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DUNN FIELD
RECORD OF DECISION AMENDMENT

Defense Depot Memphis, Tennessee

Defense Logistics Agency

AFCEE Contract FA8903-04-D-8722
Task Order No. 0043

Revision 3

January 2009

DUNN FIELD
RECORD OF DECISION AMENDMENT

Defense Depot Memphis, Tennessee

Prepared for:

Air Force Center for Engineering and the Environment
Contract No. FA8903-04-D-8722
Task Order No. 0043

Prepared by:

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LIST OF ACRONYMS AND ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Requirement
BCT	BRAC Cleanup Team
bgs	Below Ground Surface
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Constituent of Concern
CVOC	Chlorinated Volatile Organic Compound
CWM	Chemical Warfare Material
DCE	Dichloroethene
DDMT	Defense Depot Memphis, Tennessee
DLA	Defense Logistics Agency
DRI	Design-related Investigation
EISR	Early Implementation of Selected Remedy
e^2M	engineering-environmental Management, Inc.
FFA	Federal Facilities Agreement
FS	Feasibility Study
ft/d	Feet per Day
GAC	Granular Activated Carbon
HHRA	Human Health Risk Assessment
IC	Institutional Control
IRACR	Interim Remedial Action Completion Report
ISTD	In Situ Thermal Destruction
IRA	Interim Remedial Action
LTM	Long-term Monitoring
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
µg/L	Micrograms per Liter
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
MI	Main Installation
MIP	Membrane Interface Probe
MLGW	Memphis Light, Gas and Water
MNA	Monitored Natural Attenuation

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

MW	Monitoring Well
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
O&M	Operations and Maintenance
OU	Operable Unit
PCA	Tetrachloroethane
PCE	Tetrachloroethene
PRB	Permeable Reactive Barrier
ppb	Parts per Billion
ppm	Parts per Million
RA	Remedial Action
RAB	Restoration Advisory Board
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RG	Remediation Goal
RI	Remedial Investigation
ROD	Record of Decision
ROI	Radius of Influence
SDWA	Safe Drinking Water Act
SMCL	Secondary Maximum Contaminant Level
SVE	Soil Vapor Extraction
SVOC	Semivolatile Organic Compound
TAC	Tennessee Administrative Code
TBC	To Be Considered
TCE	Trichloroethene
TDEC	Tennessee Department of Environmental Conservation
TMP	Temperature Monitoring Point
USEPA	U.S. Environmental Protection Agency
VMP	Vapor Monitoring Point
VOC	Volatile Organic Compound
ZVI	Zero-valent Iron

AUTHORIZING SIGNATURES

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1.0 INTRODUCTION AND STATEMENT OF PURPOSE

engineering-environmental Management, Inc (e^2M) has prepared this Record of Decision (ROD) Amendment for Dunn Field at Defense Depot Memphis, Tennessee (DDMT) under Contract FA8903-04-D-8722, Task Order 0043 to the Air Force Center for Engineering and the Environment (AFCEE). The ROD Amendment was prepared in accordance with *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Decision Documents* (USEPA, 1999).

Site Name and Location

Former Memphis Depot
Dunn Field, Operable Unit 1 (OU-1)
2163 Airways Boulevard
Memphis, Shelby County, Tennessee
U.S. Environmental Protection Agency (USEPA) Identification Number: TN4210020570

Identification of Agencies

The lead agency for the environmental restoration activities at DDMT is the Defense Logistics Agency (DLA). The regulatory oversight agencies are U.S. Environmental Protection Agency (USEPA) Region 4 and the Tennessee Department of Environment and Conservation (TDEC). These three agencies (DLA, USEPA, and TDEC) constitute the Base Realignment and Closure (BRAC) Cleanup Team (BCT) for DDMT. In March 1995, a Federal Facilities Agreement (FFA) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Section 120, and Resource Conservation and Recovery Act, Sections 3008(h) and 3004(u) and (v), was entered into by USEPA, TDEC, and DLA. The FFA outlined the process for site investigation and cleanup at DDMT under CERCLA.

This ROD Amendment is being issued by DLA, with concurrence by USEPA and TDEC, for Dunn Field.

Citation of CERCLA Section 117 and NCP Section 300.435 (c)(2)(ii)

The change to the remedy has been determined to be a fundamental change in the remedy selected in the Dunn Field Record of Decision (ROD) (CH2M HILL, 2004a). This ROD amendment is necessary to comply with National Oil and Hazardous Substances Pollution Contingency Plan (NCP) Section 300.435(c)(2)(ii) and CERCLA Section 117.

Date of Original ROD Signature

The original ROD for Dunn Field was completed in March 2004 and was authorized by DLA on March 22, by TDEC on April 6 and USEPA on April 12, 2004.

Summary of Circumstances that Led to the Need for a ROD Amendment

Information gathered since completion of the Dunn Field ROD resulted in a reassessment of components of the selected remedy.

Three studies were performed on Dunn Field as part of the *Dunn Field Source Areas Final Remedial Design Rev. 4* (Source Areas RD) (CH2M HILL, 2007a): a field treatability study was conducted to evaluate the effectiveness of zero-valent iron (ZVI) injection for subsurface remediation of chlorinated volatile organic compounds (CVOCs); a soil vapor extraction (SVE) pilot study was performed to collect site-specific data for both the loess and the unsaturated fluvial deposits; and a remedial design investigation (RDI) was performed to delineate CVOC concentrations in the loess and to collect additional groundwater samples.

Additional studies were performed in the groundwater plume west of Dunn Field to aid the *Dunn Field Off Depot Groundwater Final Remedial Design Rev. 1* (Off Depot RD) (CH2M HILL, 2008). An Off-site Design-Related Investigation (DRI) was performed to evaluate site hydrogeology and CVOC concentrations in groundwater, with monitoring wells installed and sampled in a phased approach. The Off-site DRI showed that the high-concentration portion of the plume (<500 μg/L) extended further downgradient from Dunn Field than previously known. These findings led to the Early Implementation of Selected Remedy (EISR) to reduce contaminant mass downgradient of the planned permeable reactive barrier (PRB) location in order to ensure that the portion of the plume slated for monitored natural attenuation (MNA) in the ROD was not unduly extensive or high in concentration. The *EISR Interim Remedial Action Completion Report* (EISR IRACR) (MACTEC, 2005) was approved by USEPA in September 2005; the Off-site DRI report is included as Appendix A of the EISR IRACR.

A Zero-valent Iron (ZVI) PRB Implementation Study was performed west of Dunn Field for the Off Depot RD. A pilot-scale ZVI PRB was installed using the jet grouting technique to evaluate the implementability and cost-effectiveness for the full-scale PRB.

Groundwater flow modeling was performed to provide a quantitative description of hydrogeologic conceptual site model and allow evaluation of the effects of different treatment scenarios. The model simulated the entire potential flow path between the Off-Depot plume and the Allen well field with assumptions on the connectivity of the fluvial, intermediate, and Memphis aquifers and was useful for estimating potential contaminant migration from the fluvial aquifer to the underlying aquifers.

A microcosm study was performed for the Off Depot RD to evaluate 1,1,2,2-PCA and TCE degradation rates using three carbon substrates, site sediments and groundwater, and a commercially-available microbial consortia. The study was conducted to evaluate whether target compounds could be biodegraded efficiently under existing conditions, and to assess whether site amendments might increase degradation rates.

Operation of the Fluvial SVE system began in July 2007as part of the Source Areas remedial action (RA). Monitoring of system operations has demonstrated significant CVOC mass removal from the fluvial sands (e2M, 2008b) and semiannual groundwater monitoring for the Interim Remedial Action (IRA) groundwater removal system has demonstrated reduction in groundwater CVOC concentrations (e2M, 2008e).

These studies and monitoring results have led to seven recommended changes to components of the selected remedy.

One change is considered fundamental and has resulted in this ROD Amendment:

- use of air sparging with soil vapor extraction (AS-SVE) for the Off Depot groundwater plume instead of a permeable reactive barrier.

Five changes are considered significant:

- revision to criteria for extent of the AS-SVE system and clarification of the treatment objective for AS-SVE;
- reduction in the areal extent of SVE treatment in subsurface soils on Dunn Field;
- use of thermal-enhanced SVE in the shallow subsurface soils (loess) on Dunn Field instead of conventional SVE.
- reduction in the areal extent of ZVI injections in groundwater on Dunn Field based on potential source areas with groundwater total CVOC concentrations above 1,000 μg/L; and
- use of excavation, transportation and off-site disposal (ET&D) in two areas with shallow impacts (a small area of VOC-impacted subsurface soils and an area of buried crushed drums not previously identified).

The final change is considered minor:

- re-order sequence of remedial action components so that ZVI injections in groundwater on Dunn Field will occur after implementation of the subsurface soil remedies.

The changes to the selected remedy and the basis for the changes are described further in Section 3.

An additional revision to the original Dunn Field ROD is included for completeness. The following statement on page 2-55 of the Dunn Field ROD will be deleted: "A contingency plan may be implemented to further address remediation of the off-site VOC ground water plume entering the northeast portion of Dunn Field in the event the Parties determine the on-site remedy is inadequate and poses unacceptable risk to human health and the environment." This sentence is being stricken because it may convey the notion that the remedy described in the ROD, or in this ROD amendment, is not a final remedy for Dunn Field. The revision does not result in a change to any component of the selected remedy, and striking this statement is not meant to imply that the remedy is now unchangeable; the FFA parties can change a remedial action where warranted by the site conditions whether or not this statement is included.

