REMEDIAL ACTION WORK PLAN ADDENDUM

Main Installation
Defense Depot Memphis, Tennessee

Prepared for:

Department of the Army

HDR | ONE COMPANY *Many Solutions®*

USACE Contract No. W90FYQ-09-D-0005
Task Order No. DS01

Revision 0
October 2012

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Prepared for:

U.S. Army Corps of Engineers, Tulsa District
Contract No. W90FYQ-09-D-0005
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LIST OF ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
cDCE	cis-1,2-dichloroethene
CF	chloroform
CT	carbon tetrachloride
CVOC	chlorinated volatile organic compound
DCe	dehalococcoides ethogenes
DDMT	Defense Depot Memphis, Tennessee
DO	dissolved oxygen
DQE	data quality evaluation
e^2M	engineering-environmental Management, Inc.
EBT	enhanced bioremediation treatment
gpm	gallons per minute
IAQ	Intermediate Aquifer
IBC	intermediate bulk containers
IDW	investigation-derived waste
IRACR	Interim Remedial Action Completion Report
IW	Injection Well
JRW	JRW Bioremediation, LLC
LTM	Long-Term Monitoring
MACTEC	MACTEC Engineering and Consulting, Inc.
MAQ	Memphis Aquifer
MCL	Maximum Contaminant Level
MFA	metabolic fatty acid
µg/L	micrograms per liter
mg/L	milligrams per liter
MI	Main Installation
MIP	membrane interface probe
MNA	monitored natural attenuation
MS/MSD	matrix spike/matrix spike duplicate
MW	monitoring well
mV	milliVolts
OPS	operating properly and successfully

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

ORP	oxygen reduction potential
PCE	tetrachloroethene
PMW	performance monitoring well
ppm	parts per million
psi	pounds per square inch
PVC	polyvinyl chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RA	Remedial Action
RAO	Remedial Action Objective
RA SAP	Remedial Action Sampling and Analysis Plan
RAWP	Remedial Action Work Plan
RD	Remedial Design
RI	Remedial Investigation
RL	reporting limit
ROD	Record of Decision
SOP	Standard Operating Procedure
TA	treatment area
TCE	trichloroethene
TDEC	Tennessee Department of Environment and Conservation
TEA	terminal electron acceptor
TOC	total organic carbon
USACE	United States Army Corp of Engineers
USEPA	United States Environmental Protection Agency
TTA	target treatment area
VC	vinyl chloride
vcrA	vinyl chloride reductase
VOC	volatile organic compound

1.0 INTRODUCTION

HDR has prepared this Addendum to the *Remedial Action Work Plan, Main Installation, Defense Depot Memphis, Tennessee, Rev. 1* (MI RAWP) (MACTEC Engineering and Consulting, Inc. [MACTEC], 2005a) to describe procedures for a new round of enhanced bioremediation treatment (EBT) on the Main Installation (MI) at Defense Depot Memphis, Tennessee (DDMT). The addendum was prepared for the Office of the Assistant Chief of Staff for Installation Management, Base Realignment and Closure Division (ODB) under Contract No. W90FYQ-09-D-0005, Task Order No. DS01 with the United States Army Corps of Engineers (USACE), Tulsa District.

The selected groundwater remedy for the MI includes EBT for treatment of chlorinated volatile organic compounds (CVOCs), long-term groundwater monitoring (LTM) and land use controls. EBT was initially performed from September 2006 to February 2009. Although the remedial action objective (RAO) of reducing concentrations below maximum contaminant levels (MCLs) was not achieved, CVOC concentrations for parent compounds were reduced over 80 percent in wells with high baseline concentrations. Injections were halted based on the significant reduction in concentrations in the EBT areas, the lack of significant source areas in soil and the presence of similar low-level tetrachloroethene (PCE) concentrations in other groundwater plumes downgradient of the treatment areas (TAs).

The *Main Installation Interim Remedial Action Completion Report, Rev. 1* (MI IRACR) (HDR|e^{2}M, 2010a), including an Operating Properly and Successfully (OPS) determination, was submitted to the United States Environmental Protection Agency (USEPA) Region 4 and the Tennessee Department of Environment and Conservation (TDEC) in February 2010. The OPS determination and the IRACR were approved by USEPA in March 2010.

Based on rebound in CVOC concentration in the fluvial aquifer and the presence of CVOCs in the deeper intermediate aquifer, ODB has determined additional EBT should be performed. This addendum to the MI RAWP summarizes the selected remedy and the procedures followed during the initial round of EBT in 2006-2009, and presents the plan for injections and performance monitoring in this additional round of EBT.

1.1 SITE DESCRIPTION

DDMT is located in southeastern Memphis, Shelby County, Tennessee approximately 5 miles east of the Mississippi River and 1 mile north of Memphis International Airport (Figure 1). The property consists of approximately 632 acres and includes two components: the MI and Dunn Field. The MI contains approximately 567 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 65 acres with former mineral storage and waste disposal areas. Operations ended in 1997 when DDMT was closed under Base Realignment and Closure.

DDMT was activated in January 1942 as the Memphis General Depot to provide stock control, storage and maintenance services. From 1963 until closure, the facility was a principal distribution center under the Defense Logistics Agency for shipping and receiving a variety of materials including hazardous substances; textile products; food products; electronic equipment; construction materials; and industrial, medical, and general supplies. Activities at the MI resulted in contaminants being present in surface soil, surface water, sediment, and groundwater. In October 1992, USEPA added DDMT to the National Priorities List under site identification number TN 4210020570.

1.2 HYDROGEOLOGY

The geologic units of interest, beginning at ground surface, are: loess, including surface soil; fluvial deposits; Jackson Formation/Upper Claiborne Group; and Memphis Sand. The uppermost aquifer is the unconfined fluvial aquifer, which consists of saturated sands and gravelly sands in the lower portion of the fluvial deposits. The fluvial aquifer is not a drinking water source for area residents.

The top of the uppermost clay in the Jackson Formation/Upper Claiborne Group forms the base of the fluvial aquifer effecting the saturated thickness and groundwater flow on the MI. A gap (or ‘window’) in the uppermost clay in the northwestern portion of the MI creates a connection to the underlying intermediate aquifer (IAQ) and the Memphis Aquifer (MAQ), which provides the City of Memphis with the majority of its drinking water.

General site hydrogeology is shown by the top of clay contour map on Figure 2, the groundwater elevation contour map on Figure 3 and the lithologic cross-section on Figure 4. The top of clay contour map (Figure 2) shows the gap in the upper clay in the northwestern MI and the increasing depth of the clay in the central MI. The groundwater elevation contours (Figure 3) shows the gradient toward the window from the northeast and southwest; groundwater in the south-central MI has a slight gradient off-site to the south. The cross-section (Figure 4) shows the increase in saturated thickness in the central MI. Where the upper clay is absent, the sand and gravel of the fluvial aquifer and the fine sand of the IAQ act as a single water table aquifer. Where the upper clay is present, as in the northern portion of the cross-section, the water levels in the two units diverge and the downward gradient in the IAQ is observed. This cross-section illustrates the configuration of the different aquifer and aquitard layers, and the conceptual model of shallow fluvial aquifer groundwater moving below the aquitard separating the fluvial and intermediate aquifers and into the IAQ.

1.3 REMEDIAL ACTION

1.3.1 Selected Remedy

The *Main Installation Final Record of Decision* (MI ROD) (CH2M HILL, 2001) received final approval in September 2001. The MI ROD specified the RAOs that the selected remedy was expected to meet in order to protect human health and the environment. The groundwater RAOs are to:

- prevent human ingestion of water contaminated with volatile organic compounds (VOCs) in excess of MCLs from potential future onsite wells;
- reduce concentrations of chemicals of concern to MCLs or lower; and
- prevent horizontal and vertical offsite migration of groundwater contaminants in excess of MCLs.

The selected remedy for groundwater is:

- enhanced bioremediation of CVOCs in the most contaminated part of the groundwater plume;
- LTM to document changes in plume concentrations and to detect potential plume migration to off-site areas or into deeper aquifers; and
- deed restrictions and site controls to prevent production/consumptive use of groundwater, and drilling into deeper aquifers on the MI.

The *Main Installation Final Remedial Design* (MI RD) (CH2M HILL, 2004) was approved by USEPA in August 2004. During development of the MI RD, an EBT treatability study was performed with different electron donors (vegetable oil emulsion and sodium lactate solution) injected into the fluvial aquifer in two separate areas. Based on study results, sodium lactate was chosen for injection in two target treatment areas (TTA) where groundwater concentrations of PCE, trichloroethene (TCE) and carbon tetrachloride (CT) exceeded 100 micrograms per liter (µg/L). Other design specification addressed well spacing, screen lengths, injection solution concentrations, injection volume, and injection interval. The MI RD also included an LTM plan and a Land Use Control Implementation Plan.

The MI RAWP was prepared to guide implementation of the MI RD and was approved by USEPA in September 2005. The MI RAWP referenced the *Remedial Action Sampling and Analysis Plan* (RA SAP) (MACTEC, 2005b) which documented procedures for field and laboratory activities during the remedial action (RA).

1.3.2 EBT System Construction and Past Operations

EBT system construction included installation of 49 4-inch diameter injection wells (IWs) and 30 2-inch diameter performance monitoring wells (PMWs) in TTA-1 and TTA-2, and construction of the lactate-storage and transfer facility and two trailer-mounted injection systems. Construction was completed in August 2006. A baseline monitoring event was completed and the initial lactate injection was made in September 2006.

Sodium lactate was injected bi-weekly and then monthly from September 2006 through February 2009. Performance monitoring was conducted quarterly from October 2006 through March 2009. System operations and monitoring results were described in annual reports. CVOC concentrations for parent compounds (PCE, TCE, CT and chloroform [CF]) were reduced over 90 percent in IWs and over 80 percent in monitoring wells (MWs) at locations with baseline concentrations above 100 µg/L.

1.3.2.1 EBT Operations

Sodium lactate was injected using the 49 IWs biweekly during Year One (September 2006 through August 2007) and monthly during Year Two (September 2007 through February 2009). The injection process is summarized below with the modifications implemented:

- Field Measurements
  - Dissolved oxygen (DO), oxidation reduction potential (ORP), pH, temperature, and conductivity were measured in all injection and performance monitoring prior to each injections event.
- Injection Solution
  - The solution was mixed in the two trailer-mounted 500-gallon storage tanks. A 2.16 percent sodium lactate injection solution was created using 18 gallons of 60 percent sodium lactate and 482 gallons of potable water.
  - Beginning with Injection 13 in February 2007, one pound of sugar was added during mixing of each tank of lactate solution in order to remove DO near the well bore and to improve molecular oxygen removal. Lactate is a preferred substrate for anaerobic bacteria. However, other substrates such as starch or sucrose are preferred for aerobic or nitrate-reducing microorganisms.
  - Beginning with Injection 37 in July 2008, the baseline percentage of lactate in the solution was increased from 2.2 percent to 4.3 percent (36 gallons of sodium lactate concentrate and 464 gallons of water). The change was made because ORP measurements increased and total organic carbon (TOC) concentrations decreased after monthly injections began in September

2007. Prior to the initial event in July 2008, ORP and TOC concentration trends were reviewed, and wells with low TOC, high ORP or no indication of reductive dechlorination had an 8.6 percent solution injected. In following monthly injections, wells with an ORP greater than - 100 received a solution with double the previous month's sodium lactate concentration and wells with an ORP less than -250 received half the previous month's concentration, except that the concentration did not go below 4.3 percent.

- Also beginning with Injection 37, two pounds of cellulose was added to each 500-gallon tank to provide a slower acting carbon source and to increase the microbial population used for reductive dechlorination.

- Well Injections
  - Initial injection volumes at each well were 167 gallons at TTA-1 North (IW-21 wells), 250 gallons at TTA-1 South (IW-101 wells) and 110 gallons at TTA-2 (IW85 and IW92 wells).
  - In order to speed the injection process, the injection flow rate was increased from 10 gallons per minute (gpm) to 30 gpm, with a maximum hose pressure of 35 pounds per square inch (psi). This was begun with Injection 1 in September 2006.
  - The injection volume in the MW-21 area of TTA-1 was increased due to the lack of response observed in the monitoring wells in that area. The volume per well was increased from 167 gallons to 250 gallons during Injection 13 and then increased to 500 gallons per well during Injection 19 in May 2007.
  - Beginning with Injection 34 in April 2008, injections were made in nine selected monitoring wells to increase the area being treated. The target injection volumes were generally the same as nearby IWs, although the injection flow rate was reduced, where necessary.
  - The injections in TTA-2 were increased to 250 gallons per well for Injection 37 in July 2008; the volumes for IWs were decreased to 167 gallons per well in following monthly injections, but the volumes were maintained at 250 gallons per well in the TTA-2 monitoring wells receiving injections.
- Bioaugmentation
  - Beginning with Injection 38 in August 2008, bacterial consortia developed by AR Environmental was added to each well to increase the biodegradation of the parent compounds and daughter products. Four gallons of bacterial suspension were poured into each injection point (IWs and selected MWs) immediately before the lactate solution was injected during Injections 38 and 39 (August and September). One gallon of bacterial suspension was added to each well before Injections 40 and 41 (October and November).

EBT injections for Year 2 are summarized on Table 1. Injections were made in 49 to 58 wells with sodium lactate concentrations of 2.2 to 17.2 percent. The average solution volume injected per well was 275 gallons at 4.6 percent sodium lactate, or 7.6 percent sodium lactate concentrate (60%).

1.3.2.2 Performance Monitoring

Performance monitoring consisted of field measurements prior to each injection and quarterly groundwater sampling of IWs and PMWs for laboratory analysis. Monitoring was performed to evaluate success in establishment and maintenance of anaerobic conditions within the fluvial aquifer in the EBT zones, and subsequent decrease in VOC concentrations through reductive dechlorination. The EBT groundwater monitoring network consisted of 49 IWs and 38 PMWs, which included 30 PMWs installed for EBT and 8 existing LTM wells within the TTAs. Groundwater samples were collected using low-flow purging methods with polyvinyl chloride (PVC) or stainless steel bladder pumps. When groundwater samples were collected, the field measurements were used to confirm stabilization prior to sampling; the injections were made after sampling was completed.

Year One groundwater samples were collected during the baseline event (August 2006), and four quarterly events, EBT-1 through EBT-4, in December 2006, March, June and September 2007. The Year One samples were analyzed for VOCs and monitored natural attenuation (MNA) parameters; the MNA parameters were anions (bromide, chloride, nitrate, nitrite, sulfate, and sulfide), alkalinity, TOC, metabolic fatty acids (MFAs), dissolved gases (carbon dioxide, ethane, ethene and methane), hydrogen and metals (arsenic, manganese, and selenium).

Year Two groundwater samples were collected during five quarterly events, EBT-5 through EBT-9, in December 2007; March, June and December 2008; and March 2009. Samples were not collected in September 2008 in order to extend the monitoring period and observe the effect of changes to injection procedures. The Year Two samples were analyzed for VOCs, TOC, MFAs, and dissolved gases. The Year Two analyses omitted some MNA parameters (anions, alkalinity, metals, hydrogen) because there was either little difference in these parameters at locations where reductive dechlorination was active or not active, or the necessary information was provided by the remaining analyses. Review of the data suggested that reductive dechlorination was generally occurring where TOC was above 40 to 50 milligrams per liter (mg/L). Methane and carbon dioxide were useful as direct indicators of microbial growth, and ethene and ethane were included in the same analysis. MFAs provided supporting information for TOC in regard to microbial activity.

1.3.2.3 Performance Monitoring Results

Anaerobic aquifer conditions were created within the EBT zones where lactate was present and the areas expanded during operations, except that anaerobic conditions in the MW-21 area were generally limited to the IWs. The pre-injection ORP measurements for Year Two (Injections 27 through 44) were summarized separately for IWs and MWs in each TA in MI IRACR Tables 4, 5 and 6, which are included in Appendix A. The dominant terminal electron acceptor in a well for each measurement is denoted on the tables by clear, yellow, green, orange and red shading of data points denoting oxygen, nitrate, iron, sulfate and carbon dioxide (methanogenic), respectively.

Concentrations of PCE and TCE in groundwater began to decrease shortly after injections began. The results for the baseline and Year Two sample events were shown by area on MI IRACR Tables 7, 8 and 9 (Appendix A). PCE and TCE concentrations decreased in all areas, even where anaerobic conditions were not widespread, although decreases were greater where there was demonstrated creation of anaerobic conditions. Concentrations of cis-1,2-dichloroethene (cDCE), a product of the reductive dechlorination of PCE and TCE, increased in the EBT zones. CVOC concentrations for parent compounds (PCE, TCE, CT and CF) were reduced over 90 percent in IWs and over 80 percent in PMWs at locations with baseline concentrations above 100 µg/L.

The maximum, minimum and average concentrations from the Baseline and EBT-9 samples for PCE, TCE and cDCE in all three areas, and for CT and CF in TTA-2 were shown on MI IRACR Table 10 (Appendix A). In all three areas, maximum and average concentrations decreased for PCE and TCE and increased for cDCE. In TTA-2, average concentrations decreased for CT and CF. Average concentrations over all areas for PCE decreased 94% in IWs and 67% for PMWs, while TCE decreased 85% in IWs and 69% for PMWs. Average concentrations in TTA-2 for CT decreased 98% in IWs and 62% for PMWs, while CF decreased 65% in IWs and 68% for PMWs.

Although cDCE concentrations increased significantly in the EBT areas, the analytical results did not indicate a widespread build-up above MCLs in the fluvial aquifer. Only six PMWs exceeded the MCL for cDCE during EBT-9. Vinyl chloride (VC), the final CVOC in the reductive dechlorination sequence for PCE and TCE, was rarely detected above the reporting limit (RL) in performance monitoring samples.

1.3.3 Long Term Monitoring

MI LTM is conducted to evaluate progress in meeting the RAOs to restore groundwater to concentrations at or less than MCLs and to prevent contaminant migration horizontally and vertically offsite at concentrations in excess of MCLs. MI LTM has been performed since 2004 in accordance with the LTM

Plan. Recommendations for changes to LTM wells and sample frequency are made in annual LTM reports.

There are currently 112 MI LTM wells classified as background (6 wells), boundary (7 wells), performance (72 wells) and sentinel (24 wells). Three new wells installed in March 2012 have not been classified and their sample frequency will be determined after four semiannual sample events. The remaining 109 wells have the following sample frequency: biennial (15 wells), annual (26 wells) and semiannual (68 wells). The MI LTM well locations are shown on Figure 5.

1.3.3.1 Groundwater Plumes

Groundwater contamination at the MI is considered to result from releases at various locations. LTM results have identified six groundwater plumes although there is some mixing of the plumes. Concentrations of PCE, TCE and CT from April 2012 are shown and contoured on Figures 6, 7 and 8 respectively; the plumes are identified on the figures. Detailed soil investigations did not identify source areas with concentrations warranting RA to reduce groundwater impacts. The primary CVOCs and the maximum concentrations from the April 2012 LTM event for each plume are listed below.

Plume	Parent CVOCs: April 2012 Maximum Concentration
TTA-1 North	PCE: 88 µg/L at MW-21
TTA-1 South	PCE: 161 µg/L at DR1-6 and TCE: 154 µg/L at DR1-6A
TTA-2	PCE: 150 µg/L at MW-113 and CT: 219 µg/L at DR2-5
West-Central	PCE: 127 µg/L at MW-203A
Bldg 835	TCE: 185 µg/L at MW-62
North-Central	TCE: 57.7 µg/L at MW-258

The TTA-1 North plume is located near the central section of Building 1089 and north of former Buildings 1084 and 1085. The depth of water is approximately 90 feet below ground surface (bgs) and the average saturated thickness is 26 feet.

The TTA-1 South plume is located a few hundred feet southeast of TTA-1 North, on the west side of Building 1088 and the southern section of Building 972. Wells in the southern area have high TCE concentrations and moderate PCE concentrations while those in the northern area have high PCE concentrations and low TCE concentrations. The depth of water is approximately 90 feet bgs and the average saturated thickness is 36 feet.

The TTA-2 plume is an irregularly shaped area with elevated concentrations of PCE, TCE, CT and CF. PCE concentrations are elevated throughout most of the plume area, while CT concentrations are primarily in the northwestern plume area (near Buildings 260, 261 and 263). The depth of water is approximately 93 feet bgs and the average saturated thickness is 9 feet.

The West-Central plume is a broad area of elevated PCE concentrations in groundwater approximately 1500 feet northeast of TTA-1. The eastern end of the plume is at the former location of Buildings 873 and 875 and the central area is near Building 770. The depth of water is approximately 100 feet bgs and the saturated thickness ranges from 7 to 94 feet with an average of 48 feet.

The Building 835 plume located in the western portion of the MI contains elevated concentrations of TCE. The plume is orientated along the southern edge of the elevated clay plateau that is present in the northwest corner of the MI. The depth of water is approximately 94 feet bgs and the average saturated thickness is 6 feet.

The North-Central plume is located in the northeastern portion of the MI and contains slightly elevated concentrations of TCE. Recently installed MW-258, extended the plume to the southwest. The depth of water is approximately 66 feet bgs and the average saturated thickness is 23 feet.

1.3.3.2 LTM Findings

The LTM results have shown the effects of EBT outside the TTAs, the rebound of CVOCs after injections were halted and the extent of CVOC plumes. LTM findings relevant to additional EBT are discussed below. Additional information is available in the annual reports: *Annual Long-Term Monitoring Report-2009, Main Installation Rev.0* (HDR|e²M, 2010b); *Annual Long-Term Monitoring Report-2010, Main Installation Rev.0* (HDR, 2011); and *Main Installation, Annual Long-Term Monitoring Report-2011, Rev.1* (HDR, 2012a). Plume maps from April 2012 are shown on Figures 6 to 8.

The 2009 LTM report noted the appearance of cDCE at wells in the West-central plume indicated EBT effects in wells up to 2,000 feet from TTA-1 were occurring sooner than expected based on reported groundwater velocity. The groundwater flow velocity based on the average hydraulic conductivity (33 feet/day) and the porosity (30%) stated in the MI RD and the measured groundwater gradient (0.003) was 0.3 feet/day. The appearance of cDCE and/or a significant decrease in PCE concentration at wells in the West-central plume was noted and the travel time determined from the start of EBT injections in

September 2006. The travel time and distance of the impacted wells from MW-100B indicated groundwater velocity of 2 to 4 feet/day.

The 2009 and 2010 LTM reports reviewed VC concentrations in LTM wells. VC is the final CVOC in the reductive dechlorination sequence for PCE and TCE and was rarely detected above the RL in either EBT samples or LTM samples prior to 2009. In 2009-2011, VC was detected in up to seven LTM wells; concentrations in MW-86 and MW-100B near the TTAs were up to 180 µg/L, while concentrations in other wells at distances up to 1500 feet from the TTAs were less than 10 µg/L and generally near the MCL (2 µg/L). Concentrations of both cDCE and VC decreased after reaching a peak concentration (except at MW-100B), indicating that the contaminants will not create a long-term impact to groundwater quality. Trend plots for all CVOCs detected above MCLs are presented in the annual LTM reports.

The findings from installation of additional deep monitoring wells downgradient of the ‘window’ were presented in the 2010 LTM report. The hydrogeologic data for the new deep wells supported the conceptual model of a connection between the fluvial and deeper aquifers and indicated the IAQ and MAQ wells were appropriately located to serve as sentinel wells for vertical migration of contaminants. The analytical results were consistent with the groundwater modeling, which indicated the potential for low CVOC concentrations in the IAQ and MAQ at the MI. The results did not indicate significant impact to the MAQ.

The LTM reports also noted rebound in concentrations of parent compounds in TTA-1 and TTA-2. The 2011 samples in nine LTM wells within the former EBT areas had PCE concentrations at 20% to 60% of the baseline concentrations (August 2006) in six wells, and near or above baseline concentrations at three wells.

In 2009, PCE concentrations decreased in MW-208A and MW-90, the West-central plume and Sentinel wells with the highest concentrations; concentrations in these wells remained at reduced levels in 2010 and 2011. Trend analyses in the 2011 LTM report showed PCE concentrations in most West-central plume wells had decreasing trends, but many Sentinel wells had increasing trends. PCE concentrations in sentinel well MW-202B, within the window and downgradient of MW-90, have increased steadily to 27.1 µg/L in October 2011 and PCE concentrations in well MW-256, further downgradient, have increased to 20 µg/L since installation in 2010. However, the increased concentrations in these IAQ wells have not resulted in increased impacts to the MAQ. Individual CVOC concentrations in the two MAQ wells, MW-254 and MW-255, remained at concentrations from non-detect to near 2 µg/L. To the extent that concentrations continue to decrease in the West-central wells, concentrations in downgradient Sentinel wells should also decrease.

1.3.4 Contingency Actions

The MI ROD stated the groundwater remedy included contingency provisions to ensure that if groundwater concentrations exceed MCLs at the boundary wells or the interior sentinel wells, more active plume control would be evaluated and implemented as needed. The MI RD identified several contingencies that would be deviations from the expected conditions during the RA; general responses were identified for these conditions. Two specific deviations to the expected conditions were observed during RA:

- Contaminants of concern were detected above MCLs in sentinel wells, with the highest concentration in MW-90; this condition was noted in the RD.
- Additional source areas/plumes were identified on the MI, primarily the West-central and Building 835 plumes.

An investigation was performed to evaluate the need for additional plume control including remediation of potential source areas for the observed groundwater plumes. The initial phase was the *Main Installation Source Area Evaluation* (engineering-environmental Management, Inc. [e^2M], 2008). Sites identified during the Remedial Investigation (RI) (Screening Sites, RI Sites and Early Removal Sites) and soil sample results were compared with plume locations based on the CVOC isopleths. There was little direct correlation between identified sites and soil sample analyses with the identified plumes.

A field investigation was then performed with sample grids overlaying the upgradient areas of the plumes. The magnitude and extent of elevated CVOCs in soil was characterized using a membrane interface probe (MIP) system and confirmation soil samples selected to represent the full range of MIP responses. While the investigation identified potential sources for each of the groundwater plumes, the low CVOC concentrations did not warrant RA.

Groundwater modeling was performed to investigate potential water quality impacts to the MAQ that may occur due to vertical transport of CVOC contamination from the overlying fluvial aquifer. The model included conservative assumptions for total CVOC mass and transport to the MAQ that would overestimate plume migration into the window. In addition, trends for CVOC concentrations in monitoring wells were reviewed. The groundwater modeling and trend analysis indicated active groundwater treatment was not necessary.

The field investigation, groundwater monitoring and trend analysis were presented in *Main Installation Source Area Investigation* (e^2M, 2009). The report concluded that RA was not necessary in the West-central or Building 835 plumes.

Additional monitoring wells in the IAQ and in the upper portion of the MAQ were installed in 2010 to support the groundwater model results. As noted in Section 1.3.3.2, the hydrogeologic data from the new wells supported the conceptual model of a connection between the fluvial and deeper aquifers and the analytical results were consistent with the groundwater modeling, which indicated the potential for low CVOC concentrations in the IAQ and MAQ at the MI.

1.3.5 Baseline Sample Event and Well Abandonment

EBT components were planned to be removed following a period of monitoring after the last injection in February 2009. System removal and well abandonment were not performed because of rebound in CVOC concentrations observed in LTM samples. New baseline groundwater samples were collected from IWs and PMWs in December 2011 (EBT-10) to further evaluate rebound in the TTAs. Sample results were presented in a memorandum, *December 2011 Baseline Samples for the Enhanced Bioremediation Treatment System*, submitted to USEPA and TDEC in February 2012.

The sample results indicated rebound in concentrations of parent compounds, with increasing concentrations of PCE in all areas, TCE in TTA-1S and CT in TTA-2. Concentrations had returned to pre-EBT baseline levels throughout TTA-1N. Concentrations in TTA-1S and TTA-2 averaged approximately one-third of pre-EBT baseline levels.

While EBT will be performed in the TTAs and elsewhere on the MI, all of the existing IWs and PMWs are not required. Fewer IWs are required because performance monitoring and LTM results have shown significant migration and diffusion of carbon source material downgradient of the TTAs. Higher concentrations of sodium lactate in the injection solution can be used to provide an equivalent mass of carbon through fewer wells and less frequent injections. Based on past EBT results, performance monitoring in the TTAs can also be limited with overall progress toward RAOs evaluated through LTM outside the TAs.

Recommendations for wells to be used for EBT injections and performance monitoring and for abandonment of selected EBT wells were provided in the baseline samples memorandum. Following consultation with USEPA and TDEC, 20 IWs and 11 PMWs were abandoned in June 2012.

