06	3E-01	3E-05		
Toluene	2.3E-06	1E-01	2E-05		
Xylenes	2.1E-05	Nav	NAp		

Table 2-24
Excess Lifetime Cancer Risk Estimate for
On-Post Pedestrian/Jogger
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	Slope Factor $(mg/kg/day)^{-1}$	Excess Cancer Risk	Pathway Cancer Risk	Total Cancer Risk
Exposure Pathway: Inhalation of vapor phase chemicals from soil					
Petroleum Constituents					
Benzene	1.2E-06	2.9E-02	4E-08		
Ethylbenzene	8.0E-07	NAv	NAp		
2-Methylnaphthalene	4.8E-08	NAv	NAp		
Naphthalene	3.5E-07	NAv	NAp		
Toluene	2.6E-06	NAv	NAp		
Xylenes	2.9E-06	NAv	NAp		
Chlorinated Solvents					
1,2-DCE (cis)	9.2E-07	Nav	NAp		
PCE	1.1E-07	2.0E-03	2E-10		
TCE	6.2E-07	6.0E-03	4E-09		
				4E-08	
					4E-08

Notes:
Nav = Not available
Nap = Not applicable

Table 2-25
Excess Lifetime Cancer Risk Estimate for On-Post Utility Excavation Worker Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	Slope Factor $(mg/kg/day)^{-1}$	Excess Cancer Risk	Pathway Cancer Risk	Total Cancer Risk
Exposure Pathway: Incidental ingestion of chemicals in soil					
Petroleum Constituents					
Benzene	7.4E-11	2.9E-02	2E-12		
Ethylbenzene	2.3E-10	NAv	NAp		
2-Methylnaphthalene	7.9E-09	NAv	NAp		
Naphthalene	5.8E-09	NAv	NAp		
Toluene	3.4E-10	NAv	NAp		
Xylenes	8.6E-10	NAv	NAp		
Chlorinated Solvents					
1,2-DCE (cis)	9.2E-11	NAv	NAp		
PCE	1.2E-10	5.2E-02	6E-12		
TCE	5.5E-11	1.1E-02	6E-13		
				9E-12	
Exposure Pathway: Dermal contact with chemicals in soil					
Petroleum Constituents					
Benzene	4.9E-12	3.6E-02	2E-13		
Ethylbenzene	1.6E-11	NAv	NAp		
2-Methylnaphthalene	5.2E-10	NAv	NAp		
Naphthalene	3.8E-10	NAv	NAp		
Toluene	2.2E-11	NAv	NAp		
Xylenes	5.7E-11	NAv	NAp		
Chlorinated Solvents					
1,2-DCE (cis)	6.1E-12	NAv	NAp		
PCE	8.2E-12	6.5E-02	5E-13		
TCE	3.6E-12	1.4E-02	5E-14		
				8E-13	
Exposure Pathway: Inhalation of chemicals in fugitive dust					
Petroleum Constituents					
Benzene	7.4E-11	2.9E-02	2E-12		
Ethylbenzene	2.3E-10	NAv	NAp		
2-Methylnaphthalene	7.9E-09	NAv	NAp		
Naphthalene	5.8E-09	NAv	NAp		
Toluene	3.4E-10	NAv	NAp		
Xylenes	8.6E-10	NAv	NAp		
Chlorinated Solvents					
1,2-DCE (cis)	9.2E-11	Nav	NAp		
PCE	1.2E-10	2.0E-03	2E-13		
TCE	5.5E-11	6.0E-03	3E-13		
				3E-12	

Table 2-25 (continued)
Excess Lifetime Cancer Risk Estimate for
On-Post Utility Excavation Worker Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	Slope Factor $(mg/kg/day)^{-1}$	Excess Cancer Risk	Pathway Cancer Risk	Total Cancer Risk
Exposure Pathway: Inhalation of vapor phase chemicals from soil					
Petroleum Constituents					
Benzene	4.4E-07	2.9E-02	1E-08		
Ethylbenzene	2.9E-07	NAv	NAp		
2-Methylnaphthalene	1.7E-08	NAv	NAp		
Naphthalene	1.3E-07	NAv	NAp		
Toluene	9.4E-07	NAv	NAp		
Xylenes	1.0E-06	NAv	NAp		
Chlorinated Solvents					
1,2-DCE (cis)	3.3E-07	Nav	NAp		
PCE	4.1E-08	2.0E-03	8E-11		
TCE	2.2E-07	6.0E-03	1E-09		
				1E-08	
					1E-08

Notes:
Nav = Not available
Nap = Not applicable

Table 2-26
Excess Lifetime Cancer Risk Estimate for Racetrack Worker Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	Slope Factor $(mg/kg/day)^{-1}$	Excess Cancer Risk	Pathway Cancer Risk	Total Cancer Risk
Exposure Pathway: Ingestion of chemicals in water					
Petroleum Constituents					
Benzene	5.0E-08	2.9E-02	1E-09		
Ethylbenzene	8.8E-08	NAv	NAp		
Toluene	1.1E-07	NAv	NAp		
Xylenes	7.5E-08	NAv	NAp		
Naphthalene	6.3E-07	NAv	NAp		
Chlorinated Solvents					
1,1-DCE	7.5E-08	6.0E-01	5E-08		
1,2-DCE (cis)	3.0E-05	NAv	NAp		
1,2-DCE (trans)	5.8E-07	NAv	NAp		
PCE	2.0E-06	5.2E-02	1E-07		
TCE	1.4E-05	1.1E-02	2E-07		
Vinyl Chloride	1.0E-07	1.9E+00	2E-07		
				5E-07	
Exposure Pathway: Dermal contact with chemicals while showering					
Petroleum Constituents					
Benzene	5.2E-10	3.6E-02	2E-11		
Ethylbenzene	3.2E-09	NAv	NAp		
Toluene	2.5E-09	NAv	NAp		
Xylenes	3.0E-09	NAv	NAp		
Naphthalene	2.1E-08	NAv	NAp		
Chlorinated Solvents					
1,1-DCE	6.0E-10	NAv	NAp		
1,2-DCE (cis)	1.5E-07	NAv	NAp		
1,2-DCE (trans)	2.9E-09	NAv	NAp		
PCE	4.8E-08	6.5E-02	3E-09		
TCE	1.1E-07	1.4E-02	2E-09		
Vinyl Chloride	3.6E-10	3.1E+00	1E-09		
				6E-09	
Exposure Pathway: Inhalation of vapor phase chemicals from water					
Petroleum Constituents					
Benzene	5.7E-10	2.9E-02	2E-11		
Ethylbenzene	1.0E-09	NAv	NAp		
Toluene	1.3E-09	NAv	NAp		
Xylenes	8.6E-10	NAv	NAp		
Naphthalene	7.1E-09	NAv	NAp		