Statement that ROD Amendment Will Become Part of Administrative Record File

This ROD Amendment will become part of the Administrative Record File in accordance with the requirements of the NCP, Section 300.825(a) (2). This ROD Amendment and the documents referenced herein are available for review at the information repository:

- Defense Distribution Center (Memphis)
  2245 Truitt Street
  Memphis, TN (901) 774-3683
  Hours: 9 am to 5 pm

The information is also available for review on the Former Memphis Depot administrative record website at:

http://www.adminrec.com/DLA.asp

2.0 SITE HISTORY, CONTAMINATION AND SELECTED REMEDY

Site History

DDMT originated as a military facility in the early 1940s; it received, warehoused, and distributed supplies common to all U.S. military services and some civil agencies located primarily in the southeastern United States, Puerto Rico, and Panama. Stocked items included food; clothing; petroleum products; construction materials; and industrial, medical, and general supplies. In 1995, DDMT was placed on the list of the Department of Defense facilities to be closed under BRAC. Storage and distribution of material continued until the facility closed in September 1997.

The property consists of approximately 642 acres and includes the Main Installation (MI) and Dunn Field (Figure 1). The MI contains approximately 578 acres with open storage areas, warehouses, former military family housing, and outdoor recreational areas. Dunn Field, which is located across Dunn Avenue from the north-northwest portion of the MI, contains approximately 64 acres and includes former mineral storage and waste disposal areas. Approximately two-thirds of Dunn Field is grassed, and the remaining area is covered with crushed rock and paved surfaces.

In 1990, USEPA identified 49 Solid Waste Management Units and 8 Areas of Concern during a Resource Conservation and Recovery Act Facility Assessment (A.T. Kearney, 1990). During this time, a Hazard Ranking System Scoring Package for the facility was prepared and, in 1992, DDMT was added to the National Priorities List (57 Federal Register 47180 No. 199).

DDMT is divided into four Operable Units (OUs): Dunn Field, OU 1; Southwest Quadrant MI, OU 2; Southeastern Watershed and Golf Course, OU 3; and North-Central Area MI, OU 4. The *Main Installation, Final Record of Decision* (CH2M HILL, 2001) includes OUs 2, 3, and 4. The *Dunn Field, Final Record of Decision* (CH2M HILL, 2004a) addresses OU 1, the only known and documented waste burial area. Disposal records and interviews with facility personnel identified specific instances when some waste burials occurred, with the earliest record of burial in 1946.

Summary of Contamination

From 1998 through 2002, the Memphis Depot conducted a Remedial Investigation (RI) (CH2M HILL, 2002) and a Feasibility Study (FS) (CH2M HILL, 2003a) for Dunn Field with oversight by USEPA, TDEC, and DLA. The RI/FS identified the types, quantities, and locations of substances detected in the environment and studied the feasibility of potential cleanup solutions. Dunn Field was divided into three geographic areas to facilitate the investigation (Figure 2).

- Northeast Open Area – Approximately 20 acres of land located in the northeast quadrant of Dunn Field. This area is mostly grass covered with some lightly wooded areas.
- Disposal Area – Approximately 14 acres of open land located in the northwest quadrant of Dunn Field, where the majority of disposal sites are located. Historical information concerning the location of the disposal sites are included in the Dunn Field RI Report (July 2002).
- Stockpile Area - Approximately 30 acres of open land located in the southeastern and southwestern portions of Dunn Field. This area includes the former bauxite and fluorspar stockpiles (removed in 1999) and burial areas in the eastern and southwestern portions of Dunn Field.

The eastern portion of Dunn Field, including most of the Northeast Open Area and the Stockpile Area with approximately 41 of the total 64 acres, was found to be suitable for unrestricted use (Figure 2). The selected remedy in the ROD addresses surface soil, material within disposal sites and associated soil, and chlorinated volatile organic compounds (CVOCs) in subsurface soil and groundwater. The key findings from the Dunn Field RI relevant to this ROD Amendment are provided below.

Disposal Area – Subsurface Soils

The following CVOCs were detected at elevated concentrations in subsurface soils in the Disposal Area:

- Tetrachloroethene (PCE)
- Trichloroethene (TCE)
- 1,2 Dichloroethene (1,2-DCE)
- Vinyl Chloride
- 1,1,2,2 Tetrachloroethane (1,1,2,2-PCA)
- 1,1,2 Trichloroethane (1,1,2-TCA)
- Carbon Tetrachloride (CCl_4)
- Chloroform

CVOCs detected by laboratory analysis of soil samples correlate well with the extent of CVOCs detected during a passive soil gas survey. The apparent clustering of the higher CVOC concentrations correlates with the historical information indicating that the disposal pits and trenches were relatively small and separate. CVOCs have been transported from near the base of the disposal trenches (8 to 10 feet below ground surface [bgs]) to the fluvial aquifer (up to 83 feet bgs).

Based on comparison of soil and groundwater sample analytical results, there is a complete migration pathway for CVOCs from disposal area to subsurface soil and then to shallow groundwater. This release has not impacted the deeper Memphis Aquifer, source of the municipal drinking water supply.

Groundwater

The groundwater in the fluvial aquifer is not a drinking water source for area residents.

The nature and extent of contamination in the fluvial aquifer underlying Dunn Field and areas to the west were assessed based on groundwater samples collected during 16 sampling events from January 1996 through February 2001. Groundwater samples were collected and analyzed for the presence of explosives, herbicides, metals (total), pesticides, polychlorinated biphenyls (PCBs), semi-volatile organic compounds (SVOCs), and volatile organic compounds (VOCs). Groundwater samples were also analyzed for chemical warfare material (CWM) breakdown products, including Thiodiglycol, 1,4-Oxathiane, and 1,4-Dithiane. Based on these analyses, VOCs, dieldrin, arsenic, iron, and manganese were identified as constituents of concern (COCs) in groundwater during the RI. However in additional groundwater samples collected prior to the ROD, the metals and dieldrin were not detected at significant levels or did not have a high frequency of detection. Based on the analytical data and the low solubility of the metals and dieldrin, only CVOCs were selected as COCs in groundwater.

The investigation identified three major CVOC plumes in the shallow groundwater under Dunn Field: a northern plume, a central plume, and a southern plume. There is some mixing of the plumes, as expected from influence by the active groundwater extraction system, natural groundwater flow, and degradation processes. Nine primary CVOCs have been detected in groundwater during sampling events, including

- Tetrachloroethene (PCE)
- Trichloroethene (TCE)
- (Cis & Trans)1,2 Dichloroethene (1,2-DCE)
- 1,1 Dichloroethene (1,1-DCE)
- 1,1,2,2 Tetrachloroethane (1,1,2,2-PCA)
- 1,1,2 Trichloroethane (1,1,2-TCA)
- Carbon Tetrachloride (CCl_4)
- Chloroform

The northern plume is considered to have both on-site and off-site sources. PCE, TCE and 1,1-DCE have been detected in off-site monitoring wells, which are upgradient to the northeast of Dunn Field. PCE and TCE have been frequently detected in soil samples on Dunn Field, but 1,1- DCE has not. The CVOCs in the on-site wells are TCE, 1,1,2,2-PCA, 1,2-DCE, chloroform, PCE and 1,1-DCE. Additional sampling and analysis are being performed by USEPA and TDEC to identify the off-site source area.

The central plume is principally composed of 1,1,2,2-PCA and TCE but contains PCE, 1,2- DCE and 1,1,2-TCA. Off-site portions of this plume flow to the west and northwest. The southern plume is principally composed of 1,1,2,2-PCA, TCE, and chloroform, but contains PCE, CCl4, 1,1,2-TCA, and 1,2-DCE. The suspected sources of the central and southern plumes appear to be located within the Disposal Area of Dunn Field.

Remedial Action Objectives

No changes are being made to the Remedial Action Objectives (RAOs) or the cleanup goals in the original Dunn Field ROD.

Selected Remedy

The selected remedy for the Disposal Sites was: **Excavation, Transportation, and Off-site Disposal (ET&D).**

ET&D includes excavation of buried waste and/or affected soil, and transportation and permanent off-site disposal in a RCRA-permitted landfill as an industrial waste or hazardous waste, depending on soil/waste conditions and landfill permit requirements. Following excavation of the disposal sites, clean backfill would be placed in all areas excavated, and the site would be restored to its original condition. This remedy also includes permanent deed restrictions prohibiting residential use for the Disposal Area of Dunn Field. This remedy was selected for remediation of the Disposal Sites due to its expediency, permanency, and moderate cost. It allows the property to be used for the anticipated industrial land use, and does not preclude future removal actions if warranted. This remedial action, as described in the ROD, has been completed as described in *Disposal Sites Remedial Action Completion Report Rev. 1* (MACTEC, 2006).

The selected remedy for VOCs in subsurface soil was: **SVE.**

SVE was selected to treat soil containing VOCs to levels that are protective of human health and acceptable for industrial land use, and that are protective of groundwater. Airflow will be induced through affected soil by applying vacuum through vapor extraction wells and thus, creating a pressure gradient in the vapor phase within the unsaturated zone of the targeted soil treatment area. As the soil vapor migrates through the soil pores toward the extraction vents, VOCs will be volatilized and transported from the subsurface. The extracted soil vapor may or may not need treatment before release to the atmosphere depending on the VOC, its concentration, and the system flow rate. SVE may be implemented without any enhancements or in conjunction with technologies that enhance permeability or vapor transport, including a vapor seal at the land surface. Site controls will be in place to limit access during implementation and process controls will be implemented to minimize fugitive emissions and releases of VOCs above the acceptable levels.

SVE is the presumptive remedy for VOCs in soil. The use of presumptive remedies is recommended by USEPA because they allow the FS process to be streamlined by bypassing the technology identification and screening steps, potentially saving time and money. At the time of the ROD, total contaminant mass calculations in subsurface soils within the Disposal Area indicated that approximately 1,200 pounds of VOCs were present. SVE treatment was estimated in the ROD to require up to 4 years to meet RAOs based on the results of an SVE pilot test.