2.0 ADDITIONAL EBT

Additional EBT is planned to improve progress toward groundwater RAOs. EBT will be performed in areas where individual CVOC concentrations of parent compounds (PCE, TCE and CT) exceed 100 µg/L, TTA-1, TTA-2, the West-Central plume and the Bldg 835 plume.

Performance monitoring and LTM results showed significant migration and diffusion of carbon source material downgradient of the TAs, therefore fewer IWs will be used and injections will be made quarterly. Installation of additional IWs is not planned, but selected monitoring wells will be used to increase the TAs. Higher concentrations of sodium lactate in the injection solution will be used to provide an equivalent mass of carbon.

Performance monitoring results presented in the IRACR, including the OPS demonstration, showed that sodium lactate injections could effectively reduce CVOC concentrations at the MI. Performance monitoring will be conducted at fewer locations within the EBT injection areas. Monitoring will be performed to demonstrate anaerobic conditions, distribution of sodium lactate and reductive dechlorination through field measurements and laboratory analyses. Overall success of EBT and progress toward the RAOs will be evaluated through LTM.

2.1 SYSTEM COMPONENTS

2.1.1 Lactate Storage and Transfer Facility

Building 265 at DDMT was renovated in 2006 for storage and transfer of sodium lactate by Jones Brothers of Memphis. As-built drawings for the lactate transfer system are included in Appendix B. Sodium lactate solution is received in 265-gallon intermediate bulk containers (IBCs) and pumped through a metered system into the 500-gallon tank on the injection trailer where it is mixed with water to meet the desired concentration. The facility includes:

- Curbing and ramp for storage and transfer area.
- Lactate transfer system with drum pump for containers (IBCs), flow meter, batch controller and piping.
- Potable water line with backflow preventer, flow meter, batch controller and piping.

The transfer system components (drum pump, flow meter and batch controller) were tested by the HDR site technician in 2012 and minor repairs were made.

2.1.2 Trailer-Mounted Injection System

Two injection trailers were constructed by INTEX Environmental Group and delivered to DDMT in July 2006. The as-built drawing for the trailers is included in Appendix B. The trailer components include:

- 500-gallon polyethylene storage tank with top-mounted ports for sodium lactate and potable water, a mixer and an air vent, and a discharge port on the bottom of the tank side.
- Manually operated, electrically powered mixer.
- Transfer pump rated at 20 gpm at 50 psi.
- Gas-powered generator to power the mixer and transfer pump
- 50-foot flexible Teflon discharge hose with stainless steel braided cover with cam-lock fitting compatible with injection wellheads
- Pressure gauge and flow meter.

An INTEX field engineer evaluated and made necessary repairs to the trailers in January 2012.

2.1.3 Injection and Performance Monitoring Wells

Following abandonment of selected IWs and PMWs in June 2012, there are 30 4-inch IWs remaining to be used for EBT injections. To expand the TAs, 15 2-inch monitoring wells previously used as PMWs or LTM wells will be used for injections. In addition, 13 2-inch monitoring wells will be used as PMWs. The remaining wells on the MI will be used for LTM. The IWs and PMWs to be used for the additional EBT are listed on Table 2; the well installation data are listed on Table 3 for IWs and on Table 4 for PMWs. The well locations are shown for TTA-1 on Figure 9, TTA-2 on Figure 10, West-Central plume on Figure 11 and Building 835 plume on Figure 12.

2.1.4 Sodium Lactate Solution

During the initial round of EBT, a 60% sodium lactate concentrate was mixed with potable water to create the injection solution; table sugar and a cellulose mixture were added to increase the microbial population. The sodium lactate concentration in the injected solution varied from 2% to 17%. The sodium lactate concentrate was purchased from JRW Bioremediation, LLC (JRW) under the name WILCLEAR®. JRW has since developed and tested a sodium lactate product with a proprietary nutrient blend under the name WILCLEAR PLUS®. The new product has shown improved efficiency in enhancing reductive dechlorination and has been selected for use. Fact sheets for the two products are provided in Appendix B. WILCLEAR PLUS® has a higher viscosity and contains some solids that may prevent use in the 2-inch wells which have 0.010-inch screens. The 4-inch well screens have 0.040-inch screens and are not expected to have a problem passing the new product. During the initial injection event, WILCLEAR PLUS® will be used in the 4-inch IWs and tested in a few 2-inch IWs. The injection solution in the remaining 2-inch IWs will be WILCLEAR® with 1 pound of sugar and 2 pounds of cellulose mixture in each 500-gallon tank. WILCLEAR PLUS® contains 61% fermentable material compared to 48% fermentable material in WILCLEAR®.

The initial injection solution will be equivalent to 15% sodium lactate (25% sodium lactate concentrate [60%]) with 125 gallons of WILCLEAR® or 100 gallons of WILCLEAR PLUS® in each 500 gallon tank of injection solution. Each IW will receive 250 gallons of injection solution. The IWs and volumes are listed on Table 5; changes to the lactate concentrations and injection volumes will be evaluated based on field measurements prior to subsequent injections.

2.2 EBT INJECTIONS AND MONITORING

The initial round of injections will be made in November 2012 and injections will be quarterly thereafter. The injection events will be numbered sequentially with the previous injections; the initial event will be I-45. The initial performance monitoring will be conducted in February 2013, prior to the second round of injections. The performance monitoring events will continue the sample event identification from the initial EBT; the February 2013 event will be EBT-11. One year of injections and monitoring has been approved by ODB and an option for a second year has been approved pending funding.

Performance monitoring, including field measurements and sampling for laboratory analyses will be performed immediately prior to each quarterly injection event, except for the initial event. The field measurements will be used to adjust solution concentrations and volumes in the following injection event. The laboratory analytical results will be used to evaluate the effectiveness of previous injections within the TAs. A final round of field measurements and groundwater samples will be made three months after the final injection.

Health and safety during injection and monitoring activities will be monitored in accordance with the current *Site Safety and Health Plan for Defense Depot Memphis Tennessee, Rev. 0* (HDR, 2012c).

2.2.1 EBT Injection Summary

Procedures will follow the same general approach developed in Year 2 of the initial round of EBT. Each injection event will include the following activities:

- Clear access to injection and performance monitoring well locations.

  - Site managers for Barnhart Crane (David Dingeldein, 901-775-3000) and Memphis Depot Business Park (Anita Bunn, 901-942-4969) will be contacted two weeks prior to the injection event.
- Field measurements and groundwater samples at all injection and performance monitoring wells prior to injections.
  - Field measurements for DO, ORP, pH, temperature, and conductivity.
  - Groundwater samples will be analyzed for VOCs, TOC, MFAs and dissolved gases; analytical methods are listed on Table 6.
- Prepare the sodium lactate injection fluid in the trailer-mounted 500-gallon storage tank.
  - The initial injection mix will be 125 gallons of WILCLEAR® or 100 gallons of WILCLEAR PLUS® with potable water to fill the 500-gallon tank; this will create a 15% sodium lactate injection solution (as determined during the initial EBT injections). One pound of sugar and two pounds of cellulose will be added during mixing for each tank of lactate solution using WILCLEAR®.
  - The volume of concentrate to be injected in each well during subsequent injections will be determined based on pre-injection ORP measurements; the volume will be modified through changes to injection volume or solution concentration. The previous quarter's concentrate volume will be increased in wells with an ORP greater than -100 and decreased in wells with an ORP less than -250, except that the concentration will not go below 5 percent.
- Injection of sodium lactate at designated wells.
  - The initial injection volumes will be 250 gallons per well in all wells and will be re-evaluated prior to following injections.
  - The injection flow rate will be up to 30 gpm, where possible without exceeding hose pressure of 35 psi.

At the completion of each injection event, the injection trailers will be returned to Building 265 and rinsed with potable water to prevent biological growth in the storage tanks or in other components between injection events. Rinse water will be discarded in an adjacent grassed area.

2.2.2 Injection Procedures

The sodium lactate concentrate and potable water hoses will be connected to the appropriate injection ports on top of the storage tank and the digital batch controllers installed at the sodium lactate storage and transfer facility will be used to deliver the proper volumes of concentrate and water to the storage tank. The tank-mounted mixer will be used to blend the tank contents after the tank has been filled with the proper volumes of concentrate and water. A total of approximately 11,250 gallons of injection fluid will be used during the initial injection event requiring the 500-gallon storage tank to be filled 23 times. The form to be completed with each tank is provided on Table C-1.

Injections will be made north-to-south and upgradient-to-downgradient. The sequence in each area is listed below. At well clusters, injections will be made in the well with the shallower screen first.

- TTA-1 North: IW21-01A/B, MW-21, IW21-02 A/B, IW21-03 A/B, IW21-04 A/B, PMW21-04
- TTA-1 South: DR1-5A/5, PMW101-02 A/B, IW101-04A/B/C, IW101-05 A/B/C, IW101-02 A/B/C, IW101-03 A/B/C, IW101-07 A/B/C, DR1-6A/6
- TTA-2: DR2-2, IW92-01, IW92-02, IW92-03, IW92-07, IW92-08, MW-113, DR2-5, IW85-05, IW85-06
- West-Central Plume: MW-203B/A
- Building 835: MW-213, MW-62

The following procedure will be used to inject sodium lactate fluid:

- Before each injection, check the flexible hose connections to the storage tank discharge port, the trailer-mounted injection fluid transfer pump, and the flexible injection fluid delivery hose and tighten loose connections.
- Check the flow meter connection to the flexible injection fluid delivery hose.
- Connect the flexible injection fluid delivery hose to the cam-lock fitting on the IW head.
- Make sure that the isolation ball valve on the storage tank discharge port is closed.
- If necessary, start the truck-mounted generator.
- Open the discharge port ball valve.
- Turn the transfer pump on immediately after the discharge port ball valve is opened.
- Monitor the flow meter.
- Turn the transfer pump off as soon as the proper volume of injection fluid is delivered to the IW.
- Close the discharge port ball valve immediately after the transfer pump is turned off.
- Starting at the connection to the transfer pump, move toward the IW while lifting the flexible injection fluid delivery hose to a height of no less than 3 inches above the hose connection to the transfer pump so that fluid in the hose drains to the IW.

- Disconnect the flexible injection fluid delivery hose from the well head cam-lock fitting.
- Coil the delivery hose and place it on the trailer in a manner such that it will not fall off during movement of the trailer-mounted injection system.
- Turn the trailer-mounted generator off if the trailer-mounted injection system will be moved to the sodium lactate storage and transfer area to mix additional injection fluid, or if the system will be moved to a different injection area.

The form to be completed for each injection is provided on Table C-2.

Spills of sodium lactate injection fluids that occur during injections will be cleaned using absorbent materials. Spent absorbent materials and used towels/rags will be disposed as municipal solid waste.

2.2.3 Performance Monitoring

Monitoring will be performed to evaluate success in expanding anaerobic conditions within the fluvial aquifer in the EBT zones, and decreasing in VOC concentrations through reductive dechlorination. The EBT groundwater monitoring network consists of 45 IWs and 13 PMWs (Table 2); the objective for each PMW is listed on Table 7. Groundwater samples will be collected using low-flow purging methods with PVC or stainless steel bladder pumps; dedicated bladders and tubing will be used at each well. Water levels measurements will be made prior to each sample event. Field measurements and samples will be collected with the pump intake near the mid-point of the saturated screen interval in each well. The samples will be sent to Microbac Laboratories in Marietta, Ohio for VOCs, TOC, dissolved gases and MFAs. The laboratory analytical methods are listed on Table 6.

In addition to the chemical analyses, microbial analyses will be performed to confirm the presence of Dehalococcoides ethogenes (DCe) and to quantify the cellular equivalents present; the confirmation and quantitation are separate analyses. If DCe is present in a sample, secondary analyses will be performed to confirm whether the DCe community includes the vinyl chloride reductase (vcrA) gene and then to quantify the vcrA component. Microbial analyses will be performed on groundwater samples collected in the second and fourth quarterly sample events. Samples will be collected from a subset of EBT wells during each event; the wells will be selected based on the previous quarter analytical results and will be listed in the quarterly report, prior to sampling and analysis. The results will be used to evaluate the need for bioaugmentation. The samples will be analyzed by Microbac Laboratories in Knoxville, Tennessee.

Groundwater sampling and analytical procedures are described in the *Remedial Action Operations and Long Term Monitoring Quality Assurance Project Plan, Rev. 1* (QAPP) (HDR, 2012d). HDR Standard Operating Procedures (SOPs) to be utilized for field activities are listed below:

- SOP 1 General Procedures for Field Personnel
- SOP 3 Groundwater Sampling
- SOP 5 Sample Control and Documentation
- SOP 6 Sample Packing and Shipping
- SOP 7 Equipment Decontamination

Preparations for sampling activities are described in SOP 1. The primary activities are coordination with both field personnel for sampling and the subcontract analytical laboratory. The subcontract analytical laboratory will be notified of the planned sample event, including number of samples and analyses. Sample containers will be scheduled to arrive a few days before sampling begins. Procedures for sample containers and preservation are provided on QAPP Worksheet #19.

Procedures for groundwater sampling are provided in SOP 3. Prior to each EBT sample event, water level measurements will be made in all 58 EBT wells. In addition, the condition of each well will be noted during the water level sweep. Measurements will be taken using Solinst Model 101 water level meters with electronic sensors and tapes graduated in 0.01-foot increments. The water level measuring tape will be decontaminated before use and between wells. The probe will be lowered until an audible tone is heard signaling the water surface. The probe is then withdrawn until the tone stops and then lowered very slowly until the tone is heard and the depth is measured at marked top of casing. This measurement is repeated twice and recorded on the field sheet. The form to be used for water level measurements and well assessments is provided on Table C-3.

Low-flow sampling will be performed by 2-person crews and supervised by the field team leader. Samples will be collected using portable bladder pumps with dedicated Teflon® bladder and Teflon®-lined polyethylene tubing. The pumping rate at the well is set such that the water levels do not decline more than 4 inches (0.1 meter). Water quality parameters are measured at 5 to 10 minute intervals during purging using a flow-through cell. The units are calibrated each morning prior to sampling, and if abnormal readings are observed during the day, the instruments are recalibrated in the field. All measurements will be recorded on the field sampling forms. Purging will continue at the well for up to two hours to meet the stabilization criteria: three successive readings within 0.1 for pH, 10 milliVolts (mV) for ORP, 10 percent for specific conductance, 10 percent for DO and <20 nephelometric turbidity units for turbidity. Temperature will also be recorded but is not used as a stabilization parameter. The samples are collected in preserved 40-milliter vials when stabilization criteria are met or the site manager approves a variance. The form to be used to record water quality measurements is provided on Table C-4.

Where low-flow sampling cannot be used due to small diameter casing, slow recharge or thin saturated layer, samples will be collected by bailer. Samples will be collected after three well volumes are purged from the well or the well is purged dry. Stabilization parameters will be measured using the same instrumentation as for low-flow sampling; a sampling cup will be filled from the bailer and measurements recorded after each well volume. Wells that are purged dry will be sampled after water levels recover and within 24 hours of purging.

During the initial EBT, field measurements for DO were more variable and less useful than ORP measurements. In an attempt to obtain more useful DO results, an additional field measurement will be performed using CHEMetrics colorimetric test kits for two ranges, 1 to 12 parts per million (ppm) using indigo carmine (ASTM D 888-87) and 0 to 1 ppm using Rodazine D™ (ASTM D 5543-09). The tests will be performed on samples collected after the stabilization parameters have been met or three well volumes have been purged if low flow sampling cannot be used.

Procedures for decontamination of sampling equipment are provided in SOP 7. Field equipment that may become contaminated as a result of field sampling activities will be cleaned prior to use. Equipment rinsate samples will be collected to evaluate decontamination procedures.

Quality control (QC) samples are discussed in Section 2.4 of the QAPP. Field QC samples will be collected during each sampling event, including duplicates and matrix spikes/matrix spike duplicates (MS/MSD). One duplicate will be collected for approximately every 10 samples (10%) and 1 MS/MSD will be collected for every 20 samples (5%). Trip blanks will be included in coolers delivered from the laboratory. Laboratory quality assurance (QA)/QC samples included surrogate spikes, method blanks, laboratory control samples, in addition to MS/MSD analysis. The QC samples to be collected during each event are listed on Table 6.

Procedures for sample control and shipping are provided in SOPs 5 and 6. Sample documentation is completed in the field to ensure that the samples collected, labels, chain-of-custody, and request for analysis are in agreement. Custody seals are placed on each cooler before shipment by common carrier. Samples are typically shipped the day collected for overnight delivery to the laboratory.

Data quality evaluation (DQE) will be performed to evaluate the analytical data in accordance with procedures in SOP 8. Level III DQE of laboratory analytical results will be conducted following each sampling event to ensure the data are satisfactory and defensible and to validate the precision and accuracy of the data. The analytical results will be flagged as usable, usable with qualification, or unusable in accordance with the criteria stated in the RA SAP for each analytical method performed. The final qualified results will be incorporated into the project database. Laboratory QC data and the DQE narratives will be included in the annual report.

2.2.4 Performance Metrics

The MI RAWP identified specific metrics for anaerobic aquifer conditions:

- ORP: Sustained in the range of -50 mV to – 200 mV to promote conditions favorable for reductive dechlorination and less favorable for methanogenesis
- DO: Sustained at concentrations less than 1 mg/L
- pH: Sustained between 6 and 8 standard units

ORP**:** The dominant terminal electron acceptor (TEA) in a well is denoted by blue, yellow, green, orange and red shading of data points denoting oxygen, nitrate, iron, sulfate and carbon dioxide (methanogenic), respectively. The following assumptions are made:

1) Aerobic conditions are represented by an ORP of 200 mV or higher.
2) Nitrate reduction is the dominant TEA process from 200 to -50 mV.
3) Iron reduction is the dominant TEA process from -50 to -220 mV.
4) Sulfate reduction is dominant between -220 and -240 mV.
5) Methanogenesis will occur below -240 mV.

ORP values in the iron reducing stage -50 to -220 mV and below are indicative of anaerobic conditions.

DO**:** DO concentrations in mg/L or ppm. The condition in each well is denoted by blue, yellow and red shading denoting aerobic, nitrate reducing or anaerobic conditions, respectively.

The following assumptions are made:

1) DO above 2 ppm suggests aerobic conditions,

2) DO of 0-2 ppm represents nitrate-reducing conditions, which is transitional between aerobic and anaerobic conditions (defined by the RAWP as < 1 ppm DO); and

3) absence of DO (0 ppm) means conditions are anaerobic.

pH**:** The pH range for bioremediation is considered to be from 5 to 9, with values outside this range considered inhibitory to microbial processes.

As noted in the MI IRACR, ORP was found to be the most reliable indicator of anaerobic conditions and to provide a useful measure for considering injection modifications. The mass of lactate concentrate injected will be modified through injection volume or solution concentration in wells with ORP greater than -100 or less than -250.

The OPS demonstration in the MI IRACR was approved and further demonstration is not required. However, the criteria will be used to evaluate performance of this additional treatment where applicable. The metrics are:

- Injection and performance monitoring wells are installed at the locations and to the depths indicated in the RAWP. – Injection locations will be evaluated based on lactate distribution and other indicators of reductive dechlorination.
- Lactate is distributed throughout the EBT zones. – Lactate distribution will be reviewed through TOC and MFA analyses; modification to the injections will be considered if concentrations do not exceed 50 mg/L at IWs and PMWs.
- Planned volumes of sodium lactate injection fluid can be injected into each TTA IW. – Changes to injection locations, volumes or solution concentrations will be considered if the planned volumes cannot be injected in the designated wells.
- Anaerobic aquifer conditions are created within the EBT zones after no more than two quarters of injections. – The goal of this additional EBT will be to achieve aquifer conditions observed in February 2009 (Appendix A) after the second quarter injections.
- Anaerobic aquifer conditions are maintained within the EBT zones. – This remains the objective of the additional EBT, with expanded TAs.
- Concentrations of dissolved PCE and TCE in an EBT zone begin to decrease no more than two quarters after anaerobic aquifer conditions have been created in the EBT zone. – Reduction in PCE, TCE and CT concentrations are expected in analyses after the second quarter injections.

2.2.5 Waste Management

The waste generated during EBT injections and monitoring will be classified as either non-investigative waste or investigation-derived waste (IDW). Non-investigative waste, such as packaging materials, personal protective equipment, disposable sampling supplies, and other inert refuse, will be collected and containerized for disposal at a municipal landfill.

The IDW will consist of waste water from equipment decontamination and groundwater from purging prior to sampling. The waste water will be collected and transferred to the soil vapor extraction condensate water storage tank on Dunn Field for analysis and appropriate discharge in accordance with TDEC requirements.

Absorbent materials will be used to clean up spills that occur during mixing of sodium lactate injection fluid, transfer of fluid to the IWs, or injection of the fluid. The used material will be disposed as municipal solid waste.

2.3 LONG-TERM MONITORING

In accordance with the MI ROD, LTM is performed to document changes in plume concentrations and to detect potential plume migration to off-site areas or into deeper aquifers. The results will also be used to evaluate progress of EBT downgradient of the TTAs. Wells are sampled semiannually, annually or biennially; new wells are sampled quarterly for one year to develop a trend prior to selection of a sample frequency in accordance with the LTM plan. The next MI LTM event will be biennial sampling of all MI LTM wells in October 2012. The recommended sample frequency at each well in 2013 will be provided in the annual report to be submitted in January 2013. LTM wells used as IWs or PMWs for EBT will not be included in LTM sampling

2.4 REPORTING DURING RA OPERATIONS

Summary reports will be prepared following each quarterly sampling and injection event. Quarterly summaries of remedial action operation will include the following information with respect to operation of the EBT systems:

- Quarterly injection summary.
- Results of performance monitoring prior to injections, including secondary monitoring parameters and preliminary laboratory results for groundwater samples.
- Maps of EBT zones with CVOC concentrations.

- Evaluations of the effectiveness of EBT in maintaining anaerobic aquifer conditions within the EBT zones, and in reducing PCE, TCE, and CT concentrations in the zones
- Recommendations for the next quarter monitoring and injection activities.

An annual report will fully document the monitoring activities, DQE and analytical results. Analytical data will be presented in data summary tables, concentration versus time graphs, and maps showing the contaminant isoconcentration contours. Progress toward groundwater RAOs will be evaluated.

2.5 CONTINGENCIES

Contingency planning for environmental restoration is conducted so that there is a process for identifying deviations from expected conditions and taking appropriate response actions. The expected conditions and potential contingencies described in the MI RAWP are still considered applicable.

2.6 PROJECT MANAGEMENT AND SCHEDULE

Roles and responsibilities for additional EBT are outlined on the organization chart in Appendix D and summarized below:

Office of the Assistant Chief of Staff for Installation Management, Base Realignment and Closure Division (ODB)

ODB personnel include Carolyn Jones, Program Manager and Joan Hutton, Base Realignment and Closure Environmental Coordinator. They will monitor the progress of RA and will review and approve RA documents, including progress updates, schedules, and annual reports, prior to submittal to the Site Management Team. ODB will be responsible for overall project direction and funding, and implementing the responsibilities identified in the Federal Facilities Agreement.

Site Management Team

The Site Management Team consists of Turpin Ballard, Remedial Project Manager (RPM) for USEPA and Jamie Woods, RPM for TDEC. They will review and approve documents submitted during the RA and will coordinate with ODB to determine when RA objectives have been met.

United States Army Corps of Engineers, Tulsa District

The USACE, Tulsa District will manage RA contracts. Diane Cianci, USACE Contract Officer will oversee all contractual matters in consultation with ODB and HDR, and Tyler Jones, Technical Manager will be the primary contact for project activities.

HDR

Key HDR personnel are listed below with their project roles and past involvement at DDMT:

- Program Managers – Glen Turney and Angela Clark will be informed on project status and consulted on project resource and contracting issues, and will provide a resource to ODB and USACE regarding project progress and issues. Mr. Turney has provided engineering expertise and oversight for DDMT since 2006. Ms. Clark has assisted on community relations, risk assessment and regulatory issues for DDMT since 2004.
- Project Manager – Tom Holmes will oversee daily operations and quality functions for all tasks and will be the primary author for reports. Mr. Holmes has been the remedial action project manager at DDMT since 2004 and has directed implementation of all selected remedies.
- Field Team Leader – Kevin Sedlak will supervise major field activities including EBT injections and performance monitoring. Mr. Sedlak has performed or directed field activities at DDMT since 2006, including installation of the EBT, fluvial soil vapor extraction and air sparging with soil vapor extraction systems and numerous sampling events. John Sperry will serve as an alternate field team leader. He attended the University of Memphis and worked as on-site field geologist at DDMT from 2007 to 2011.
- Senior Chemist – Lynn Lutz will ensure data quality objectives are met and will provide oversight of laboratory analyses and data quality evaluation. Ms. Lutz has coordinated soil, vapor and groundwater sample events at DDMT since 2010. She is the primary contact for analytical and data validation subcontractors.
- Database/GIS Manager – Travis Ritter has maintained the analytical and GIS database for DDMT since 2006. Mr. Ritter worked with the remedial design contractor to incorporate historical analytical and hydrogeologic data into the database at the start of remedial action at DDMT. He works with the senior chemist and field team leader to ensure analytical and hydrogeologic data is properly incorporated into the database, performs data analysis for trends and achievement of remediation goals, and prepares tables and figures for report and presentations.

Subcontractors

The following subcontractors have been selected to support the additional EBT:

- Analytical Sub-Contractor – Microbac has been selected as the analytical subcontractor through competitive bids under several contracts for DDMT.

- Data Validation Sub-Contractor – Diane Short and Associates have been selected as the data validation subcontractor through competitive bids under several contracts for DDMT.
- EBT Sub-Consultant – AR Environmental Services will assist HDR in review of EBT monitoring results and remedy optimization as in the initial injections in 2006 to 2009.
- Lactate Supplier – JRW Bioremediation supplied the sodium lactate concentrate during the initial injections and will supply standard concentrate and an improved version with proprietary additives during the additional EBT.

The discrete activities required for completion of each task are shown with the relationship to other activities in the project schedule for EBT field activities is provided in Appendix D. The work plan and reports are shown with the applicable review periods.