Table 2-26 (continued)
Excess Lifetime Cancer Risk Estimate for
Racetrack Worker Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	Slope Factor $(mg/kg/day)^{-1}$	Excess Cancer Risk	Pathway Cancer Risk	Total Cancer Risk
Exposure Pathway: Inhalation of vapor phase chemicals from water (cont.)					
Chlorinated Solvents					
1,1-DCE	8.6E-10	1.8E-01	2E-10		
1,2-DCE (cis)	3.4E-07	NAv	NAp		
1,2-DCE (trans)	6.6E-09	NAv	NAp		
PCE	2.3E-08	2.0E-03	5E-11		
TCE	1.6E-07	6.0E-03	1E-09		
Vinyl Chloride	1.1E-09	3.0E-01	3E-10		
				2E-09	
					5E-07

Notes:
Nav = Not available
Nap = Not applicable

Table 2-27
Excess Lifetime Cancer Risk Estimate for Adult Racetrack Patron Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	Slope Factor $(mg/kg/day)^{-1}$	Excess Cancer Risk	Pathway Cancer Risk	Total Cancer Risk
Exposure Pathway: Ingestion of chemicals in tap water					
Petroleum Constituents					
Benzene	6.8E-08	2.9E-02	2E-09		
Ethylbenzene	9.6E-08	NAv	NAp		
Toluene	5.5E-08	NAv	NAp		
Xylenes	4.1E-08	NAv	NAp		
Naphthalene	3.4E-07	NAv	NAp		
Chlorinated Solvents					
1,1-DCE	7.7E-08	6.0E-01	5E-08		
1,2-DCE (cis)	3.6E-05	NAv	NAp		
1,2-DCE (trans)	2.6E-07	NAv	NAp		
PCE	5.3E-06	5.2E-02	3E-07		
TCE	2.3E-06	1.1E-02	3E-08		
Vinyl Chloride	5.5E-08	1.9E+00	1E-07		
				5E-07	
Exposure Pathway: Dermal contact with chemicals in tap water					
Petroleum Constituents					
Benzene	1.6E-09	3.6E-02	6E-11		
Ethylbenzene	7.7E-09	NAv	NAp		
Toluene	2.7E-09	NAv	NAp		
Xylenes	3.6E-09	NAv	NAp		
Naphthalene	2.6E-08	NAv	NAp		
Chlorinated Solvents					
1,1-DCE	1.4E-09	7.5E-01	1E-09		
1,2-DCE (cis)	3.9E-07	NAv	NAp		
1,2-DCE (trans)	2.9E-09	NAv	NAp		
PCE	2.8E-07	6.5E-02	2E-08		
TCE	4.1E-08	1.4E-02	6E-10		
Vinyl Chloride	4.4E-10	2.4E+00	1E-09		
				2E-08	
					5E-07

Notes:
Nav = Not available
Nap = Not applicable

Table 2-28
Excess Lifetime Cancer Risk Estimate for Current Adult Resident Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	Slope Factor $(mg/kg/day)^{-1}$	Excess Cancer Risk	Pathway Cancer Risk	Total Cancer Risk
Exposure Pathway: Ingestion of chemicals in tap water					
Petroleum Constituents					
Benzene	3.0E-06	2.9E-02	9E-08		
Ethylbenzene	5.2E-06	NAv	NAp		
Toluene	3.0E-06	NAv	NAp		
Xylenes	4.5E-06	NAv	NAp		
Naphthalene	3.7E-05	NAv	NAp		
Chlorinated Solvents					
1,1-DCE	4.5E-06	NAv	NAp		
1,2-DCE (cis)	1.5E-04	NAv	NAp		
1,2-DCE (trans)	3.7E-06	NAv	NAp		
PCE	8.2E-06	5.2E-02	4E-07		
TCE	4.5E-06	1.1E-02	5E-08		
Vinyl Chloride	5.9E-06	1.9E+00	1E-05		
				1E-05	
Exposure Pathway: Dermal contact with chemicals while showering					
Petroleum Constituents					
Benzene	1.5E-07	3.6E-02	5E-09		
Ethylbenzene	9.3E-07	NAv	NAp		
Toluene	3.2E-07	NAv	NAp		
Xylenes	8.6E-07	NAv	NAp		
Naphthalene	6.2E-06	NAv	NAp		
Chlorinated Solvents					
1,1-DCE	1.7E-07	NAv	NAp		
1,2-DCE (cis)	3.5E-06	NAv	NAp		
1,2-DCE (trans)	9.0E-08	NAv	NAp		
PCE	9.5E-07	6.5E-02	6E-08		
TCE	1.7E-07	1.4E-02	2E-09		
Vinyl Chloride	1.1E-07	2.4E+00	2E-07		
				3E-07	
Exposure Pathway: Inhalation of vapor phase chemicals while showering					
Petroleum Constituents					
Benzene	9.9E-06	2.9E-02	3E-07		
Ethylbenzene	1.7E-05	NAv	NAp		
Toluene	9.9E-06	NAv	NAp		
Xylenes	1.5E-05	NAv	NAp		
Naphthalene	1.2E-04	NAv	NAp		

Table 2-28 (continued)
Excess Lifetime Cancer Risk Estimate for
Current Adult Resident Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	Slope Factor $(mg/kg/day)^{-1}$	Excess Cancer Risk	Pathway Cancer Risk	Total Cancer Risk
Exposure Pathway: Inhalation of vapor phase chemicals while showering (cont.)					
Chlorinated Solvents					
1,1-DCE	1.5E-05	1.8E-01	3E-06		
1,2-DCE (cis)	4.8E-04	NAv	NAp		
1,2-DCE (trans)	1.2E-05	NAv	NAp		
PCE	2.7E-05	2.0E-03	6E-08		
TCE	1.5E-05	6.0E-03	9E-08		
Vinyl Chloride	2.0E-05	3.0E-01	6E-06		
				9E-06	
					2E-05