The selected remedy for groundwater in the fluvial aquifer was: **ZVI Injection, PRB, and MNA with Institutional Controls.**

This combination of treatment technologies was selected because it is expected to achieve risk reduction through the reductive destruction of VOCs via the injection of ZVI into the four source areas of the groundwater plumes on Dunn Field (total areas of approximately 312,000 square feet). The off-site, downgradient VOC plume will be passively treated through an iron PRB that will be installed as a permanent unit across the flow path of the off-site contaminant plume (approximately 1000 linear feet in length). This alternative also relies on MNA to reduce groundwater COC concentrations in the untreated parts of the groundwater plumes. The three components together were considered sufficient to achieve the RAOs for groundwater. Groundwater monitoring will document changes in plume concentrations, and detect potential further plume migration to off-site areas or into deeper aquifers. The remedy also includes use restrictions to prevent future exposure to currently affected groundwater during the life of the remedy.

ZVI injection is intended to destroy chlorinated organic contaminants by in-situ chemical reduction utilizing ZVI injected into the source areas on Dunn Field. Through a series of reactions, the ZVI treatment process breaks down the CVOCs to harmless byproducts. The ZVI will be injected into the groundwater through boreholes to maximum depth of 100 feet bgs. A bench-scale and pilot field study will assist design of the ZVI treatment zone for the groundwater source areas and the groundwater COCs.

A PRB is a passive in-situ chemical reduction treatment zone of reactive material like granular iron or ZVI that degrades contaminants as groundwater flows through it. A permeable treatment barrier will be installed as a permanent unit across the flow path of the off-site contaminant plume (approximately 1000 linear feet in length) through jetting or vertical hydrofracturing to a maximum depth of 90-ft below land surface. Both delivery techniques use iron suspended in a biodegradable slurry. Natural groundwater flow transports contaminants through strategically placed treatment media. This degradation barrier will facilitate reactions that break down CVOCs in the plume into harmless byproducts through chemical reduction. The applicability of PRBs to the site COCs will be demonstrated with the use of bench-scale testing.

Deed restrictions, in conjunction with existing land use controls, are the main types of institutional controls proposed for Dunn Field. The deed restrictions for Dunn Field are:

- Prevention of residential development land use on the Disposal Area of Dunn Field.
- Maintenance of fencing around the disposal area during active remediation to protect the public.
- Production/consumptive use groundwater well controls to restrict use of water in the fluvial aquifer, and preventing drilling into aquifers below the fluvial aquifer until aquifer restoration is achieved.

Tennessee Code (TAC) § 68-21-225 requires "Notice of Land Use Restrictions" to ensure that the land use restrictions are recorded into the deeds transferring the property. TAC § 68-21-225 requires that the locations and dimensions of the areas of environmental concern be identified through surveyed, permanent benchmarks.

3.0 BASIS FOR THE DOCUMENT

Information that Prompted and Supports Fundamentally Changing the Remedy Selected in the ROD

Off Depot Groundwater

Changes to the PRB component for Off Depot groundwater are recommended based on information from the EISR (MACTEC, 2005), the PRB Implementation Study in Appendix B of the Off Depot Pre-final RD (CH2M HILL, 2007b), the Laboratory Microcosm Study Results in Appendix D of the Off Depot RD (CH2M HILL, 2008), and the results of the Fluvial SVE implementation (e^2M, 2008a).

Additional monitoring wells installed for the EISR provided new information on groundwater flow gradient, saturated thickness, and contaminant concentrations around the ROD-proposed location of the ZVI PRB, shown on Figure 3. The relatively low groundwater gradient in that area would make it difficult to ensure consistent flow through a ZVI PRB, while the thicker saturated zone would increase the construction cost. In addition, concentrations of chlorinated volatile organic compounds (CVOCs) downgradient of the ROD-proposed location exceed 5,000 parts per billion (ppb), which is an order-of-magnitude higher than those identified at the time of the ROD. These concentrations are higher than considered appropriate for MNA and would require active treatment downgradient of the ZVI PRB.

To comply with the ROD and account for the new hydrogeologic information, a new ZVI PRB alignment near the midpoint of the off-Depot plume was considered. This location was selected because of a thinner saturated zone and a narrowing of the CVOC plume. The Field PRB Implementation Study was performed in this area (Figure 3). The results of the PRB study indicate that formation of a uniform PRB was not achieved and that several technical issues would need to be solved for installation of an effective full-scale PRB. Key findings that could adversely impact the expected effectiveness and cost of a full-scale ZVI PRB include the following:

- **Highly variable clay surface.** The top of the clay surface is highly variable, which could result in iron/sand columns that are either above or below the top of clay. Consequences of the variable clay surface include the potential for the CVOC plume to pass over or under the full-scale ZVI PRB or that iron installed below the top of clay is essentially wasted.
- **High groundwater velocities.** Aquifer testing conducted as part of the study indicated much higher groundwater velocities than previously understood (up to 6 feet per day [ft/d] versus the

previous estimate of 1 ft/day). These new groundwater velocities could require a 6 foot thick ZVI PRB.

- **Construction challenges.** The jetting technique used for the pilot-scale ZVI PRB requires modification to address incomplete removal of formation material during the jetting process and impacts of sidewall sloughing and variable column diameter on overall system effectiveness. The percentage of ZVI in the columns was highly variable and the consistency would need to be improved.

- **Supplemental technologies would be required.** Multiple injection wells for enhanced bioremediation were proposed in the 60% Off-Depot RD to address elevated CVOC concentrations downgradient of the full-scale ZVI PRB location.

Based on the challenges to successful installation of a full-scale ZVI PRB, enhanced bioremediation through injection of a carbon substrate and a consortia of bacteria was considered as an alternative for the Off-Depot groundwater plume. The initial results of microcosm testing suggested enhanced bioremediation could be effectively used to address site CVOCs, and enhanced bioremediation was proposed for the off-Depot plume in the Off-Depot Groundwater Pre-final RD (July 2007). However, the uncertainty of enhanced bioremediation effectiveness and an updated cost estimate for implementation led to additional review. The factors creating the uncertainty in the effectiveness of enhanced bioremediation include:

- **Lack of field verification.** Although the commercially-available microbial consortia (WBC-2) and carbon sources used during the microcosm study resulted in complete 1,1,2,2-PCA and TCE dechlorination in the laboratory, it has not been applied in the field.

- **Aquifer conditions**. WBC-2 viability and overall enhanced bioremediation effectiveness is highly contingent on the ability to sustain strongly reducing conditions, which may be challenging in the Fluvial aquifer, which is strongly aerobic. In addition, buffering would be required to sustain neutral pH levels to optimize WBC-2 effectiveness and maximum CVOC degradation rates.

- **Substrate delivery**. Development of horizontally and vertically continuous enhanced bioremediation zones is contingent on uniform delivery of carbon substrate in the aquifer. Given the variability seen in ZVI delivery during the EISR and in vapor extraction in the Fluvial SVE operations, uniform distribution of the carbon substrate may not be possible.

- **Additional studies required**. Additional field testing would be essential to optimize the enhanced bioremediation system prior to full-scale implementation. Critical parameters to be determined prior to implementation include the achievable radius of injection during substrate injection, the actual subsurface distribution of WBC-2 following injections, and the need for and magnitude of pH adjustments to sustain microbial activity.
- **Field labor and access**. Injection of carbon substrate to sustain enhanced bioremediation would require significant field labor (several man-years) and regular access to off-site properties.

AS-SVE was evaluated as an alternative to enhanced bioremediation for the Off Depot remedy. AS-SVE had been considered in the Dunn Field ROD for remediation of groundwater beneath the source areas. Although it was not selected because ZVI injection offered rapid reduction of CVOC concentrations without continuing operations and maintenance and was slightly less expensive, AS-SVE was considered a viable treatment technology.

The use of AS-SVE to treat the Off-Depot plume is similar to the use of the ZVI PRB in the Dunn Field ROD. The following similarities are noted:

- Both technologies rely on physical and/or chemical, rather than biological, processes.
- Both would treat a large portion of the Off Depot Plume, with only a small portion to be treated by MNA.
- Operations and maintenance activities are limited relative to the injection activities required for enhanced bioremediation.

The other elements that resulted in selection of AS-SVE are summarized below.

- **Proven technology.** AS-SVE has been implemented to remove CVOCs from groundwater at numerous sites, completed or in-process. The Fluvial SVE system is operating successfully on Dunn Field.
- **Straight-forward implementation**. Construction of AS and SVE wells is relatively rapid using conventional drilling methods. Air compressor and blower equipment are easily procured.
- **Rapid evaluation**. AS-SVE effectiveness can be assessed in a relatively short period, unlike enhanced bioremediation, which requires many months to implement and reliably assess.

Therefore, based on the hydrogeologic and CVOC data collected since the ROD was signed and the challenges associated with the installation of a cost-effective, full-scale ZVI PRB, AS-SVE is considered a more appropriate remedy for the Off-Depot CVOC plume.

In addition to the fundamental change to the remedy through use of AS-SVE instead of the ZVI PRB, significant changes and clarifications to the Off Depot groundwater remedy are also being made. Changes to the extent and the treatment objective of the AS-SVE system are being made based on information from groundwater monitoring results, groundwater modeling and the effect of Fluvial SVE operations on CVOC concentrations in groundwater.

The ROD stated that the length of the PRB would be based on the furthest northeast and southwest 50 ug/L isoconcentration contour for any COC. The extent of the recommended active remedy (AS-SVE), shown on Figure 3, crosses the core of the plume near the downgradient end. The MLGW substation prevents shifting the AS-SVE system further north to capture more of the plume. The criteria for the length of active treatment presented in the ROD were conservative to address the level of uncertainty on groundwater flow and contaminant transport. Studies completed since completion of the ROD have greatly reduced the uncertainty, and the planned extent of the AS-SVE system in combination with natural attenuation is considered sufficient to achieve groundwater RAOs.

Thirty-one new monitoring wells were installed in 2004 in the Off Depot area to determine the extent of the groundwater plume. Groundwater monitoring results since 2005 (Figure 4) demonstrate that the overall plume extent has been stable since that time. Groundwater modeling conducted for the Off Depot RD suggests that while the AS-SVE system will reduce CVOC concentrations in the fluvial aquifer, the system is not needed to protect the Memphis Sand aquifer. Estimated CVOC concentrations in the Memphis Sand aquifer are well below maximum contaminant levels with or without the AS-SVE system. Based on groundwater monitoring results since 2005 shown on Figure 4, operation of the Fluvial SVE system on Dunn Field has greatly reduced groundwater concentrations upgradient of the AS-SVE system location.