3.0 REFERENCES

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TABLES

TABLE 1
EBT YEAR 2 INJECTION VOLUMES
RAWP ADDENDUM
Main Installation - Defense Depot Memphis, Tennessee

Injection Number	Date	Number of Wells	Solution Concentration (%)	Total Solution (gallons)	Average Solution per well (gallons)	Total Lactate Concentrate (gallons)	Average Concentrate per well (gallons)
27	Sep-07	49	2.2	13,046	266	470	9.6
28	Oct-07	49	2.2	12,950	264	466	9.5
29	Nov-07	49	2.2	12,878	263	464	9.5
30	Dec-07	49	2.2	12,628	258	455	9.3
31	Jan-08	49	2.2	12,900	263	464	9.5
32	Feb-08	49	2.2	12,823	262	462	9.4
33	Mar-08	49	2.2	12,885	263	464	9.5
34	Apr-08	58	2.2	15,854	273	571	9.8
35	May-08	58	2.2	15,288	264	550	9.5
36	Jun-08	58	2.2	15,270	263	550	9.5
37	Jul-08	58	4.3 to 8.6	18,271	315	1,528	26.3
38	Aug-08	58	4.3 to 8.6	16,871	291	1,651	28.5
39	Sep-08	58	4.3 to 17.2	16,740	289	1,975	34.1
40	Oct-08	58	4.3 to 17.2	16,487	284	2,235	38.5
41	Nov-08	58	4.3 to 17.2	16,385	282	1,575	27.1
42	Dec-08	58	4.3 to 17.2	16,621	287	2,255	38.9
43	Jan-09	58	4.3 to 17.2	16,399	283	2,149	37.1
44	Feb-09	58	4.3 to 17.2	16,437	283	2,291	39.5
				270,732		20,574	
				Avg Lactate Conc %		7.6%	
				Avg Lactate %		4.6%	

TABLE 2
EBT INJECTION AND PERFORMANCE MONITORING WELLS
RAWP ADDENDUM
Main Installation - Defense Depot Memphis Tennessee

TTA-1N (MW-21 area)		TTA-1S (MW-101 area)		TTA-2		West-Central		Bldg 835	
Injection Well	Monitoring Well	Injection Well	Monitoring Well	Injection Well	Monitoring Well	Injection Well	Monitoring Well	Injection Well	Monitoring Well
IW21-01A	PMW21-01	IW101-02A	PMW101-04A	IW85-05	PMW85-01	MW-203A	MW-197A	MW-62	MW-212
IW21-01B	PMW21-02	IW101-02B	PMW101-04B	IW85-06	PMW85-05	MW-203B	MW-197B	MW-213	
IW21-02A		IW101-02C	PMW101-07A	IW92-01	PMW92-03				
IW21-02B		IW101-03A	PMW101-07B	IW92-02	MW-85				
IW21-03A		IW101-03B		IW92-03					
IW21-03B		IW101-03C		IW92-07					
IW21-04A		IW101-04A		IW92-08					
IW21-04B		IW101-04B		DR2-2					
MW-21		IW101-04C		DR2-5					
PMW21-04		IW101-05A		MW-113					
		IW101-05B							
		IW101-05C							
		IW101-07A							
		IW101-07B							
		IW101-07C							
		DR1-5							
		DR1-5A							
		DR1-6							
		DR1-6A							
		PMW101-02A							
		PMW101-02B							

TABLE 3
INJECTION WELL INSTALLATION SUMMARY
RAWP ADDENDUM
Main Installation - Defense Depot Memphis, Tennessee

Well ID	Plume	Date Completed	Northing (ft)	Easting (ft)	Top of Casing Elevation (ft, msl)	Ground Elevation (ft, msl)	Total Boring Depth (ft, bgs)	Depth to Clay (ft, bgs)	Depth to Groundwater (ft, btoc)	Depth to Top of Screen (ft, bgs)	Screen Length (ft)	Total Well Depth (ft, bgs)
IW21-01A	TTA-1N	5/19/06	276504.77	800599.88	294.34	294.99	110	110	89.6	99.4	10	109.5
IW21-01B	TTA-1N	5/24/06	276500.95	800605.89	294.61	294.85	101	NA	89.7	90.1	10	100.3
IW21-02A	TTA-1N	5/31/06	276464.81	800594.24	294.62	295.25	116	112	89.9	100.8	10	111.0
IW21-02B	TTA-1N	6/2/06	276462.20	800598.51	294.65	295.12	102	NA	90.1	92.2	10	102.3
IW21-03A	TTA-1N	5/18/06	276551.96	800698.20	292.81	293.23	116	110	89.8	100.1	10	110.3
IW21-03B	TTA-1N	5/19/06	276549.21	800705.08	292.50	293.12	101	NA	89.8	90.4	10	100.6
IW21-04A	TTA-1N	5/23/06	276518.82	800711.10	292.69	293.20	116	110	89.9	100.4	10	110.6
IW21-04B	TTA-1N	5/24/06	276515.66	800715.39	292.79	293.30	101	NA	90.1	90.2	10	100.4
MW-21	TTA-1N	Mar-89	276473.39	800602.39	295.00	295.21	110	NA	89.1	92.3	15	107.3
PMW21-04	TTA-1N	5/16/06	276601.83	800771.56	291.87	292.20	116	109	89.0	89.3	20	109.5
IW101-02A	TTA-1S	7/6/05	276198.80	801107.92	291.12	291.60	146	139	88.5	124.5	15	139.6
IW101-02B	TTA-1S	7/7/06	276200.62	801111.95	291.14	291.72	126	NA	88.5	110.6	15	125.8
IW101-02C	TTA-1S	7/19/06	276203.32	801116.22	291.53	291.74	111	NA	88.1	93.9	15	109.1
IW101-03A	TTA-1S	6/23/06	276164.62	801104.58	291.94	292.36	141	141	89.7	125.6	15	140.8
IW101-03B	TTA-1S	6/27/06	276161.58	801106.45	291.91	292.51	126	NA	89.7	110.0	15	125.1
IW101-03C	TTA-1S	6/28/06	276158.05	801108.62	292.04	292.54	111	NA	89.7	94.1	15	109.3
IW101-04A	TTA-1S	6/13/06	276249.13	801142.39	291.72	292.18	142	138	89.3	123.9	15	139.0
IW101-04B	TTA-1S	6/14/06	276252.94	801142.79	291.59	292.08	126	NA	89.5	107.5	15	122.7
IW101-04C	TTA-1S	6/15/06	276257.10	801143.03	291.47	292.05	111	NA	89.3	92.8	15	108.0
IW101-05A	TTA-1S	6/13/06	276214.93	801126.64	291.52	292.12	141	138	89.2	122.0	15	137.2
IW101-05B	TTA-1S	6/14/06	276218.44	801125.04	291.41	292.06	126	NA	89.0	108.4	15	123.6
IW101-05C	TTA-1S	6/15/06	276221.88	801122.88	291.27	291.89	108	NA	88.8	92.8	15	108.0
IW101-07A	TTA-1S	7/10/06	276125.77	801099.90	292.83	293.13	141	138	89.4	123.3	15	138.5
IW101-07B	TTA-1S	7/10/06	276123.62	801102.61	292.81	293.15	126	NA	89.4	106.9	15	122.1
IW101-07C	TTA-1S	7/11/06	276121.28	801105.60	292.78	293.08	111	NA	89.4	93.6	15	108.8
DR1-5	TTA-1S	5/8/04	276079.76	800828.18	294.50	294.88	156	144	93.1	125.1	20	145.5
DR1-5A	TTA-1S	5/23/04	276086.88	800835.32	294.61	294.88	112	NA	93.2	90.4	20	110.8
DR1-6	TTA-1S	6/19/04	276044.05	801103.49	292.98	293.44	146	136	91.8	114.7	20	135.1
DR1-6A	TTA-1S	6/21/04	276035.13	801103.29	293.14	293.52	116	NA	91.9	91.1	20	111.5
PMW101-02A	TTA-1S	6/19/06	276281.77	801144.74	291.47	291.87	141	138	89.4	117.5	20	137.7
PMW101-02B	TTA-1S	6/21/06	276286.48	801145.09	291.60	291.83	121	NA	89.5	97.7	20	117.8
IW85-05	TTA-2	2/22/07	276815.58	806162.75	304.73	305.30	111	102	95.2	93.0	10	103.4
IW85-06	TTA-2	2/27/07	276779.47	806183.37	304.81	305.45	111	NA	96.1	96.1	10	106.5
IW92-01	TTA-2	7/24/06	276769.42	806506.97	304.51	304.88	96	93	86.2	80.7	10	90.9
IW92-02	TTA-2	7/25/06	276719.57	806513.90	304.05	304.87	96	91	81.5	80.3	10	90.5

TABLE 3
INJECTION WELL INSTALLATION SUMMARY
RAWP ADDENDUM
Main Installation - Defense Depot Memphis, Tennessee

Well ID	Plume	Date Completed	Northing (ft)	Easting (ft)	Top of Casing Elevation (ft, msl)	Ground Elevation (ft, msl)	Total Boring Depth (ft, bgs)	Depth to Clay (ft, bgs)	Depth to Groundwater (ft, btoc)	Depth to Top of Screen (ft, bgs)	Screen Length (ft)	Total Well Depth (ft, bgs)
IW92-03	TTA-2	7/26/06	276669.17	806511.19	304.20	304.72	96	94	90.5	84.0	10	94.2
IW92-07	TTA-2	7/31/06	276725.81	806366.98	303.78	304.31	101	96	91.8	88.3	10	98.5
IW92-08	TTA-2	7/28/06	276784.63	806289.19	304.55	304.93	106	96	92.5	85.7	10	95.9
DR2-2	TTA-2	5/19/04	276771.06	806658.74	304.37	304.49	106	103	81.4	78.6	15	94.0
DR2-5	TTA-2	6/6/04	276830.90	806180.36	305.44	305.55	106	99	95.5	84.6	15	100.0
MW-113	TTA-2	Apr-02	276685.34	806279.10	304.81	304.92	115	105	94.5	96.1	10	106.1
MW-203A	W-C	3/28/2007	276841.61	801740.37	290.59	290.78	176.0	167	91.8	142.9	15.0	158.1
MW-203B	W-C	4/17/2007	276821.58	801741.76	290.51	290.75	110.0	NA	91.7	92.8	15.0	108.2
MW-62	B-835	Oct-98	278289.89	801858.16	293.65	294.10	107	97	91.1	86.5	10	96.5
MW-213	B-835	4/6/2007	278426.83	801668.99	293.83	294.12	106.0	92	92.1	77.2	15.0	92.5

Notes:
bgs: below ground surface
btoc: below top of casing
ft: feet
msl: mean sea level

TABLE 4
PERFORMANCE MONITORING WELL INSTALLATION SUMMARY
RAWP ADDENDUM
Main Installation - Defense Depot Memphis, Tennessee

Well ID	Plume	Date Completed	Northing	Easting	Top of Casing Elevation (ft, msl)	Ground Elevation (ft, msl)	Total Boring Depth (ft, bgs)	Depth to Clay (ft, bgs)	Depth to Groundwater (ft, btoc)	Depth to Top of Screen (ft, bgs)	Screen Length (ft)	Total Well Depth (ft, bgs)
PMW21-01	TTA-1N	5/15/06	276533.24	800599.91	294.73	295.12	110	110	90.8	88.8	20	109.0
PMW21-02	TTA-1N	5/16/06	276574.64	800701.00	292.98	293.19	116	108	89.8	91.5	20	111.6
PMW101-04A	TTA-1S	6/6/06	276299.41	801182.12	291.07	291.43	141	138	89.0	118.3	20	138.5
PMW101-04B	TTA-1S	6/6/06	276296.40	801186.86	291.47	291.75	121	NA	89.5	98.8	20	119.0
PMW101-07A	TTA-1S	6/7/06	276143.43	801171.78	292.20	292.52	146	138	90.0	118.2	20	138.4
PMW101-07B	TTA-1S	6/8/06	276141.84	801176.74	292.36	292.70	118	NA	90.2	98.3	20	118.5
PMW85-01	TTA-2	5/12/06	276802.18	806146.13	305.08	305.39	106	103	96.0	93.5	10	103.7
PMW85-05	TTA-2	2/22/07	276752.08	806222.46	305.12	305.32	111	103	96.3	93.4	10	103.0
PMW92-03	TTA-2	5/5/06	276678.91	806438.66	303.91	304.17	106	103	92.4	92.7	10	102.9
MW-85	TTA-2	Sep-01	276704.14	806064.51	304.13	304.50	115	112	95.9	96.3	15	111.3
MW-197A	W-C	8/4/06	276975.42	802042.30	291.26	291.54	186	176	93.0	162.0	15	177.4
MW-197B	W-C	8/7/06	276973.14	802036.92	291.03	291.43	111	NA	92.8	94.2	15	109.6
MW-212	B-835	4/5/2007	278028.36	802225.40	295.34	295.68	107	100	97.7	85.7	15	101.0

Notes:
bgs: below ground surface
btoc: below top of casing
ft: feet
msl: mean sea level

TABLE 5
INITIAL EBT INJECTION PLAN
RAWP ADDENDUM
Main Installation - Defense Depot Memphis, Tennessee

Well ID	Area	Screen Length	Percent Sodium Lactate	Target Volume (gallons)
TTA-1 North				
IW21-01A	TTA-1N	10	15	250
IW21-01B	TTA-1N	10	15	250
IW21-02A	TTA-1N	10	15	250
IW21-02B	TTA-1N	10	15	250
IW21-03A	TTA-1N	10	15	250
IW21-03B	TTA-1N	10	15	250
IW21-04A	TTA-1N	10	15	250
IW21-04B	TTA-1N	10	15	250
MW-21	TTA-1N	15	15	250
PMW21-04	TTA-1N	20	15	250
TTA-1 South				
IW101-02A	TTA-1S	15	15	250
IW101-02B	TTA-1S	15	15	250
IW101-02C	TTA-1S	15	15	250
IW101-03A	TTA-1S	15	15	250
IW101-03B	TTA-1S	15	15	250
IW101-03C	TTA-1S	15	15	250
IW101-04A	TTA-1S	15	15	250
IW101-04B	TTA-1S	15	15	250
IW101-04C	TTA-1S	15	15	250
IW101-05A	TTA-1S	15	15	250
IW101-05B	TTA-1S	15	15	250
IW101-05C	TTA-1S	15	15	250
IW101-07A	TTA-1S	15	15	250
IW101-07B	TTA-1S	15	15	250
IW101-07C	TTA-1S	15	15	250
DR1-5	TTA-1S	20	15	250
DR1-5A	TTA-1S	20	15	250
DR1-6	TTA-1S	20	15	250
DR1-6A	TTA-1S	20	15	250
PMW101-02A	TTA-1S	20	15	250
PMW101-02B	TTA-1S	20	15	250
TTA-2				
IW85-05	TTA-2	10	15	250
IW85-06	TTA-2	10	15	250
IW92-01	TTA-2	10	15	250
IW92-02	TTA-2	10	15	250
IW92-03	TTA-2	10	15	250
IW92-07	TTA-2	10	15	250
IW92-08	TTA-2	10	15	250
DR2-2	TTA-2	15	15	250
DR2-5	TTA-2	10	15	250
MW-113	TTA-2	10	15	250
West Central				
MW-203A	W-C	15	15	250
MW-203B	W-C	15	15	250
Building 835				
MW-213	B835	15	15	250
MW-62	B835	10	15	250
	Total Injection Solution (gallons)			11250
	Total Concentrate (gallons)			2812.5
	No. of Totes (260 gallons)			10.8

TABLE 6
ANALYTICAL METHODS AND QC SAMPLES
RAWP ADDENDUM
Main Installation - Defense Depot Memphis, Tennessee

Quarterly Performance Monitoring

Parameter	Method	Matrix	Field Samples	Field Duplicates	MS	MSD	Trip Blanks	Equipment Blanks	Total No. of Samples
Volatile Organic Compounds	SW8260B	groundwater	58	6	3	3	5	3	78
Total Organic Carbon	SW9060	groundwater	58	6	3	3	0	3	73
Dissolved Gases	RSK-175	groundwater	58	6	3	3	0	3	73
Metabolic Fatty Acids	ASTM-D1522	groundwater	58	6	3	3	0	3	73

Microbial Analysis

Parameter	Method	Matrix	Field Samples	Field Duplicates	MS	MSD	Trip Blanks	Equipment Blanks	Total No. of Samples
Dehalococcoides ethogenes (DCe)-vinyl chloride reductase (vcrA)	PCR-60106/ 60112*	groundwater	22	3	0	0	0	2	27

TABLE 7
PERFORMANCE MONITORING WELL OBJECTIVES
RAWP ADDENDUM
Main Installation - Defense Depot Memphis, Tennessee

Well ID	Objective of Performance Monitoring Well
	TTA-1 North
PMW21-01	Monitor side-gradient of IW21-01
PMW21-02	Monitor down-gradient of IW21-01
	TTA-1 South
PMW101-04A/B	Monitor down-gradient of IW101-04
PMW101-07A/B	Monitor down-gradient of IW101-05
	TTA-2
PMW85-01	Monitor down-gradient of IW85-05 and DR2-5
PMW85-05	Monitor down-gradient of IW92-08
PMW92-03	Monitor down-gradient of IW92-01 and IW92-02
MW-85	Monitor down-gradient of multiple IWs
	West-Central Plume
MW-197A/B	Monitor down-gradient of MW-203A/B
	Building 835 Plume
MW-212	Monitor down-gradient of MW-62

FIGURES

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Figure 1

SITE LOCATION MAP

RAWP ADDENDUM

MAIN INSTALLATION
DEFENSE DEPOT
MEMPHIS, TENNESSEE

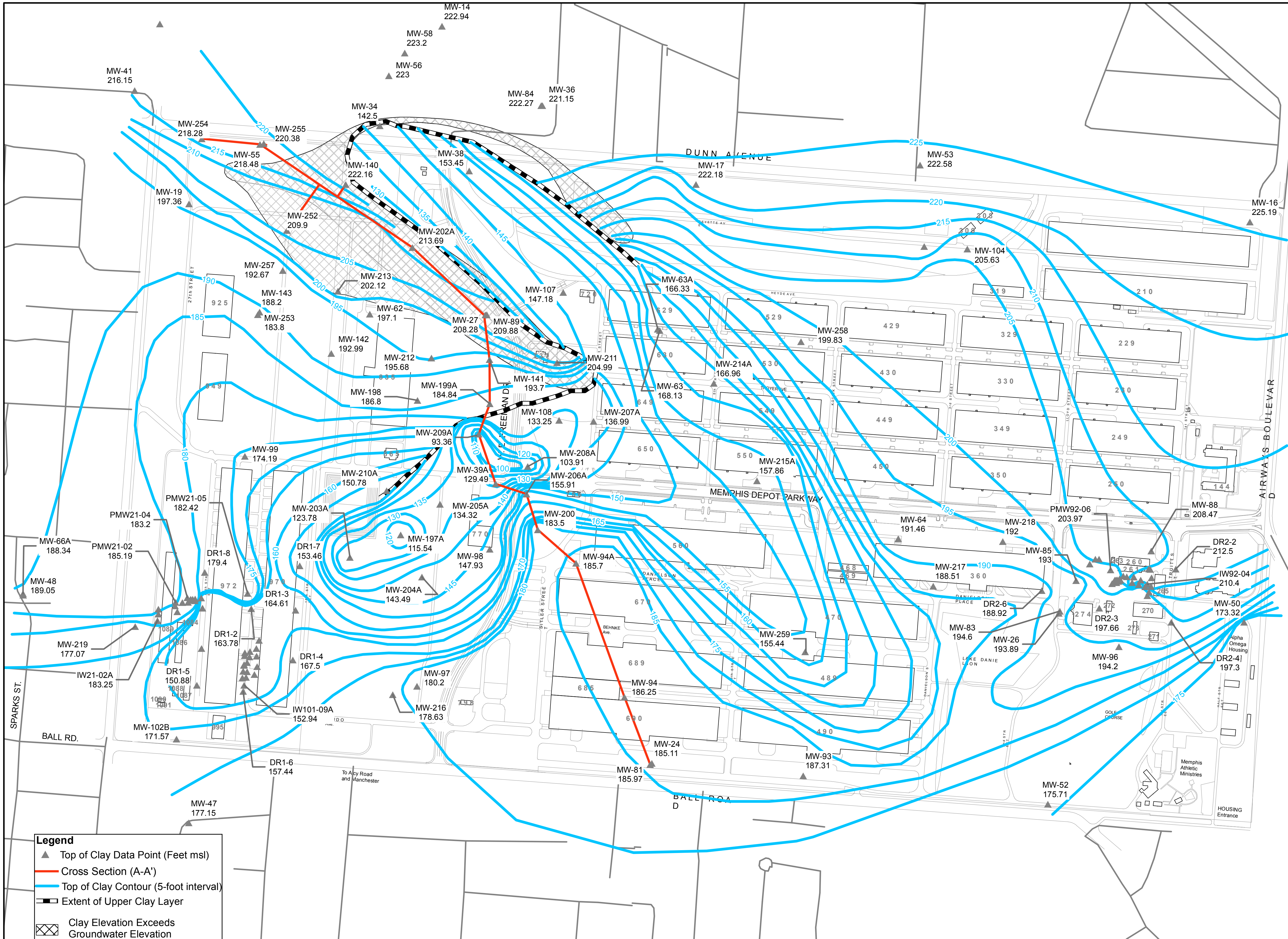
Projection: NAD 1927 StatePlane Tennessee
Units: Feet

0 0.6 1.2 1.8 2.4 3 Miles

Installation Location
Memphis, Tennessee

Date: October 2012
Edition: Rev 0

HDR



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N
W E
S

Figure 2

TOP OF CLAY ELEVATIONS

RAWP ADDENDUM

MAIN INSTALLATION
DEFENSE DEPOT
MEMPHIS, TENNESSEE

Projection: NAD 1927 StatePlane Tennessee
Units: Feet

0 200 400 800
Feet

Installation Location
Memphis, Tennessee

HDR

Date: October 2012
Edition: Rev 0

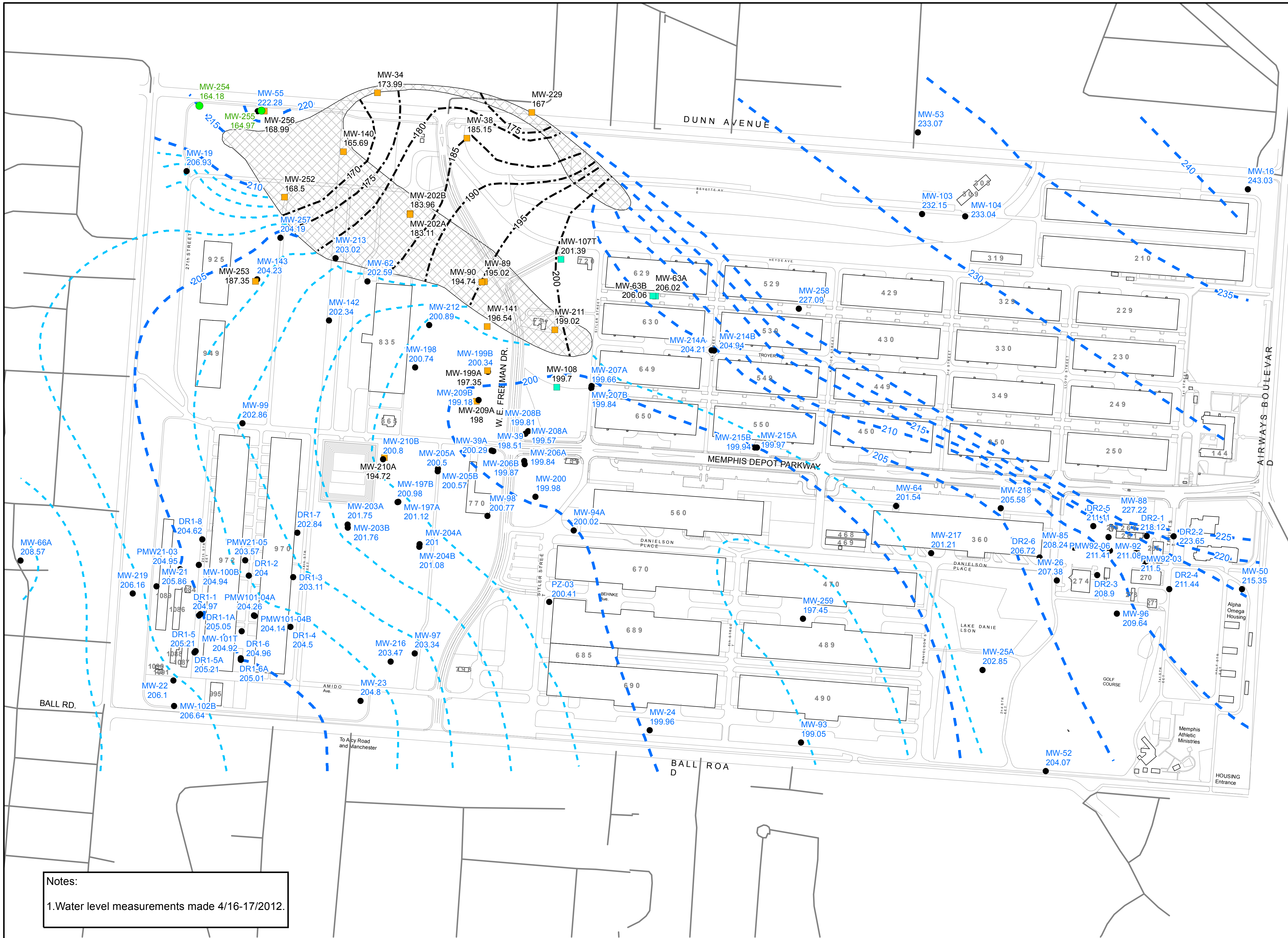


Figure 3

GROUNDWATER ELEVATIONS

RAWP ADDENDUM

MAIN INSTALLATION
DEFENSE DEPOT
MEMPHIS, TENNESSEE

Legend

- Monitoring Well Screened in the Fluvial Aquifer
- Monitoring Well Screened in the Intermediate Aquifer
- Monitoring Well Screened in the Transition Zone
- Potentiometric surface of the Fluvial Aquifer 1-ft. contour
- Potentiometric surface of the Fluvial Aquifer 5-ft. contour
- Potentiometric surface of the Intermediate Aquifer 5-ft. contour
- Clay Elevation Exceeds Groundwater Elevation

MW-03 100.12 — Blue: value used for Fluvial Aquifer groundwater contours
MW-237 100.15 — Black: value used for Intermediate Aquifer groundwater contours
MW-254 156.83 — Green: Memphis Aquifer, not contoured

Projection: NAD 1927 StatePlane Tennessee
Units: Feet

0 250 500 1,000
Feet

Installation Location
Memphis, Tennessee

Date: October 2012
Edition: Rev 0

Notes:

1.Water level measurements made 4/16-17/2012.

Path: G:\DDMT\RAWP Addendum\GIS\Figure 3 Fluvial Aq GW Elev, Apr 2012.mxd

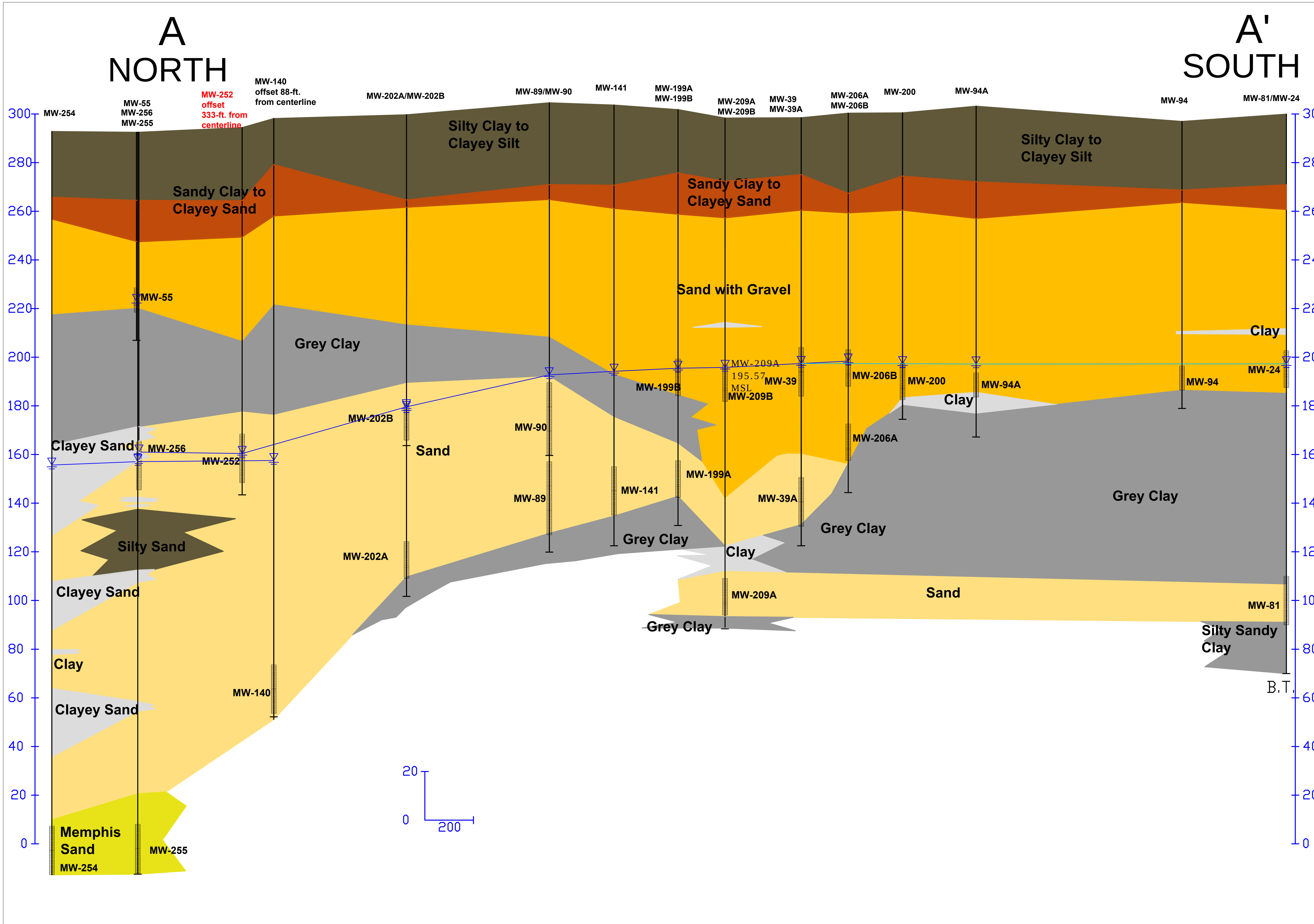
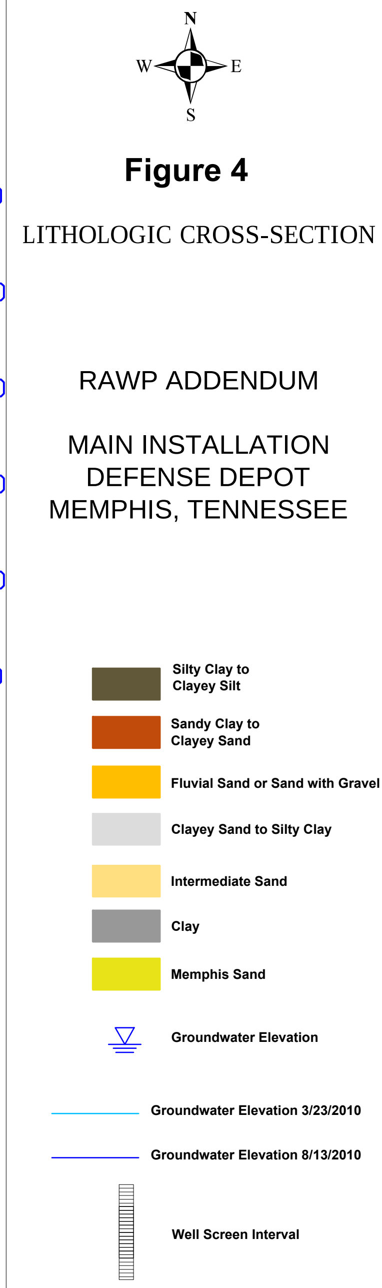