Notes:
Nav = Not available
Nap = Not applicable

Table 2-29
Excess Lifetime Cancer Risk Estimate for
Future Resident Farmer Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	Slope Factor $(mg/kg/day)^{-1}$	Excess Cancer Risk	Pathway Cancer Risk	Total Cancer Risk
Exposure Pathway: Ingestion of chemicals in tap water					
Petroleum Constituents					
Benzene	1.4E-05	2.9E-02	4E-07		
Ethylbenzene	2.6E-06	NAv	NAp		
Toluene	6.4E-07	NAv	NAp		
Xylenes	5.9E-06	NAv	NAp		
Chlorinated Solvents					
1,1-DCE	1.8E-05	6.0E-01	1E-05		
1,2-DCE (cis)	1.1E-03	NAv	NAp		
1,2-DCE (trans)	3.7E-05	NAv	NAp		
PCE	7.5E-06	5.2E-02	4E-07		
TCE	2.4E-05	1.1E-02	3E-07		
Vinyl Chloride	7.3E-06	1.9E+00	1E-05		
				2E-05	
Exposure Pathway: Dermal contact with chemicals while showering					
Petroleum Constituents					
Benzene	7.1E-07	3.6E-02	3E-08		
Ethylbenzene	4.6E-07	NAv	NAp		
Toluene	7.0E-08	NAv	NAp		
Xylenes	1.1E-06	NAv	NAp		
Chlorinated Solvents					
1,1-DCE	6.9E-07	7.5E-01	5E-07		
1,2-DCE (cis)	2.7E-05	NAv	NAp		
1,2-DCE (trans)	9.0E-07	NAv	NAp		
PCE	8.7E-07	6.5E-02	6E-08		
TCE	9.2E-07	1.4E-02	1E-08		
Vinyl Chloride	1.3E-07	2.4E+00	3E-07		
				9E-07	
Exposure Pathway: Inhalation of vapor phase chemicals while showering					
Petroleum Constituents					
Benzene	4.6E-05	2.9E-02	1E-06		
Ethylbenzene	8.5E-06	NAv	NAp		
Toluene	2.1E-06	NAv	NAp		
Xylenes	2.0E-05	NAv	NAp		

Table 2-29 (continued)
Excess Lifetime Cancer Risk Estimate for
Future Resident Farmer Scenario
FFTA-MAAF Record of Decision

Chemical	Daily Intake (mg/kg/day)	Slope Factor $(mg/kg/day)^{-1}$	Excess Cancer Risk	Pathway Cancer Risk	Total Cancer Risk
Exposure Pathway: Inhalation of vapor phase chemicals while showering (cont.)					
Chlorinated Solvents					
1,1-DCE	5.9E-05	1.8E-01	1E-05		
1,2-DCE (cis)	3.7E-03	NAv	NAp		
1,2-DCE (trans)	1.2E-04	NAv	NAp		
PCE	2.5E-05	2.0E-03	5E-08		
TCE	7.9E-05	6.0E-03	5E-07		
Vinyl Chloride	2.4E-05	3.0E-01	7E-06		
				2E-05	
Exposure Pathway: Inhalation of vapor phase chemicals while irrigating crops					
Petroleum Constituents					
Benzene	1.1E-07	2.9E-02	3E-09		
Ethylbenzene	9.1E-08	NAv	NAp		
Toluene	5.2E-09	NAv	NAp		
Xylenes	4.8E-08	NAv	NAp		
Chlorinated Solvents					
1,1-DCE	1.4E-07	1.8E-01	3E-08		
1,2-DCE (cis)	7.8E-06	NAv	NAp		
1,2-DCE (trans)	3.0E-07	NAv	NAp		
PCE	7.5E-08	2.0E-03	2E-10		
TCE	2.0E-07	6.0E-03	1E-09		
Vinyl Chloride	5.4E-08	3.0E-01	2E-08		
				5E-08	
					4E-05

Notes:
Nav = Not available
Nap = Not applicable

Table 2-30
Secondary Soil Benchmark Screening for Wildlife
FFTA-MAAF Record of Decision
Fort Riley, Kansas

Chemical	Representative Wildlife Species	Maximum Concentration Detected in FFTA Soil (mg/kg)	Dose Received from FFTA Soil (mg/kg/day)	Lowest Observed Adverse Effects Level (NOAEL)[1] (mg/kg/day)	Ecological Quotient (EQ)	Chemical of Potential Ecological Concern (COPEC)
VOCs						
cis-1,2-Dichloroethene (DCE)	American Robin	0.58	8.82E-02	NA	--	yes[2]
Ethylbenzene[8]	American Robin	13	1.98E+00	NA	--	yes[2]
Tetrachloroethene (PCE)	American Robin	0.12	1.82E-02	NA	--	yes[2]
Toluene	American Robin	30	4.56E+00	NA	--	yes[2]
Xylene (mixed isomers)	American Robin	49	7.45E+00	NA	--	yes[2]
SVOCs						
Acenaphthene	American Robin	0.34	5.17E-02	NA	--	yes[2]
Fluorene	American Robin	0.34	5.17E-02	NA	--	yes[2]
2-Methyl Naphthalene	American Robin	46	6.99E+00	NA	--	yes[2]
Naphthalene	American Robin	18	2.74E+00	NA	--	yes[2]
Phenanthrene	American Robin	11	1.67E+00	NA	--	yes[2]
Pyrene	American Robin	2.8	4.26E-01	NA	--	yes[2]
Metals						
Beryllium	American Robin	1.2	1.82E-01	NA	--	yes[2]
Cadmium	American Robin	1.6	2.43E-01	NA	--	yes[2]
Lead	American Robin	507	7.71E+01	22.4[3]	3.44	yes
Zinc	American Robin	89	1.35E+01	NA	--	yes[2]

Notes:

[1] (ORNL, 1996)

[2] Chemical was considered a COPEC because toxicity information was not available from the reference.

[3] LOAEL was not available from the reference. LOAEL was assumed to be 10 times the NOAEL.

Table 2-31
Macroinvertebrate Benchmark Screening for Surface Water
FFTA-MAAF - Record of Decision
Fort Riley, Kansas

Chemical	Source	Aquatic Life Benchmark[1] (µg/l)	Estimated Future Maximum Concentration Detected in Groundwater at the Kansas River (µg/l)	Ecological Quotient (EQ)	Chemical of Potential Ecological Concern[2] (COPEC)
VOCs					
1,2-Dichloroethene (DCE)	Lowest Chronic Value for Daphnids[1]	NA	54	--	no
	Kansas Surface Water Quality Criteria (Aquatic Life Chronic)[2]	NA		--	
	National Recommended Water Quality Criteria[3]	NA		--	
	EPA Tier II Secondary Chronic Value[4]	590		0.09	
	National Ambient Water Quality Criteria[5]	NA		--	
Tetrachloroethene (PCE)	Lowest Chronic Value for Daphnids[1]	750	8	0.01	no
	Kansas Surface Water Quality Criteria (Aquatic Life Chronic)[2]	840		0.01	
	National Recommended Water Quality Criteria[3]	NA		--	
	EPA Tier II Secondary Chronic Value[4]	98		0.08	
	National Ambient Water Quality Criteria[5]	NA		--	
Trichloroethene (TCE)	Lowest Chronic Value for Daphnids[1]	7257	8	0.00	no
	Kansas Surface Water Quality Criteria (Aquatic Life Chronic)[2]	21900		0.00	
	National Recommended Water Quality Criteria[3]	NA		--	
	EPA Tier II Secondary Chronic Value[4]	47		0.17	
	National Ambient Water Quality Criteria[5]	NA		--	
Vinyl Chloride[6]	Lowest Chronic Value for Daphnids[1]	7257	0.6	0.00	no
	Kansas Surface Water Quality Criteria (Aquatic Life Chronic)[2]	21900		0.00	
	National Recommended Water Quality Criteria[3]	NA		--	
	EPA Tier II Secondary Chronic Value[4]	47		0.01	
	National Ambient Water Quality Criteria[5]	NA		--	

Notes:
NA - Not Available
[1]ORNL, 1996b
[2]KSWQC, 1999
[3]FR, 1998
[4]USEPA, 1992d
[5]USEPA, 1992b
[6]Toxicity data for vinyl chloride was not available from the all utilized sources. Toxicity data for TCE was used as surrogate for vinyl cloride.