The ROD stated that the PRB would treat the COCs to non-toxic end products and achieve a 95% CVOC degradation rate. The recommended active remedy will reduce the CVOC concentrations to 50 ug/L or less. Groundwater modeling results indicate that the AS-SVE system in combination with natural attenuation processes will reduce groundwater concentrations to MCLs in accordance with the RAOs within a reasonable period of time.

Subsurface Soil

Changes to the SVE component for subsurface soil are based on information from the RDI and the SVE pilot study. The reports for the RDI and the SVE study are included as Appendices A and B, respectively, in the Source Areas RD (CH2M HILL, 2007a).

SVE was selected as the presumptive remedy for CVOCs in subsurface soil (the vadose zone) at Dunn Field and was expected to meet the RAOs in less than 5 years.

The impacted vadose zone at Dunn Field consists of two distinct geological units: (1) a shallow, relatively low-permeability loess composed of silt, silty clay and silty fine sand, and (2) a deep, relatively high-permeability alluvium composed of sand and gravel with discontinuous layers of silt and clay, designated the fluvial deposits. The loess extends from the ground surface to a depth of about 30 feet, bgs. Underlying the loess are several feet of sandy clay, followed by 30 to 75 ft of the fluvial sands, silt, and gravel.

The SVE pilot study was conducted in four phases to collect site-specific data for design of a full-scale system. The study findings supported use of SVE in the fluvial deposits and indicated the RAOs could be met within 5 years in that unit. However, the study demonstrated limited vapor extraction rates and high applied vacuum requirements for the loess. The estimated times required to meet RAOs for the two primary CVOCs in the loess were up to 235 years for 1,1,2,2 PCA and up to 14 years for TCE.

The RDI included a membrane interface probe (MIP) investigation and soil sample analyses to characterize the magnitude and extent of elevated CVOCs in the loess on 40-foot by 40-foot grid throughout the treatment areas identified in the ROD. The study resulted in better delineation of the loess deposits exceeding the remedial goals (RGs) and requiring SVE treatment. The total area within the four treatment areas was reduced from 5.5 acres as shown in the ROD to 1.3 acres. The RDI determined that CVOC concentrations in the upper 5 feet of soil in the treatment areas were below RGs. Therefore, the treatment interval in the loess will extend from a depth of 5 feet to approximately the top of the fluvial deposits at a depth of 30 to 35 feet.

Soil sampling and MIP results indicated a CVOC, chloroform, was present slightly above the RG at depths of 8.5 to 13 feet in one RDI boring. None of the surrounding borings had CVOCs above the RGs. Based on the limited extent and depth; this area will be excavated rather than treated by thermal-enhanced SVE. A second area of shallow soil contamination was identified during construction of the Fluvial SVE system in June 2007. Crushed metal drums were found at a depth of 2.5 feet bgs during hand-auguring prior to installation of Fluvial SVE vapor monitoring points in TA-3. Residual material in the drums was determined to be primarily diesel range and heavier hydrocarbons. The extent of the buried, crushed drums was estimated based on a surface geophysical survey and test pit excavations to cover approximately 10,500 square feet with a volume of approximately 1,950 cubic yards. Excavation was also selected as the most effective remedy for this area.

The revised loess treatment areas and the excavation areas are shown on Figure 5. The highest CVOC concentrations in the fluvial vadose zone are assumed to be directly below the highest CVOC concentrations in the loess; the fluvial SVE layout is also shown on Figure 5.

The original Proposed Plan (CH2M HILL, 2003) stated that the SVE remedy may be implemented with enhancements to improve permeability or vapor transport. The reduced area requiring SVE treatment allowed cost-effective implementation of thermal enhancements to the SVE system for the loess. In situ thermal desorption (ISTD) was the thermal technology selected for implementation at Dunn Field. In addition, implementation of ISTD substantially reduced the time required to achieve the cleanup goals in loess soils to be protective of groundwater.

The ISTD technology heats subsurface soils via radiation and conductive heat transfer. The heating converts subsurface moisture to steam, which mobilizes and volatizes contaminants. The heated vapor is removed from the subsurface via SVE and is treated before release to the atmosphere. Temperature monitoring points installed throughout the treatment areas provide a three-dimensional profile of the subsurface temperature throughout the remediation process. Site controls are put in place to limit access during implementation. Further, process controls are implemented to minimize fugitive emissions and releases of VOCs above the acceptable levels.

The thermal-enhanced SVE system operated in the loess treatment areas from May 2008 to December 2008 and removed over 12,000 pounds of CVOCs. The system was shut down after soil confirmation samples demonstrated that the RAO for subsurface soils in the treatment areas had been achieved. The Fluvial SVE system began operation in July 2007 and has removed approximately 2,750 pounds of CVOCs as of August 2008; operations are expected to continue to July 2012. Source area remedial actions, including SVE, will be described in the Source Areas Interim Remedial Action Completion Report.

Groundwater on Dunn Field

Changes to the ZVI component for groundwater on Dunn Field are recommended based on information from the ZVI field treatability study, the EISR, the RDI, Fluvial SVE operations monitoring and recent groundwater sampling results from the IRA.

The ZVI component uses pressurized pneumatic injection of ZVI powder into the saturated zone (fluvial aquifer). Pneumatic fracturing is conducted as a first step to maximize ZVI dispersal in the treatment zone. The Dunn Field ROD stated that ZVI would be injected into the fluvial aquifer underlying Dunn Field in areas suspected of acting as a source for groundwater contamination and estimated that ZVI injections would be made at 53 injection borings with a spacing of 60 to 80 feet.

In the treatability study, ZVI injections were made in four borings spaced 25 to 30 feet apart; approximately 25,000 pounds of ZVI was injected at 1 to 2-foot intervals spanning the approximately 13-foot saturated thickness of the fluvial aquifer at that location. An 84 to 99 percent reduction of CVOCs was observed in groundwater samples from the ZVI treatment zone during post-injection groundwater monitoring over six months. Later groundwater samples indicated CVOC rebounding at some wells possibly as the result of contaminant leaching from overlying soils; desorption of CVOCs not directly treated by iron emplacement; overall iron distribution and longevity; and/or transport of dissolved-phase CVOCs into treated areas.

In the EISR, ZVI injections were made in 14 borings at 2-foot intervals over the fluvial aquifer thickness, which averaged 21 feet; the injection borings were spaced 60 to 80 feet apart. The total mass of ZVI injected was approximately 192,500 pounds. In the central injection area, TCE concentrations were reduced approximately 46 percent and PCA concentrations were reduced approximately 65 percent. The report recommended decreased spacing between injection locations in future remedial actions to achieve increased reduction in CVOCs.

The RDI included installation of 12 new monitoring wells on Dunn Field and groundwater sampling from the new and existing wells. The groundwater data provided greater delineation of the CVOC concentrations underlying the source areas in the loess.

Based on the additional information, ZVI injections are recommended to be limited to source areas identified by the 1000 ug/L total CVOC contour and the loess treatment areas, which were the source of CVOCs in groundwater. The spacing between injection borings would be approximately 30 feet. The

CVOC plume outside the ZVI injection area will be treated by the Off-Depot groundwater remedy. The planned ZVI injection zones from the Source Areas RD are shown on Figure 6.

The sequencing of the ZVI injections relative to the other Source Areas RA remedies was also changed. The groundwater remedy will be implemented after installation and start-up of the fluvial SVE system and after completion of thermal-enhanced SVE in the loess. This change is recommended to minimize rebounding of CVOC concentrations in groundwater after injection due to leaching from the overlying source areas.

The Fluvial SVE system began operation in July 2007 and has removed approximately 2,750 pounds of CVOCs as of August 2008. The removal of CVOCs from the fluvial sands has had a significant effect on CVOC concentrations in groundwater based on sampling events since SVE operations began. Total CVOC concentrations in groundwater samples collected in October 2008 are shown on Figure 6; the maximum concentration in groundwater on Dunn Field is 225 ug/L (MW-227). The reduction in groundwater concentrations indicates a continuing source of CVOCs in the fluvial aquifer is not present and that ZVI injections are not necessary. The thermal-enhanced SVE in the loess operated from May 2008 through November 2008 and removed over 12,000 pounds of CVOCs; this is expected to prevent movement of CVOCs from the loess to the fluvial sands and further reduce groundwater impacts.

4.0 DESCRIPTION OF SIGNIFICANT DIFFERENCES

To facilitate remedy design and implementation, the remedial design and remedial action for Dunn Field were divided into three parts:

- Disposal Sites
- Source Areas
- Off Depot Groundwater

The selected remedy for Dunn Field also includes institutional controls (ICs) consisting of deed restrictions in conjunction with existing land use controls. No changes to the ICs are planned and they are not discussed further in this ROD Amendment.

The Disposal Sites include surface soil and waste materials in the Disposal Area. The selected remedy was excavation, transportation, offsite disposal, and institutional controls (ICs) to prevent residential development. The RD/RA has been completed as described in *Disposal Sites Final Remedial Design Rev. 1* (CH2M HILL, 2004b) and *Disposal Sites Remedial Action Completion Report Rev. 1* (MACTEC, 2006).

The Source Areas include source area subsurface soil and groundwater on Dunn Field. The selected remedy was soil vapor extraction (SVE), zero-valent iron (ZVI) injection, and ICs to restrict land uses and prevent groundwater use. The RD has been completed as described in *Dunn Field Source Areas Final Remedial Design Rev. 4* (CH2M HILL, 2007a). The RA mobilization occurred May 14, 2007. The Fluvial SVE system began operations in July 2007 and the thermal-enhanced SVE in the loess was operated from May to November 2008.

The scope of the Off Depot Groundwater element of the selected remedy includes dissolved phase contamination in the groundwater downgradient from the source areas on Dunn Field. The selected remedy was a ZVI permeable reactive barrier (PRB), monitored natural attenuation (MNA), and ICs to prevent groundwater use.