Figure 4

LITHOLOGIC CROSS-SECTION

RAWP ADDENDUM

MAIN INSTALLATION
DEFENSE DEPOT
MEMPHIS, TENNESSEE



Date: October 2012
Edition: Rev 0

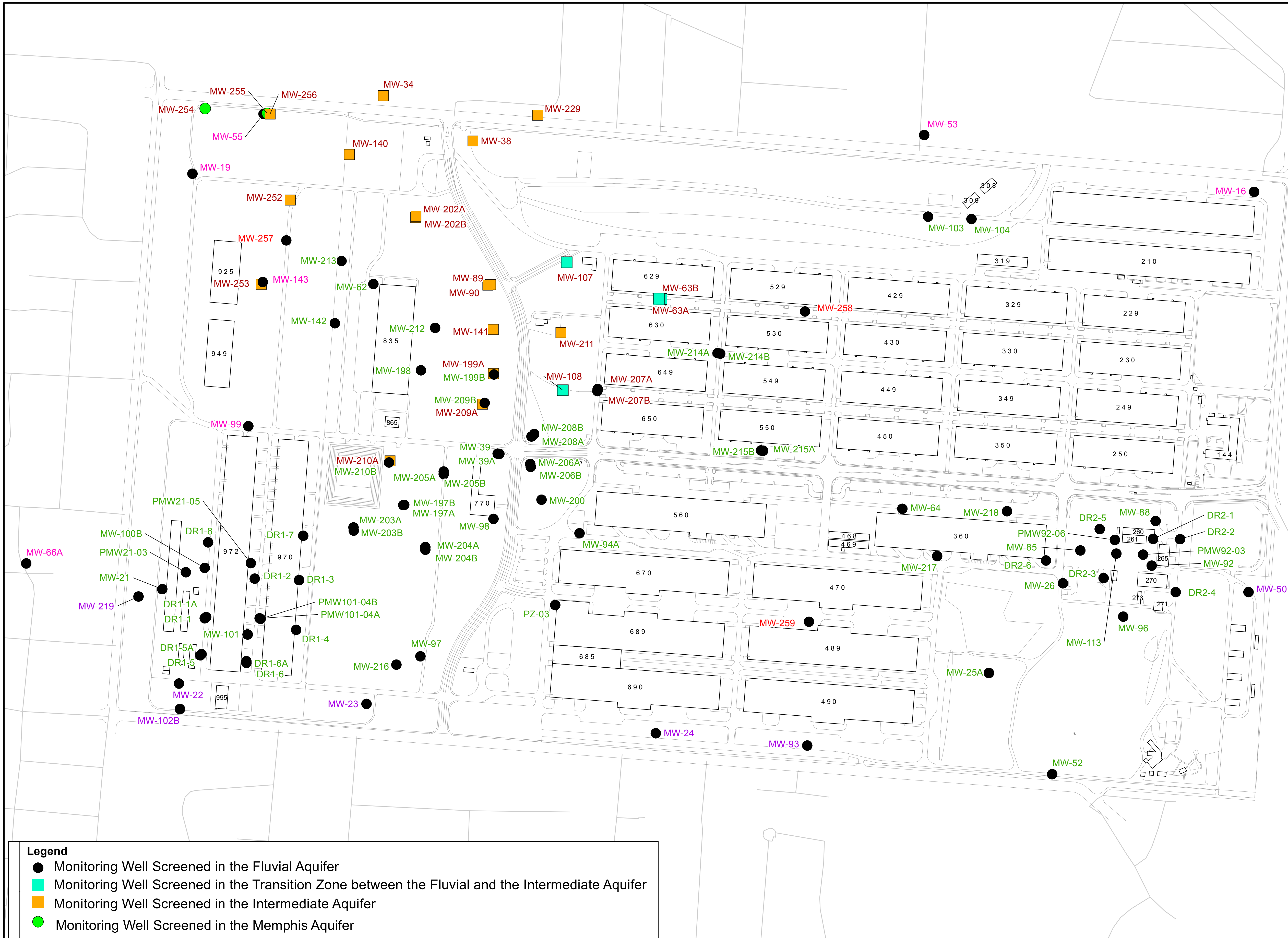


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Figure 5

LTM WELL LOCATION MAP

RAWP ADDENDUM

MAIN INSTALLATION
DEFENSE DEPOT
MEMPHIS, TENNESSEE

Well Classification

- MW-16 Background
- MW-34 Sentinel
- MW-21 Performance
- MW-219 Boundary
- MW-257 New - Not Classified

Projection: NAD 1927 StatePlane Tennessee
Units: Feet

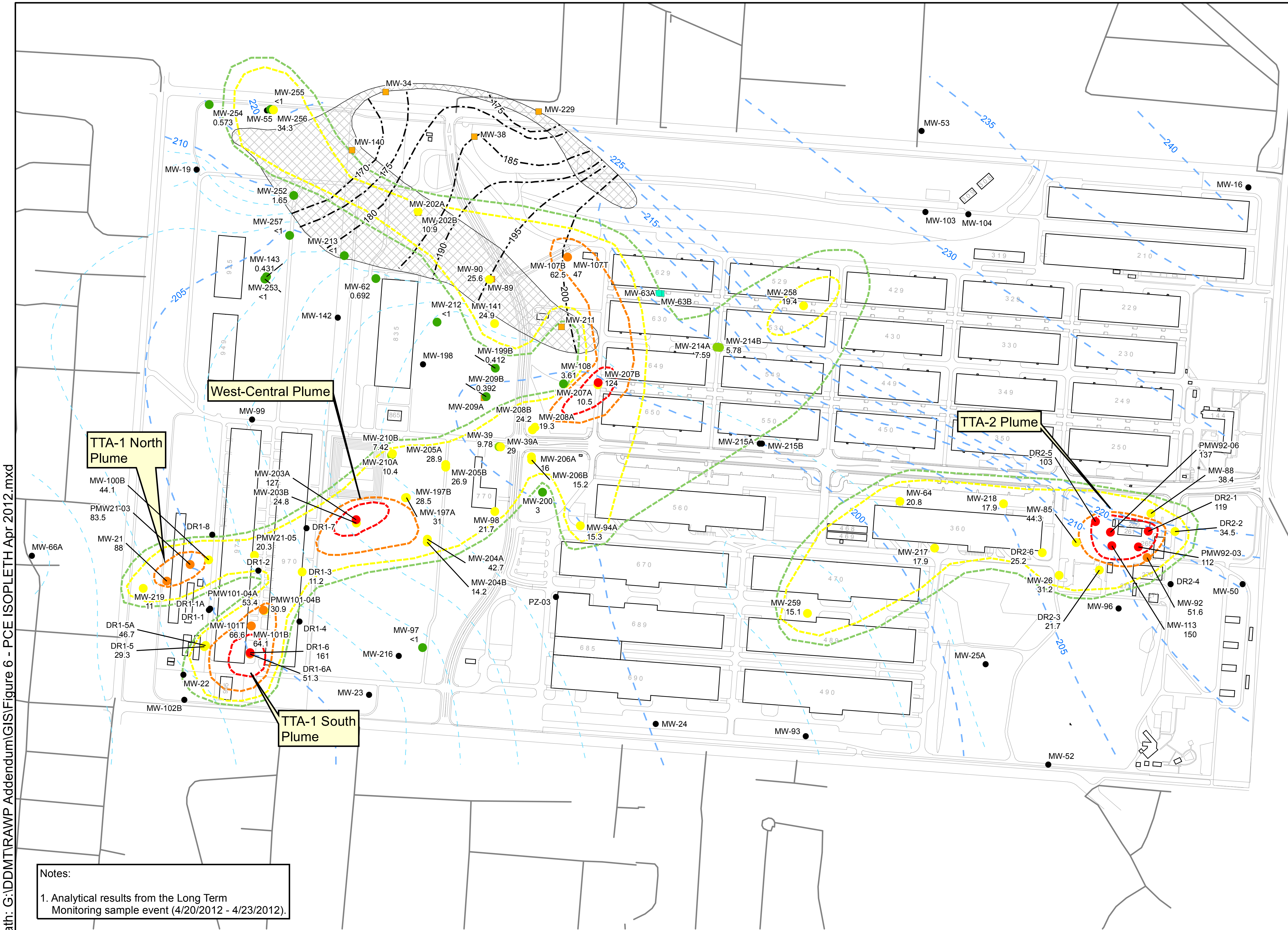
0 250 500 1,000

Feet

Installation Location
Memphis, Tennessee

HDR

Date: October 2012
Edition: Rev 0



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N
W E
S

Figure 6

PCE CONCENTRATIONS, APRIL 2012

RAWP ADDENDUM

MAIN INSTALLATION
DEFENSE DEPOT
MEMPHIS, TENNESSEE

Legend

PCE Ranges
ug/L

- 0 - 5
- 5 - 10
- 10 - 50
- 50 - 100
- 100 - 300

PCE Isopleth
ug/L

- 5
- 10
- 50
- 100

Clay Elevation Exceeds Groundwater Elevation

Potentiometric surface of the Fluvial Aquifer 1-ft. contour
Potentiometric surface of the Fluvial Aquifer 5-ft. contour
Potentiometric surface of the Intermediate Aquifer 5-ft. contour

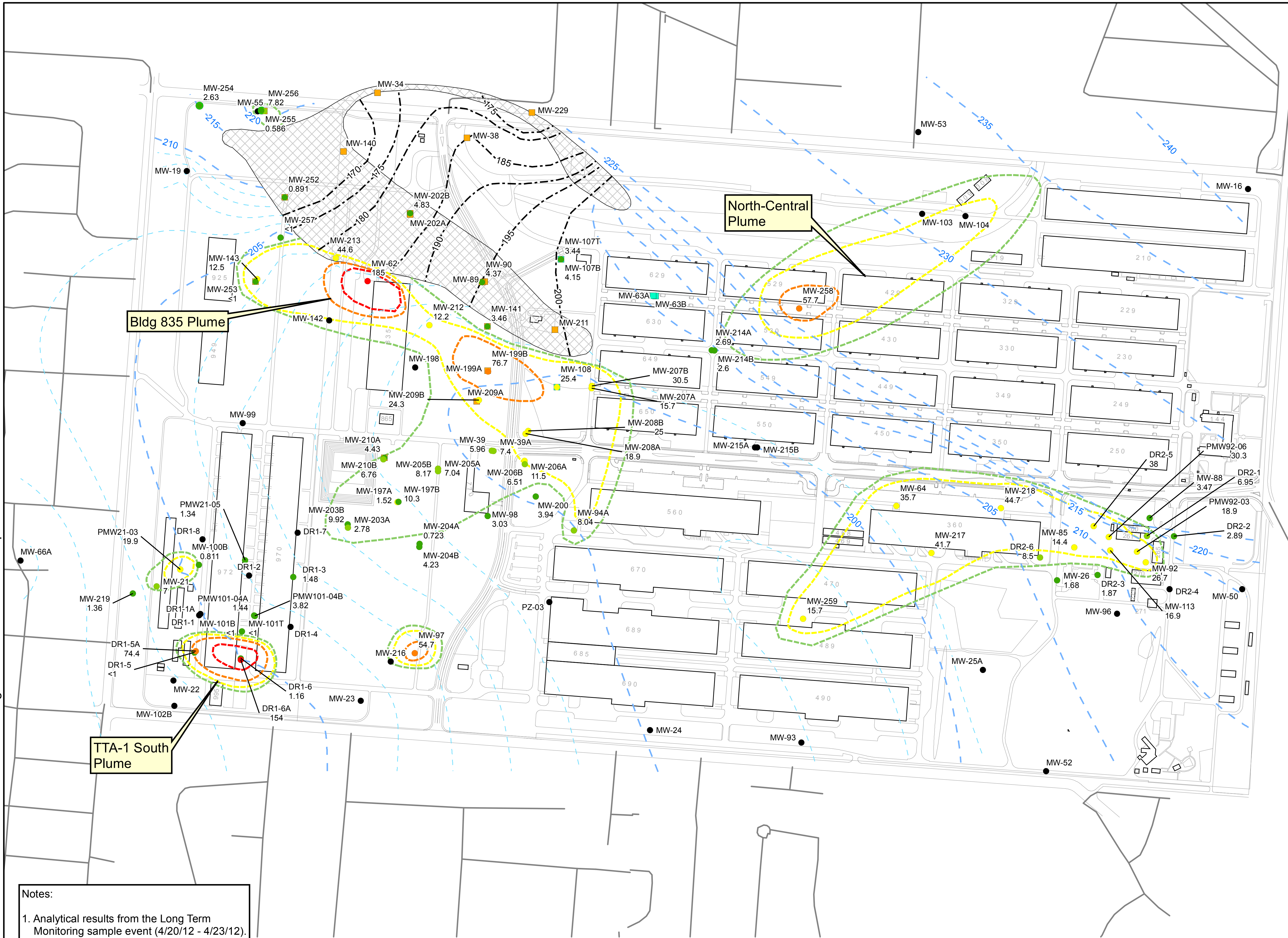
Projection: NAD 1927 StatePlane Tennessee
Units: Feet

0 200 400 800
Feet

Installation Location
Memphis, Tennessee

HDR

Date: October 2012
Edition: Rev 0



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N
W E
S

Figure 7

TCE CONCENTRATIONS, APRIL 2012

RAWP ADDENDUM

MAIN INSTALLATION
DEFENSE DEPOT
MEMPHIS, TENNESSEE

Legend

TCE Ranges
ug/L
- 0 - 5
- 5 - 10
- 10 - 50
- 50 - 100
- 100 - 300

TCE Isopleth
ug/L
- 5
- 10
- 50
- 100
- Clay Elevation Exceeds Groundwater Elevation

- Potentiometric surface of the Fluvial Aquifer 1-ft. contour
- Potentiometric surface of the Fluvial Aquifer 5-ft. contour
- Potentiometric surface of the Intermediate Aquifer 5-ft. contour

Projection: NAD 1927 StatePlane Tennessee
Units: Feet

0 200 400 800
Feet

Installation Location
Memphis, Tennessee

Date: October 2012
Edition: Rev 0

HDR

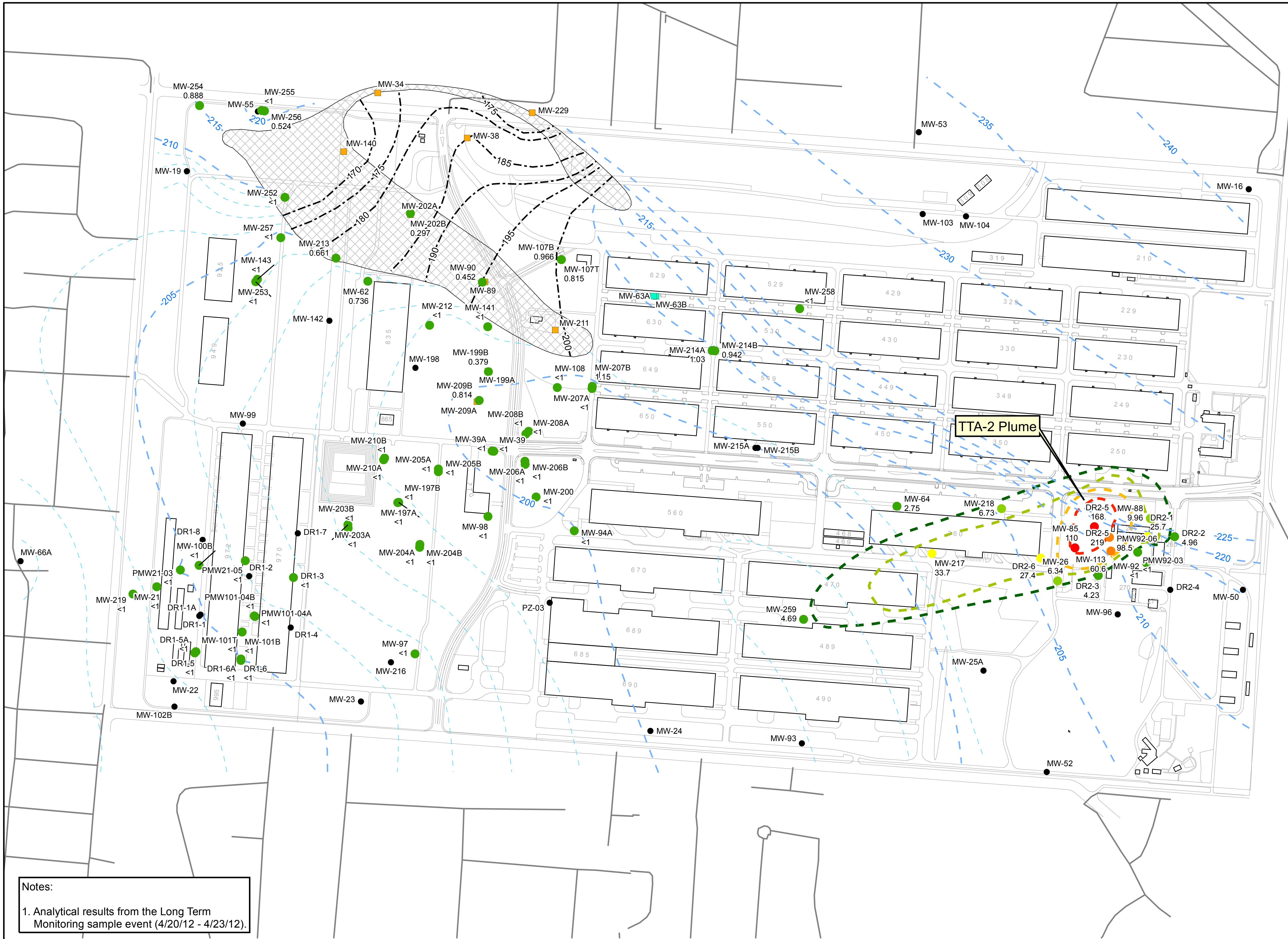

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Figure 8

CT CONCENTRATIONS, APRIL 2012

RAWP ADDENDUM

MAIN INSTALLATION
DEFENSE DEPOT
MEMPHIS, TENNESSEE

Legend

CT Ranges
ug/L
- 0-5
- 5-10
- 10-50
- 50-100
- 100-200

CT Isopleth
ug/L
- 5
- 10
- 50
- 100

Clay Elevation Exceeds Groundwater Elevation

Potentiometric surface of the Fluvial Aquifer 1-ft. contour
Potentiometric surface of the Fluvial Aquifer 5-ft. contour
Potentiometric surface of the Intermediate Aquifer 5-ft. contour

Projection: NAD 1927 StatePlane Tennessee
Units: Feet

0 200 400 800
Feet

Installation Location
Memphis, Tennessee

Date: October 2012
Edition: Rev 0

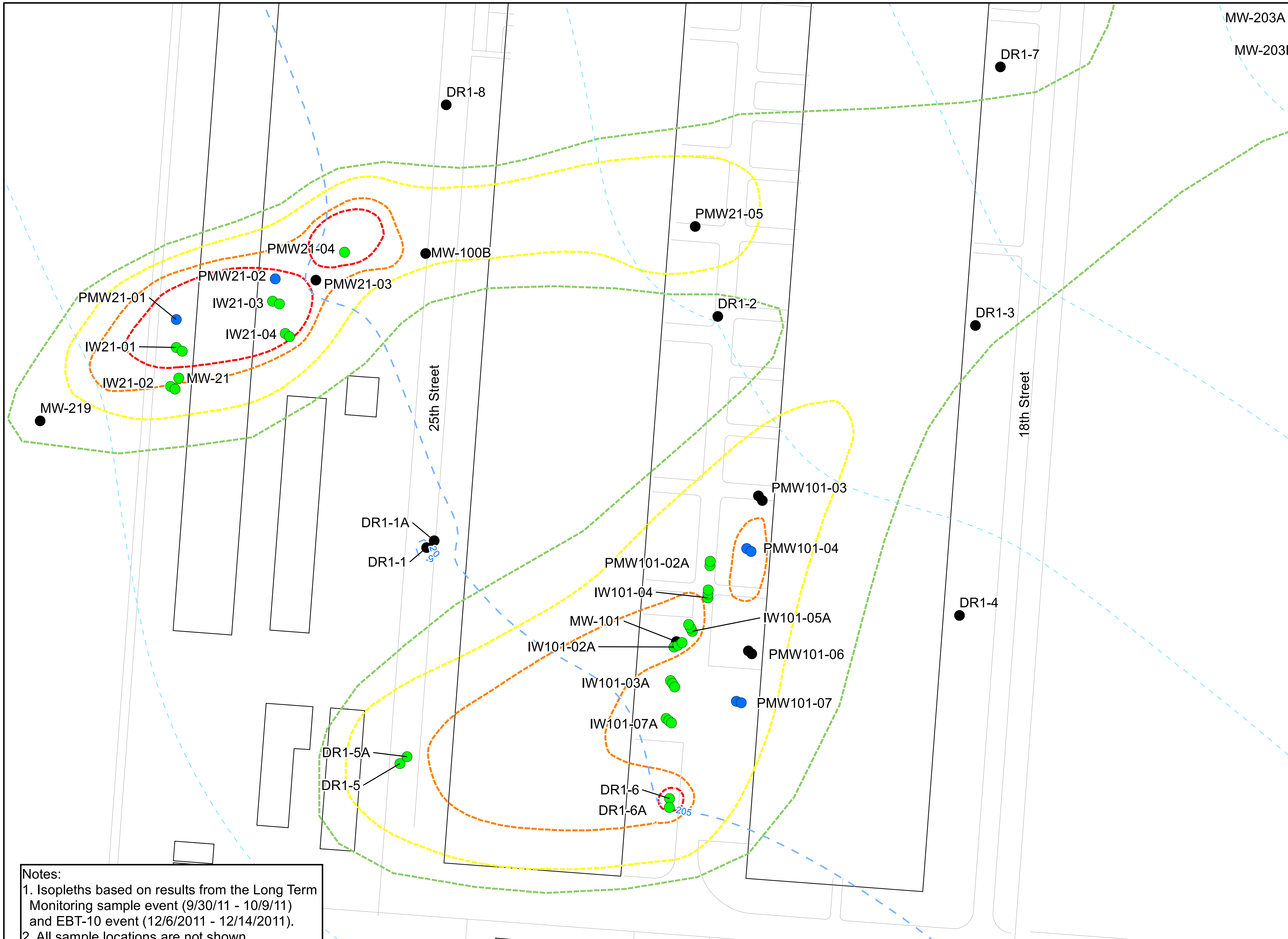
HDR

Figure 9

TTA-1 WELL LOCATIONS

RAWP ADDENDUM

MAIN INSTALLATION
DEFENSE DEPOT
MEMPHIS, TENNESSEE



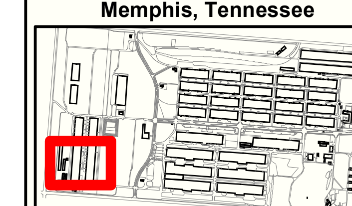
Legend

- Injection
- Performance Monitoring
- Long Term Monitoring

PCE Isopleth ug/L

- 5
- 10
- 50
- 100
- Potentiometric surface of the Fluvial Aquifer 1-ft. contour

0 25 50 100 150
Feet



Date: October 2012
Edition: Rev 0

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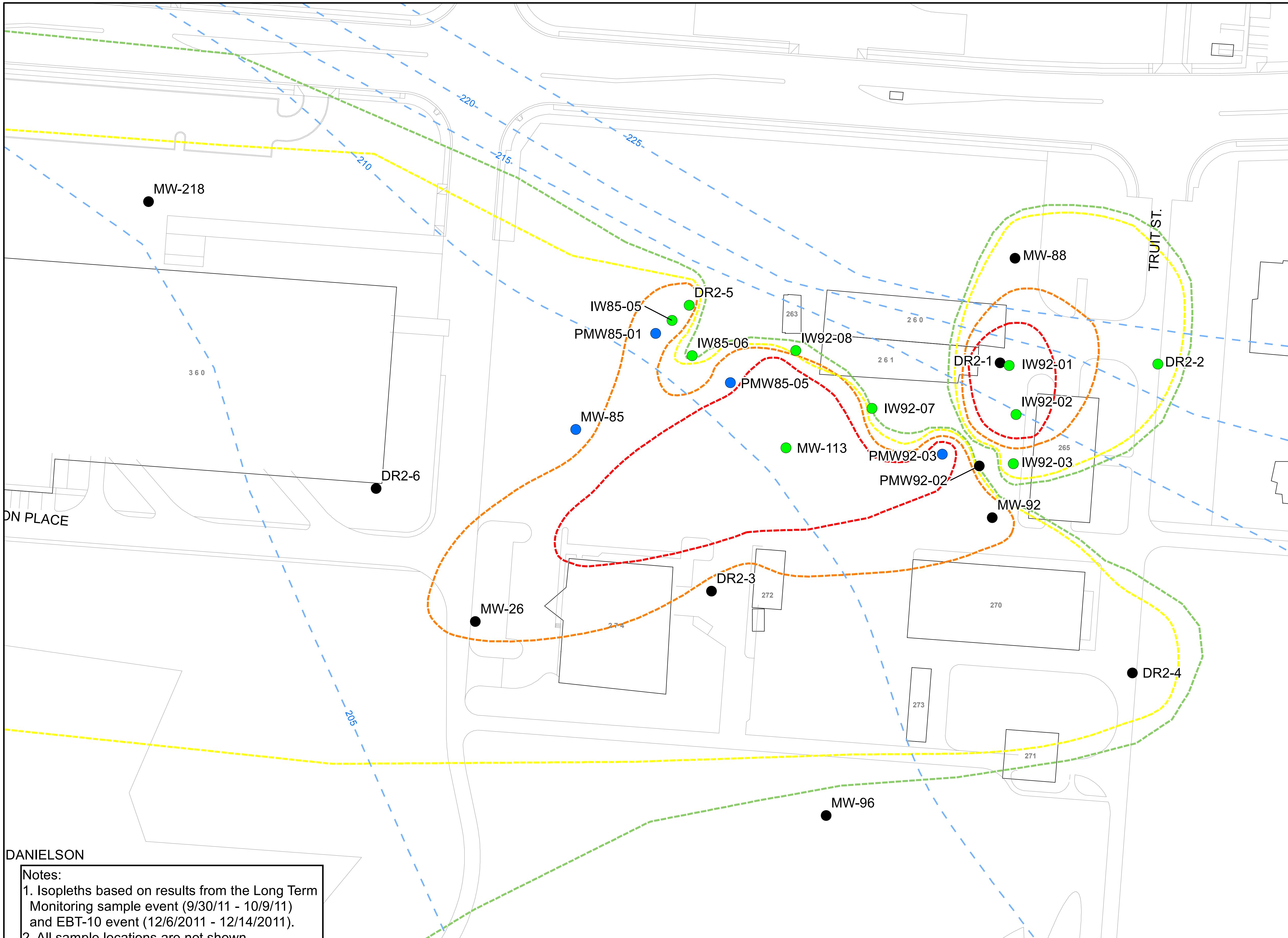


Path: G:\DDMT\RAWP Addendum\GIS\Figure 10 Well Locations TTA-2.mxd

Figure 10

TTA-2 WELL LOCATIONS

RAWP ADDENDUM

MAIN INSTALLATION
DEFENSE DEPOT
MEMPHIS, TENNESSEE

Legend

- Injection
- Performance Monitoring
- Long Term Monitoring

PCE Isopleth ug/L

- 5
- 10
- 50
- 100
- Potentiometric surface of the Fluvial Aquifer 1-ft. contour
- Potentiometric surface of the Fluvial Aquifer 5-ft. contour