Table 2-32
Comparative Evaluation Summary
FFTA-MAAF Record of Decision

Alternatives	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8
	No Action	MNA	EAB	Fe^0 PRB	ISRM	BNP	Air Sparge	Pump & Treat
Protection of Human Health and the Environment	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Compliance with ARARs	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Long-term Effectiveness and Permanence	NC	1	1	1	1	1	3	4
Reduction of Toxicity, Mobility, or Volume	NC	1	1	1	1	1	5	5
Short-term Effectiveness	NC	6	4	7	5	5	3	4
Implementability	NC	1	2	7	5	4	7	5
Cost	NC	1	2	6	5	3	5	5
Total of Rankings	**NC**	**10**	**10**	**22**	**17**	**14**	**23**	**23**
Overall Rank	**NC**	**1**	**1**	**5**	**4**	**3**	**6**	**6**

Notes

Ranking 1 Most favorable alternative
3 Good, generally favorable
5 Fair, potentially unfavorable
7 Poor, unfavorable
10 Completely fails the criteria

Yes Meets the requirements of the threshold criteria.
No Does not meet the requirements of the threshold criteria.
NC Not considered. Does not meet the threshold criteria.

Table 2-33
Cost Estimate for Alternative 2
FFTA-MAAF Record of Decision

Monitored Natural Attenuation with Institutional Controls and Contingency for Future Action

Description	Quantity	Unit	Unit Cost	Line Cost	Source[1]
Capital Costs					
Institutional Controls: Groundwater Restrictions and Access Easements	ls	1	$ 40,000.00	$ 40,000	BMcD
			Subtotal Capital Costs	**$ 40,000**	
			Contingency (20%)[2]	**$ 8,000**	
			Total Capital Costs	**$ 48,000**	
Annual Operation and Maintenance Costs					
Semiannual Natural Attenuation/Groundwater Monitoring[3]					
Groundwater Sampling	ea	2	$ 29,887.00	$ 59,774	BMcD
Laboratory Analyses	ea	2	$ 28,827.00	$ 57,654	BMcD
Quality Control Summary Report (QCSR)	ea	2	$ 14,092.00	$ 28,184	BMcD
Data Summary Report (DSR)	ea	2	$ 21,966.00	$ 43,932	BMcD
E Data Submittal	ea	2	$ 3,018.00	$ 6,036	BMcD
Project Administration	ea	2	$ 5,813.00	$ 11,626	BMcD
Maintenance	ea	2	$ 3,849.00	$ 7,698	BMcD
			Subtotal Annual O&M	**$ 214,904**	
			Contingency (20%)[2]	**$ 42,981**	
			Total Annual O&M	**$ 257,885**	
Periodic Costs					
Five-Year Review of Remedial Action	ea	1	$ 20,000.00	$ 20,000	BMcD
Closure Report	ls	1	$ 30,000.00	$ 30,000	BMcD
			Subtotal Periodic Costs	**$ 50,000**	
			Contingency (20%)[2]	**$ 10,000**	
			Total Periodic Costs	**$ 60,000**	
			Total Project Cost	**$ 2,348,021**	
			Total Present Value Project Cost at 3.2%	**$ 1,982,598**	

Notes:

1) BMcD costs represent estimates obtained from similar projects and/or professional experience.

2) Contingency covers unknowns, unforeseen circumstances, or unanticipated conditions associated with remediation. Twenty percent is an average contingency factor (EPA, 2000c). Contingency for future action (a component of this alternative) was not included in this cost estimate.

3) Unit costs taken from *Proposal for Groundwater Sampling Events (2000/2001/2002) at Marshall Army Airfield* (BMcD, 1999c).

BMcD Burns & McDonnell Engineering Company, Inc.
ea Each
ls Lump Sum

Table 2-34
Present Value Costs for Alternative 2
FFTA-MAAF Record of Decision

Monitored Natural Attenuation with Institutional Controls and Contingency for Future Action

Year	Capital Costs	Annual O&M Costs[1,2]	Periodic Costs[3]	Total Cost	Discount Factor at 3.2%	Total Present Value Cost at 3.2%
0	$ 48,000	$ -	$ -	$ 48,000	1.000	$ 48,000
1	$ -	$ 257,885	$ -	$ 257,885	0.969	$ 249,888
2	$ -	$ 257,885	$ -	$ 257,885	0.939	$ 242,140
3	$ -	$ 257,885	$ -	$ 257,885	0.910	$ 234,632
4	$ -	$ 257,885	$ -	$ 257,885	0.882	$ 227,356
5	$ -	$ 257,885	$ 24,000	$ 281,885	0.854	$ 240,809
6	$ -	$ 128,942	$ -	$ 128,942	0.828	$ 106,738
7	$ -	$ 128,942	$ -	$ 128,942	0.802	$ 103,428
8	$ -	$ 128,942	$ -	$ 128,942	0.777	$ 100,221
9	$ -	$ 128,942	$ -	$ 128,942	0.753	$ 97,113
10	$ -	$ 128,942	$ 24,000	$ 152,942	0.730	$ 111,617
11	$ -	$ 128,942	$ -	$ 128,942	0.707	$ 91,184
12	$ -	$ 128,942	$ 60,000	$ 188,942	0.685	$ 129,471
Total	**$ 48,000**	**$ 2,192,021**	**$ 108,000**	**$ 2,348,021**		**$ 1,982,598**

Notes:

1) It is assumed that groundwater monitoring for the first five years will be performed semi-annually. Subsequent sampling will be performed annually.

2) Contaminant transport modeling for this alternative estimates that MCLs will be reached after ten years (from 2002) [Appendix B]. It is assumed that annual groundwater monitoring will be required for two years after the remediation is complete, and then a final review and closure report would be submitted.

3) $24,000 included the cost of a five-year review. $60,000 includes the cost of a five-year review and a closure report

Burns & McDonnell
SINCE 1898

February 10, 2005

Directorate of Environment & Safety
ATTN: AFZN-ES-OM (O Saulters)
407 Pershing Court
Fort Riley, KS 66442-6016

Draft Final Record of Decision
Former Fire Training Area – Marshall Army Airfield, Fort Riley, Kansas
BMCD Project No. 27755
Contract No. DACA41-96-D-8010 Task Order #0035

Dear Mr. Saulters:

Enclosed are seven copies of the Draft Final Record of Decision (ROD) for the above referenced site. You will find an electronic copy of the ROD in pdf on the enclosed CD. The distribution list and comment responses are also enclosed.

If you have any questions, please call me at (816) 822-3369.

Sincerely,

Tracy Cooley
Project Manager

Enclosures

9400 Ward Parkway
Kansas City, Missouri 64114-3319
Tel: 816 333-9400
Fax: 816 333-3690
www.burnsmcd.com

DISTRIBUTION LIST

Commander U. S. Army Engineer District, Kansas City ATTN: CENWK-PM-E (R Van Saun) 601 E 12th Street Kansas City, MO 64106-2896	1 copy Draft Final Record of Decision, Comment Responses, and Distribution List
Directorate of Environment & Safety ATTN: AFZN-ES-OM (O Saulters) 407 Pershing Court Fort Riley, KS 66442-6016	7 copies Draft Final Record of Decision, 1 CD, Comment Responses, and Distribution List
Bryant Burnett Federal Facilities, Special Emphasis Section U.S. Environmental Protection Agency 901 North 5th Street Kansas City, KS 66101	2 copies Draft Final Record of Decision and Regulator Comment Responses
Jim Anstaett Bureau of Environmental Remediation Kansas Department of Health and Environment 1000 SW Jackson, Suite 410 Topeka, KS 66612-1367	1 copy Draft Final Record of Decision and Regulator Comment Responses
U.S. Army Environmental Center ATTN: SFIM-AEC-CDN (P Rissell) Building E4480, Edgewood Area Aberdeen Proving Ground, MD21010-5401	1 copy Draft Final Record of Decision

Responses to comments from Bryant Burnett, USEPA

1. Page 1-6, Signature sheet for the ROD; The Superfund Division Director is "Cecilia Tapia". Please make this change in the final document.

   Response: Concur. The text was revised as requested.

2. Mention should be made in the document, not just in the "Summary of Site Risk", that drinking water wells have been supplied to adjacent landowners. Providing alternative water supplies, in the form of wells, is considered a "removal action" by the EPA.

   Response: Concur. The requested information was added to Sections 1.4, 2.5.5, 2.7, 2.12.1, and 2.13.5.

3. In discussions throughout the document, the selected remedy of Monitored Natural Attenuation (MNA) and Institutional Controls (ICs) is discussed as a stand alone remedy. This misperception should be alleviated by discussing the other work that has been performed, as this resulted in the ability to select this final remedy.

   Response: Concur. The requested information regarding other work performed was added to Sections 1.4, 2.5.5, 2.7, 2.12.1, and 2.13.5.

Responses to comments from Robert J. Weber, KDHE

1. **Page 1-2, Section 1.4, Description of the Selected Remedy.** Fort Riley discusses the reduction of the contaminants through a source removal pilot study. Fort Riley should also include information on the installation of two new drinking water wells outside of the contaminant plume and the plugging of several wells located in and near the contaminant plume. These measures have assisted to reduce the exposure of nearby residents and visitors to contaminated groundwater.

   Response: Concur. Requested information was added to the text in this section and to other sections as per USEPA's comment #2..

2. **Page 2-11, Section 2.6.1, Land Uses.** Fort Riley should include a discussion about its Installation Compatibility Use Zone (ICUZ) if this is still in use for the site area.

   Response: Concur. Requested information was added to the text.

3. **Page 2-17, Table 2-2.** The Total Hazard Index, USEPA Acceptable Level should be represented as less than or equal to one, not greater than one.

   Response: Concur. Table 2-2 was revised as requested.

4. **Page 2-20, Section 2.9.1.2, Alternative 2 – MNA with Institutional Controls.** KDHE/BER appreciates the consideration of our Identified Sites List (ISL) database as an institutional control. KDHE/BER suggests that the Army consider incorporating the following language when listing the ISL database as an institutional control. "The ISL database is not used for enforcement and does not place restrictions on site usage. The ISL database is a public record of environmentally contaminated sites (excluding underground and above-ground tank sites). The ISL database allows the public to conduct a web-based search to find contaminated sites within a specific community or area." If Fort Riley is considering using informational sources as institutional controls, then public project files, public databases, and public websites for the Army, EPA, and KDHE should be considered.

   Response: Concur. Requested information was added to the text.

5. **Page 2-37, Section 2.12.2.2, Institutional Controls.** See comment 4.

   Response: Concur. Requested information was added to the text.

Responses to Fort Riley Review Comments for
Draft Record of Decision
FFTA-MAAF, December 2004

1. Overall the Draft ROD is an excellent document!

Response: Noted.

2. [Internal Comment] The Draft ROD makes reference to the Remedial Design (Monitored Natural Attenuation and Institutional Controls Plans). It is not clear if Burns & McDonnell or the Army will develop theses documents.

Response: Concur. Burns and McDonnell will prepare the Remedial Design. This information was added to the text.

3. *1.7 Authorizing Signatures, page 1-5*
Line 9, this section indicates that the basis for selection is the *RI*. This should likely be broadened to the *RI/FS*.

Response: Concur. Reference to the FS was added to the text as requested.

4. *2.2 Site History and Enforcement Activities, page 2-3*
Line 7, the info contained in this statement is not entirely accurate (FFTA-MAAF was not explicitly included in the evaluation). The HRS ranking performed in 1988 by EPA was based on the aggregation of three individual sites, the Southwest Funston Landfill, the Main Post Landfill, and the Pesticide Storage Facility. However, it was noted that other potentially contaminated areas exist at Fort Riley (e.g., burn pits, fire training areas, and dry cleaner operations).

Response: Concur. The text was revised as requested.

5. *2.2 Site History and Enforcement Activities, page 2-3*
Line 9, please consider modifying *"formerly"* to *"formally"*.

Response: Concur. The text was revised as requested.

6. *2.2 Site History and Enforcement Activities, page 2-4*
Line 14, please consider incorporating additional text, "*Consistent with a lawsuit settlement in 2001,* two alternate water supply wells..."

Response: Concur. Requested information was added to the text.

7. *2.3 Highlights of Community Participation, page 2-5*
Line 20, this section states that the reports were released to the public between April 1998 through *May 2004*; however, the Proposed Plan was also released for public comment on July 13 – August 11, 2004. Therefore consider modifying *May 2004* to *August 2004*.

Response: Concur. The text was revised as requested.

8. *2.3 Highlights of Community Participation, page 2-5*
Line 22, please consider deleting *"Planning and Restoration Division"* after DES.

Response: Concur. The text was revised as requested.

9. *2.5.5 Known or Suspected Sources, Types, and Location of Contamination, page 2-11*
Please consider including the 2002 construction of the Alternate Water Supply/Interim Removal Action (installing two private supply wells and plugging and abandonment of four existing wells) by Fort Riley, in the major findings list. Consider noting that the wells are located outside of the contaminated groundwater plume, thus further reducing the potential human health risk.

Response: Concur. Requested information was added to the text.

10. *2.6.1 Land Uses, page 2-11*
Please consider adding a brief discussion of Executive Order 11988 -- Floodplain Management into this section, if/where appropriate, see http://www.fema.gov/library/eo11988.shtm

Response: Concur. Requested information was added to the text.

11. *2.7 Summary of Site Risks, page 2-13*
Line 7, please consider modifying the sentence to "However, *t*he DA Fort Riley's remedy decision is based primarily on the presence of site-related contaminants ~~*are*~~ present off the site in the alluvial aquifer at levels exceeding drinking water standards (MCLs), *identified as an ARAR".*

Response: Concur. The text was revised as requested.

12. *2.7 Summary of Site Risks, page 2-13*
Line 18, please consider incorporating additional text, such as, "Although additional sampling of groundwater has occurred since 2001 *and an Alternate Water Supply IRA was successfully completed,* the BLRA presented in the RI was not updated for this ROD."

Response: Concur. Requested information was added to the text.

13. *2.7.3 Basis for Action, page 2-18*
Line 9, please considering incorporating "*identified ARAR"* after MCLs for clarification.

Response: Concur. Requested information was added to the text.

14. *2.9 Description of Remediation Alternatives, page 2-18*
Line 26, please consider modifying Fe0 to Fe^0.

Response: Concur. The text was revised as requested.

15. *2.9.1.2 Alternative 2-MNA with ICs, page 2-20*
Line 7, please consider including the following, "...replaces the need *for* proprietary controls...".

Response: Concur. The text was revised as requested.

16. *2.9.2 Common Elements, page 2-24*
Line 9, please consider modifying "*conformational"* to "*confirmational".*

Response: Concur. The text was revised as requested.

17. *2.10.2 Evaluation Method, page 2-26*
Line 29, please consider modifying to "...KDHE *and EPA* approved the Proposed Plan...".

Response: Concur. Requested information was added to the text.

18. *2.10.3 Comparative Analysis, page 2-27*
Line 19, although this section states that the alternatives are compared against the *nine* criteria, section *2.10.2 Evaluation Method* states that only the selected remedy is evaluated against the final two modifying criteria. Please clarify the Line 19 statement indicating this distinction (all alternatives evaluated against the initial seven criteria and only the selected remedy for the final two criteria).

Response: Concur. Clarification was added to the text.

19. *2.11 Principal Threat Wastes, page 2-34*
Line 10, it might be useful to include a supporting citation/reference for the statement regarding contaminated groundwater not being considered a source material.

Response: Concur. This statement was derived from the ROD Guidance Document which has been referenced in the text.

20. *2.11 Principal Threat Wastes, page 2-34*
Line 14, please consider modifying the soil treatment sentence from "*no*" risk to "*minimal*" risk.

Response: Concur. The text was revised as requested.

21. *2.12.1 Summary of the Rationale for the Selected Remedy, page 2-34*
Please consider incorporating a statement regarding the Alternate Water Supply/Interim Removal Action successfully completed in 2002 (two new private water supply wells and plugging and abandonment of four existing wells). This greatly reduced and/or eliminated the potential exposure of human health receptors to contaminated groundwater and thus the overall risk; further supporting MNA.

Response: Concur. Requested information was added to the text.

22. *2.13.1 Protection of Human Health and the Environment, page 2-40*
Line 23, please consider qualifying the eco risk statement to "There is no *evidence* of ecological risk to the Kansas River from the contaminated groundwater plume *based on the evaluations performed.*"

Response: Concur. Requested information was added to the text.

23. *2.13.2 Compliance with ARARs, page 2-40*
Although this section generally mentions compliance with ARARs, because of the significance of the ARARs criterion, it would be beneficial to include a summary table of those specific ARARs that apply to the selected remedy.

Response: Concur. Requested information was added to the text.

24. *2.13.5 Preference for Treatment as a Principal Element, page 2-42*
Line 3, please consider incorporating info describing the Alternate Water Supply/IRA.

Response: Concur. Requested information was added to the text.

25. *2.14 Documentation of Significant Changes, page 2-43*
Line 2, this statement may require some clarification, the revised (Draft Final) Proposed Plan was submitted (to the EPA and the KDHE) on May 12, 2004 and was indirectly available to the public (via the Fort Riley IRP administrative library). However, the Proposed Plan was officially released to the public during the July 13, 2004 through August 11, 2004 public comment period, including the July 20, 2004 public meeting (held in concert with the [public] Restoration Advisory Board meeting).

Response: Concur. The text was revised as requested.

Responses to Fort Riley Review Comments for
Draft Record of Decision
FFTA-MAAF, December 2004

"Saulters, Oral S CIV DES" <oral.saulters@us.army.mil> 12/09/2004 12:01:34 PM >>>
Mr. Cooley/Dr. Van Saun.

As part of the FFTA-MAAF Draft ROD, incorporation of a brief summary of the Flint Hills Joint Land Use Study (see link below) currently underway, might be useful in section 2.6.1 Land Uses. This in essence relates to the KDHE review comment #2 regarding ICUZ.

http://www.edaw.com/flinthillsjlus/ <http://www.edaw.com/flinthillsjlus/>

Response: Concur. Requested information was added to the text.

Responses to Fort Riley Review Comments for
Draft Record of Decision
FFTA-MAAF, December 2004

From: "Saulters, Oral S CIV DES" <oral.saulters@us.army.mil>
To: "Van-saun, Richard NWK" <Richard.Van-saun@nwk02.usace.army.mil>, Tracy Cooley <tcooley@burnsmcd.com>
Date: 1/6/2005 11:37:28 AM
Subject: RE: MAAF ROD

Yes, your info is correct (only Thompson connected to lawsuit). We could state simply that the two wells were installed after the lawsuit settlement (instead of "based on") or something to that effect. My intent was only to note that there was a lawsuit nexus for the record, nothing more.

Response: Concur. The text was revised as requested.

From: Van-saun, Richard NWK [mailto:Richard.Van-saun@nwk02.usace.army.mil]
Sent: Wednesday, January 05, 2005 10:27 AM
To: Tracy Cooley
Cc: Oral Saulters (E-mail)
Subject: RE: MAAF ROD

Tracy,

I believe you are correct.The original EE/CA provided for the two wells but Thompson would not allow us to install his. We could have just installed More's at that time but elected to wait until the Thompson lawsuit was settled.

Oral,

Do you agree?

-----Original Message-----
From: Tracy Cooley [mailto:tcooley@burnsmcd.com]
Sent: Tuesday, January 04, 2005 3:03 PM
To: Van-saun, Richard NWK
Subject: MAAF ROD

Rick
Last question. Oral comment #6 states that we should add a statement that says 2 alternate water supply wells were installed based on the lawsuit settlement. Is this correct or was it just the Thompson alternate well? More was not lawsuit driven.

Thanks,
Tracy

From: "Saulters, Oral S CIV DES" <oral.saulters@us.army.mil>
To: 'Michelle Beckman' <mbeckman@burnsmcd.com>
Date: 2/1/2005 11:33:32 AM
Subject: RE: Draft Final ROD for MAAF

Excellent job of addressing comments and incorporating changes.

Response: Noted.

I must make one confession, my references to the Alternate Water Supply/Interim Removal Action were not completely accurate. Instead of four wells, five private wells (M1, R-1, R-2, R-3, and R-4) were actually plugged and abandoned as part of the removal action. Please modify as necessary, my bad.

Response: Concur. The text was revised as requested.

HTRW Center of Expertise - Review Comments

Reviewer Name:	Dave Becker
Discipline	Geologist
CX Project Review No.	2537.69313
Date:	26 November 2004
Project Location	Former Fire Training Area, Marshall Army Airfield, OU 4
Document Name:	Draft Record of Decision, 11/5/2004, Burns and McDonnell for CENWK

Comment # 1: General. I have briefly reviewed the document and defer to the Kansas City District technical staff for a detailed review. My comments are not major, and I concur with the remedy.

Response: Noted.

Comment # 2: p. 2-2, fig 2-2. The text on page 1-2 says there are three wells above MCLs (as of Feb 04), but this figure shows four (as of Aug 03). Can you revise figure to show extent as of Feb 04?

Response: Concur. The figure was revised as requested.

Comment # 3: p. 2-3, sec. 2.2. In first full paragraph, "formerly" should be "formally".

Response: Concur. The text was revised as requested.

Comment # 4: p. 2-36, sec. 2.12.2.2. Is it appropriate to cite a bill (House Bill 2247) that is not a statute?

Response: Concur. The text was clarified to state that the provisions of Kansas House Bill 2247 are unenforceable until the Bill becomes law and is incorporated into the Kansas state statutes.

Comment # 5: p. 2-39, sec. 2.12.3. Please clarify the present worth cost of $2M is the present worth of the $2.3M capital and O&M costs and check the value of the total project cost (the capital cost, total O&M cost, and the periodic costs do not add to $2.3M).

Response: Concur. The costs were reviewed, and the text was revised as requested.

Comment # 6: p. 2-40, sec. 2.12.4. Last sentence of section. Change "should be changed ..." to "will be changed..."

Response: Concur. The text was revised as requested.

Reviewer Name:	Charles G. Coyle
Discipline	Environmental Engineer
CX Project Review No.	69313.2537
Date:	01 December 2004
Project Location	Ft. Riley, KS
Document Name:	Draft Record of Decision; Former Fire Training Area (FFTA), Marshall Army Airfield (MAAF), prepared by Burns & McDonnell for CENWK; Nov 2004.

Comment # 1 : 2.12.2.1, p. 2-36 The text states that If the groundwater MCLs are not exceeded for three consecutive years, the FFTA-MAAF Site will be recommended for discontinuance of sampling and for site closeout. I wasn't able to locate any discussion of the required groundwater monitoring frequency in the document. If an agreement with the regulators has been reached on the groundwater monitoring frequency, then including it in the ROD should be considered.

Response: Noted. No agreement with the regulators has been reached regarding the groundwater monitoring frequency, but the MNA Plan Section of the Remedial Design will cover this issue.

Comment # 2 : 2.12.2.1, p. 2-36 Along with groundwater monitoring frequency, another factor that should be taken into consideration is seasonal trends in contaminant levels. It could take more or less time to meet the "below MCLs for three consecutive years" criteria depending on what time of year that groundwater sampling is performed. If an agreement with the regulators has been reached regarding the timing of groundwater monitoring, then including it in the ROD should be considered.

Response: Noted. No agreement with the regulators has been reached regarding the timing of the groundwater monitoring frequency, but the MNA Plan Section of the Remedial Design will cover this issue.

Reviewer Name:	Beverly VanCleef
Discipline	Regulatory Specialist
CX Project Review No.	69313
Date:	18 November 2004
Project Location	Ft Riley Kansas, Marshall Army Airfield
Document Name:	Draft ROD OU 004 Former Fire Training Area

Comment #1: Page 1-1, section 1.2, line 19 states, "The remedy was chosen in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan."

Delete "and to the extent practicable". Same comment for similar statement on page 1-3, section 1.5, line19.

Response: Concur. The text was revised as requested.

Comment #2: Page 2-28, section 2.10.3.2, Compliance with ARARs. This section needs to list the key ARARs that the remedy will achieve. This is a requirement of the National Contingency Plan, 40 CFR 300.430(f)(5)(B) and will be important when conducting the 5 year reviews.

Response: Concur. The information requested was added to the text.

Burns & McDonnell
SINCE 1898

September 2, 2005

Directorate of Environment & Safety
ATTN: AFZN-ES-OM (D Shields)
407 Pershing Court
Fort Riley, KS 66442-6016

Final Record of Decision
Former Fire Training Area – Marshall Army Airfield, Fort Riley, Kansas
BMCD Project No. 27755
Contract No. DACA41-96-D-8010 Task Order #0035

Dear Mr. Shields:

Enclosed are two copies of new covers, spines, and change pages for the final Record of Decision (ROD) for the above referenced site. Two electronic copies of the ROD in pdf and a copy of the distribution list are also enclosed.

If you have any questions, please call me at (816) 822-3369.

Sincerely,

Tracy Cooley

Tracy Cooley
Project Manager

Enclosures

9400 Ward Parkway
Kansas City, Missouri 64114-3319
Tel: 816 333-9400
Fax: 816 333-3690
www.burnsmcd.com

DISTRIBUTION LIST

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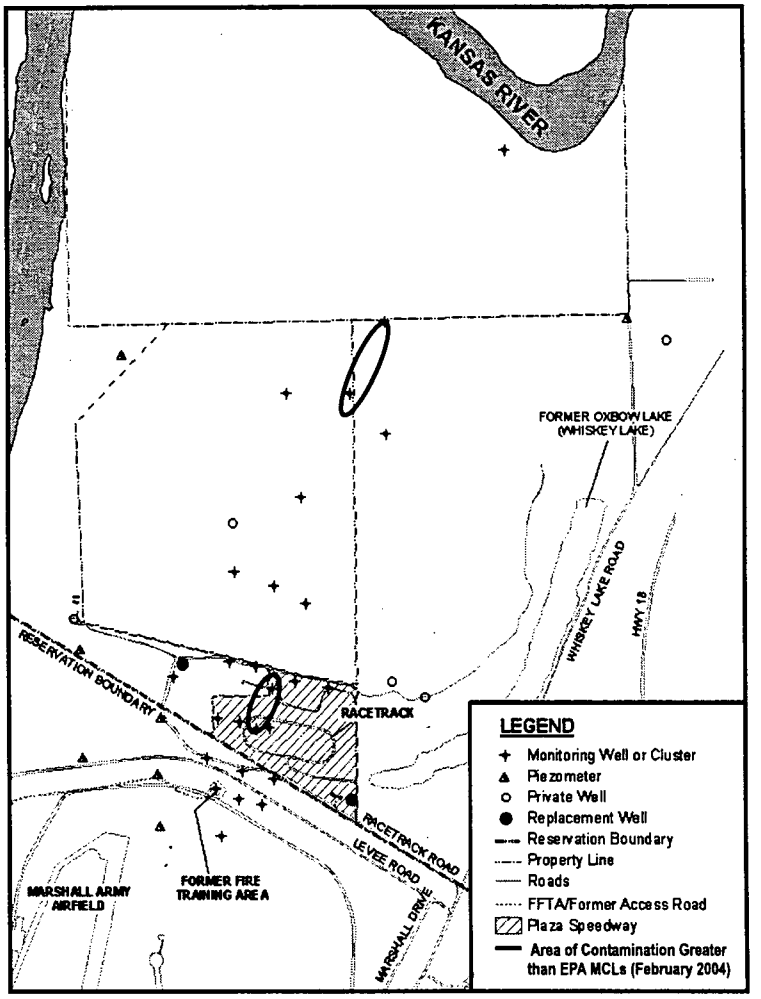
Directorate of Public Works ATTN: AFZN-ES-OM (D Shields) 407 Pershing Court Fort Riley, KS 66442-6016	2 copies final Record of Decision, 2 CDs, and Distribution List
Robin Paul U.S. Environmental Protection Agency SUPR/FFSE 901 North 5th Street Kansas City, KS 66101	2 copies final Record of Decision
Jim Anstaett Bureau of Environmental Remediation Kansas Department of Health and Environment 1000 SW Jackson, Suite 410 Topeka, KS 66612-1367	1 copy final Record of Decision
U.S. Army Environmental Center ATTN: SFIM-AEC-CDN (P Rissell) Building E4480, Edgewood Area Aberdeen Proving Ground, MD21010-5401	2 copies final Record of Decision

The Fort Riley National Priorities List (NPL) site currently encompasses seven OUs around the military installation. The OUs have been designated by the DA, Fort Riley based on the results of prior investigations. The seven OUs include: the Southwest Funston Landfill site (OU 001); the Pesticides Storage Facility site (OU 002); the Dry Cleaning Facilities Area (DCFA) site (OU 003); the FFTA-MAAF Site (OU 004); the 354 Area solvent Detections site (OU 005); the Southeast Funston Landfill and others (OU 006); and the Custer Hill PX USTs Bldg 5320 and other sites (OU 007). Two of the OUs, the 354 Area Solvent Detections site and the DCFA site are currently the subject of feasibility studies (FSs) for cleanup/remediation of chlorinated solvents in groundwater.



2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

The FFTA was operated from the mid-1960s through 1984 to conduct fire-training exercises. During these exercises, flammable liquids were poured into the FFTA, ignited, and then extinguished. The predominant fuels used for the fire training exercises were JP-4 (jet fuel), diesel, and MOGAS (a generic term for leaded motor gasoline). In August 1982, reportedly 55 gallons of tetrachloroethene (PCE) were inadvertently poured into a pit at the FFTA. The next day it was pumped out of the pit and into 55-gallon drums. Fire fighting training has not been conducted at the FFTA since 1984. Contaminants at the FFTA-MAAF Site (OU 004) are believed to have entered the environment through the FFTA and moved downward through the soil to the groundwater. Some of these contaminants have migrated in the groundwater northward from the FFTA and currently exist under private property (BMcD, 2003c).

Additionally, personal letters inviting the five adjacent landowners (Thompson, Boller, More, Strauss, and Wahle) to comment on the Proposed Plan and attend the public meeting were sent by Fort Riley on June 29, 2004 (Saulters, 2004a).

A public comment period for this remedial action was declared from July 13, 2004 through August 11, 2004 to provide a reasonable opportunity for comment and to disseminate information regarding the Proposed Plan. No comments were received from the public (Saulters, 2004a).

A public meeting was held at the PWE, Building 407 Pershing Court, Fort Riley, Kansas at 7:00 pm local time on July 20, 2004 in conjunction with the Restoration Advisory Board (RAB) meeting to discuss the Proposed Plan. At this meeting, representatives for the DA, KDHE, and USEPA were available to inform the public about the FFTA-MAAF Site (OU 004) and remedial options under consideration. The official transcript for the public meeting was recorded and transcribed verbatim by Ms. Jennifer L. Gibson, court reporter. There were no significant comments made by the public during the meeting (Saulters, 2004a).

2.4 SCOPE AND ROLE OF OPERABLE UNIT

This response action will be the final response action for the FFTA-MAAF Site (OU 004). Other actions will be implemented at the other OUs on the Fort Riley military installation which may include pilot studies, removal actions, and/or remedial actions under the investigation, removal, or remedial authorities of CERCLA. This response action will be conducted under the remedial authority of CERCLA. The FFTA-MAAF Site (OU 004) is part of the overall cleanup of the Fort Riley NPL site that currently includes seven OUs. The FFTA-MAAF Site (OU 004) is a discrete area of contamination that does not affect or is not affected by the other OUs at the Fort Riley NPL site. OUs 001 and 002 are the first OUs that have progressed to the remedy selection phase and have approved RODs. Other OUs are being addressed in subsequent phases to their initial investigations. OUs 003 and 004 are in the FS phase.

The selected response action addresses the remedial action objectives (RAOs) established for the FFTA-MAAF Site (OU 004). Refer to Section 2.8 for more information on RAOs and PRGs.

2.5 SITE CHARACTERISTICS

The conceptual site model (CSM); site overview; summary of surface and subsurface features; sampling strategy; known or suspected sources, types, and location of contamination; and nature and extent of

Burns & McDonnell
9400 Ward Parkway
Kansas City, Missouri 64114
PO Box 419173 (64141-6173)

Phone: (816) 333-9400
Fax: (816) 822-3494
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TRANSMITTAL MEMORANDUM

To: DPW –Environmental Division
IMNW-RLY-PWE
407 Pershing Court
Fort Riley, Kansas 66442

Date: July 21, 2005

Attention: Dick Shields

Project: 27755

Subject: Record of Decision

Via:

Enclosed are the following:

No. of copies	Description
2	Record of Decision- Former Fire Training Area- Marshall Army Airfield, Fort Riley, Kansas
	Contract No. DACA41-96-D-8010

Copies to:

Sincerely,

Burns & McDonnell Engineering Company, Inc.

By: Tracy Cooley