The fundamental change described in this ROD Amendment is to the Off Depot Groundwater remedy. This component of the original selected remedy and the amended remedy is described below.

Off Depot Groundwater

Original Remedy

The offsite granular iron PRB will be placed across the flow path of the VOC plume, as the plume flows through the PRB under natural gradients, the VOCs are destroyed to non-toxic end products. The PRB will be approximately 1,050 feet in length as shown on Figure 3. Untreated parts of the plume will degrade under natural attenuation processes. Groundwater monitoring will include monitoring of the PRB and the untreated parts of the plume with 43 monitoring wells, including 15 new wells. Groundwater monitoring will be performed over the cleanup time estimated to be approximately 15 years after remedial action implementation. The uncertainties noted in the ROD for this component were: (1) the vertical installation of the offsite PRB to depths of 100 feet below land surface; (2) the degradation rate of the VOCs through in situ chemical reduction and natural attenuation; and (3) the potential movement of the plume and the length of time required for cleanup.

Amended Remedy

The AS-SVE system will be installed to intercept the majority of the Off-Depot CVOC plume and reduce individual CVOC concentrations to below 50 µg/L. The approximate location is shown on Figure 3. The AS barrier will include approximately 78 vertical sparge points spaced at 15-foot intervals in two rows at the distal end of the plume along Menager Avenue. Twelve additional sparge points will be installed in the central portion of the AS barrier to address the core of the plume. Each sparge point will be installed at the base of the fluvial aquifer (90 to 100 feet bgs). Twelve SVE wells will be installed on approximately 50-foot centers to capture the vapors from the AS wells. Each SVE well will include a 30-ft screened interval, generally extending from 35 to 65 feet bgs. The final locations of the individual AS and SVE wells will be based on the results of additional groundwater sampling events and site access.

The SVE system will be operated in concert with the AS system. The AS and SVE wells will be connected via buried piping to two equipment buildings; one housing the compressed air system for the sparge points and the other housing the blowers for the SVE wells. System controls will be located in a control room in one of the buildings.

Nine new fluvial aquifer and two new intermediate aquifer groundwater monitoring wells will be installed to expand the groundwater monitoring network in the vicinity of the AS barrier. Additionally, 10 sets of nested vapor monitoring points (VMPs) screened at 50 and 70 feet bgs will be installed to monitor the ROI of the SVE wells and the CVOC concentrations in the vadose zone.

The AS-SVE system is expected to operate for 5 years in order to reduce individual CVOC concentrations to below 50 µg/L. Performance monitoring will include the collection of water samples for field and laboratory analyses, water levels measurement, periodic SVE well and off-gas quality monitoring, VMP monitoring, and indoor air quality monitoring as needed. While the estimated time of operation is 5 years, the system will continue to operate until the influent (upgradient) concentrations from the Dunn Field plume do not exceed 50 ppb for individual CVOCs.

Groundwater monitoring will consist of performance monitoring near the AS barrier and LTM throughout the groundwater plume. Baseline groundwater samples will be collected prior to operation of the AS-SVE system to establish a basis for evaluating remedy effectiveness. Groundwater samples will then be collected quarterly during the first year of AS-SVE operation and semiannually during the second year. After the second year, the performance monitoring wells will be incorporated into LTM. The LTM wells will be monitored at semiannual to biennial intervals based on location and past results. Groundwater samples will be analyzed for CVOCs parameters. Long-term monitoring will continue until the groundwater RAOs are achieved.

Effect of Changes on Remedial Action Objectives

No changes to the RAOs are planned or necessary due to the amended remedy.

5.0 EVALUATION OF ALTERNATIVES

The original and amended remedies for Off Depot Groundwater are compared using the nine USEPA criteria in the following paragraphs.

Overall Protection of Human Health and the Environment

Both alternatives are considered protective of human health and the environment. The original remedy (PRB/MNA/ICs) and the amended remedy (AS-SVE/MNA/ICs) provide protection through active treatment of the groundwater to remediation goals in the fluvial aquifer, and provide protection for the deeper, underlying Memphis aquifer. Both alternatives also include institutional controls to prevent the use of the groundwater in the fluvial aquifer during remediation.

Compliance with ARARs

Both alternatives are expected to meet Applicable or Relevant and Appropriate Requirements (ARARs) at the completion of implementation. The groundwater underneath Dunn Field would be considered "General Use Ground Water" based upon the yield and Total Dissolved Solids levels. The Criteria specified in the TDEC Rule 1200-4-3-.08(2) for General Use Ground Water are considered an ARAR. The Criteria consist of SDWA MCLs, maximum contaminant level goals (MCLGs), secondary maximum contaminant levels (SMCLs) and Action-levels for organic and inorganic constituents. Accordingly, the MCLs and non-zero MCLGs are considered relevant and appropriate remediation goals for the Dunn Field groundwater including the offsite plume.

The alternatives provide treatment of the off-depot plume through installation of a PRB or an AS-SVE system. MNA is used in both alternatives for contaminants beyond the areas of active in situ remediation.

Long-term Effectiveness and Permanence

The long-term effectiveness of the PRB was brought in to question by the PRB implementation study. The effectiveness of AS-SVE is supported by the ongoing fluvial SVE at the Dunn Field Source Areas. Both alternatives if successful provide permanent solutions through reductive dechlorination of CVOCs in the groundwater. The ZVI that would be injected as part of a PRB has been shown to last for up to two decades without replacement. The AS-SVE system is expected to operate for the estimated treatment period with limited O&M activity required.

Reduction of Toxicity, Mobility, or Volume (TMV) through Treatment

Both alternatives are expected to reduce the toxicity, mobility and volume for the CVOCs through treatment at the completion of implementation. The original remedy relies primarily on in-situ chemical reduction using a PRB for treatment. The amended remedy removes CVOCs from groundwater through AS-SVE and the vapors would be treated with recycled granular activated carbon as necessary to meet discharge limits.

Short-term Effectiveness

Both alternatives require some engineering controls during installation to protect the environment and safety controls to protect workers. Engineering controls would not be required during treatment.

Implementability

Both alternatives are considered technically feasible and can be implemented with available labor, materials, and equipment. However, the results of the ZVI PRB implementation study create doubt on the installation of an effective full-scale system as installation modifications would be necessary to address iron distribution uniformity, formation materials inclusion, and the variable clay surface. AS-SVE was deemed a more appropriate remedy for the off-depot plume based on the success of the Fluvial SVE system at Dunn Field and the use of AS-SVE at numerous sites throughout the United States.

Cost

Present worth costs are summarized in the following list.

Alternative	**Capital Cost**	**O&M Cost**	**Present Worth**
Original Remedy – PRB and MNA	$2,686,946	$1,067,400	$3,754,346
Amended Remedy – AS-SVE and MNA	$2,549,069	$2,369,658	$4,918,727

Costs for the Original Remedy for Off Depot groundwater were taken from the ROD (Table 2-22c) and were not adjusted for inflation since preparation of the estimate in 2003. The groundwater remedy costs in the ROD were adjusted to omit ZVI injections since that component of the groundwater remedy is included in the Source Areas RA. Costs for the Amended Remedy for were taken from the Off Depot RD, Table 7-1b. The O&M costs for the amended remedy are higher than the original remedy; however, the amended remedy estimated costs include 30 years of groundwater monitoring while the ROD estimated costs include 15 years of monitoring. The amended remedy is considered cost-effective.

State Acceptance

State has accepted both alternatives.

Community Acceptance

Community has accepted both alternatives. No comments were received during the public comment period for the Dunn Field Revised Proposed Plan (e^{2}M, October 2008c). Ongoing community involvement activities will be an important element of remedy implementation.

Summary

The comparative analysis of the original remedy and the amended remedy for off-depot groundwater is summarized as follows.

Evaluation Criteria	**Original Remedy – PRB and MNA**	**Amended Remedy – AS-SVE and MNA**
Protective of Human Health and Environment	High	High
Complies with ARARs	Yes	Yes
Effective and Permanent	Low	High
Reduces Toxicity, Mobility or Volume through Treatment	Yes	Yes
Short-term Effectiveness	Medium	High
Implementable	Low	High
Cost	$3,754,346	$4,918,727
State Acceptance	Yes	Yes
Community Acceptance	Yes	Yes

6.0 SUPPORT AGENCY COMMENTS

The amended remedy was developed by DLA and approved by USEPA and TDEC. The basis for the change and the development of the remedy was discussed in BCT meetings and is contained within documents in the Administrative Record.

7.0 STATUTORY DETERMINATIONS

The original selected remedy was stated in the ROD to satisfy the statutory requirements as stipulated in CERCLA Section 121(b). The remedy was considered to: (1) be protective of human health and the environment under the industrial land use scenario, (2) comply with ARARs, (3) be cost-effective, and (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. This determination is considered valid for the amended remedy as well.

The amended remedy has the same remedial goals and additional waste streams or emissions (vapor condensate) during remediation will be minimal. ARARs for the amended remedy are listed on Table 1. The amended remedy is considered cost-effective because of the expected increase in effectiveness. The amended remedy has no appreciable change in the utilization of permanent solutions and alternative treatment technologies or resource recovery technologies.

8.0 PUBLIC PARTICIPATION COMPLIANCE

The Former Memphis Depot has conducted public participation activities throughout the CERCLA site cleanup process prior to this ROD Amendment. These include Restoration Advisory Board (RAB) meetings since 1994, Community Information Sessions and public meetings, a regular newsletter, and the establishment of information repositories, including a Community Outreach Room.

Public comments on the environmental remedial action proposed at Dunn Field were requested. The Defense Logistics Agency (DLA) placed the Dunn Field Revised Proposed Plan, which documents and recommends changes to the selected remedy, in the Information Repository before October 27, 2008, when the 30-day public comment period began. The information repository is located at the:

- Memphis Depot Business Park
  DLA Community Outreach Room
  2245 Truitt Street
  Memphis, TN (901) 774-3683
  Hours: 9 am to 5 pm

A public meeting was held November 13, 2008 to describe the revised remedy and to solicit comments from the public. Comments were requested, either verbal or in writing during the public comment meeting and in writing during the 30-day comment period. No comments were received through the end of the comment period on November 25, 2008.