0 25 50 100 150
Feet

Installation Location
Memphis, Tennessee

Date: October 2012
Edition: Rev 0

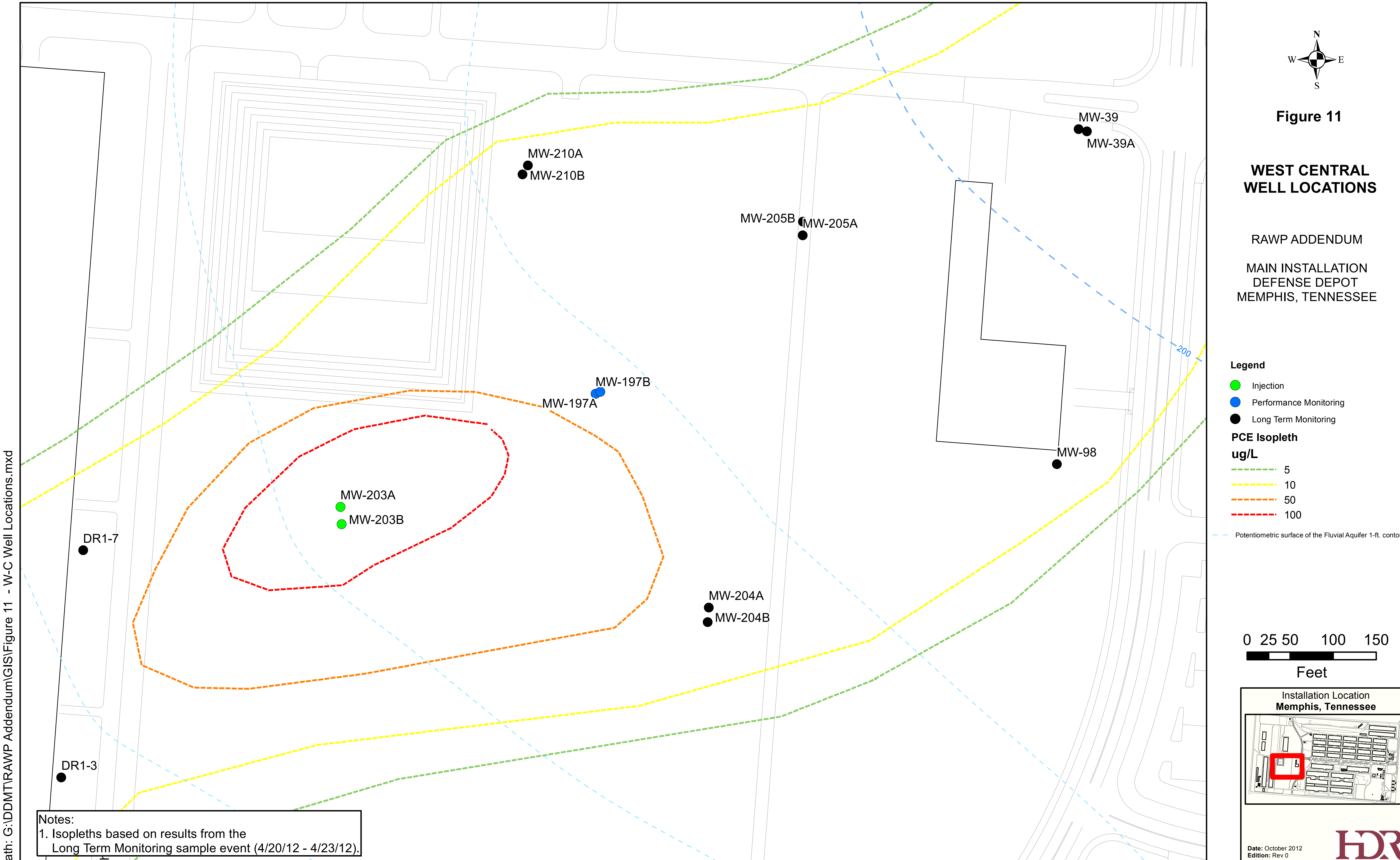
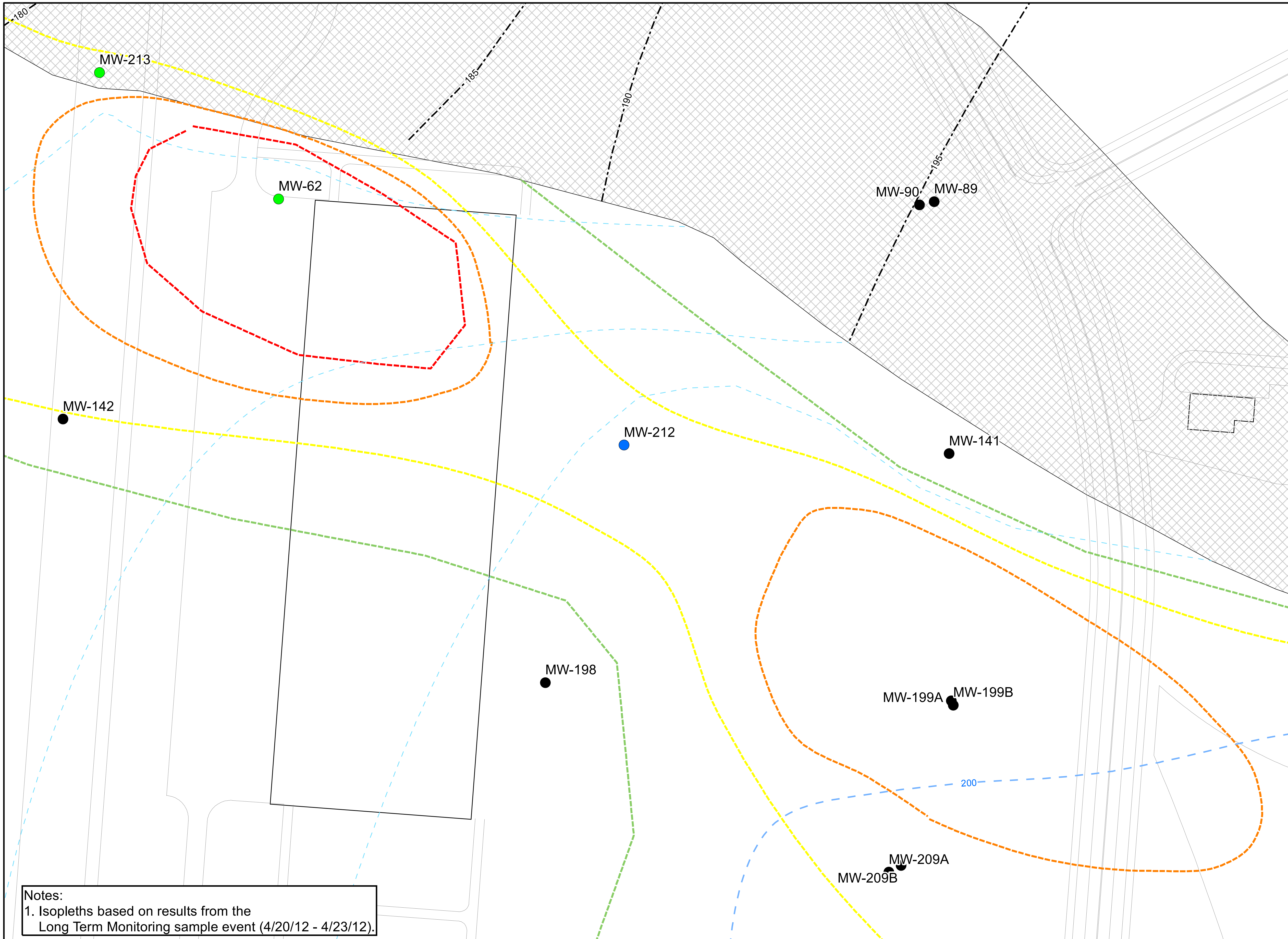


Figure 11

WEST CENTRAL
WELL LOCATIONS

RAWP ADDENDUM

MAIN INSTALLATION
DEFENSE DEPOT
MEMPHIS, TENNESSEE



N
W
E
S

Figure 12

BLDG. 835
WELL LOCATIONS

RAWP ADDENDUM

MAIN INSTALLATION
DEFENSE DEPOT
MEMPHIS, TENNESSEE

Legend

- Injection
- Performance Monitoring
- Long Term Monitoring

TCE Isopleth
ug/L

- 5
- 10
- 50
- 100

Potentiometric surface of the Fluvial Aquifer 1-ft. contour

0 25 50 100 150
Feet

Installation Location
Memphis, Tennessee

Date: October 2012
Edition: Rev 0

HDR

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APPENDIX A

EBT YEAR 2 MONITORING DATA

TABLE 4
YEAR TWO ORP MEASUREMENTS - TTA-1, MW-21 AREA
INTERIM REMEDIAL ACTION COMPLETION REPORT
Main Installation - Defense Depot Memphis, Tennessee

	FIFTH QUARTER			SIXTH QUARTER			SEVENTH QUARTER			EIGHTH QUARTER			NINTH QUARTER			TENTH QUARTER			FINAL
Injection Wells	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	
Well ID	**9/24/2007**	**10/23/2007**	**11/27/2007**	**12/19/2007**	**1/30/2008**	**2/28/2008**	**3/24/2008**	**4/30/2008**	**5/29/2008**	**6/23/2008**	**7/28/2008**	**8/28/2008**	**9/24/2008**	**10/29/2008**	**11/21/2008**	**12/18/2008**	**1/23/2009**	**2/16/2009**	**3/12/2009**
IW21-01A	-54	-187	-205	-94	-184	-207	-136	-75	-62	-31	-183	-87	-223	-91	-211	-73	-205	-267	-60
IW21-01B	-78	-158	-206	-103	-136	-164	-75	-157	-60	-28	-85	-169	-166	-111	-275	-87	-119	-101	-84
IW21-02A	75	-37	-31	-25	45	49	-157	-18	54	-8	25	-51	-142	-51	-144	-17	-139	-234	41
IW21-02B	4	-107	16	-76	116	96	-106	62	-14	8	-127	-121	-68	11	-406	-52	-231	-265	-121
IW21-03A	72	9	39	39	95	122	12	85	34	2	34	-190	-136	-113	-229	-47	-162	-222	-17
IW21-03B	-88	-171	-202	-129	-129	-209	-131	-93	-86	-84	-158	-177	-192	-240	-347	-41	-187	-186	-23
IW21-04A	12	-167	-105	-46	-150	-215	-184	-29	-92	-89	-173	-106	-204	-110	-250	-168	-230	-275	-11
IW21-04B	103	-205	-35	-22	-137	-209	-146	-91	-106	-22	-138	-207	-109	-9	-210	-96	-226	-239	-33
IW21-05A	26	-138	-234	-72	-122	-167	-142	-153	-74	-30	-168	19	-192	-176	-292	-126	-152	-244	-129
IW21-05B	-10	-121	-147	-110	-43	-186	-175	-20	-98	-122	-91	-114	-175	-87	-196	-160	-193	-264	-80
Average	**6**	**-128**	**-111**	**-64**	**-65**	**-109**	**-124**	**-49**	**-50**	**-40**	**-106**	**-120**	**-161**	**-98**	**-256**	**-87**	**-184**	**-230**	**-52**

Monitoring Wells	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	
Well ID	**9/24/2007**	**10/23/2007**	**11/27/2007**	**12/19/2007**	**1/30/2008**	**2/28/2008**	**3/24/2008**	**4/30/2008**	**5/29/2008**	**6/23/2008**	**7/28/2008**	**8/28/2008**	**9/24/2008**	**10/29/2008**	**11/21/2008**	**12/18/2008**	**1/23/2009**	**2/16/2009**	**2/16/2009**
PMW21-01*	154	2	213	177	164	163	74	151	108	161	97	14	72	69	-14	-32	-44	-46	0
PMW21-02*	176	202	231	158	183	192	129	172	160	162	87	-5	-2	33	-40	-25	-44	-26	31
PMW21-03	242	216	227	190	182	192	130	174	178	168	96	97	138	77	-50	-57	-64	-14	-9
PMW21-04*	158	211	209	173	184	193	110	176	182	148	129	10	55	-173	-17	-33	27	5	-15
PMW21-05	202	202	187	87	167	148	82	141	165	204	94	185	163	181	78	41	64	38	135
MW-115	-107	-18	158	78	167	188	97	170	184	137	62	81	11	-87	-74	-55	-9	-21	-35
MW-21	195	211	222	150	177	181	98	167	169	199	127	134	87	146	152	68	61	95	125
Average	**146**	**147**	**207**	**145**	**175**	**179**	**103**	**163**	**174**	**177**	**95**	**124**	**100**	**79**	**27**	**-1**	**13**	**25**	**54**

Aerobic	> 200 mV
Nitrate	-50 to 200 mV
Iron Red.	-220 to -50 mV
Sulfate Red.	-240 to -220 mV
Methanogenic	**< -240 MV**

Dates above reflect first day of lactate injection event
*Converted to Injection Well as of 4/30/2008

TABLE 5
YEAR TWO ORP MEASUREMENTS - TTA-1, MW-101 AREA
INTERIM REMEDIAL ACTION COMPLETION REPORT
Main Installation - Defense Depot Memphis, Tennessee

	FIFTH QUARTER			SIXTH QUARTER			SEVENTH QUARTER			EIGHTH QUARTER			NINTH QUARTER			TENTH QUARTER			FINAL
Injection Wells	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	
Well ID	**9/24/2007**	**10/23/2007**	**11/27/2007**	**12/19/2007**	**1/30/2008**	**2/28/2008**	**3/24/2008**	**4/30/2008**	**5/29/2008**	**6/23/2008**	**7/28/2008**	**8/28/2008**	**9/24/2008**	**10/29/2008**	**11/21/2008**	**12/18/2008**	**1/23/2009**	**2/16/2009**	**3/12/2009**
IW101-01A	-23	-132	-127	-104	-109	-178	-73	-70	-66	-13	-178	-33	-160	-45	-234	-149	-181	-184	-151
IW101-01B	-68	-187	-193	-132	-204	-181	-116	-120	-106	-42	-168	-256	-270	-45	-201	-169	-200	-244	-165
IW101-01C	-86	-13	-30	-118	48	52	-137	-150	-131	-50	46	-123	-62	16	-156	-134	-133	-200	-73
IW101-02A	-20	-153	-143	-163	-175	-207	-142	-197	-119	-128	-142	-99	-135	-22	-178	-157	-226	-284	-204
IW101-02B	110	-137	-83	-86	16	-242	69	-131	-319	-103	-141	-121	-313	-124	-203	-140	-344	-278	-199
IW101-02C	-96	-172	-186	-150	-86	-198	-177	-140	-117	-35	-114	-284	-219	-1	0	-123	-215	-211	-178
IW101-03A	-68	-176	-182	-80	-154	-184	-124	-95	-100	-30	-127	-90	-240	-17	-64	-129	-191	-239	-109
IW101-03B	33	3	-3	43	169	210	-106	-178	-25	-107	-149	-249	-201	-46	-180	-105	-241	-198	-91
IW101-03C	-27	-115	-125	-96	-127	-174	-121	-94	-92	-44	-113	-76	-205	33	-138	-72	-155	-138	-51
IW101-04A	-27	-166	-141	-102	-138	-196	-14	-83	-101	-51	-155	-119	-161	-67	-212	-199	-220	-315	-162
IW101-04B	-102	-149	-151	-96	-147	-170	-110	-41	-98	-20	-113	-252	-264	-88	-221	-142	-243	-222	-160
IW101-04C	-123	-40	-146	-86	-134	-56	-128	-106	-125	-20	-110	-135	-121	-128	-137	-96	-134	-185	-126
IW101-05A	-156	-155	-117	-32	-133	-163	-124	-78	-118	32	-149	-116	-204	-71	-211	-153	-212	-213	-163
IW101-05B	-33	-136	15	25	-43	39	60	-78	-137	155	115	-223	-122	-37	-178	-138	-171	-268	-192
IW101-05C	-104	-103	-46	-86	10	15	-142	-99	-76	-31	-101	-126	-74	3	-190	-122	-208	-178	-68
IW101-06A	-66	-106	-187	-23	-177	-224	-20	-107	-118	18	-130	-105	-140	-101	-187	-116	-208	-325	-98
IW101-06B	62	39	-30	12	118	40	-107	77	-27	64	-1	-189	-192	-32	-146	-72	-189	-198	-75
IW101-06C	-83	-112	-163	-61	-123	-188	-154	-98	-104	0	-163	-161	-48	3	-143	-75	-147	-165	-43
IW101-07A	-56	-181	-184	-42	-114	-209	-109	-141	-107	-75	-114	-250	-172	-30	-218	-100	-205	-249	-125
IW101-07B	-105	-208	-199	-90	5	-344	-127	-135	-139	-55	-252	-150	-229	-17	-193	-40	-186	-203	-154
IW101-07C	-41	-154	-151	-67	-148	-157	-121	-32	-37	16	-145	-90	-128	-5	-132	-69	-139	-133	-101
IW101-08A	-81	-129	-181	-52	-141	-208	-113	-95	-98	-21	-106	-196	-221	-124	-229	-146	-229	-225	-66
IW101-08B	-118	-158	-185	-116	-138	-179	-75	-183	-120	-126	-185	-116	-205	-98	-152	-115	-215	-217	-98
IW101-08C	-81	-137	-176	-58	-116	-162	-101	-124	-87	-40	.146.3	-182	-161	-40	-219	-66	-173	-380	-85
IW101-09A	-24	-200	-188	-6	-153	-207	-124	-202	-186	11	-132	-162	-273	-165	-302	-26	-315	-339	-225
IW101-09B	-69	-85	-146	-34	-108	-138	-33	-71	-128	-20	-169	-170	-168	-94	-179	-99	-155	-184	-106
IW101-09C	-15	-52	-101	-15	-60	-98	-87	-5	-33	73	-57	-64	-184	-41	-199	-89	-188	-315	-91
Average	**-54**	**-123**	**-131**	**-67**	**-87**	**-137**	**-95**	**-103**	**-108**	**-24**	**-117**	**-153**	**-180**	**-51**	**-178**	**-113**	**-201**	**-233**	**-124**

Monitoring Wells	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	
Well ID	**9/24/2007**	**10/23/2007**	**11/27/2007**	**12/19/2007**	**1/30/2008**	**2/28/2008**	**3/24/2008**	**4/30/2008**	**5/29/2008**	**6/23/2008**	**7/28/2008**	**8/28/2008**	**9/24/2008**	**10/29/2008**	**11/21/2008**	**12/18/2008**	**1/23/2009**	**2/16/2009**	**3/12/2009**
PMW101-01A	-166	-159	-158	-155	-127	-94	-99	-88	-45	-109	-81	-97	-121	-72	-122	-17	-108	-104	-50
PMW101-01B	-181	-98	-29	-95	-75	-47	-69	-34	-6	-68	-128	-71	-71	-51	-136	-93	-127	-99	-103
PMW101-02A	-181	-113	69	-146	-104	-47	-74	-22	53	-45	-55	-32	-18	0	-90	-84	-124	-81	-117
PMW101-02B	-143	129	-126	-126	-88	-67	-83	-58	-18	-103	-92	-81	-54	-34	-127	-101	-62	-87	-64
PMW101-03A	106	121	92	40	3	3	-11	4	7	-67	-73	-75	-64	-37	135	-100	-82	-82	-37
PMW101-03B	-77	-75	-6	-105	-77	-76	-16	-76	-43	-87	-104	-95	-87	-46	-141	-82	-81	-95	-56
PMW101-04A	-157	-129	-137	-175	-96	0	-138	9	99	-38	-33	-5	21	38	-78	-122	9	-65	-90
PMW101-04B	-87	-99	-13	-102	-80	-129	-65	-35	26	-32	-47	-28	-19	17	-43	-40	-10	-71	-97
PMW101-05A	-137	-122	-35	-121	-89	-14	-28	-56	-4	43	-68	-73	-56	-4	-59	-74	-68	-76	-105
PMW101-05B	-12	-5	-36	-65	-21	-4	34	5	73	50	-21	55	-6	67	-9	-36	6	-25	-82
PMW101-06A	95	137	185	58	50	120	48	51	111	102	31	-49	-17	28	-68	-61	-25	-30	-70
PMW101-06B	-135	-120	-27	-129	-86	-53	-18	-49	38	47	-73	-147	-74	-17	-70	-73	-62	-71	-66
PMW101-07A	-56	-72	63	-64	-10	2	12	85	109	87	57	-74	9	62	-42	-42	11	-44	-51
PMW101-07B	119	165	150	105	110	146	117	126	0	147	91	134	131	177	90	-14	120	-55	41
PMW101-08A*	26	95	189	52	46	120	84	105	20	16	76	-119	-1	74	-57	-5	-110	31	-70
PMW101-08B*	150	156	203	78	139	143	108	134	117	94	70	-2	-26	45	-68	-94	-103	-82	-49
MW101B	33	84	50	87	124	113	-110	-17	-89	47	81	72	-149	48	-273	-173	16	-228	-145
MW101T	104	38	3	124	69	43	71	-35	-16	158	121	89	-206	1	-225	-212	-18	-211	-126
DR1-3	-96	-86	-14	-30	-65	15	-41	26	86	44	7	-40	-24	12	-72	-51	-22	55	-17
Average	**-42**	**-8**	**22**	**-40**	**-20**	**9**	**-15**	**-10**	**22**	**10**	**-23**	**-31**	**-47**	**11**	**-78**	**-81**	**-37**	**-81**	**-73**

Aerobic	> 200 mV
Nitrate	-50 to 200 mV
Iron Red.	-220 to -50 mV
Sulfate Red.	-240 to -220 mV
Methanogenic	**< -240 MV**

Dates above reflect first day of lactate injection event
*Converted to Injection Well as of 4/30/2008
Note: MW101B and MW101T are two intervals in one well

TABLE 6
YEAR TWO ORP MEASUREMENTS - TTA-2
INTERIM REMEDIAL ACTION COMPLETION REPORT
Main Installation - Defense Depot Memphis, Tennessee

	FIFTH QUARTER			SIXTH QUARTER			SEVENTH QUARTER			EIGHTH QUARTER			NINTH QUARTER			TENTH QUARTER			FINAL
Injection Wells	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	
Well ID	**9/24/2007**	**10/23/2007**	**11/27/2007**	**12/19/2007**	**1/30/2008**	**2/28/2008**	**3/24/2008**	**4/30/2008**	**5/29/2008**	**6/23/2008**	**7/28/2008**	**8/28/2008**	**9/24/2008**	**10/29/2008**	**11/21/2008**	**12/18/2008**	**1/23/2009**	**2/16/2009**	**3/12/2009**
IW85-01	-74	-75	-197	25	-45	-158	-20	-35	26	-88	-114	-107	-181	-211	-388	-228	-164	-383	-345
IW85-02	-77	18	-183	-77	-66	-103	-32	-103	40	-98	-55	-135	-204	-219	-257	-163	-167	-227	-305
IW85-05	-30	21	-6	-40	-22	-183	15	-122	58	-69	-185	-77	-215	-135	-226	-24	-187	-199	-147
IW85-06	-38	-117	-181	-35	-74	-150	-72	-92	26	-95	-165	-144	-283	-113	-197	-168	-202	-222	-91
IW92-01	39	-152	-83	-45	-167	-238	-74	-75	-146	-31	-74	-317	-76	-15	-246	-42	-354	-246	-16
IW92-02	17	-53	-89	4	-134	-209	-46	-56	-88	-228	-165	-197	-165	-54	-167	-22	-320	-142	24
IW92-03	13	-136	-52	20	-118	-196	-41	-45	-56	-182	-140	-391	-224	2	-160	-75	-292	-94	-282
IW92-04	-58	-122	-70	15	-156	-177	-7	-59	-100	-160	-187	-381	-364	-227	-284	-54	-188	-379	-340
IW92-05	-45	-177	-103	-112	-179	-160	-73	-99	-152	-191	-255	-387	-244	-118	-183	-170	-75	-365	-343
IW92-06	-69	-119	-147	-81	-153	-144	-44	-110	-119	-230	-233	-255	-114	7	-376	-140	-223	-163	-337
IW92-07	-64	-88	-139	-13	-102	-139	-89	-38	-36	-151	-156	-108	-180	-151	-261	-102	-194	-197	-253
IW92-08	-92	-82	-126	2	-101	-147	-86	-85	-98	-108	-150	-117	-16	-234	-235	-71	-197	-163	-82
Average	**-40**	**-90**	**-115**	**-28**	**-110**	**-167**	**-47**	**-76**	**-54**	**-136**	**-157**	**-218**	**-189**	**-122**	**-248**	**-105**	**-214**	**-232**	**-210**

Monitoring Wells	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	
Well ID	**9/24/2007**	**10/23/2007**	**11/27/2007**	**12/19/2007**	**1/30/2008**	**2/28/2008**	**3/24/2008**	**4/30/2008**	**5/29/2008**	**6/23/2008**	**7/28/2008**	**8/28/2008**	**9/24/2008**	**10/29/2008**	**11/21/2008**	**12/18/2008**	**1/23/2009**	**2/16/2009**	**3/12/2009**
DR2-1	-1	98	157	116	63	112	27	108	190	70	99	161	163	136	-19	63	37	622	89
DR2-5	214	105	103	104	63	126	84	178	115	106	57	118	120	68	112	139	166	108	0
IW-01*	168	135	194	110	131	142	114	200	121	-74	-17	39	-9	-301	-238	-54	-129	-241	-143
MW-85	-8	-6	-94	-68	32	-18	-115	29	60	-111	1	60	120	108	97	-60	106	14	74
PMW85-01	22	73	60	99	17	86	-70	101	86	35	92	-63	37	-106	-81	-100	-16	-39	-44
PMW85-04	-102	-135	-117	-105	-57	-38	-123	14	-21	-103	-101	-58	-66	-138	-96	-98	-94	-94	-144
PMW85-05*	225	147	127	106	106	151	154	162	88	-46	-10	135	9	-97	-68	-387	60	-11	-18
PMW92-01*	184	17	180	146	48	151	102	132	68	161	-82	-96	-149	-361	-227	-337	-97	-333	-350
PMW92-02	-86	-159	-79	-108	-136	-104	-120	-63	-54	-228	-140	-117	-132	-180	-160	-115	-88	-157	-131
PMW92-03	41	-95	101	107	37	79	107	167	77	89	31	38	65	-28	24	54	20	-48	-35
PMW92-04	-40	31	-4	-29	-66	-30	-73	116	89	-136	-67	17	-2	-70	-37	-39	-14	-48	-18
PMW92-05*	217	153	147	191	153	97	127	179	152	112	115	-43	-24	-169	-137	-80	33	-156	-116
PMW92-06	-27	-7	-2	-81	-74	-60	-125	0	-18	-174	-115	-105	-118	-143	-160	-120	7	-84	-39
Average	**62**	**28**	**59**	**45**	**24**	**53**	**7**	**72**	**58**	**-50**	**-16**	**6**	**21**	**-39**	**-35**	**-31**	**14**	**30**	**-28**

Aerobic	> 200 mV
Nitrate	-50 to 200 mV
Iron Red.	-220 to -50 mV
Sulfate Red.	-240 to -220 mV
Methanogenic	**< -240 MV**

*Converted to Injection Well as of 4/30/2008
Dates above reflect first day of lactate injection event

TABLE 7
YEAR TWO CVOC CONCENTRATIONS - TTA-1, MW-21 AREA
INTERIM REMEDIAL ACTION COMPLETION REPORT
Main Installation - Defense Depot Memphis, Tennessee

Tetrachloroethene

	Baseline	EBT-5	EBT-6	EBT-7	EBT-8	EBT-9	Change*	Change*
Injection Well	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	%
IW21-01A	**234.0**	**30.9**	**20.7**	**21.7**	**4.5**	**3.4**	**-230.6**	**-99%**
IW21-01B	**144.0**	**0.7**	**1.5**	**<1**	**5.7**	**7.1**	**-136.9**	**-95%**
IW21-02A	99.7	156.0	151.0	119.0	62.9	111.0	11.3	11%
IW21-02B	80.2	67.1	76.3	68.0	18.6	10.7	-69.5	-87%
IW21-03A	**193.0**	**89.4**	**133.0**	**127.0**	**0.4**	**3.7**	**-189.3**	**-98%**
IW21-03B	49.4	36.6	31.4	24.2	<5	0.3	-49.1	-99%
IW21-04A	**276.0**	**19.2**	**10.5**	**32.4**	**5.5**	**8.8**	**-267.3**	**-97%**
IW21-04B	**286.0**	**4.6**	**1.5**	**2.4**	**<5**	**0.4**	**-285.6**	**-100%**
IW21-05A	83.6	12.4	9.8	9.7	<5	<1	-83.6	-100%
IW21-05B	41.5	26.8	16.9	12.2	3.1	2.1	-39.4	-95%
Monitoring Well	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	%
MW-21	**106**	178	173	154	192.0	**179.0**	**73.0**	**69%**
MW-115	10.1	9.81	8.94	8.89	9.5	10.8	0.7	7%
PMW21-01**	**156**	**130**	**193**	**114**	**73.3**	**23.5**	**-132.5**	**-85%**
PMW21-02**	**108**	**32.6**	**31.1**	**11.4**	**48.4**	**49.5**	**-58.5**	**-54%**
PMW21-03	**185**	**28.5**	**36.9**	**30.8**	**22.2**	**18.7**	**-166.3**	**-90%**
PMW21-04**	**199**	**93.4**	**93.9**	**90.9**	**16.2**	**13.5**	**-185.5**	**-93%**
PMW21-05	6.37	50.3	43.2	36.9	40.3	61.2	54.8	861%