9.0 SUPPORTING DOCUMENTS FROM ADMINISTRATIVE RECORD

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CH2M HILL, 1995. *Record of Decision for Interim Remedial Action of the Groundwater at Dunn Field (OU-1) at the Defense Distribution Depot Memphis.* Prepared for U.S. Army Corps of Engineers, Huntsville Division.

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CH2M HILL. 2002. *Memphis Depot Dunn Field Remedial Investigation Report* - Volumes I through III Prepared for the Defense Logistics Agency and presented to U.S. Army Engineering and Support Center, Huntsville, Alabama. July 2002.

CH2M HILL, 2003a. *Memphis Depot Dunn Field Feasibility Study, Rev. 2.* Prepared for U.S. Army Corps of Engineers, Huntsville Division.

CH2M HILL, 2003b. *Memphis Depot – Dunn Field Proposed Plan.* Defense Distribution Center (Memphis). Prepared for the U.S. Army Engineering and Support Center, Huntsville, Alabama. May 2003.

CH2M HILL, 2004a. *Final Memphis Depot Dunn Field Record of Decision.* Prepared for the U.S. Army Engineering and Support Center, Huntsville, Alabama. March 2004.

CH2M HILL, 2004b. *Memphis Depot Dunn Field Disposal Sites Final Remedial Design Rev. 2.* Prepared for the U.S. Army Engineering and Support Center, Huntsville, Alabama. April 2004.

CH2M HILL, 2007a. *Memphis Depot Dunn Field Source Areas Final Remedial Design Rev. 4.* Prepared for the U.S. Army Engineering and Support Center, Huntsville, April 2007.

CH2M HILL, 2007b. *Memphis Depot Dunn Field Off Depot Groundwater Pre-final Remedial Design Rev. 1.* Prepared for the U.S. Army Engineering and Support Center, Huntsville, July 2007.

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MACTEC Engineering and Consulting, Inc., 2005. *Early Implementation of Selected Remedy Interim Remedial Action Completion Report, Rev. 1*. Prepared for U.S. Air Force Center for Environmental Excellence. September 2005.

MACTEC Engineering and Consulting, Inc., 2006. *Dunn Field Disposal Sites Remedial Action Completion Report, Rev. 1*. Prepared for U.S. Air Force Center for Environmental Excellence, July 2006.

USEPA, 1999. *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Decision Documents*. EPA 540-R-98-031. OSWER 9200.1-23P. PB98-963241. July, 1999.

TABLES

TABLE 1
ARARS AND TBC GUIDANCE
DUNN FIELD ROD AMENDMENT
Defense Depot Memphis, Tennessee

Action/medium	Requirements	Prerequisite	Citation(s)
Chemical-Specific			
Restoration of groundwater to its designated uses(s)	May not exceed MCLS and MCLGs above zero established under the Safe Drinking Water Act for public water systems	Presence of contaminants in ground water of the State designated as *General Use* as defined in TDEC 1200-4-3-07(4)(b) - **relevant and appropriate**	TDEC 1200-5-1-.06 40 CFR 141 *et seq.*
	Except for naturally occurring levels, shall not contain constituents that exceed those levels specified in Rules 1200-4-3-.03(1)j and k.		TDEC 1200-4-3-.08(2)(a)
	Except for naturally occurring levels, shall contain no other constituents at levels and conditions which pose an unreasonable risk to the public health or the environment.		TDEC 1200-4-3-.08(2)(b)
Action-Specific	*General Construction standards - all land-disturbing activities (i.e., excavation, trenching, clearing, etc.)*		
Activities causing fugitive dust emissions	Shall take reasonable precautions to prevent particulate matter from becoming airborne; reasonable precautions shall include, but are not limited to, the following:	Fugitive emissions from demolition of existing buildings or structures, construction operations, grading of roads, or the clearing of land -**applicable**	TDEC 1200-3-8-.01(1)
	• use, where possible, of water or chemicals for control of dust; and		TDEC 1200-3-8-.01(1)(a)
	• application of asphalt, oil, water, or suitable chemicals on dirt roads, materials stock piles, and other surfaces which can create airborne dusts.		TDEC 1200-3-8-.01(1)(b)
	Shall not cause or allow fugitive dust to be emitted in such a manner as to exceed 5 minute/hour or 20 minute/day beyond property boundary lines on which emission originates.		TDEC 1200-3-8-.01(2)

TABLE 1
ARARS AND TBC GUIDANCE
DUNN FIELD ROD AMENDMENT
Defense Depot Memphis, Tennessee

Action/medium	Requirements	Prerequisite	Citation(s)
Activities causing storm water runoff (e.g., clearing, grading, excavation)	Implement good construction management techniques (including sediment and erosion controls, vegetative controls, and structural controls) in accordance with the substantive requirements of General Permit No. TNR10-0000 Appendix F, to ensure that storm water discharge	Dewatering or storm water runoff discharges from land disturbed by construction activity - disturbance of ≥5 acres total -**applicable**; <5 acres - **relevant and appropriate**	TCA 69-3-108(j) TDEC 1200-4-10-.03(2)
	• does not violate water quality criteria as stated in TDEC 1200-4-3-.03 including but not limited to prevention of discharges that causes a condition in which visible solids, bottom deposits, or turbidity impairs the usefulness of waters of the state for any of the designated uses for that water body by TDEC 1200-4-4	Storm water discharges from construction activities **– TBC**	*General Permit No. TNR10-0000* Part III D.2.a
	• does not contain distinctly visible floating scum, oil, or other matter;		*General Permit No. TNR10-0000* Part III D.2.a
	• does not cause an objectionable color contrast in the receiving stream; and		*General Permit No. TNR10-0000* Part III D.2.a
	• results in no materials in concentrations sufficient to be hazardous or otherwise detrimental to humans, livestock, wildlife, plant life, or fish and aquatic life in the receiving stream.		*General Permit No. TNR10-0000* Part III D.2.a
Action-Specific	***Groundwater Monitoring well installation and closure***		
Installation and maintenance of groundwater monitoring well(s) and soil borings	All wells shall be constructed in a manner that will guard against contamination of the groundwater aquifers underlying Shelby County.	Construction, modification, and repair of groundwater monitoring well(s) and boreholes - **relevant and appropriate**	*Rules and Regulations of Wells* in Shelby County Section 6 and Section 7 *et. seq.*
Closure of groundwater monitoring well(s)	Well shall be completely filled and sealed in such a way as to prevent vertical movement of water from one aquifer to another.	Permanent plugging and abandonment of a well - **relevant and appropriate**	*Rules and Regulations of Wells* in Shelby County Section 9 *et. seq.*
Action-Specific	***SVE treatment system - air emissions control***		
Emissions from SVE treatment system	Discharge of air contaminants must be in accordance with the appropriate provisions of Rules of the TDEC Chapter 1200-3 et seq., any applicable measures of control strategy and provisions of the Tennessee Pollution Control Act.	Emissions of air pollutants from new air contaminant sources - **applicable**	TDEC 1200-3-9-.01(1)(d) Memphis Code 16-77

TABLE 1
ARARS AND TBC GUIDANCE
DUNN FIELD ROD AMENDMENT
Defense Depot Memphis, Tennessee

Action/medium	Requirements	Prerequisite	Citation(s)
Action-Specific	***Waste generation, characterization, segregation, and storage - primary remediation wastes (excavated contaminated soil, disposal pit materials) and secondary wastes (wastewaters, spent treatment media, etc.)***		
Characterization of solid waste	Must determine if solid waste is hazardous waste or if waste is excluded under 40 CFR 261.4(b); and	Generation of solid waste as defined in 40 CFR 261.2 and which is not excluded under 40 CFR 261.4(a) -**applicable**	40 CFR 262.11(a) TDEC 1200-1-11-.03(1)(b)(1)
	Must determine if waste is listed under 40 CFR Part 261; or		40 CFR 262.11(b) TDEC 1200-1-11-.03(1)(b)(2)
	Must characterize waste by using prescribed testing methods or applying generator knowledge based on information regarding material or processes used.		40 CFR 262.11(c) TDEC 1200-1-11-.03(1)(b)(3)
	Must refer to Parts 261, 262, 264, 265, 266, 268, and 273 of Chapter 40 for possible exclusions or restrictions pertaining to management of the specific waste.	Generation of solid waste which is determined to be hazardous – **applicable**	40 CFR 262.11(d); TDEC 1200-1-11-.03(1)(b)(4)
Characterization of hazardous waste	Must obtain a detailed chemical and physical analysis on a representative sample of the waste(s), which at a minimum contains all the information that must be known to treat, store, or dispose of the waste in accordance with pertinent sections of 40 CFR 264 and 268.	Generation of RCRA-hazardous waste for storage, treatment or disposal - **applicable**	40 CFR 264.13(a)(1) TDEC 1200-1-11-.06(2)(d)(1)
	Must determine the underlying hazardous constituents [as defined in 40 CFR 268.2(i)] in the waste	Generation of RCRA characteristic hazardous waste (and is not D001 non-wastewaters treated by CMBST, RORGS, or POLYM of Section 268.42 Table 1) for storage, treatment or disposal – **applicable**	40 CFR 268.9(a) TDEC 1200-1-11-.10(1)(l)(1)
	Must determine if the waste is restricted from land disposal under 40 CFR 268 et seq. by testing in accordance with prescribed methods or use of generator knowledge of waste.		40 CFR 268.7 TDEC 1200-1-11-.10(1)(g)(1)(i)
	Must determine each EPA Hazardous Waste Number (Waste Code) to determine the applicable treatment standards under 40 CFR 268.40 et. seq.		40 CFR 268.9(a) TDEC 1200-1-11-.10(1)(l)(1)

TABLE 1
ARARS AND TBC GUIDANCE
DUNN FIELD ROD AMENDMENT
Defense Depot Memphis, Tennessee

Action/medium	Requirements	Prerequisite	Citation(s)
Temporary storage of hazardous waste in containers	A generator may accumulate hazardous waste at the facility provided that:	Accumulation of RCRA hazardous waste on site as defined in 40 CFR 260.10 - **applicable**	40 CFR 262.34(a); TDEC 1200-1-11-.03(4)(e)
	• waste is placed in containers that comply with 40 CFR 265.171-173; and		40 CFR 262.34(a)(1)(i); TDEC 1200-1-11-.03(4)(e)(2)(ii)(I)
	• the date upon which accumulation begins is clearly marked and visible for inspection on each container;		40 CFR 262.34(a)(2); TDEC 1200-1-11-.03(4)(e)(2)(ii)
	• container is marked with the words "hazardous waste" or		40 CFR 264.34(a)(3) TDEC 1200-1-11-.03(4)(e)(2)(iv)
	• container may be marked with other words that identify the contents.	Accumulation of 55 gal. or less of RCRA hazardous waste at or near any point of generation - **applicable**	40 CFR 262.34(c)(1) TDEC 1200-1-11-.03(4)(e)(5)(i)(II)
Use and management of hazardous waste in containers	If container is not in good condition (e.g. severe rusting, structural defects) or if it begins to leak, must transfer waste into container in good condition.	Storage of RCRA hazardous waste in containers – **applicable**	40 CFR 265.171 TDEC 1200-1-11-.05(9)(b)
	Use container made or lined with materials compatible with waste to be stored so that the ability of the container is not impaired.		40 CFR 265.172 TDEC 1200-1-11-.05(9)(c)
	Keep containers closed during storage, except to add/remove waste.		40 CFR 265.173(a) TDEC 1200-1-11-.05(9)(d)(1)
	Open, handle and store containers in a manner that will not cause containers to rupture or leak.		40 CFR 265.173(b) TDEC 1200-1-11-.05(9)(d)(2)
Storage of hazardous waste in container area	Area must have a containment system designed and operated in accordance with 40 CFR 264.175(b).	Storage of RCRA-hazardous waste in containers with free liquids – **applicable**	40 CFR 264.175(a) TDEC 1200-1-11-.06(9)(f)(1)
	Area must be sloped or otherwise designed and operated to drain liquid from precipitation, or	Storage of RCRA-hazardous waste in containers that do not contain free liquids - **applicable**	40 CFR 264.175(c) TDEC 1200-1-11-.06(9)(f)(3)
	Containers must be elevated or otherwise protected from contact with accumulated liquid.		

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TABLE 1
ARARS AND TBC GUIDANCE
DUNN FIELD ROD AMENDMENT
Defense Depot Memphis, Tennessee

Action/medium	Requirements	Prerequisite	Citation(s)
Action-Specific	*Treatment/disposal of wastes - primary and secondary wastes*		
Disposal of RCRA-hazardous waste in a land-based unit	May be land disposed if it meets the requirements in the table "Treatment Standards for Hazardous Waste" at 40 CFR 268.40 before land disposal.	Land disposal, as defined in 40 CFR 268.2, of restricted RCRA waste - **applicable**	40 CFR 268.40(a) TDEC 1200-1-11-.10(3)(a)
	Must be treated according to the alternative treatment standards of 40 CFR 268.49(c) or according to the UTSs [specified in 40 CFR 268.48 Table UTS] applicable to the listed and/or characteristic waste contaminating the soil prior to land disposal.	Land disposal, as defined in 40 CFR 268.2, of restricted hazardous soils - **applicable**	40 CFR 268.49(b) TDEC 1200-1-11-.10(3)(j)(2)
Disposal of RCRA wastewaters in an CWA wastewater treatment unit	Are not prohibited, unless the wastes are subject to a specified method of treatment other than DEACT in 40 CFR 268.40, or are D003 reactive cyanide.	Restricted RCRA characteristic hazardous wastewaters managed in a wastewater treatment system which is NPDES permitted - **applicable**	40 CFR 268.1(c)(4)(iv) TDEC 1200-1-11-.10(1)(a)(3)(iv)(IV)
Action-Specific	*Transportation*		
Transportation of hazardous materials	Shall be subject to and must comply with all applicable provisions of the HMTA and HMR at 49 CFR 171-180.	Any person who, under contract with a department or agency of the federal government, transports "in commerce," or causes to be transported or shipped, a hazardous material - **applicable**	49 CFR 171.1(c)
Transportation of hazardous waste off site	Must comply with the generator requirements of 40 CFR 262.20–23 for manifesting, Sect. 262.30 for packaging, Sect. 262.31 for labeling, Sect. 262.32 for marking, Sect. 262.33 for placarding and Sect. 262.40, 262.41(a) for record keeping requirements and Sect. 262.12 to obtain EPA ID number.	Off-site transportation of RCRA hazardous waste – **applicable**	40 CFR 262.10(h) TDEC 1200-1-11-.03(1)(a)(8)
	Must comply with the requirements of 40 CFR 263.11– 263.31.	Transportation of hazardous waste within the United States requiring a manifest – **applicable**	40 CFR 263.10(a) TDEC 1200-1-11-.04(1)(a)(1)
	A transporter who meets all applicable requirements of 49 CFR 171–179 and the requirements of 40 CFR 263.11 and 263.31 will be deemed in compliance with 40 CFR 263.		

TABLE 1
ARARS AND TBC GUIDANCE
DUNN FIELD ROD AMENDMENT
Defense Depot Memphis, Tennessee

Action/medium	Requirements	Prerequisite	Citation(s)
Management of treatability samples (i.e., contaminated soils, wastewaters)	Are not subject to any requirements of 40 CFR Parts 261 through 263, nor are such samples included in the quantity determinations of 40 CFR 261.5 and 262.34(d) when:	Generation of samples of hazardous waste for purpose of conducting treatability studies as defined in 40 CFR 260.10 -**applicable**	40 CFR 261.4(e)(1) TDEC 1200-1-11-.02(1)(d)(5)(i)
	• The sample is being collected and prepared for transportation by the generator or sample collector;		40 CFR 261.4(e)(1)(i) TDEC 1200-1-11-.02(1)(d)(5)(i)(I)
	• The sample is being accumulated or stored by the generator or sample collector prior to transportation to a laboratory or testing facility; or		40 CFR 261.4(e)(1)(ii) TDEC 1200-1-11-.02(1)(d)(5)(i)(II)
	• The sample is being transported to the laboratory or testing facility for purpose of conducting a treatability study.		40 CFR 261.4(e)(1)(iii) TDEC 1200-1-11-.02(1)(d)(5)(i)(III)
Transportation of hazardous waste on site	The generator manifesting requirements of 40 CFR 262.20–262.32(b) do not apply. Generator or transporter must comply with the requirements set forth in 40 CFR 263.30 and 263.31 in the event of a discharge of hazardous waste on a private or public right-of-way.	Transportation of hazardous wastes on a public or private right-of-way within or along the border of contiguous property under the control of the same person, even if such contiguous property is divided by a public or private right-of-way – **applicable**	40 CFR 262.20(f) TDEC 1200-1-11-.03(3)(a)(6)

ARAR = applicable or relevant and appropriate requirement
CFR = Code of Federal Regulations
EPA = U.S. Environmental Protection Agency
NPDES = National Pollutant Discharge Elimination System
CWA = Clean Water Act of 1972
DEACT = deactivation
DOT = U.S. Department of Transportation
HMR = Hazardous Materials Regulations
HMTA = Hazardous Materials Transportation Act
MCLs = Maximum Contaminant Level
MCLG = Maximum Contaminant Level Goals
RCRA = Resource Conservation and Recovery Act of 1976
TBC = to be considered
TCA = Tennessee Code Annotated
TDEC = Tennessee Department of Environment and Conservation
UTS = Universal Treatment Standard