Trichloroethene

	Baseline	EBT-5	EBT-6	EBT-7	EBT-8	EBT-9	Change*	Change*
Injection Well	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	%
IW21-01A	55.7	21.7	13.1	16.7	5.2	2.3	-53.4	-96%
IW21-01B	30.1	0.4	2.4	<1	2.9	4.0	-26.1	-87%
IW21-02A	17.0	26.0	23.2	21.6	13.9	17.8	0.8	5%
IW21-02B	14.8	6.6	6.9	5.8	2.1	1.8	-13.0	-88%
IW21-03A	56.1	29.6	42.6	42.9	<1	4.1	-52.0	-93%
IW21-03B	23.4	15.8	19.6	13.8	<5	1.3	-22.1	-94%
IW21-04A	64.5	9.5	5.8	14.4	3.9	7.8	-56.7	-88%
IW21-04B	56.4	3.6	2.8	2.2	1.3	1.0	-55.4	-98%
IW21-05A	30.8	7.0	7.1	7.8	<5	0.5	-30.3	-98%
IW21-05B	16.7	9.7	9.1	6.8	1.4	1.2	-15.5	-93%
Monitoring Well	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	%
MW-21	16.3	32.5	28.9	26.1	20.4	16.6	0.3	2%
MW-115	5.0	1.4	1.0	1.8	1.7	2.4	-2.5	-51%
PMW21-01**	40.6	39.5	54.2	32.2	23.9	7.6	-33.0	-81%
PMW21-02**	37.8	17.0	12.6	12.8	20.4	21.4	-16.4	-43%
PMW21-03	58.0	9.8	9.0	9.7	9.8	8.0	-50.0	-86%
PMW21-04**	87.7	49.0	47.0	55.5	5.8	5.5	-82.2	-94%
PMW21-05	34.4	18.2	34.6	10.3	10.4	13.0	-21.4	-62%

Notes
1) Wells with Baseline concentrations above 100 µg/L shown in bold.
2) * Change from Baseline through the 9th Quarter (EBT-9)
3) ** Converted to an Injection Well as of 4/30/2008

TABLE 7
YEAR TWO CVOC CONCENTRATIONS - TTA-1, MW-21 AREA
INTERIM REMEDIAL ACTION COMPLETION REPORT
Main Installation - Defense Depot Memphis, Tennessee

cis 1,2-Dichloroethene

Injection Well	Baseline µg/L	EBT-5 µg/L	EBT-6 µg/L	EBT-7 µg/L	EBT-8 µg/L	EBT-9 µg/L	Change* µg/L	Change* %
IW21-01A	3.2	88.2	80.2	91.4	75.2	104.0	100.8	3181%
IW21-01B	2.0	59.3	9.4	35.2	63.7	40.8	38.8	1950%
IW21-02A	1.8	6.7	14.3	15.8	24.1	38.6	36.8	2069%
IW21-02B	1.0	38.6	49.8	82.8	2.4	4.4	3.4	345%
IW21-03A	2.7	7.8	9.5	31.6	96.8	134.0	131.3	4845%
IW21-03B	0.9	13.5	10.1	21.8	16.1	34.0	33.1	3612%
IW21-04A	4.1	37.3	62.2	72.6	65.0	70.8	66.7	1614%
IW21-04B	3.6	5.4	15.4	22.0	22.0	16.7	13.1	368%
IW21-05A	1.6	25.6	30.9	38.5	7.1	12.8	11.3	726%
IW21-05B	0.8	20.2	19.5	17.8	10.0	10.6	9.8	1302%

Monitoring Well	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	%
MW-21	1.3	2.1	1.8	2.3	2.4	2.3	1.0	73%
MW-115	4.2	2.5	0.6	1.6	3.6	7.5	3.3	78%
PMW21-01**	2.0	2.2	2.6	1.9	1.8	1.3	-0.6	-33%
PMW21-02**	1.5	0.6	0.5	0.3	1.0	0.9	-0.6	-41%
PMW21-03	2.6	0.4	0.4	0.5	19.2	57.4	54.9	2151%
PMW21-04**	2.9	1.8	1.6	2.3	3.5	13.9	11.0	373%
PMW21-05	0.5	0.5	0.3	<1	0.9	1.5	0.9	180%

Notes
1) Wells with Baseline concentrations above 100 µg/L shown in bold.
2) * Change from Baseline through the 9th Quarter (EBT-9)
3) ** Converted to an Injection Well as of 4/30/2008

TABLE 8
YEAR TWO CVOC CONCENTRATIONS - TTA-1, MW-101 AREA
INTERIM REMEDIAL ACTION COMPLETION REPORT
Main Installation - Defense Depot Memphis, Tennessee

Tetrachloroethene

Injection Well	Baseline µg/L	EBT-5 µg/L	EBT-6 µg/L	EBT-7 µg/L	EBT-8 µg/L	EBT-9 µg/L	Change* µg/L	Change* %
IW101-01A	47.5	1.5	0.5	<1	<1	<1	-47.5	-100.0%
IW101-01B	71.8	1.4	0.4	1.1	1.9	0.3	-71.5	-99.6%
IW101-01C	**228.0**	**96.8**	**70.3**	**68.2**	**12.5**	**8.4**	**-219.6**	**-96.3%**
IW101-02A	**232.0**	**11.4**	**1.4**	**24.0**	**4.9**	**10.4**	**-221.6**	**-95.5%**
IW101-02B	**221.0**	**102.0**	**98.4**	**44.0**	**17.9**	**18.4**	**-202.6**	**-91.7%**
IW101-02C	**190.0**	**49.9**	**48.4**	**30.1**	**22.0**	**1.1**	**-188.9**	**-99.4%**
IW101-03A	4.0	13.3	17.8	14.2	0.9	1.0	-2.9	-74.4%
IW101-03B	89.9	88.4	86.2	17.6	9.3	16.1	-73.8	-82.1%
IW101-03C	59.0	25.8	15.3	17.5	11.2	2.4	-56.7	-96.0%
IW101-04A	**190.0**	**0.4**	**0.3**	**0.5**	**<1**	**<1**	**-190.0**	**-100.0%**
IW101-04B	**182.0**	**2.9**	**2.4**	**2.1**	**0.5**	**0.3**	**-181.7**	**-99.8%**
IW101-04C	**169.0**	**2.9**	**2.1**	**2.8**	**3.5**	**0.9**	**-168.1**	**-99.5%**
IW101-05A	63.1	10.5	8.9	10.1	7.4	5.2	-57.9	-91.8%
IW101-05B	**202.0**	**76.9**	**80.2**	**79.6**	**24.6**	**26.1**	**-175.9**	**-87.1%**
IW101-05C	**219.0**	**44.0**	**27.2**	**27.6**	**15.2**	**4.2**	**-214.8**	**-98.1%**
IW101-06A	6.8	22.4	17.7	12.3	1.5	1.1	-5.8	-84.6%
IW101-06B	47.0	50.8	50.3	20.8	17.2	6.3	-40.7	-86.6%
IW101-06C	66.2	10.4	6.0	5.3	10.6	5.7	-60.5	-91.4%
IW101-07A	5.2	8.6	9.3	6.1	1.9	1.1	-4.1	-78.7%
IW101-07B	38.0	2.1	1.4	1.6	3.0	6.0	-32.0	-84.2%
IW101-07C	60.9	24.2	2.0	<2	2.5	0.7	-60.2	-98.8%
IW101-08A	0.9	1.3	1.4	2.6	<1	<1	-0.9	-100.0%
IW101-08B	17.5	0.7	3.9	1.3	0.8	0.8	-16.7	-95.6%
IW101-08C	66.6	2.1	2.0	3.2	7.1	0.8	-65.8	-98.8%
IW101-09A	0.6	0.4	0.5	0.9	0.4	0.5	-0.1	-21.3%
IW101-09B	45.8	1.7	1.2	0.6	0.9	0.4	-45.4	-99.1%
IW101-09C	**101.0**	**13.4**	**4.6**	**5.3**	**3.4**	**1.0**	**-100.0**	**-99.0%**
Monitoring Well	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	%
DR1-3	45.7	0.9	2.1	3.0	2.6	2.4	-43.3	-94.7%
MW-101B	**239.0**	**120.0**	**81.3**	**78.9**	**47.0**	**55.6**	**-183.4**	**-76.7%**
MW-101T	**251.0**	**125.0**	**113.0**	**101.0**	**16.5**	**46.9**	**-204.1**	**-81.3%**
PMW101-01A	**110.0**	**1.4**	**2.3**	**1.8**	**2.4**	**1.6**	**-108.4**	**-98.6%**
PMW101-01B	**158.0**	**23.4**	**14.7**	**20.1**	**1.7**	**5.5**	**-152.5**	**-96.5%**
PMW101-02A	**257.0**	**13.9**	**20.3**	**24.5**	**24.0**	**5.2**	**-251.8**	**-98.0%**
PMW101-02B	**196.0**	**<1**	**<1**	**<1**	**4.0**	**27.0**	**-169.0**	**-86.2%**
PMW101-03A	**100.0**	**24.9**	**9.2**	**1.9**	**0.8**	**0.9**	**-99.1**	**-99.1%**
PMW101-03B	**144.0**	**13.8**	**8.6**	**3.3**	**5.8**	**10.4**	**-133.6**	**-92.8%**
PMW101-04A	**199.0**	**5.9**	**5.7**	**4.6**	**13.9**	**22.6**	**-176.4**	**-88.6%**
PMW101-04B	90.4	29.3	5.3	12.8	37.0	22.4	-68.0	-75.2%
PMW101-05A	**194.0**	**0.8**	**0.7**	**0.9**	**0.8**	**3.8**	**-190.2**	**-98.0%**
PMW101-05B	38.7	26.8	21.8	16.4	26.1	15.9	-22.8	-58.9%
PMW101-06A	4.2	7.2	7.1	5.5	0.3	1.2	-3.0	-71.9%
PMW101-06B	23.3	2.6	3.2	1.2	<1	<1	-23.3	-100.0%
PMW101-07A	0.6	0.3	0.4	0.3	0.5	0.4	-0.2	-30.6%
PMW101-07B	53.6	21.6	20.6	14.9	13.3	14.4	-39.2	-73.1%
PMW101-08A**	0.7	9.9	13.8	28.8	65.4	36.3	35.6	4838.8%
PMW101-08B**	46.6	39.8	34.7	43.2	25.4	10.9	-35.7	-76.6%

Trichloroethene

Injection Well	Baseline µg/L	EBT-5 µg/L	EBT-6 µg/L	EBT-7 µg/L	EBT-8 µg/L	EBT-9 µg/L	Change* µg/L	Change* %
IW101-01A	0.6	3.0	<1	<1	<1	<1	-0.6	-100.0%
IW101-01B	<1	0.8	0.4	1.0	0.6	<1	0.0	-
IW101-01C	0.9	7.0	6.7	6.7	22.1	19.9	19.0	2086.8%
IW101-02A	<1	5.5	0.9	5.6	2.8	3.1	3.1	-
IW101-02B	0.4	4.0	1.7	1.8	3.3	2.3	1.9	464.0%
IW101-02C	3.7	12.3	11.7	9.5	40.3	1.3	-2.5	-66.0%
IW101-03A	<1	4.2	4.3	4.2	0.5	0.4	0.4	-
IW101-03B	1.1	0.6	1.7	2.9	1.9	2.4	1.4	125.0%
IW101-03C	78.5	47.4	31.1	28.9	54.0	11.4	-67.1	-85.5%
IW101-04A	0.3	0.4	0.4	0.7	<1	<1	0.3	-100.0%
IW101-04B	0.3	2.0	1.8	1.6	0.6	0.5	0.2	66.9%
IW101-04C	29.7	13.3	8.2	12.4	13.4	2.9	-26.9	-90.4%
IW101-05A	<1	1.0	2.0	2.0	1.7	1.3	1.3	-
IW101-05B	0.3	2.5	1.9	1.6	6.8	4.7	4.4	1379.6%
IW101-05C	3.4	5.6	5.1	5.5	31.3	8.8	5.4	156.4%
IW101-06A	<1	2.3	2.4	2.1	0.9	0.5	0.5	-
IW101-06B	64.7	7.9	7.3	5.0	6.5	4.2	-60.5	-93.6%
IW101-06C	**204.0**	**29.2**	**15.7**	**13.3**	**48.7**	**33.4**	**-170.6**	**-83.6%**
IW101-07A	2.6	10.9	9.5	5.4	2.7	1.4	-1.2	-45.2%
IW101-07B	**138.0**	**7.0**	**4.4**	**4.1**	**9.9**	**23.5**	**-114.5**	**-83.0%**
IW101-07C	**207.0**	**100.0**	**7.3**	**2.6**	**5.9**	**1.9**	**-205.1**	**-99.1%**
IW101-08A	1.0	1.1	1.0	1.8	<1	<1	1.0	-100.0%
IW101-08B	51.0	0.7	1.8	1.5	2.5	1.8	-49.2	-96.4%
IW101-08C	**240.0**	**7.7**	**8.4**	**9.0**	**36.2**	**3.4**	**-236.6**	**-98.6%**
IW101-09A	0.3	0.3	0.3	0.9	<1	0.3	0.0	2.2%
IW101-09B	96.0	5.0	4.0	2.4	3.2	0.5	-95.5	-99.5%
IW101-09C	**316.0**	**46.5**	**18.2**	**20.4**	**13.8**	**4.2**	**-311.8**	**-98.7%**
Monitoring Well	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	%
DR1-3	4.2	0.3	1.3	2.0	1.3	1.3	-2.9	-69.9%
MW-101B	0.3	0.8	2.2	4.2	0.9	3.5	3.2	1104.8%
MW-101T	0.3	0.3	1.4	1.1	1.6	2.2	1.9	624.8%
PMW101-01A	<1	0.3	0.7	0.8	<1	<1	0.0	-
PMW101-01B	1.2	1.5	0.8	1.6	1.8	1.4	0.2	18.5%
PMW101-02A	0.3	1.3	3.9	6.0	2.3	<1	0.3	-100.0%
PMW101-02B	4.7	<1	<1	0.7	5.4	21.0	16.3	344.0%
PMW101-03A	<1	0.3	0.3	<1	<1	0.5	-0.5	-
PMW101-03B	2.4	1.6	1.1	1.0	1.0	3.3	0.9	37.3%
PMW101-04A	0.3	0.3	0.6	1.7	2.7	6.8	6.6	2526.9%
PMW101-04B	23.2	2.9	1.6	4.9	5.0	2.4	-20.8	-89.7%
PMW101-05A	<1	0.4	0.3	1.0	0.4	1.8	1.8	-
PMW101-05B	**151.0**	**116.0**	**85.3**	**60.7**	**77.8**	**50.0**	**-101.0**	**-66.9%**
PMW101-06A	<1	<1	0.3	<1	0.3	0.6	0.6	-
PMW101-06B	16.2	1.0	1.7	1.3	<1	<1	-16.2	-100.0%
PMW101-07A	0.8	<1	0.5	0.3	<1	<1	-0.8	-
PMW101-07B	**187.0**	**46.3**	**43.0**	**34.0**	**24.5**	**29.2**	**-157.8**	**-84.4%**
PMW101-08A**	<1	0.3	0.4	2.1	9.9	9.4	9.4	-
PMW101-08B**	**232.0**	**132.0**	**115.0**	**161.0**	**103.0**	**44.4**	**-187.6**	**-80.9%**

Notes
1) Wells with Baseline concentrations above 100 µg/L shown in bold.
2) * Change from Baseline through the 9th Quarter (EBT-9)
3) ** Converted to an Injection Well as of 4/30/2008

TABLE 8
YEAR TWO CVOC CONCENTRATIONS - TTA-1, MW-101 AREA
INTERIM REMEDIAL ACTION COMPLETION REPORT
Main Installation - Defense Depot Memphis, Tennessee

cis-1,2-Dichloroethene

Injection Well	Baseline µg/L	EBT-5 µg/L	EBT-6 µg/L	EBT-7 µg/L	EBT-8 µg/L	EBT-9 µg/L	Change* µg/L	Change* %
IW101-01A	<1	18.6	6.8	13.8	10.1	8.8	8.8	-
IW101-01B	0.3	27.6	24.3	23.1	21.7	19.4	19.1	7568%
IW101-01C	<1	21.3	21.8	15.7	75.5	110.0	110.0	-
IW101-02A	<1	64.7	48.5	46.2	47.9	42.7	42.7	-
IW101-02B	<1	20.6	12.6	13.2	39.5	44.2	44.2	-
IW101-02C	0.3	58.2	53.3	52.9	92.5	145.0	144.7	52627%
IW101-03A	<1	16.6	16.1	15.4	22.9	15.4	15.4	-
IW101-03B	<1	0.8	2.2	53.0	41.4	28.2	28.2	-
IW101-03C	3.0	63.6	89.8	86.4	207.0	184.0	181.0	5973%
IW101-04A	<1	32.0	26.1	33.3	23.2	17.7	17.7	-
IW101-04B	<1	46.5	42.3	44.5	45.2	35.5	35.5	-
IW101-04C	1.6	232.0	227.0	192.0	108.0	103.0	101.4	6258%
IW101-05A	<1	39.7	46.8	43.0	31.8	27.8	27.8	-
IW101-05B	<1	28.8	15.2	8.5	32.4	27.0	27.0	-
IW101-05C	0.3	70.7	76.6	69.7	127.0	136.0	135.7	47787%
IW101-06A	<1	3.3	5.0	9.3	14.0	9.8	9.8	-
IW101-06B	2.2	1.1	3.4	15.9	11.5	19.9	17.7	809%
IW101-06C	11.2	115.0	126.0	102.0	209.0	184.0	172.8	1543%
IW101-07A	<1	14.2	21.0	25.5	30.3	32.7	32.7	-
IW101-07B	5.6	109.0	119.0	111.0	176.0	155.0	149.4	2653%
IW101-07C	16.2	255.0	325.0	307.0	295.0	238.0	221.8	1369%
IW101-08A	0.3	21.2	22.2	17.2	37.8	43.7	43.4	13642%
IW101-08B	2.1	71.5	54.5	73.4	60.5	51.8	49.7	2378%
IW101-08C	19.9	250.0	287.0	311.0	236.0	167.0	147.1	739%
IW101-09A	<1	0.3	0.5	<1	<1	4.6	4.6	-
IW101-09B	5.4	166.0	187.0	150.0	138.0	86.2	80.8	1508%
IW101-09C	22.9	206.0	310.0	245.0	169.0	163.0	140.1	612%
Monitoring Well	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	%
DR1-3	<1	22.6	17.0	19.5	16.5	13.3	13.3	-
MW-101B	0.3	5.3	35.6	23.3	29.1	31.2	30.9	11083%
MW-101T	0.3	0.6	10.1	3.2	51.2	35.2	34.9	13133%
PMW101-01A	0.3	13.3	18.2	20.3	16.8	19.6	19.3	7526%
PMW101-01B	0.3	54.9	55.3	42.9	60.3	49.0	48.7	16233%
PMW101-02A	<1	58.7	48.0	37.7	31.2	37.7	37.7	-
PMW101-02B	0.3	101.0	87.7	96.1	55.0	35.2	34.9	10698%
PMW101-03A	<1	38.0	38.1	56.5	73.0	68.1	68.1	-
PMW101-03B	<1	87.6	87.6	86.8	60.8	58.1	58.1	-
PMW101-04A	<1	72.6	81.3	42.6	60.7	47.0	47.0	-
PMW101-04B	1.0	48.1	69.3	52.2	26.0	37.2	36.2	3731%
PMW101-05A	<1	92.6	73.9	77.0	69.6	61.9	61.9	-
PMW101-05B	8.9	89.8	76.2	70.6	57.4	72.1	63.3	715%
PMW101-06A	<1	0.4	0.9	0.4	3.6	1.7	1.7	-
PMW101-06B	0.7	40.5	45.8	39.3	31.9	25.5	24.8	3612%
PMW101-07A	0.3	0.4	0.3	<1	<1	<1	-0.3	-100%
PMW101-07B	14.6	1.6	1.7	5.5	1.4	1.7	-12.9	-88%
PMW101-08A**	0.3	<1	<1	3.6	7.2	23.1	23.1	7921%
PMW101-08B**	12.8	4.9	3.9	15.4	172.0	155.0	142.2	1111%

Notes
1) Wells with Baseline concentrations above 100 µg/L shown in bold.
2) * Change from Baseline through the 9th Quarter (EBT-9)
3) ** Converted to an Injection Well as of 4/30/2008

TABLE 9
YEAR TWO CVOC CONCENTRATIONS - TTA-2
INTERIM REMEDIAL ACTION COMPLETION REPORT
Main Installation - Defense Depot Memphis, Tennessee

Tetrachloroethene

Injection Well	Baseline µg/L	EBT-5 µg/L	EBT-6 µg/L	EBT-7 µg/L	EBT-8 µg/L	EBT-9 µg/L	Change* µg/L	Change* %
IW85-01	79.2	23.4	40.0	27.7	10.6	4.8	-74.4	-93.9%
IW85-02	48.7	10.0	28.7	7.3	3.2	3.6	-45.1	-92.6%
IW85-05	-	31.2	45.0	1.4	8.3	1.9	-29.3	-94.0%
IW85-06	-	2.7	16.1	0.9	3.2	5.5	2.8	103.0%
IW92-01	**160.0**	**29.0**	**7.5**	**3.2**	**<5**	**0.3**	**-159.7**	**-99.8%**
IW92-02	**104.0**	**3.2**	**36.3**	**38.6**	**<5**	**0.4**	**-103.6**	**-99.6%**
IW92-03	**184.0**	**7.5**	**4.4**	**2.4**	**0.9**	**<1**	**-184.0**	**-100.0%**
IW92-04	**170.0**	**2.6**	**3.7**	**3.7**	**2.9**	**0.7**	**-169.3**	**-99.6%**
IW92-05	**194.0**	**8.3**	**18.9**	**13.3**	**6.6**	**1.4**	**-192.6**	**-99.3%**
IW92-06	51.2	21.7	24.9	6.9	7.4	3.6	-47.6	-92.9%
IW92-07	**196.0**	**20.1**	**6.8**	**15.7**	**4.3**	**0.7**	**-195.3**	**-99.7%**
IW92-08	**156.0**	**6.4**	**13.3**	**9.0**	**3.0**	**1.8**	**-154.2**	**-98.9%**
Monitoring Well	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	%
DR2-1	**176.0**	**192.0**	**33.7**	**50.7**	**137.0**	**150.0**	**-26.0**	**-14.8%**
DR2-5	54.2	57.3	49.5	41.7	48.9	114.0	59.8	110.3%
IW-01**	40.4	70.9	74.4	50.8	2.5	<10	-40.4	-100.0%
MW-85	74.8	21.0	14.4	22.0	36.4	33.9	-40.9	-54.7%
PMW85-01	79.6	30.7	16.3	19.3	22.5	0.9	-78.7	-98.9%
PMW85-04	-	4.0	2.9	3.6	0.9	1.3	-2.7	-67.7%
PMW85-05**	**-**	**127.0**	**138.0**	**126.0**	**71.0**	**30.5**	**-96.5**	**-76.0%**
PMW92-01**	73.0	79.5	90.0	24.8	5.3	<10	-73.0	-100.0%
PMW92-02	**157.0**	**<1**	**<1**	**<1**	**<1**	**<1**	**-157.0**	**-100.0%**
PMW92-03	**252.0**	**30.9**	**30.8**	**27.1**	**33.3**	**15.6**	**-236.4**	**-93.8%**
PMW92-04	**165.0**	**12.1**	**19.8**	**8.8**	**14.0**	**5.0**	**-160.0**	**-97.0%**
PMW92-05**	**223.0**	**178.0**	**173.0**	**168.0**	**55.2**	**33.9**	**-189.1**	**-84.8%**
PMW92-06	**179.0**	**6.8**	**2.0**	**0.8**	**0.7**	**3.9**	**-175.1**	**-97.8%**

Trichloroethene

Injection Well	Baseline µg/L	EBT-5 µg/L	EBT-6 µg/L	EBT-7 µg/L	EBT-8 µg/L	EBT-9 µg/L	Change* µg/L	Change* %
IW85-01	26.3	10.3	14.7	10.7	3.4	1.8	-24.5	-93.2%
IW85-02	15.5	5.1	10.2	3.4	2.1	2.0	-13.5	-87.0%
IW85-05	-	10.1	15.3	1.0	6.2	0.8	-9.3	-91.8%
IW85-06	-	0.7	6.4	<1	2.1	2.7	2.0	283.6%
IW92-01	6.4	9.5	2.8	2.3	<5	<1	-6.4	-100.6%
IW92-02	4.0	0.9	2.7	8.6	<5	<1	-4.0	-99.8%
IW92-03	6.8	1.9	1.4	1.6	<1	<1	-6.8	-99.4%
IW92-04	6.2	0.6	0.9	2.1	0.5	<2	-6.2	-100.6%
IW92-05	6.1	3.2	1.4	2.5	0.8	0.3	-5.8	-94.5%
IW92-06	2.6	5.7	4.2	3.6	0.9	0.4	-2.2	-85.4%
IW92-07	9.2	2.9	2.1	3.6	<5	0.3	-8.9	-96.9%
IW92-08	26.9	3.6	3.3	4.4	1.0	<5	-26.9	-100.0%
Monitoring Well	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	%
DR2-1	8.5	5.7	12.7	5.4	5.5	5.1	-3.4	-40.2%
DR2-5	18.3	18.9	17.5	13.7	17.0	35.0	16.7	91.3%
IW-01**	5.9	8.6	9.5	11.6	0.4	<10	-5.9	-100.9%
MW-85	25.1	9.2	7.0	10.4	14.4	11.6	-13.5	-53.8%
PMW85-01	26.1	10.1	6.6	7.7	7.3	<1	-26.1	-100.0%
PMW85-04	-	2.8	1.1	2.1	<1	<1	-2.8	-101.8%
PMW85-05**	-	39.3	38.7	34.5	26.6	14.8	-24.5	-62.3%
PMW92-01**	2.9	2.8	3.9	1.5	<1	<10	-2.9	-101.0%
PMW92-02	5.8	<1	<1	<1	<1	<1	-5.8	-99.8%
PMW92-03	11.5	6.9	4.7	8.8	12.7	6.0	-5.5	-47.9%
PMW92-04	7.8	1.6	2.0	2.1	2.4	0.9	-6.9	-88.3%
PMW92-05**	17.1	15.6	13.9	14.3	3.4	7.0	-10.1	-58.9%
PMW92-06	39.7	2.3	0.7	<1	<1	3.0	-36.7	-92.5%

Notes
1) Wells with Baseline concentrations above 100 µg/L shown in bold.
2) * Change from Baseline through the 9th Quarter (EBT-9)
3) ** Converted to an Injection Well as of 4/30/2008

TABLE 9
YEAR TWO CVOC CONCENTRATIONS - TTA-2
INTERIM REMEDIAL ACTION COMPLETION REPORT
Main Installation - Defense Depot Memphis, Tennessee

cis 1,2-Dichloroethene

Injection Well	Baseline µg/L	EBT-5 µg/L	EBT-6 µg/L	EBT-7 µg/L	EBT-8 µg/L	EBT-9 µg/L	Change* µg/L	Change* %
IW85-01	40.3	56.3	59.0	54.3	21.7	27.1	-13.2	-33%
IW85-02	29.4	40.7	57.3	53.3	42.6	46.0	16.6	56%
IW85-05	-	36.3	54.3	105.0	70.8	49.0	12.7	35%
IW85-06	-	94.2	68.8	65.6	36.7	37.8	-56.4	-60%
IW92-01	14.1	130.0	50.6	107.0	97.0	83.3	69.2	491%
IW92-02	10.4	123.0	37.6	90.5	139.0	126.0	115.6	1112%
IW92-03	9.3	107.0	53.0	63.9	147.0	50.0	40.7	437%
IW92-04	10.2	98.4	56.2	45.8	77.3	37.7	27.5	270%
IW92-05	5.9	39.4	9.9	10.0	20.7	11.7	5.8	99%
IW92-06	3.1	51.0	30.4	34.9	7.3	6.1	3.0	96%
IW92-07	13.3	76.7	104.0	67.5	52.3	32.9	19.6	147%
IW92-08	57.9	134.0	20.5	35.4	101.0	47.8	-10.1	-17%
Monitoring Well	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	%
DR2-1	17.0	7.7	86.4	38.1	9.1	7.6	-9.4	-55%
DR2-5	31.0	33.7	32.0	29.2	34.5	62.0	31.0	100%
IW-01**	**149.0**	**76.6**	**64.9**	**108.0**	**119.0**	**114.0**	**-35.0**	**-23%**
MW-85	26.1	51.0	59.2	39.1	7.5	7.3	-18.8	-72%
PMW85-01	28.3	12.2	79.3	18.3	29.8	50.4	22.1	78%
PMW85-04	-	92.3	107.0	107.0	99.2	89.3	-3.0	-3%
PMW85-05**	-	83.8	87.9	94.8	127.0	166.0	82.2	98%
PMW92-01**	4.7	38.3	27.0	19.4	5.6	4.4	-0.3	-6%
PMW92-02	10.9	123.0	87.7	130.0	99.2	124.0	113.1	1038%
PMW92-03	19.9	159.0	161.0	159.0	159.0	139.0	119.1	598%
PMW92-04	10.7	160.0	135.0	159.0	152.0	112.0	101.3	947%
PMW92-05**	26.2	27.3	23.8	25.2	33.9	87.5	61.3	234%
PMW92-06	91.4	150.0	179.0	178.0	193.0	200.0	108.6	119%

Notes
1) Wells with Baseline concentrations above 100 µg/L shown in bold.
2) * Change from Baseline through the 9th Quarter (EBT-9)
3) ** Converted to an Injection Well as of 4/30/2008

TABLE 9
YEAR TWO CVOC CONCENTRATIONS - TTA-2
INTERIM REMEDIAL ACTION COMPLETION REPORT
Main Installation - Defense Depot Memphis, Tennessee

Carbon Tetrachloride

Injection Well	Baseline µg/L	EBT-5 µg/L	EBT-6 µg/L	EBT-7 µg/L	EBT-8 µg/L	EBT-9 µg/L	Change* µg/L	Change* %
IW85-01	**168**	**43.4**	**31.2**	**21.5**	**<1**	**<1**	**-168.0**	**-100%**
IW85-02	71.4	14.3	38.6	9.5	<1	<1	-71.4	-100%
IW85-05	-	59.8	32.2	5.6	<1	<1	-59.8	-100%
IW85-06	-	0.665	27	<1	0.9	6.7	6.0	906%
IW92-01	22.7	1.28	0.808	<1	<5	<1	-22.7	-100%
IW92-02	13	0.295	5.18	3.7	<5	<1	-13.0	-100%
IW92-03	30.5	<1	<1	<1	<1	<1	-30.5	-100%
IW92-04	30	<1	<1	<2	<1	<2	-30.0	-100%
IW92-05	29.9	<1	<1	<1	<1	<1	-29.9	-100%
IW92-06	8.77	<1	<1	<1	<1	<1	-8.8	-100%
IW92-07	38.4	3.82	2.46	0.8	<5	<1	-38.4	-100%
IW92-08	**103**	**<1**	**2.42**	**<1**	**<1**	**<5**	**-103.0**	**-100%**
Monitoring Well	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**%**
DR2-1	32.3	15.5	1.26	2.8	20.4	22.7	-9.6	-30%
DR2-5	**142**	**138**	**114**	**103.0**	**112.0**	**206.0**	**64.0**	**45%**
IW-01**	9.79	16.1	16.6	8.4	<1	<10	-9.8	-100%
MW-85	**188**	**34.3**	**22.5**	**47.2**	**76.2**	**69.9**	**-118.1**	**-63%**
PMW85-01	**222**	**72.9**	**24.5**	**57.3**	**0.9**	**<1**	**-222.0**	**-100%**
PMW85-04	-	<1	0.407	1.0	0.7	0.4	0.4	-
PMW85-05**	-	158	154	143.0	44.5	5.1	-152.9	-97%
PMW92-01**	8.92	6.86	8.34	<1	<1	<10	-8.9	-100%
PMW92-02	19.8	<1	<1	<1	<1	<1	-19.8	-100%
PMW92-03	58.1	0.969	0.586	<1	<1	<1	-58.1	-100%
PMW92-04	33.1	1.51	1.85	1.0	1.3	<1	-33.1	-100%
PMW92-05**	77.5	51.6	58.5	62.7	0.8	2.4	-75.1	-97%
PMW92-06	**182**	**1.53**	**<1**	**<1**	**<1**	**<1**	**-182.0**	**-100%**

Chloroform

Injection Well	Baseline µg/L	EBT-5 µg/L	EBT-6 µg/L	EBT-7 µg/L	EBT-8 µg/L	EBT-9 µg/L	Change* µg/L	Change* %
IW85-01	51.8	58.0	79.3	81.7	18.6	10.4	-41.4	-80%
IW85-02	39.5	29.5	59.2	42.0	7.0	3.8	-35.7	-90%
IW85-05	-	87.4	143	36.4	37.8	3.9	-83.5	-95%
IW85-06	-	6.6	20.5	0.6	6.2	8.4	1.8	27%
IW92-01	7.8	11.9	5.75	9.1	<1.5	<0.3	-7.8	-100%
IW92-02	9.5	12.7	10.4	27.7	5.7	0.3	-9.2	-97%
IW92-03	12.8	7.8	4.03	3.4	<0.3	<0.3	-12.8	-100%
IW92-04	13.1	0.6	0.334	0.6	<0.3	<0.6	-13.1	-100%
IW92-05	18.5	0.8	2.72	0.3	<0.3	0.2	-18.3	-99%
IW92-06	7.6	0.6	0.992	<0.3	<0.3	<0.3	-7.6	-100%
IW92-07	21.0	5.8	7.65	5.9	3.3	<0.3	-21.0	-100%
IW92-08	68.9	26.4	33	11.4	7.2	1.0	-67.9	-99%
Monitoring Well	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**%**
DR2-1	9.91	11.3	4.19	5.8	9.2	7.5	-2.4	-24%
DR2-5	46.7	43.6	40.9	37.2	37.9	68.8	22.1	47%
IW-01**	8.72	8.36	11.5	10.8	0.3	1.5	-7.2	-83%
MW-85	43.8	51.5	38.6	8.0	9.8	8.5	-35.3	-81%
PMW85-01	58.9	41	36.3	29.9	78.0	0.5	-58.4	-99%
PMW85-04	-	61.7	9.37	6.6	0.8	0.5	-61.2	-
PMW85-05**	-	64.6	63.8	73.6	98.7	86.4	21.8	34%
PMW92-01**	5.59	8.46	7.6	1.9	0.4	<3	-5.6	-100%
PMW92-02	12.2	<0.3	<0.3	<0.3	<0.3	<0.3	-12.2	-100%
PMW92-03	19.2	3.12	0.994	0.5	0.2	<0.3	-19.2	-100%
PMW92-04	11.4	5.3	6.6	3.9	2.1	0.7	-10.7	-94%
PMW92-05**	28.8	22.6	20.5	24.7	5.7	14.4	-14.4	-50%
PMW92-06	82.7	78.7	22.9	1.11	<0.3	<0.3	-82.7	-100%

Notes
1) Wells with Baseline concentrations above 100 µg/L shown in bold.
2) * Change from Baseline through the 9th Quarter (EBT-9)
3) ** Converted to an Injection Well as of 4/30/2008

TABLE 10
CHANGE IN CVOC CONCENTRATIONS, EBT WELLS
INTERIM REMEDIAL ACTION COMPLETION REPORT
Main Installation - Defense Depot Memphis, Tennessee

PCE	MCL	**Baseline**				**EBT-9**				
	5 µg/L	Max	Min	Avg	No. of Wells Exceeding MCLs	Max	Min	Avg	No. of Wells Exceeding MCLs	Avg % Change
TTA-1, MW-21	IW	286	41.5	148.7	10	111	<1	11.2	7	-92.5%
	PMW	199	6.4	110.1	7	179	10.8	67.4	4	-38.8%
TTA-1, MW-101	IW	232	0.6	97.2	24	36.3	<1	5.7	11	-94.1%
	PMW	257	0.6	113.3	16	55.6	<1	13.9	9	-87.7%
TTA-2	IW	196	1.1	122.2	10	33.9	<1	5.6	3	-95.4%
	PMW	252	40.4	134	11	150	<1	36.1	5	-73.1%

TCE	MCL	**Baseline**				**EBT-9**				
	5 µg/L	Max	Min	Avg	No. of Wells Exceeding MCLs	Max	Min	Avg	No. of Wells Exceeding MCLs	Avg % Change
TTA-1, MW-21	IW	64.5	14.8	36.5	10	21.4	0.4	5.2	5	-85.8%
	PMW	87.7	5	40	6	16.6	2.4	10	3	-75.0%
TTA-1, MW-101	IW	316	0.3	53.4	10	44.4	<1	6.5	7	-87.8%
	PMW	232	0.3	32.9	5	29.2	<1	7.3	4	-77.8%
TTA-2	IW	26.9	2.6	10	8	14.8	<1	1.9	2	-81.0%
	PMW	39.7	2.9	15.3	10	35	<1	6.8	4	-55.6%

cDCE	MCL	**Baseline**				**EBT-9**				
	70 µg/L	Max	Min	Avg	No. of Wells Exceeding MCLs	Max	Min	Avg	No. of Wells Exceeding MCLs	Avg % Change
TTA-1, MW-21	IW	4.1	0.8	2.2	0	134	0.9	29.9	3	1259.1%
	PMW	4.2	0.5	2.2	0	57.4	1.5	17.2	0	681.8%
TTA-1, MW-101	IW	22.9	0.3	3.4	0	238	4.6	78.6	12	2211.8%
	PMW	14.6	0.3	2.2	0	72.1	<1	35	1	1490.9%
TTA-2	IW	57.9	0.7	17.7	0	166	4.4	58	5	227.7%
	PMW	149	4.7	37.8	2	200	7.3	88	5	132.8%

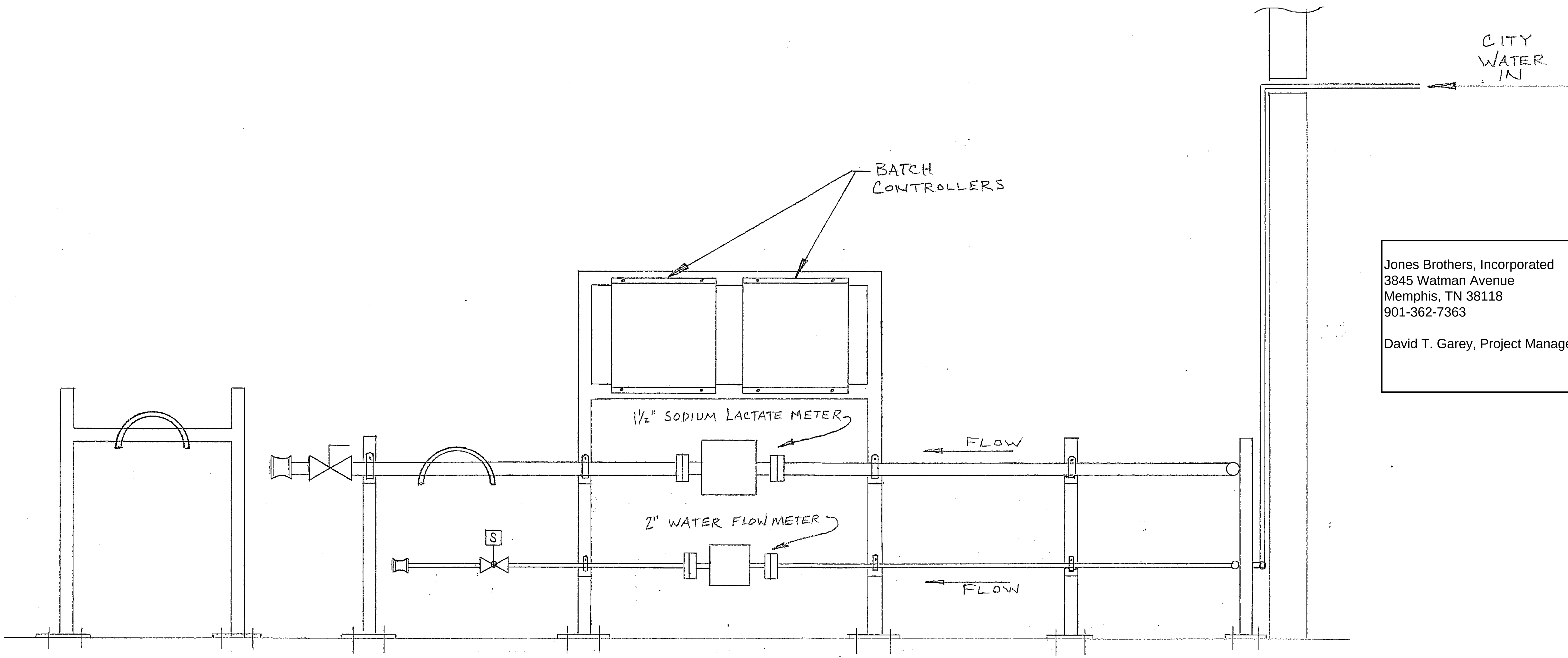
CT	MCL	**Baseline**				**EBT-9**				
	5 µg/L	Max	Min	Avg	No. of Wells Exceeding MCLs	Max	Min	Avg	No. of Wells Exceeding MCLs	Avg % Change
TTA-2	IW	168	2	47.1	10	6.7	<1	0.9	2	-98.1%
	PMW	222	8.9	88.5	11	206	<1	33.2	3	-62.5%

CF	MCL	**Baseline**				**EBT-9**				
	80 µg/L*	Max	Min	Avg	No. of Wells Exceeding MCLs	Max	Min	Avg	No. of Wells Exceeding MCLs	Avg % Change
TTA-2	IW	68.9	7	23.4	0	86.4	<.3	8.1	1	-65.4%
	PMW	82.7	5.6	29.8	1	68.8	<.3	9.6	0	-67.8%

Notes:
* MCL for total trihalomethanes shown.

APPENDIX B

AS-BUILT DRAWINGS AND SODIUM LACTATE FACT SHEETS

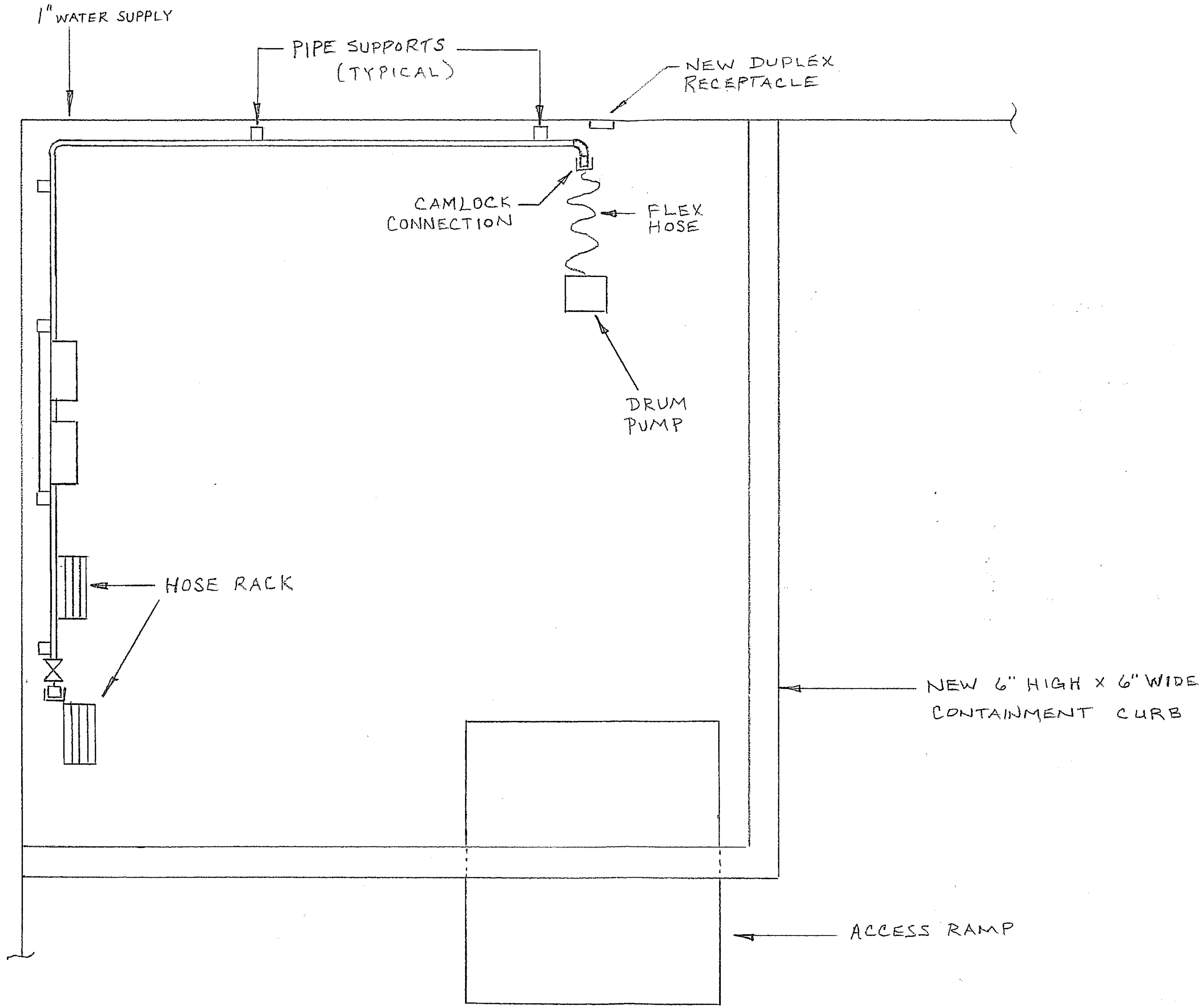


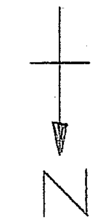
Jones Brothers, Incorporated
3845 Watman Avenue
Memphis, TN 38118
901-362-7363

David T. Garey, Project Manager

MEMPHIS ARMY DEPOT

LACTATE METERING SYSTEM



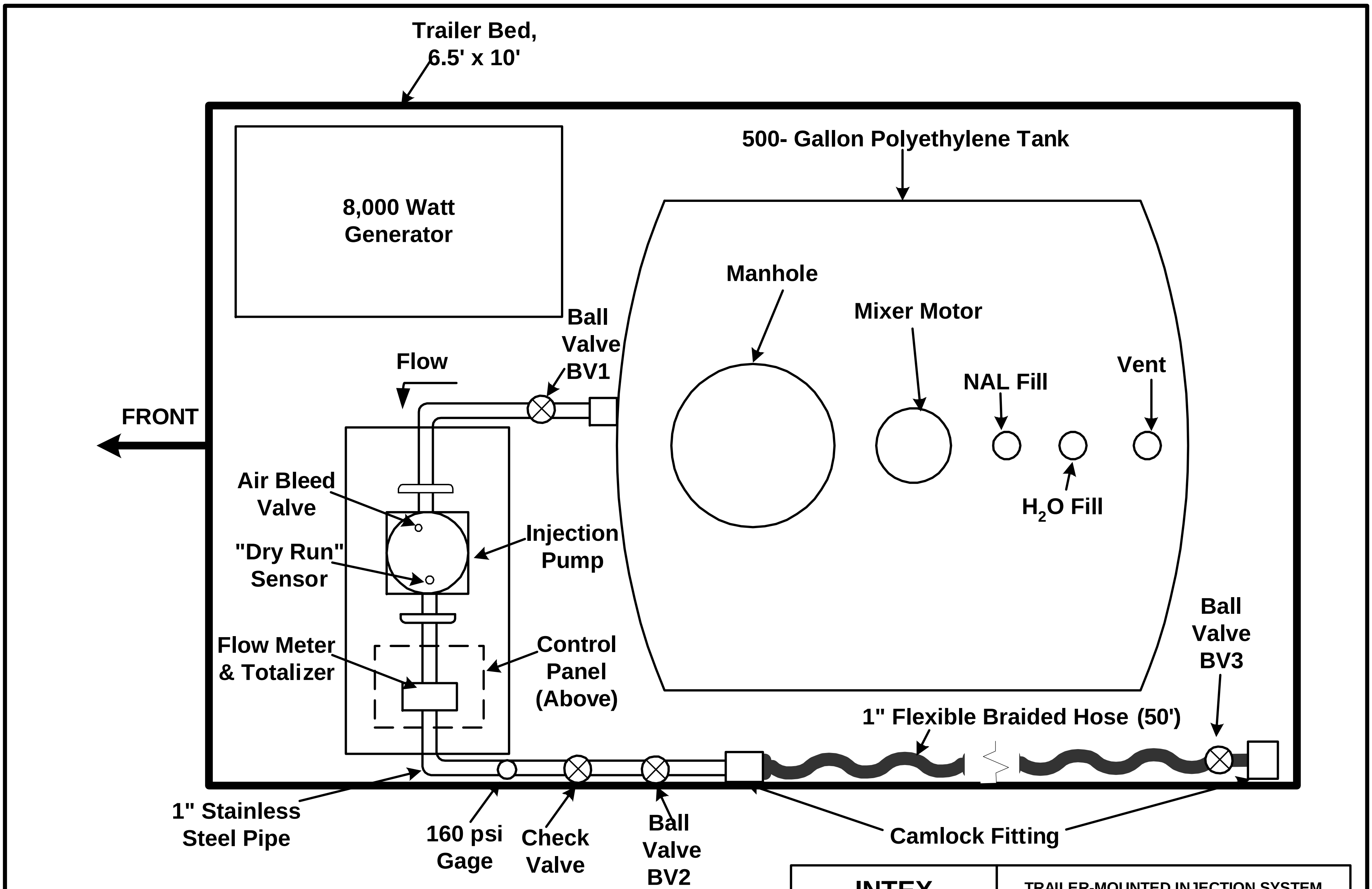


Jones Brothers, Incorporated
3845 Watman Avenue
Memphis, TN 38118
901-362-7363

David T. Garey, Project Manager

MEMPHIS DEPOT

SODIUM LACTATE ADDITION FACILITY



INTEX Environmental Group, Inc 6205 Easton Road Pipersville, PA 18947 215-766-7230 fax 215-766-9730 info@intexenv.com	TRAILER-MOUNTED INJECTION SYSTEM SCHEMATIC DIAGRAM		
	Figure 1		
	Drawn by: MOT	Date: JULY 2006	NOT TO SCALE

TANK.vsd

WILCLEAR® LACTATE CONCENTRATE

PROVEN ELECTRON DONOR EFFICIENCY AND DECHLORINATION KINETICS AT A LOW COST

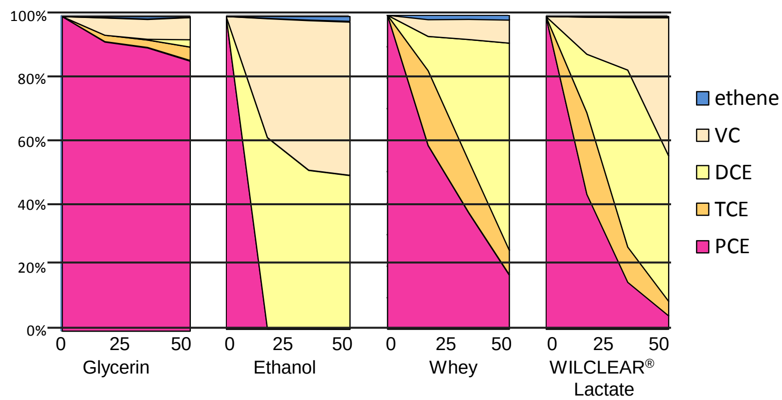
WILCLEAR® is a food grade 60% sodium or potassium lactate solution that has been deployed at U.S. Department of Energy sites and military installations, Superfund sites, mining sites, Brownfields, industrial sites, private chemical plants, and dry cleaners across North America and Europe. To date, WILCLEAR® has been used on over 250 projects in nearly every state in the US, including Hawaii and Alaska.

BENEFITS OF WILCLEAR®

- Provides carbon for rapid establishment of anaerobic conditions needed for reduction of nitrate, hexavalent chromium, perchlorate, and RDX.
- Miscibility in water and low viscosity allow for advective transport with groundwater; enhancing subsurface distribution and minimizing the number of injection points.
- Effective for both dissolved phase and DNAPL source area treatment.

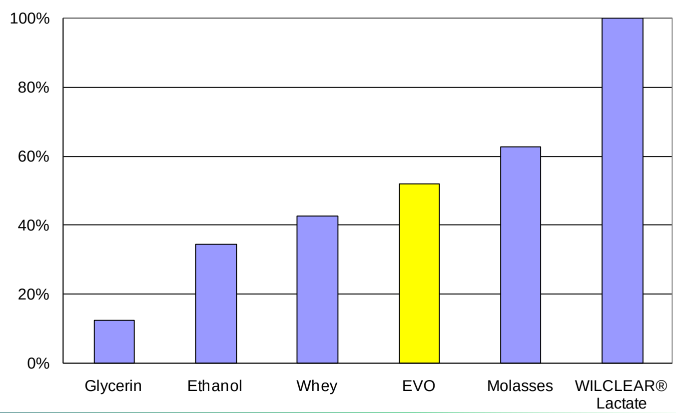
RAPID DECHLORINATION KINETICS

Microcosm studies comparing WILCLEAR® to other soluble donors show that while all four donors stimulate complete dechlorination of PCE to ethene, WILCLEAR® and ethanol have the fastest dechlorination kinetics.



GREATER DONOR EFFICIENCY

Efficiency (amount of contaminant remediated per unit donor added) should be considered when determining donor cost performance. Of the three donors that show both complete dechlorination and reasonable remediation rates, lactate has the best efficiency.



TYPICAL PROPERTIES

- WILCLEAR® sodium lactate (% wt/wt): 60 ± 1.2
- pH: 7 ± 1.0
- Viscosity: 110cP at 20ºC
- Specific gravity: 1.32 – 1.35
- Soluble in water
- Color: clear to light straw

JRW BIOREMEDIATION LLC

www.jrwbioremediation.com
(913)438-5544
info@jrwbiorem.com

WILCLEAR PLUS®
LACTATE w/ACCELERITE®

PROVEN ELECTRON DONOR EFFICIENCY AND RAPID DECHLORINATION KINETICS OF SODIUM LACTATE ENHANCED BY ACCELERITE® NUTRIENT BLEND

Wilclear Plus® lactate with Accelerite® is a proprietary blend of neutral pH fatty acids combined with Accelerite® nutrient blend for use in enhanced anaerobic reductive dechlorination. Wilclear Plus® contains 61% fermentable material providing a high fermentable fraction with minimum amount of water.

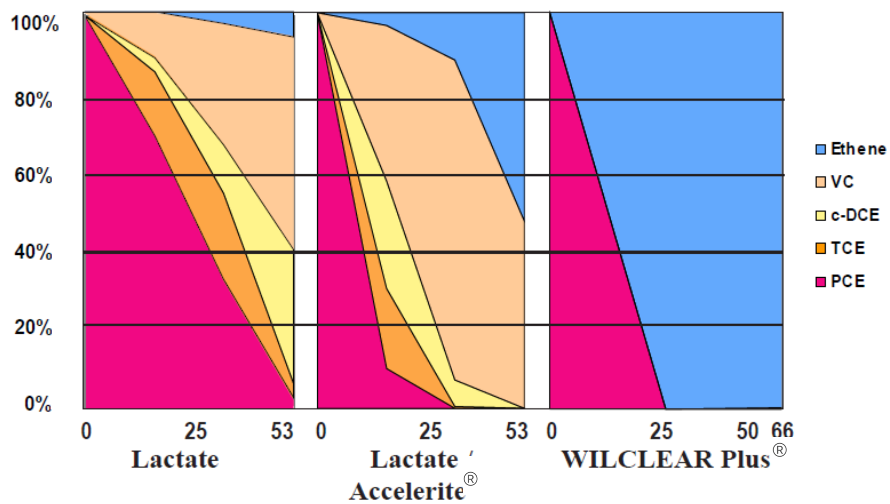
BENEFITS OF WILCLEAR PLUS®

Lactate provides carbon for rapid establishment of anaerobic conditions.

- Volatile fatty acids and fermentables provide a range of material to help promote the growth of an assortment of dechlorinating microbial populations.
- Accelerite® provides growth factors to increase efficiency and kinetics.

RAPID DECHLORINATION KINETICS

Microcosm studies comparing Wilclear Plus® to lactate and lactate plus Accelerite® showed that Wilclear Plus® demonstrated dechlorination kinetics faster than the other substrates. At 25 days, the Wilclear Plus® microcosm converted more than 99% of PCE to ethene.



TYPICAL PROPERTIES

- Sodium lactate (wt/wt): 29-35%
- Sodium propionate (wt/wt): 0-8%
- Sodium acetate (wt/wt): 0-8%
- Sodium butyrate (wt/wt): 0-8%
- Carbohydrates/metabolites (wt/wt): 21-25%

- pH: 7 ±1.0
- Viscosity: 500 - 1000cP at 20ºC
- Specific gravity: 1.2 - 1.3
- Soluble in water
- Color: light to dark brown

JRW BIOREMEDIATION LLC

www.jrwbioremediation.com
(913)438-5544
info@jrwbiorem.com

APPENDIX C

EBT FIELD FORMS

TABLE C-1
EBT TANK MIXING FORM
RAWP ADDENDUM
Main Installation - Defense Depot Memphis, Tennessee

Site Name: DDMT Injection Event: ____________ Project No.: ________________________

Date: _________

Tank No: _________ for Area: ______________ Injection Wells: __________________

Target Lactate Concentration (by vol): ____________

Lactate Type (circle): Wilclear™ or Wilclear Plus™ Other: __________________

Concentrate/Water Addition Time: Start: ______________ Finish: __________

Mixing Fluid Volumes (gal) - Concentrate: ______________ Water: __________

Fluid Mixing Time: Start: ______________ Finish: __________

Mixing Personnel: ____

Comments: ____

____

____

Form Completed by: __________________________ ______________

Signature **Date**

TABLE C-2
EBT INJECTION FORM
RAWP ADDENDUM
Main Installation - Defense Depot Memphis, Tennessee

Site Name: DDMT Injection Event: ____________ Project No.: ______________________

Well ID: ____________ Area: ____________ Tank No: ____________

Target Injection Volume: ________________ (gal) Lactate Concentration: ____________

Lactate Type (circle): Wilclear™ or Wilclear Plus™ Other: ______________________

Pre-Injection Groundwater Depth: ____________ (ft, btoc) Date/Time: ______________________

Injection Measurements Date: ____________

Time: Start: ____________ Finish: ____________

Duration (min): ____________

Injection Flow Rate (gpm): Start: ____________ Finish: ____________

Injection Pressure (psi): Start: ____________ Finish: ____________

Variations in Flow Rate, Pressure or Amperage: ____

Total Volume of Injection Fluid Delivered to Well (gal): ________________

Injection Personnel: ____

Comments: ____

Form Completed by: ____________________________ ____________
Signature **Date**

TABLE C-3
EBT PRE-INJECTION WATER LEVEL AND WELL ASSESSMENT FORM
RAWP ADDENDUM
Main Installation - Defense Depot Memphis, Tennessee

Sample Event:

Well ID	Plume	Depth to Top of Screen (ft. btoc)	Screen Length (ft)	Total Well Depth (ft. btoc)	Prev Water Depth (ft. btoc)	Date	Water Depth (ft. btoc)	Well Assessment
IW21-01A	TTA-1N	98.7	10	108.7				
IW21-01B	TTA-1N	89.9	10	99.9				
IW21-02A	TTA-1N	100.2	10	110.2				
IW21-02B	TTA-1N	91.7	10	101.7				
IW21-03A	TTA-1N	99.7	10	109.7				
IW21-03B	TTA-1N	89.8	10	99.8				
IW21-04A	TTA-1N	99.9	10	109.9				
IW21-04B	TTA-1N	89.7	10	99.7				
MW-21	TTA-1N	92.1	15	107.1				
PMW21-04	TTA-1N	89.0	20	109.0				
PMW21-01	TTA-1N	88.4	20	108.4				
PMW21-02	TTA-1N	91.3	20	111.3				
IW101-02A	TTA-1S	124.0	15	139.0				
IW101-02B	TTA-1S	110.1	15	125.1				
IW101-02C	TTA-1S	93.7	15	108.7				
IW101-03A	TTA-1S	125.2	15	140.2				
IW101-03B	TTA-1S	109.4	15	124.4				
IW101-03C	TTA-1S	93.6	15	108.6				
IW101-04A	TTA-1S	123.4	15	138.4				
IW101-04B	TTA-1S	107.0	15	122.0				
IW101-04C	TTA-1S	92.3	15	107.3				
IW101-05A	TTA-1S	121.4	15	136.4				
IW101-05B	TTA-1S	107.8	15	122.8				
IW101-05C	TTA-1S	92.2	15	107.2				
IW101-07A	TTA-1S	123.0	15	138.0				
IW101-07B	TTA-1S	106.6	15	121.6				
IW101-07C	TTA-1S	93.3	15	108.3				
DR1-5	TTA-1S	124.7	20	144.7				
DR1-5A	TTA-1S	90.1	20	110.1				
DR1-6	TTA-1S	114.2	20	134.2				
DR1-6A	TTA-1S	90.7	20	110.7				
PMW101-02A	TTA-1S	117.1	20	137.1				
PMW101-02B	TTA-1S	97.4	20	117.4				
PMW101-04A	TTA-1S	117.9	20	137.9				
PMW101-04B	TTA-1S	98.6	20	118.6				
PMW101-07A	TTA-1S	117.9	20	137.9				

TABLE C-3
EBT PRE-INJECTION WATER LEVEL AND WELL ASSESSMENT FORM
RAWP ADDENDUM
Main Installation - Defense Depot Memphis, Tennessee

Well ID	Plume	Depth to Top of Screen (ft. btoc)	Screen Length (ft)	Total Well Depth (ft. btoc)	Prev Water Depth (ft. btoc)	Date	Water Depth (ft. btoc)	Well Assessment
PMW101-07B	TTA-1S	98.0	20	118.0				
IW85-05	TTA-2	92.4	10	102.4				
IW85-06	TTA-2	95.5	10	105.5				
IW92-01	TTA-2	80.4	10	90.4				
IW92-02	TTA-2	79.5	10	89.5				
IW92-03	TTA-2	83.5	10	93.5				
IW92-07	TTA-2	87.8	10	97.8				
IW92-08	TTA-2	85.3	10	95.3				
DR2-2	TTA-2	78.5	15	93.5				
DR2-5	TTA-2	84.5	15	99.5				
MW-113	TTA-2	96.0	10	106.0				
PMW85-01	TTA-2	93.2	10	103.2				
PMW85-05	TTA-2	93.2	10	103.2				
PMW92-03	TTA-2	92.5	10	102.5				
MW-85	TTA-2	95.9	15	110.9				
MW-203A	W-C	142.8	15.0	157.8				
MW-203B	W-C	92.6	15.0	107.6				
MW-197A	W-C	161.7	15	176.7				
MW-197B	W-C	93.7	15	108.8				
MW-62	B-835	86.0	10	96.0				
MW-213	B-835	76.9	15.0	91.9				
MW-212	B-835	85.3	15	100.3				

Form Completed by: ____________________ ____________

Signature **Date**

TABLE C-4
WATER QUALITY DATA COLLECTION FORM
RAWP ADDENDUM
Main Installation - Defense Depot Memphis, Tennessee

Site Name: DDMT Sample Event: ____________ Project No.: ____________________

Well ID: __________ Area: ____________ Samplers: ____________________

Sample Method: _______________

Duplicate Sample: Yes __ No __ Duplicate ID: __________

Sample Depth: _______________ (ft, btoc) Water Depth: __________ (ft, btoc)

Date: __________ Time Start: ____________ Finish: __________

Total Purge: _______________ vol units: ____________

Time (24 hour)	Amount purged (ml)	Water Depth (ft, btoc)	COND (mS/m)	TURB (NTU)	DO (mg/L)	TEMP (Cº)	ORP (mV)	pH

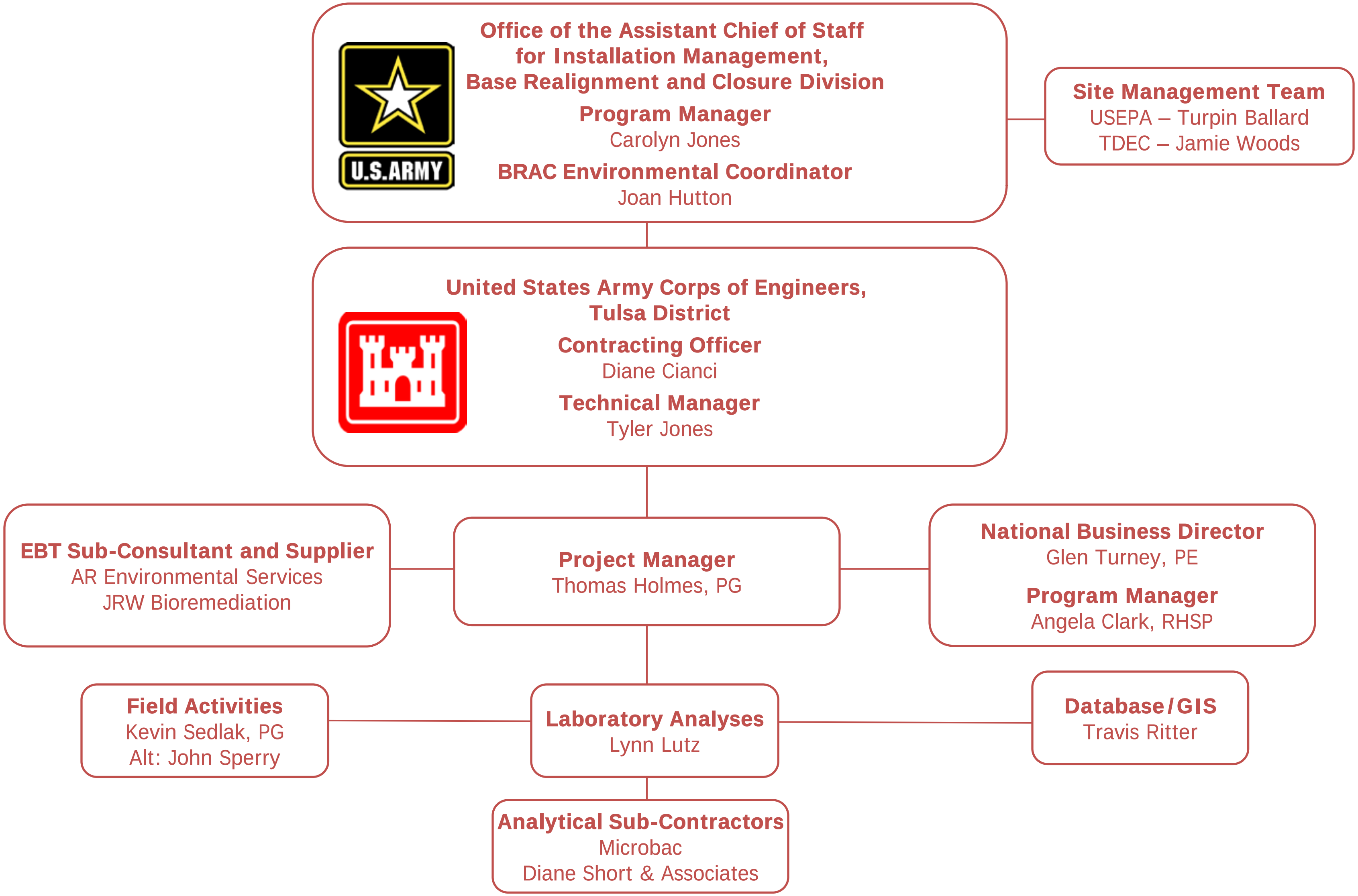
Avg purge rate: _______________

Comments: ____

Form Completed by: ____________________________ __________
Signature **Date**

APPENDIX D

ORGANIZATION CHART AND PROJECT SCHEDULE



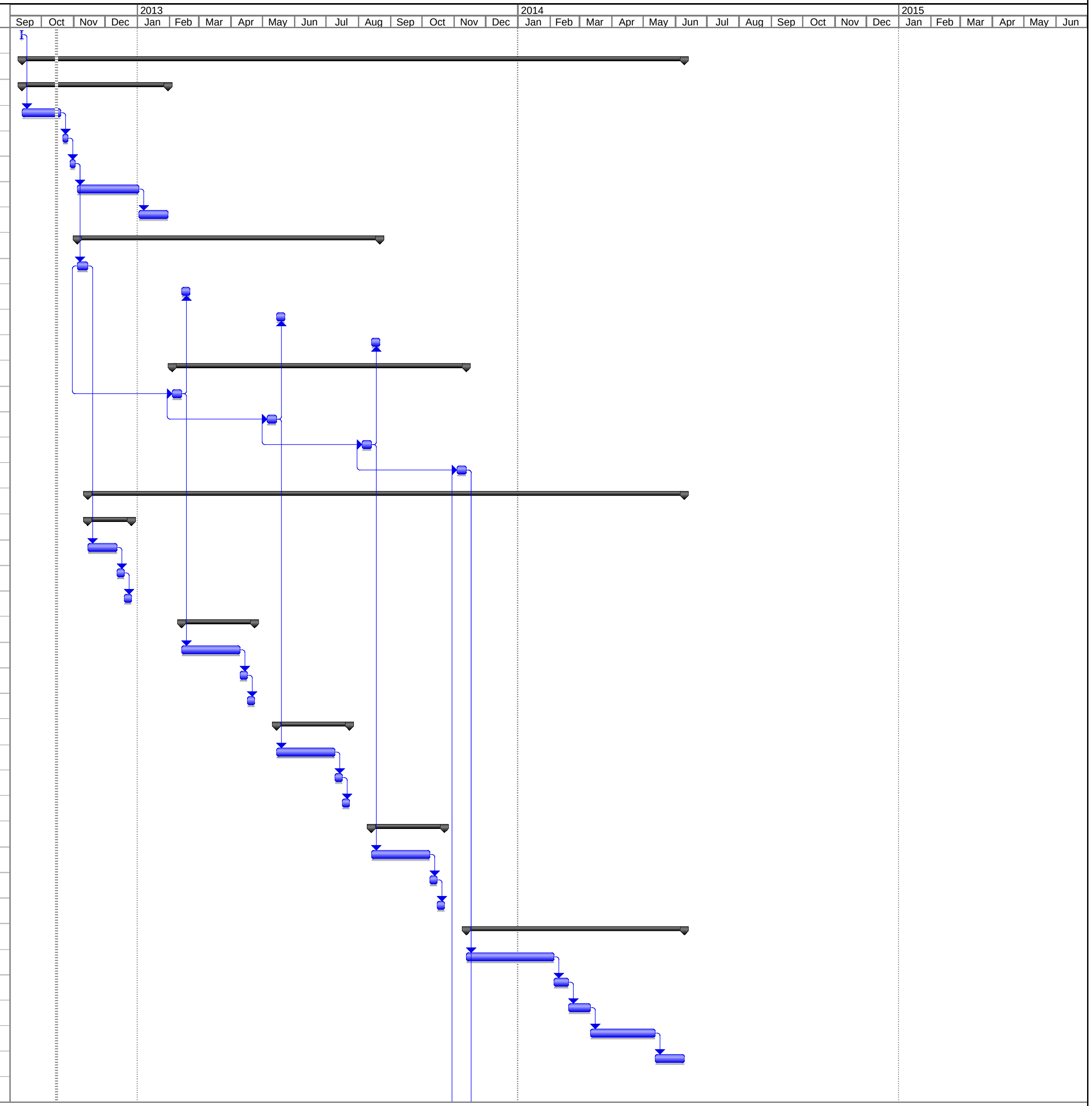
HDR | ONE COMPANY *Many Solutions*®

APPENDIX D

ORGANIZATION CHART
RAWP ADDENDUM
Main Installation - Defense Depot Memphis, Tennessee

Additional Enhanced Bioremediation Treatment
Main Installation - Defense Depot Memphis, Tennessee

ID	Task Name	Duration	Start	Finish	Predecessors
1	**Task Order Award - Base Tasks**	1 day	Wed 9/12/12	Wed 9/12/12	
2	**Task 2: Y1 EBT**	**453 days**	**Thu 9/13/12**	**Mon 6/9/14**	
3	**Task 2a: Y1 EBT Evaluation & Work Plan**	**100 days**	**Thu 9/13/12**	**Wed 1/30/13**	
4	Review Data, Prepare and Submit EBT WP Internal Draft	27 days	Thu 9/13/12	Fri 10/19/12	1
5	EBT WP - Army Review	5 days	Mon 10/22/12	Fri 10/26/12	4
6	Revise and Submit EBT WP Rev 0	5 days	Mon 10/29/12	Fri 11/2/12	5
7	EBT WP - EPA/TDEC Review	43 days	Mon 11/5/12	Wed 1/2/13	6
8	Revise and Submit EBT WP Rev 1	20 days	Thu 1/3/13	Wed 1/30/13	7
9	**Task 2b: Y1 EBT Injections**	**208 days**	**Mon 11/5/12**	**Wed 8/21/13**	
10	Quarterly Injection I-45	8 days	Mon 11/5/12	Wed 11/14/12	6
11	Quarterly Injection I-46	6 days	Wed 2/13/13	Wed 2/20/13	15
12	Quarterly Injection I-47	6 days	Wed 5/15/13	Wed 5/22/13	16
13	Quarterly Injection I-48	6 days	Wed 8/14/13	Wed 8/21/13	17
14	**Task 2c: Y1 EBT Sampling**	**202 days**	**Mon 2/4/13**	**Tue 11/12/13**	
15	Quarterly Sample EBT-11	7 days	Mon 2/4/13	Tue 2/12/13	10SS+65 days
16	Quarterly Sample EBT-12	7 days	Mon 5/6/13	Tue 5/14/13	15SS+65 days
17	Quarterly Sample EBT-13	7 days	Mon 8/5/13	Tue 8/13/13	16SS+65 days
18	Quarterly Sample EBT-14	7 days	Mon 11/4/13	Tue 11/12/13	17SS+65 days
19	**Task 2d: Y1 EBT Reports**	**408 days**	**Thu 11/15/12**	**Mon 6/9/14**	
20	**Quarterly Report I-45**	**30 days**	**Thu 11/15/12**	**Wed 12/26/12**	
21	Prepare and Submit Internal Draft	20 days	Thu 11/15/12	Wed 12/12/12	10
22	Army Review	5 days	Thu 12/13/12	Wed 12/19/12	21
23	Revise and Submit Rev 0	5 days	Thu 12/20/12	Wed 12/26/12	22
24	**Quarterly Report EBT-11/I-46**	**50 days**	**Wed 2/13/13**	**Tue 4/23/13**	
25	Prepare and Submit Internal Draft	40 days	Wed 2/13/13	Tue 4/9/13	15
26	Army Review	5 days	Wed 4/10/13	Tue 4/16/13	25
27	Revise and Submit Rev 0	5 days	Wed 4/17/13	Tue 4/23/13	26
28	**Quarterly Report EBT-12/I-47**	**50 days**	**Wed 5/15/13**	**Tue 7/23/13**	
29	Prepare and Submit Internal Draft	40 days	Wed 5/15/13	Tue 7/9/13	16
30	Army Review	5 days	Wed 7/10/13	Tue 7/16/13	29
31	Revise and Submit Rev 0	5 days	Wed 7/17/13	Tue 7/23/13	30
32	**Quarterly Report EBT-13/I-48**	**50 days**	**Wed 8/14/13**	**Tue 10/22/13**	
33	Prepare and Submit Internal Draft	40 days	Wed 8/14/13	Tue 10/8/13	17
34	Army Review	5 days	Wed 10/9/13	Tue 10/15/13	33
35	Revise and Submit Rev 0	5 days	Wed 10/16/13	Tue 10/22/13	34
36	**EBT Y1 Annual Report**	**149 days**	**Wed 11/13/13**	**Mon 6/9/14**	
37	Prepare and Submit EBT Y1 Internal Draft	60 days	Wed 11/13/13	Tue 2/4/14	18
38	EBT Y1 Report - Army Review	10 days	Wed 2/5/14	Tue 2/18/14	37
39	Revise and Submit EBT Y1 Rev 0	15 days	Wed 2/19/14	Tue 3/11/14	38
40	EBT Y1 Report - EPA/TDEC Review	44 days	Wed 3/12/14	Mon 5/12/14	39
41	Revise and Submit EBT Y1 Rev 1	20 days	Tue 5/13/14	Mon 6/9/14	40
42					



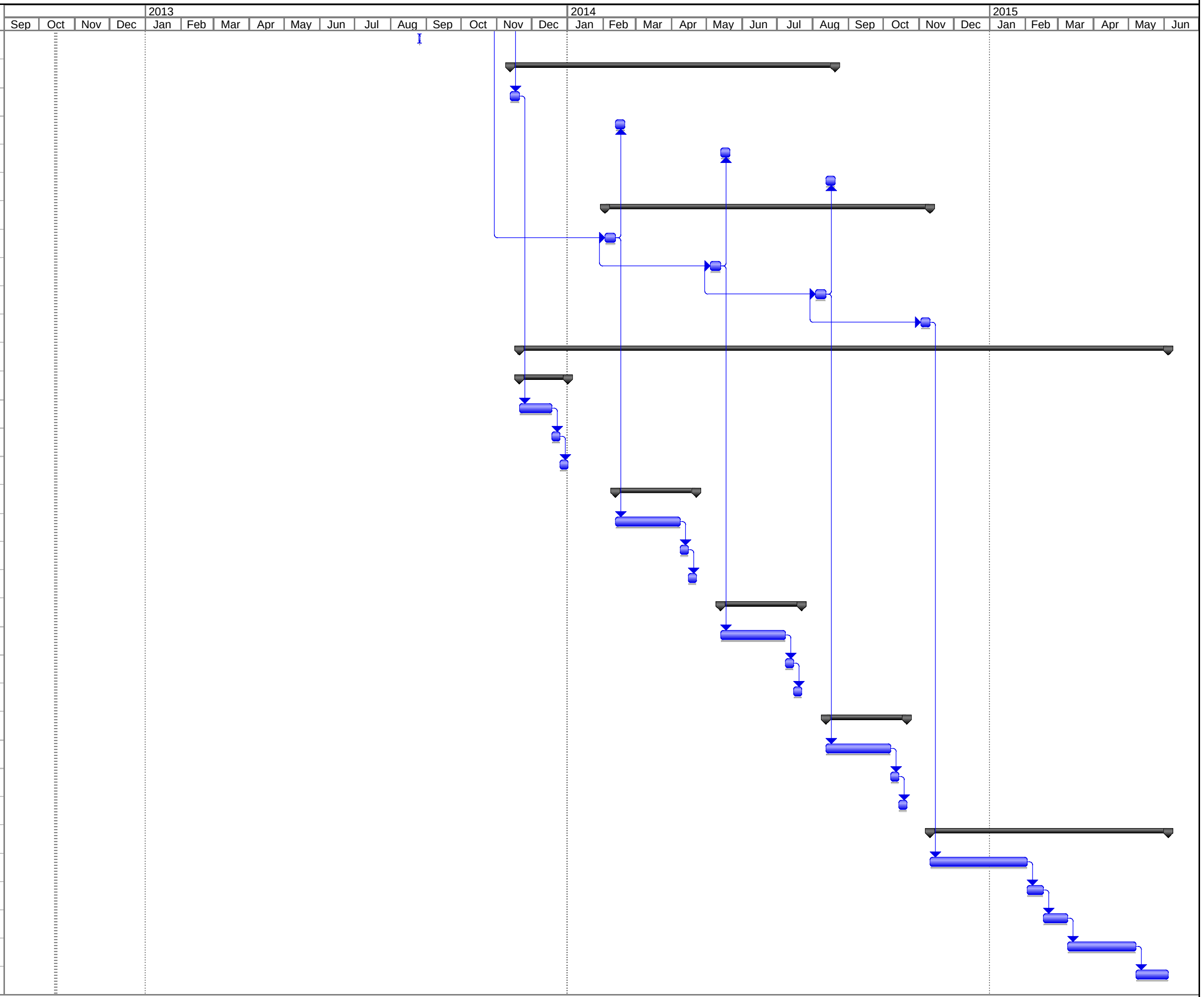
Project: DS01 PMP Project Schedule r
Date: Mon 10/15/12

Task	Progress	Summary	External Tasks
Split	Milestone	Project Summary	External Milestone

Deadline

Additional Enhanced Bioremediation Treatment
Main Installation - Defense Depot Memphis, Tennessee

ID	Task Name	Duration	Start	Finish	Predecessors
43	**Estimated Task Order Award - Y2 EBT Option**	1 day	Mon 8/26/13	Mon 8/26/13	
44	**Task 10b: Y2 EBT Injection**	**201 days**	**Wed 11/13/13**	**Wed 8/20/14**	
45	Quarterly Injection I-49	6 days	Wed 11/13/13	Wed 11/20/13	18
46	Quarterly Injection I-50	6 days	Wed 2/12/14	Wed 2/19/14	50
47	Quarterly Injection I-51	6 days	Wed 5/14/14	Wed 5/21/14	51
48	Quarterly Injection I-52	6 days	Wed 8/13/14	Wed 8/20/14	52
49	**Task 10c: Y2 EBT Sampling**	**201 days**	**Mon 2/3/14**	**Mon 11/10/14**	
50	Quarterly Sample EBT-15	7 days	Mon 2/3/14	Tue 2/11/14	18SS+65 days
51	Quarterly Sample EBT-16	7 days	Mon 5/5/14	Tue 5/13/14	50SS+65 days
52	Quarterly Sample EBT-17	7 days	Mon 8/4/14	Tue 8/12/14	51SS+65 days
53	Quarterly Sample EBT-18	6 days	Mon 11/3/14	Mon 11/10/14	52SS+65 days
54	**Task 10d: Y2 EBT Reports**	**401 days**	**Thu 11/21/13**	**Thu 6/4/15**	
55	**Quarterly Report I-49**	**30 days**	**Thu 11/21/13**	**Wed 1/1/14**	
56	Prepare and Submit Internal Draft	20 days	Thu 11/21/13	Wed 12/18/13	45
57	Army Review	5 days	Thu 12/19/13	Wed 12/25/13	56
58	Revise and Submit Rev 0	5 days	Thu 12/26/13	Wed 1/1/14	57
59	**Quarterly Report EBT-15/I-50**	**50 days**	**Wed 2/12/14**	**Tue 4/22/14**	
60	Prepare and Submit Internal Draft	40 days	Wed 2/12/14	Tue 4/8/14	50
61	Army Review	5 days	Wed 4/9/14	Tue 4/15/14	60
62	Revise and Submit Rev 0	5 days	Wed 4/16/14	Tue 4/22/14	61
63	**Quarterly Report EBT-16/I-51**	**50 days**	**Wed 5/14/14**	**Tue 7/22/14**	
64	Prepare and Submit Internal Draft	40 days	Wed 5/14/14	Tue 7/8/14	51
65	Army Review	5 days	Wed 7/9/14	Tue 7/15/14	64
66	Revise and Submit Rev 0	5 days	Wed 7/16/14	Tue 7/22/14	65
67	**Quarterly Report EBT-17/I-52**	**50 days**	**Wed 8/13/14**	**Tue 10/21/14**	
68	Prepare and Submit Internal Draft	40 days	Wed 8/13/14	Tue 10/7/14	52
69	Army Review	5 days	Wed 10/8/14	Tue 10/14/14	68
70	Revise and Submit Rev 0	5 days	Wed 10/15/14	Tue 10/21/14	69
71	**EBT Y2 Annual Report**	**148 days**	**Tue 11/11/14**	**Thu 6/4/15**	
72	Prepare and Submit EBT Y2 Internal Draft	60 days	Tue 11/11/14	Mon 2/2/15	53
73	EBT Y2 Report - Army Review	10 days	Tue 2/3/15	Mon 2/16/15	72
74	Revise and Submit EBT Y2 Rev 0	15 days	Tue 2/17/15	Mon 3/9/15	73
75	EBT Y2 Report - EPA/TDEC Review	43 days	Tue 3/10/15	Thu 5/7/15	74
76	Revise and Submit EBT Y2 Rev 1	20 days	Fri 5/8/15	Thu 6/4/15	75



Project: DS01 PMP Project Schedule r
Date: Mon 10/15/12

Task		Progress		Summary		External Tasks	Deadline
Split		Milestone		Project Summary		External Milestone	