FIGURES

Figure 1

MAJOR FEATURES OF THE DEPOT

DUNN FIELD
ROD AMENDMENT

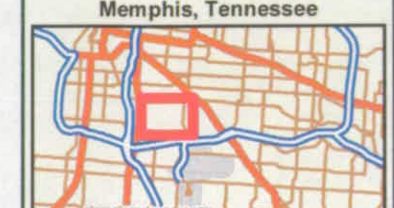
DEFENSE DEPOT
MEMPHIS, TENNESSEE

Projection: NAD 1927 StatePlane Tennessee
Datum : WGS 84
Units: Feet

Aerial Photo Date: 2006

0 250 500 1,000 1,500
Feet

Installation Location
Memphis, Tennessee



Date: January 2009
Edition: Rev. 3

Figure 2

AREA DESIGNATIONS AT DUNN FIELD

DUNN FIELD
ROD AMENDMENT

DEFENSE DEPOT
MEMPHIS, TENNESSEE

Projection: NAD 1927 StatePlane Tennessee
Units: Feet

Aerial Photo Date: 2006

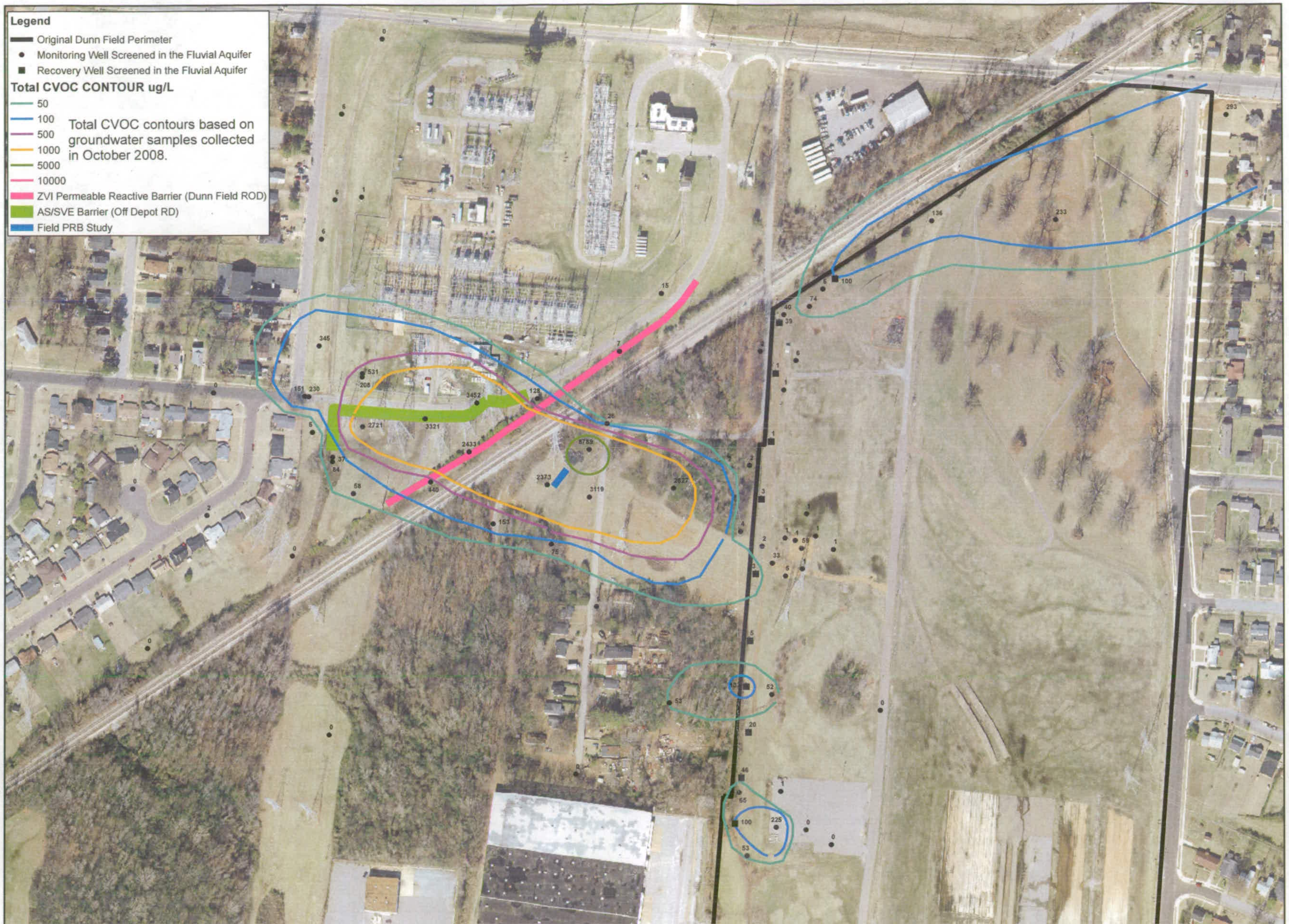


Figure 3

OFF DEPOT GROUNDWATER REMEDY

DUNN FIELD
ROD AMENDMENT

DEFENSE DEPOT
MEMPHIS, TENNESSEE

Projection: NAD 1927 StatePlane Tennessee
Units: Feet

0 125 250 500
Feet

Date: January 2009
Edition: Rev. 3

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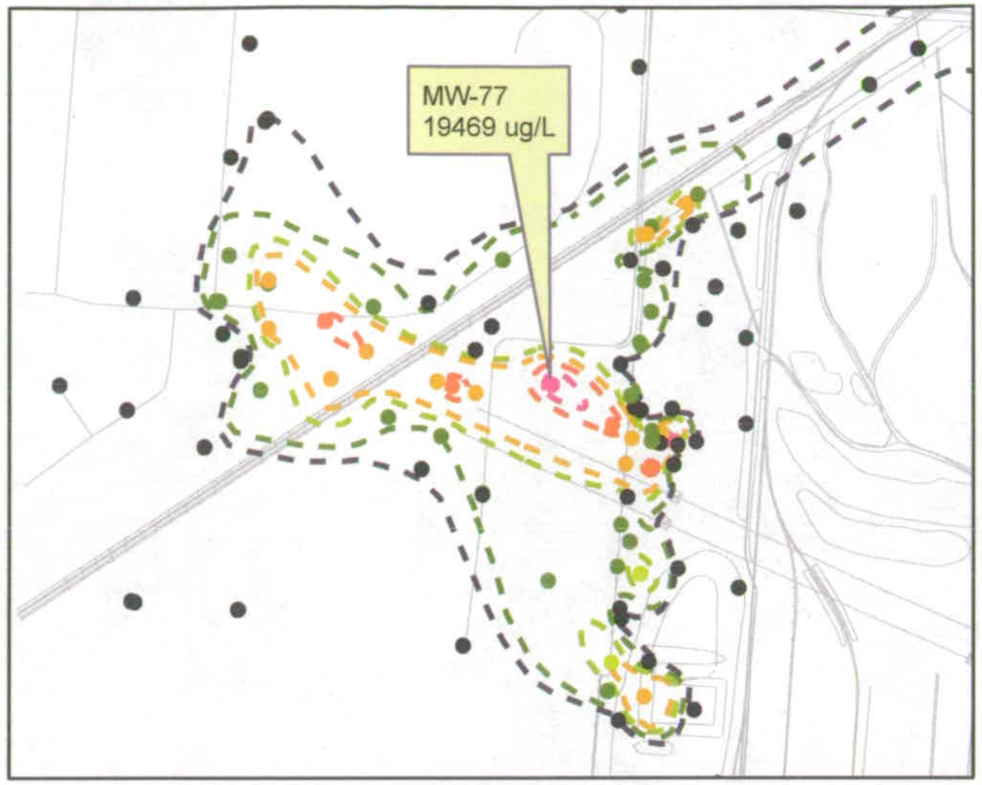
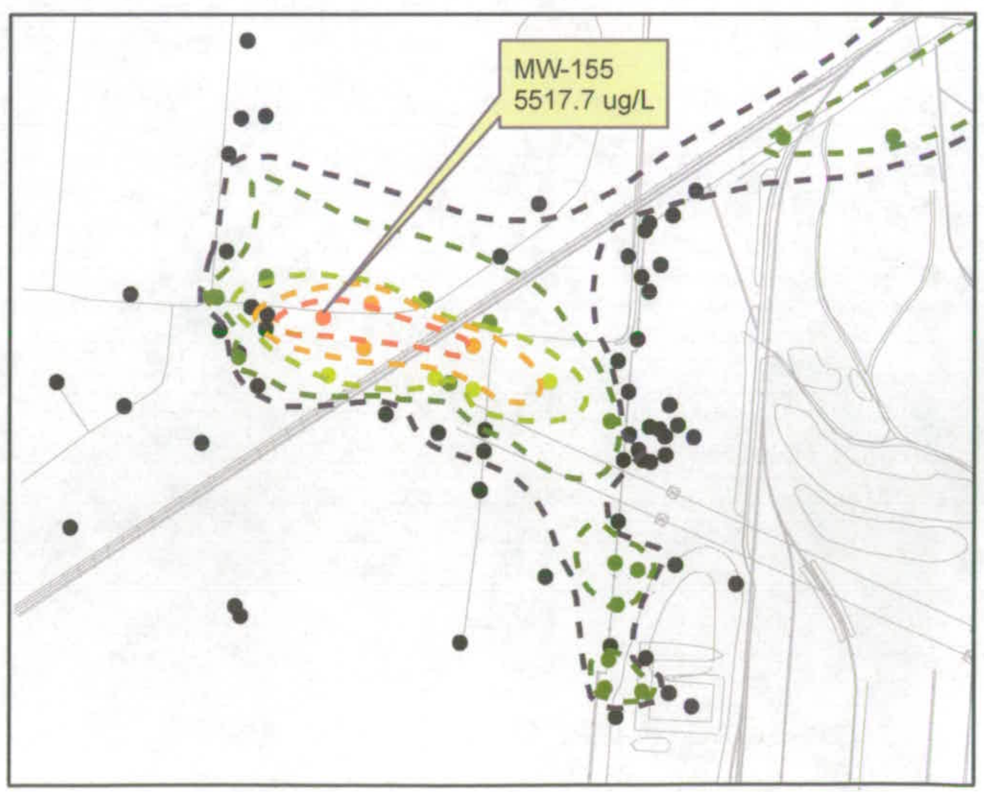


October 2005

October 2007



April 2008

October 2008

N
W E
S

Figure 4

TOTAL CVOC CONCENTRATIONS, TIME TREND

DUNN FIELD
ROD AMENDMENT

DEFENSE DEPOT
MEMPHIS, TENNESSEE

Legend

Total CVOC Isopleth (ug/L)
- 50
- 100
- 500
- 1000
- 5000
- 10000

Total CVOC Ranges (ug/L)
- 0 - 100
- 101 - 500
- 501 - 1000
- 1001 - 5000
- 5001 - 10000
- 10001 - 50000

Notes:
1. Highest concentration at well pairs used for contour.
2. Total CVOCs include: CT, CF, DCE, cDCE, tDCE, TCA, TCE, PCE, PCA and VC.
3. Highest Total CVOC labeled for each event.

Installation Location
Memphis, Tennessee

Date: January 2009
Edition: Rev 3

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N E S W

Figure 5

SOURCE AREAS SUBSURFACE SOIL REMEDY

DUNN FIELD
ROD AMENDMENT

DEFENSE DEPOT
MEMPHIS, TENNESSEE

Projection: NAD 1927 StatePlane Tennessee
Datum : WGS 84
Units: Feet

0 50 100 200 300
Feet

Date: January 2009
Edition: Rev. 3

N
W E
S

Figure 6

SOURCE AREAS GROUNDWATER REMEDY

DUNN FIELD
ROD AMENDMENT

DEFENSE DEPOT
MEMPHIS, TENNESSEE

Projection: NAD 1927 StatePlane Tennessee
Units: Feet

0 125 250 500
Feet

Date: January 2009
Edition: Rev. 3

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FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE