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Memorandum

To: John Hill, CIV AFCEE/EXA
Carolyn Jones, DAIM-ODB

From: Kevin Sedlak
Tom Holmes

Date: 24 October 2011

Re: **Work Plan for Partial Abandonment of Enhanced Bioremediation Treatment System**
Main Installation - Defense Depot Memphis, Tennessee

HDR has prepared this work plan to describe plans for partial abandonment of the enhanced bioremediation treatment (EBT) system on the Main Installation (MI) at Defense Depot Memphis, Tennessee. This work plan was prepared for the Department of the Army (DA), Base Realignment and Closure Division (DAIM-ODB) under Contract FA8903-08-D-8771, Task Order 0069 to the Air Force Center for Environmental Excellence.

INTRODUCTION

Remedial action objectives (RAOs) and the selected remedy were presented in the *Memphis Depot Main Installation Record of Decision* (CH2M HILL, 2001). The RAOs included:

- reduce concentrations of chemicals of concern to maximum contaminant levels (MCLs) or lower; and
- prevent horizontal and vertical offsite migration of groundwater contaminants in excess of MCLs.

The selected remedy included:

- enhanced bioremediation of chlorinated volatile organic compounds (CVOCs) in the most contaminated part of the groundwater plume; and
- long-term groundwater monitoring to document changes in plume concentrations and to detect potential plume migration to off-site areas or into deeper aquifers.

Remedial Action

EBT system construction, operations and performance monitoring and long-term monitoring (LTM) from 2006 to 2009 were described in the *Interim Remedial Action Completion Report, Main Installation, Rev. 1* (IRACR) (HDR|e^{2}M, 2010), which included an Operating Properly and Successfully (OPS) demonstration. United States Environmental Protection Agency (USEPA) approved the OPS demonstration and the IRACR in March 2010.

EBT system construction included installation of 50 injection and 30 performance monitoring wells (PMWs), a lactate storage and transfer facility in Building 265 and two injection trailers; construction was completed in August 2006. Injection and performance monitoring wells in each target treatment area (TTA) are listed on Table 1 and the locations are shown on Figures 1 to 3.

EBT operations were performed from September 2006 through February 2009 and consisted of biweekly and then monthly injections of sodium lactate solutions with modifications to the solution and injection procedures over time. Groundwater monitoring consisted of EBT performance monitoring in the treatment areas and LTM throughout the MI. EBT performance monitoring incorporated the new injection and monitoring wells and 8 existing LTM wells near the treatment areas.

EBT injections were halted based on reduction in tetrachloroethene (PCE) and trichloroethene (TCE) concentrations in the treatment areas and the lack of significant contaminant concentrations in identified soil source areas. CVOC isopleths maps and trend analysis of LTM wells indicated plumes were stable and CVOC concentrations had decreased outside the EBT areas; offsite migration of CVOCs in excess of MCLs was not observed.

LTM

LTM was initiated in April 2004 and will continue until the RAOs for groundwater are achieved; the *Long-Term Groundwater Monitoring Plan* (LTM Plan) was included in the *Main Installation Final Remedial Design* (CH2MHILL, 2004). Existing wells are sampled semiannually, annually or biennially; new wells are sampled quarterly for one year prior to sample frequency selection. Recommendations for changes to LTM are presented in the annual LTM reports, as necessary. The latest recommendations for changes to LTM wells and sample frequency were made in the *Annual Long-Term Monitoring Report-2010, Main Installation Rev.0* (HDR, 2011), which was approved by Tennessee Department of Environment and Conservation in March 2011 and USEPA in April 2011.

Additional sentinel wells were installed in the Intermediate aquifer (IAQ) and the Memphis aquifer (MAQ) in June and July 2010 in accordance with recommendations in the IRACR. The hydrogeologic data from the new wells supported the conceptual model of a connection between the fluvial and deeper aquifers and indicated the wells were appropriately located to serve as sentinel wells for vertical migration of contaminants. The wells also delineated the extent of CVOCs in the IAQ and improved the LTM network's effectiveness in monitoring CVOC migration from the fluvial aquifer. The analytical results were consistent with the groundwater modeling described in the IRACR, which indicated the potential for low CVOC concentrations in the IAQ and MAQ at the MI.

Groundwater monitoring since completion of EBT in February 2009 has demonstrated rebound in concentrations of PCE, TCE and carbon tetrachloride (CT) in TTA-1 and TTA-2, and PCE concentrations above the MCL in the IAQ. However, the effect of EBT in TTA-1 was still apparent in the West-central plume; PCE concentrations in the plume and in sentinel well MW-90 decreased significantly in 2009 and remained at reduced concentrations in 2010. October 2010 isopleth maps for PCE and TCE are shown on Figures 4 and 5.

Planned Activities

MI EBT components were planned to be removed following a period of monitoring after injections were halted, but complete removal is not recommended at present due to

rebound in contaminant concentrations and potential for additional EBT. Baseline groundwater monitoring of injection and performance monitoring wells followed by abandonment of selected wells is planned.

Additional EBT may be implemented to improve progress toward groundwater RAOs thereby lessening the period of time required for LTM and decreasing potential for impacts to the MAQ. EBT would be performed in areas where individual CVOC concentrations of parent compounds (PCE, TCE and CT) exceed 100 micrograms per liter (µg/L); this would include TTA-1, TTA-2, the west-central plume and the Bldg 835 plume. Reduction of CVOC concentrations in the west-central plume and the sentinel wells would be a primary goal of additional EBT. The decision to re-start EBT will be made by DA following consultation with USEPA and TDEC.

Performance monitoring and LTM since EBT began in 2006 indicated significant migration and diffusion of carbon source material. Review of groundwater monitoring results in the *Annual Long-Term Monitoring Report-2009, Main Installation Rev.0* (HDR|e^{2}M, 2010) demonstrated the impact of EBT up to 2,000 feet downgradient of the treatment area. The appearance of cis-1,2 dichloroethene at the wells in the West-central plume following start-up of EBT injection in September 2006 indicated migration at 2 to 4 feet/day as compared to the calculated groundwater flow velocity of 0.3 feet/day based on average hydraulic conductivity, porosity and gradient. The observed increase in the area of reductive dechlorination indicates that using rows of injection wells in the treatment areas is not necessary as long as sufficient mass of carbon substrate is available.

Higher concentrations of sodium lactate in the injection solution can be used to provide an equivalent mass of carbon through fewer wells. In addition, injections in monitoring wells can be used to expand the treatment areas as done during Year 2 injections on the MI. Installation of additional injection wells is not planned.

If EBT is re-started, injection procedures will follow the same general approach as in Year 2:

- Use of injection wells and selected monitoring wells to increase the area being treated.
- Initial injection of 10 percent sodium lactate solution. Pre-injection oxidation reduction potential (ORP) measurements will be used to adjust the lactate concentration in later quarterly injections.
- Additives to sodium lactate (sugar and cellulose) or proprietary additives from supplier.

Baseline groundwater samples will be collected in TTA-1 and TTA-2 from the injection wells and performance monitoring wells not included in LTM. The wells to be sampled are listed on Table 2. Analytical results will be compared to past results to determine the level of rebound in contaminant concentrations as wells as the actual concentrations. Wells with greater rebound and higher concentrations will be retained for future injections and performance monitoring. Based on results of the initial EBT at the MI and approval of the OPS demonstration, performance monitoring in the treatment area would be limited with success of additional EBT determined through LTM outside the treatment areas. A summary report will be prepared following groundwater sampling to present the recommendations for well abandonment.

PROCEDURES

Groundwater Sampling

Baseline groundwater samples will be collected by low-flow sampling from 49 injection wells and 24 performance monitoring wells (Table 2). Well IW85-04 was installed in a perched zone and will not be sampled.

Groundwater sampling and analytical procedures are described in the *Remedial Action Operations and Long-term Monitoring Quality Assurance Project Plan* (QAPP) (HDR, 2011). Specific standard operating procedures (SOPs) to be utilized are included in Appendix A and listed below:

- SOP 1 General Procedures for Field Personnel
- SOP 2 Well Abandonment
- SOP 3 Groundwater Sampling
- SOP 5 Sample Control and Documentation
- SOP 6 Sample Packing and Shipping
- SOP 7 Sampling Equipment Decontamination

Preparation

Preparations for sampling activities are described in SOP 1. The primary activities are coordination with 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. Requirements for sample containers and preservation are provided in QAPP Worksheet #19.

Water Level Sweep

Water level measurements will be made in the wells prior to sampling. 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, by hand washing and rinsing with de-ionized water 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 condition of each well will be recorded, including the pad and locks, during the water level sweep. Replacement of well caps or locks, if necessary, will be made the same day.

Sampling

Baseline groundwater samples will be collected by low-flow sampling from 49 injection wells and 24 performance monitoring wells (Table 2). Groundwater sampling procedures are described in SOP 3.

Sampling will be performed by 2-person crews and supervised by the field team leader. Groundwater samples will be analyzed for volatile organic compounds (VOCs) by USEPA Method SW8260B.

Low-flow sampling is performed using a bladder pump with dedicated Teflon® bladder and Teflon®-lined polyethylene tubing. The majority of PMWs have dedicated pumps which remain in the wells between sample events. For wells without dedicated pumps, the bladder and tubing for the well are placed in sealed plastic bags after sampling and stored for future sample events.

The pumping rate at the well is set such that the water levels do not decline more than 4 inches. 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 for ORP, 10 percent for specific conductance, 10 percent for dissolved oxygen 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.

Where low-flow sampling cannot be used due to 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.

Equipment Decontamination

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.

Health and Safety

Health and safety during field activities will be monitored in accordance with the *Site Health and Safety Plan, Main Installation Source Area Investigation and BRAC Remedial Action Operations* Rev. 1 (e^2M, 2008).

Quality Assurance/Quality Control Samples

Quality Assurance/Quality Control (QA/QC) samples are described in the QAPP (Worksheet #20). 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 QA/QC samples included surrogate spikes, method blanks, laboratory control samples, in addition to MS/MSD analysis. The QC samples to be collected during the baseline event are listed on Table 3.

Sample Control and Shipping

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.

The samples will be sent to the subcontract laboratory, Microbac Laboratories in Marietta, Ohio, for VOC analysis by USEPA Method SW8260B.

Well Abandonment

Recommendations for well abandonment will be provided in a summary report following baseline sampling. Well abandonment will be performed as described in SOP 2.

The selected wells will be properly abandoned by a licensed Tennessee Well driller in accordance with Memphis Shelby County Health Department (MSCHD) regulations. The well locations will be provided in the summary report following baseline sampling with well construction data. Well abandonment will be observed by HDR field staff to confirm the work plan is followed.

The total depth of each well will be measured to confirm that obstructions will not interfere with abandonment. One-half gallon of bleach will be poured into each well in accordance with MSCHD regulations. Bentonite chips will be placed into the well to seal the screened section and absorb existing water in each well. The wells will then be filled with grout from the bentonite up until undiluted grout is visible at the surface. The grout will be tremied into the casing, keeping the side-discharge tremie pipe approximately 1 foot below the grout surface. Water displaced by the grout will be contained for proper disposal. After allowing at least two days for grout settlement, the grout will be topped off with concrete. The well casing will be cut down to 6-inches below ground surface. The area around each well will be restored to match surrounding area.

The driller will maintain a daily log of well abandonment activities including work performed, personnel and hours on site, problems encountered from site conditions or mechanical breakdown, and other information as appropriate. All downhole equipment will be decontaminated prior to use, according to procedures in the QAPP.

IDW Management

The waste generated during sampling and well abandonment will be classified as either non-investigative waste or investigative derived waste (IDW). Non-investigative waste, such as packaging materials, personal protective equipment and other inert refuse, will be collected, containerized, and transported to a designated collection bin for disposal at a municipal landfill.

The IDW consists of waste water from equipment decontamination and groundwater collected during purging and well abandonment. The waste water is collected and added to the fluvial soil vapor extraction condensate water storage tank on Dunn Field for analysis and appropriate discharge.

DATA QUALITY EVALUATION

Data quality evaluation (DQE) will be performed to evaluate the analytical data relative to the data quality objectives described in the QAPP. 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 QAPP for each analytical method performed. Upon final review the data will be incorporated into the project database. Laboratory quality control data and the DQE narratives will be included in the final report.

REPORTING

An initial summary report will be submitted after the baseline sample event. The report will include a brief introduction and scope of work, description of field activities, discussion of analytical results (prior to DQE) and a summary of findings. A second summary report will be prepared to document abandonment of approved wells.

TABLES

TABLE 1
WELL INSTALLATION SUMMARY
EBT SYSTEM ABANDONMENT WORK PLAN
Main Installation - Defense Depot Memphis, Tennessee

Well ID	Area	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, toc)	Date Measured	Depth to Top of Screen (ft, bgs)	Screen Length (ft)	Total Well Depth (ft, bgs)
IW101-01A	TTA-1	6/22/06	276256.66	801113.21	290.76	291.29	142	137	88.2	7/12/06	122.6	15	137.8
IW101-01B	TTA-1	6/27/06	276253.67	801115.21	290.70	291.34	126	NA	88.4	7/13/06	107.7	15	122.9
IW101-01C	TTA-1	6/28/06	276250.06	801117.88	290.66	291.52	112	NA	88.4	7/13/06	92.7	15	107.9
IW101-02A	TTA-1	7/6/05	276198.80	801107.92	291.12	291.60	146	139	88.5	7/20/06	124.5	15	139.6
IW101-02B	TTA-1	7/7/06	276200.62	801111.95	291.14	291.72	126	NA	88.5	7/21/06	110.6	15	125.8
IW101-02C	TTA-1	7/19/06	276203.32	801116.22	291.53	291.74	111	NA	88.1	7/26/06	93.9	15	109.1
IW101-03A	TTA-1	6/23/06	276164.62	801104.58	291.94	292.36	141	140.5	89.7	7/27/06	125.6	15	140.8
IW101-03B	TTA-1	6/27/06	276161.58	801106.45	291.91	292.51	126	NA	89.7	7/27/06	110.0	15	125.1
IW101-03C	TTA-1	6/28/06	276158.05	801108.62	292.04	292.54	111	NA	89.7	8/2/06	94.1	15	109.3
IW101-04A	TTA-1	6/13/06	276249.13	801142.39	291.72	292.18	142	138	89.3	7/10/06	123.9	15	139.0
IW101-04B	TTA-1	6/14/06	276252.94	801142.79	291.59	292.08	126	NA	89.5	7/10/06	107.5	15	122.7
IW101-04C	TTA-1	6/15/06	276257.10	801143.03	291.47	292.05	111	NA	89.3	6/26/06	92.8	15	108.0
IW101-05A	TTA-1	6/13/06	276214.93	801126.64	291.52	292.12	141	138	89.2	7/13/06	122.0	15	137.2
IW101-05B	TTA-1	6/14/06	276218.44	801125.04	291.41	292.06	126	NA	89.0	7/20/06	108.4	15	123.6
IW101-05C	TTA-1	6/15/06	276221.88	801122.88	291.27	291.89	108	NA	88.8	7/20/06	92.8	15	108.0
IW101-06A	TTA-1	6/19/06	276161.26	801126.99	292.16	292.76	141	140.5	89.4	6/20/06	124.2	15	139.4
IW101-06B	TTA-1	6/21/06	276157.44	801129.81	292.19	292.85	126	NA	89.6	7/26/06	109.2	15	124.4
IW101-06C	TTA-1	6/22/06	276153.03	801133.11	292.18	292.74	111	NA	89.5	7/27/06	94.7	15	109.8
IW101-07A	TTA-1	7/10/06	276125.77	801099.90	292.83	293.13	141	138	89.4	8/20/06	123.3	15	138.5
IW101-07B	TTA-1	7/10/06	276123.62	801102.61	292.81	293.15	126	NA	89.4	8/3/06	106.9	15	122.1
IW101-07C	TTA-1	7/11/06	276121.28	801105.60	292.78	293.08	111	NA	89.4	8/3/06	93.6	15	108.8
IW101-08A	TTA-1	7/12/06	276128.26	801121.54	292.28	292.83	141	140	89.6	8/3/06	125.7	15	140.8
IW101-08B	TTA-1	7/17/06	276125.66	801124.75	292.20	292.92	126	NA	89.6	8/3/06	108.4	15	123.6
IW101-08C	TTA-1	7/18/06	276122.92	801128.62	292.73	293.07	108	NA	89.3	8/3/06	93.3	15	108.5
IW101-09A	TTA-1	7/13/06	276081.94	801109.57	292.59	292.94	141	140	89.2	8/3/06	125.4	15	140.6
IW101-09B	TTA-1	7/18/06	276076.82	801108.99	292.51	292.85	126	NA	89.1	8/3/06	110.3	15	125.5
IW101-09C	TTA-1	7/19/06	276072.99	801108.55	292.59	292.99	111	NA	89.0	8/3/06	95.3	15	110.5
IW21-01A	TTA-1	5/19/06	276504.77	800599.88	294.34	294.99	110	110	89.6	7/22/06	99.4	10	109.5
IW21-01B	TTA-1	5/24/06	276500.95	800605.89	294.61	294.85	101	NA	89.7	7/22/06	90.1	10	100.3
IW21-02A	TTA-1	5/31/06	276464.81	800594.24	294.62	295.25	116	112	89.9	7/26/06	100.8	10	111.0
IW21-02B	TTA-1	6/2/06	276462.20	800598.51	294.65	295.12	102	NA	90.1	7/26/06	92.2	10	102.3

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IW21-03A	TTA-1	5/18/06	276551.96	800698.20	292.81	293.23	116	110	89.8	6/21/06	100.1	10	110.3
IW21-03B	TTA-1	5/19/06	276549.21	800705.08	292.50	293.12	101	NA	89.8	6/21/06	90.4	10	100.6
IW21-04A	TTA-1	5/23/06	276518.82	800711.10	292.69	293.20	116	110	89.9	7/10/06	100.4	10	110.6
IW21-04B	TTA-1	5/24/06	276515.66	800715.39	292.79	293.30	101	NA	90.1	7/26/06	90.2	10	100.4
IW21-05A	TTA-1	5/31/06	276574.89	800775.75	291.78	292.16	113	110	89.2	6/21/06	101.1	10	111.3
IW21-05B	TTA-1	6/1/06	276579.92	800772.71	291.82	292.26	101	NA	89.5	6/21/06	90.4	10	100.6
IW85-01	TTA-2	7/24/06	276831.34	806201.28	304.79	305.15	101	98	93.0	8/14/06	88.6	10	98.8
IW85-02	TTA-2	7/27/06	276797.38	806222.47	304.93	305.33	106	101	93.7	8/14/06	91.6	10	101.8
IW85-04	TTA-2	7/26/06	276779.33	806187.62	304.87	305.53	86	81	78.3	8/14/06	71.7	10	81.0
IW85-05	TTA-2	2/22/07	276815.58	806162.75	304.73	305.30	111	102	95.17	3/2/07	93.0	10	103.4
IW85-06	TTA-2	2/27/07	276779.47	806183.37	304.81	305.45	111	-	96.05	2/28/07	96.1	10	106.5
IW92-01	TTA-2	7/24/06	276769.42	806506.97	304.51	304.88	96	93	86.2	8/7/06	80.7	10	90.9
IW92-02	TTA-2	7/25/06	276719.57	806513.90	304.05	304.87	96	91	81.5	8/7/06	80.3	10	90.5
IW92-03	TTA-2	7/26/06	276669.17	806511.19	304.20	304.72	96	94	90.5	8/11/06	84.0	10	94.2
IW92-04	TTA-2	7/27/06	276681.90	806489.63	303.80	304.40	96	94	90.6	8/11/06	83.9	10	94.0
IW92-05	TTA-2	8/2/06	276707.03	806449.26	303.99	304.28	96	93	91.7	8/11/06	83.8	10	94.0
IW92-06	TTA-2	8/1/06	276723.89	806409.15	304.07	304.34	96	94	90.7	8/11/06	84.7	10	94.8
IW92-07	TTA-2	7/31/06	276725.81	806366.98	303.78	304.31	101	96	91.8	8/11/06	88.3	10	98.5
IW92-08	TTA-2	7/28/06	276784.63	806289.19	304.55	304.93	106	96	92.5	8/14/06	85.7	10	95.9
PMW101-01A	TTA-1	6/9/06	276273.17	801114.48	290.78	291.17	141	140	88.7	7/12/06	121.2	20	141.4
PMW101-01B	TTA-1	6/12/06	276269.05	801119.27	290.86	291.20	118	NA	88.7	7/12/06	98.4	20	118.6
PMW101-02A	TTA-1	6/19/06	276281.77	801144.74	291.47	291.87	141	138	89.4	7/11/06	117.5	20	137.7
PMW101-02B	TTA-1	6/21/06	276286.48	801145.09	291.60	291.83	121	NA	89.5	7/12/06	97.7	20	117.8
PMW101-03A	TTA-1	6/2/06	276348.46	801198.37	291.61	291.99	146	141	89.5	6/21/06	119.6	20	139.7
PMW101-03B	TTA-1	6/5/06	276353.09	801194.14	291.55	291.82	121	NA	89.6	6/22/06	99.6	20	119.8
PMW101-04A	TTA-1	6/6/06	276299.41	801182.12	291.07	291.43	141	138	89.0	6/22/06	118.3	20	138.5
PMW101-04B	TTA-1	6/6/06	276296.40	801186.86	291.47	291.75	121	NA	89.5	6/22/06	98.8	20	119.0
PMW101-05A	TTA-1	6/5/06	276252.74	801184.91	291.43	291.84	126	125	89.1	6/22/06	105.2	20	125.4
PMW101-05B	TTA-1	6/5/06	276250.14	801189.77	291.68	292.11	106	NA	89.5	6/22/06	85.3	20	105.5
PMW101-06A	TTA-1	6/6/06	276191.88	801187.45	292.13	292.72	142	139	89.8	6/23/06	120.6	20	140.8
PMW101-06B	TTA-1	6/7/06	276194.93	801183.96	292.17	292.40	119	NA	89.9	6/23/06	99.5	20	119.7

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Well ID	Area	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, toc)	Date Measured	Depth to Top of Screen (ft, bgs)	Screen Length (ft)	Total Well Depth (ft, bgs)
PMW101-07A	TTA-1	6/7/06	276143.43	801171.78	292.20	292.52	146	138	90.0	8/2/06	118.2	20	138.4
PMW101-07B	TTA-1	6/8/06	276141.84	801176.74	292.36	292.70	118	NA	90.2	8/2/06	98.3	20	118.5
PMW101-08A	TTA-1	7/9/06	276070.28	801119.02	293.01	293.30	140	NA	90.8	8/2/06	120.0	20	140.2
PMW101-08B	TTA-1	7/10/06	276065.11	801121.34	293.03	293.47	118	NA	90.7	8/2/06	98.5	20	118.7
PMW21-01	TTA-1	5/15/06	276533.24	800599.91	294.73	295.12	110	110	90.8	6/7/06	88.8	20	109.0
PMW21-02	TTA-1	5/16/06	276574.64	800701.00	292.98	293.19	116	108	89.8	6/7/06	91.5	20	111.6
PMW21-03	TTA-1	5/17/06	276573.43	800742.52	292.11	292.72	116	109	89.1	6/7/06	90.9	20	111.1
PMW21-04	TTA-1	5/16/06	276601.83	800771.56	291.87	292.20	116	109	89.0	6/7/06	89.3	20	109.5
PMW21-05	TTA-1	5/17/06	276628.32	801129.72	288.53	288.92	116	106.5	87.0	6/7/06	94.6	20	114.8
PMW85-01	TTA-2	5/12/06	276802.18	806146.13	305.08	305.39	106	103	96.0	6/6/06	93.5	10	103.7
PMW85-04	TTA-2	2/21/07	276763.50	806168.69	305.18	305.33	111	102	97.27	3/2/07	91.9	10	102.7
PMW85-05	TTA-2	2/22/07	276752.08	806222.46	305.12	305.32	111	103	96.27	3/2/07	93.4	10	103.0
PMW92-01	TTA-2	5/2/06	276635.28	806499.78	304.23	304.52	106	101	92.8	6/5/06	92.9	10	103.1
PMW92-02	TTA-2	5/3/06	276667.02	806476.47	304.17	304.35	106	99	93.3	6/5/06	95.0	10	105.1
PMW92-03	TTA-2	5/5/06	276678.91	806438.66	303.91	304.17	106	103	92.4	6/5/06	92.7	10	102.9
PMW92-04	TTA-2	5/8/06	276690.56	806399.29	303.93	304.08	102	86	93.5	6/6/06	91.4	10	101.5
PMW92-05	TTA-2	5/9/06	276730.22	806346.44	304.07	304.31	101	98	93.0	6/6/06	88.6	10	98.7
PMW92-06	TTA-2	5/11/06	276766.94	806270.66	304.65	304.97	106	101	94.1	6/6/06	91.9	10	102.1

Notes:

ft: feet

bgs: below ground surface

msl: mean sea level

toc: top of casing

TABLE 2
BASELINE SAMPLE LOCATIONS
EBT SYSTEM ABANDONMENT WORK PLAN
Main Installation - Defense Depot Memphis Tennessee

TTA-1N (MW-21 area)	
Injection Well	Monitoring Well
IW21-01A	PMW21-01
IW21-01B	PMW21-02
IW21-02A	PMW21-03**
IW21-02B	PMW21-04
IW21-03A	PMW21-05**
IW21-03B	
IW21-04A	
IW21-04B	
IW21-05A	
IW21-05B	

TTA-1S (MW-101 area)	
Injection Well	Monitoring Well
IW101-01A	PMW101-01A
IW101-01B	PMW101-01B
IW101-01C	PMW101-02A
IW101-02A	PMW101-02B
IW101-02B	PMW101-03A
IW101-02C	PMW101-03B
IW101-03A	PMW101-04A**
IW101-03B	PMW101-04B**
IW101-03C	PMW101-05A
IW101-04A	PMW101-05B
IW101-04B	PMW101-06A
IW101-04C	PMW101-06B
IW101-05A	PMW101-07A
IW101-05B	PMW101-07B
IW101-05C	PMW101-08A
IW101-06A	PMW101-08B
IW101-06B	
IW101-06C	
IW101-07A	
IW101-07B	
IW101-07C	
IW101-08A	
IW101-08B	
IW101-08C	
IW101-09A	
IW101-09B	
IW101-09C	

TTA-2	
Injection Well	Monitoring Well
IW85-01	PMW85-01
IW85-02	PMW85-04
IW85-05	PMW85-05
IW85-06	PMW92-01
IW92-01	PMW92-02
IW92-02	PMW92-03**
IW92-03	PMW92-04
IW92-04	PMW92-05
IW92-05	PMW92-06**
IW92-06	
IW92-07	
IW92-08	

Notes:

** Well included in LTM and will not be sampled during baseline monitoring

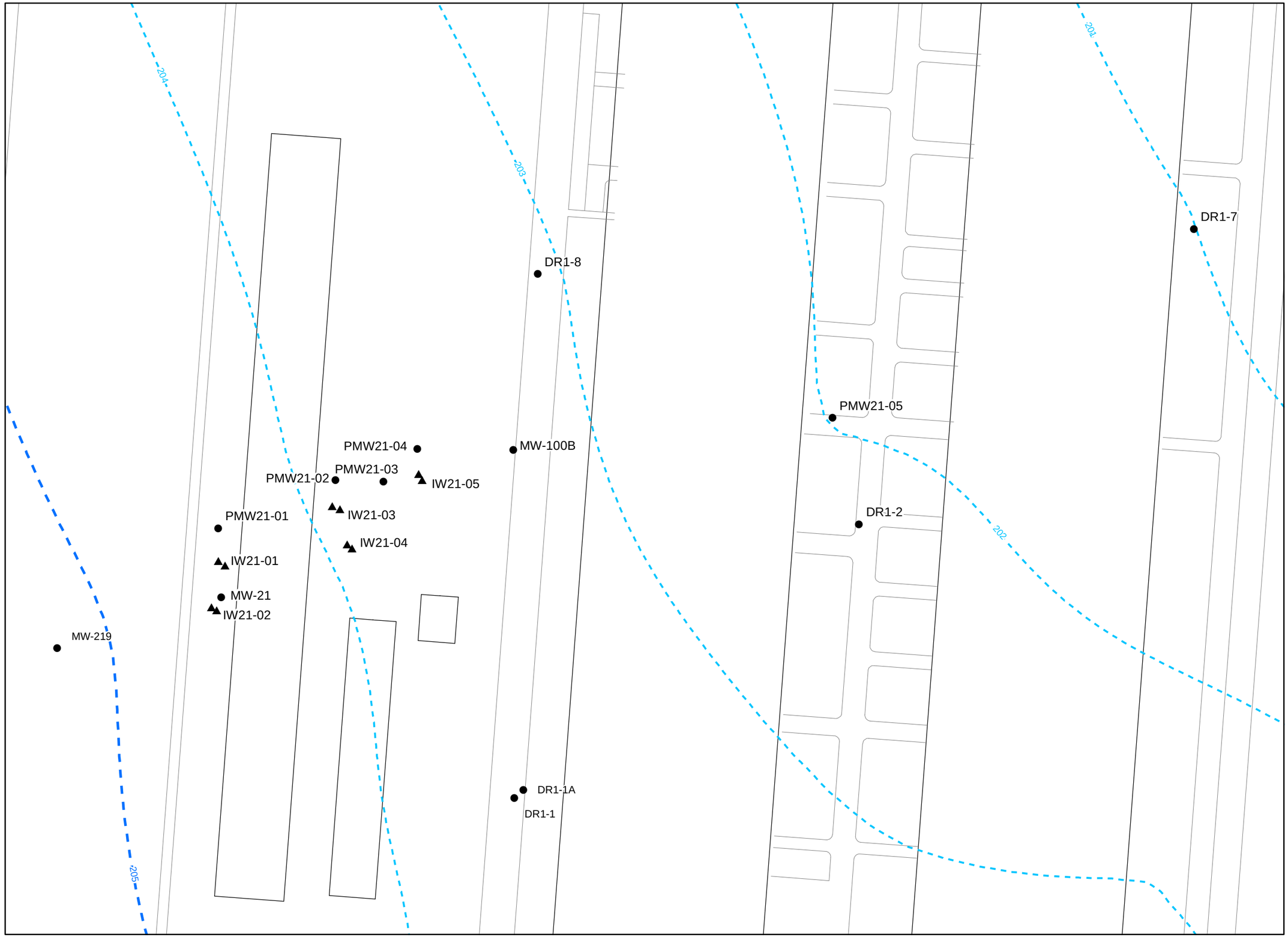
TTA: target treatment area

TABLE 3
QUALITY CONTROL SAMPLES
EBT SYSTEM ABANDONMENT WORK PLAN
Main Installation - Defense Depot Memphis, Tennessee

Event	Date	Field Samples	Field Duplicates	Matrix Spike	Matrix Spike Duplicate	Trip Blanks	Equipment Blanks	Total	Analysis
MI EBT Baseline	Dec-11	73	7	4	4	4	2	94	VOCs

Notes:
EBT: Enhanced Bioremediation Treatment
MI: Main Installation
VOC: volatile organic compound

FIGURES



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N
W E
S

Figure 1

WELL LOCATIONS
TTA-1 NORTH

EBT SYSTEM
ABANDONMENT
WORK PLAN

MAIN INSTALLATION
DEFENSE DEPOT
MEMPHIS, TENNESSEE

▲ Injection Well
● Monitoring Well
Potentiometric surface of the Fluvial Aquifer 1-ft. contour

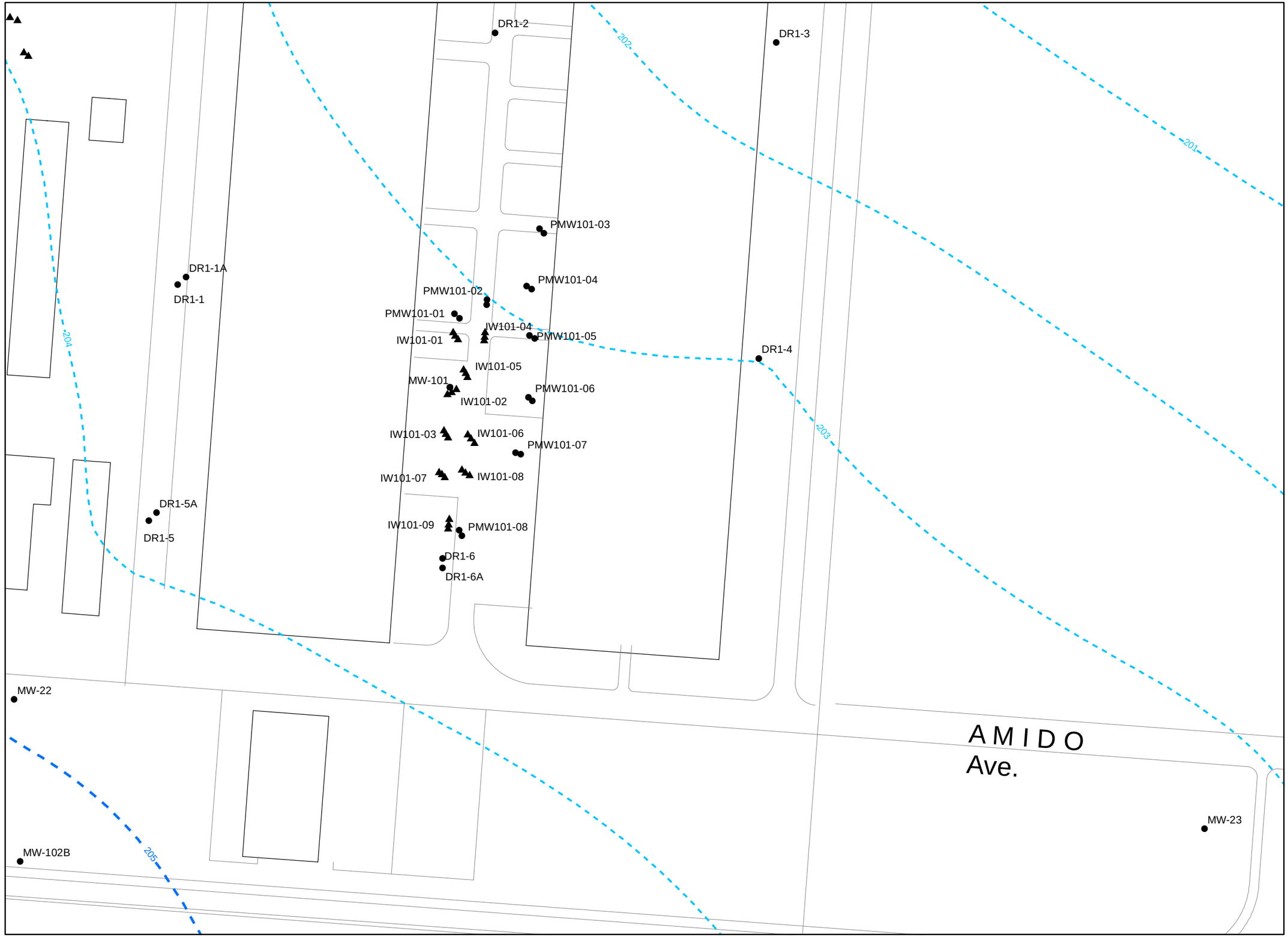
Projection: NAD 1927 StatePlane Tennessee
Units: Feet

0 25 50 100
Feet

Installation Location
Memphis, Tennessee

Date: October 2011
Edition: Rev 0

HDR



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N
W E
S

Figure 2

WELL LOCATIONS
TTA-1 SOUTH

EBT SYSTEM
ABANDONMENT
WORK PLAN

MAIN INSTALLATION
DEFENSE DEPOT
MEMPHIS, TENNESSEE

▲ Injection Well
● Monitoring Well
Potentiometric surface of the Fluvial Aquifer 1-ft. contour

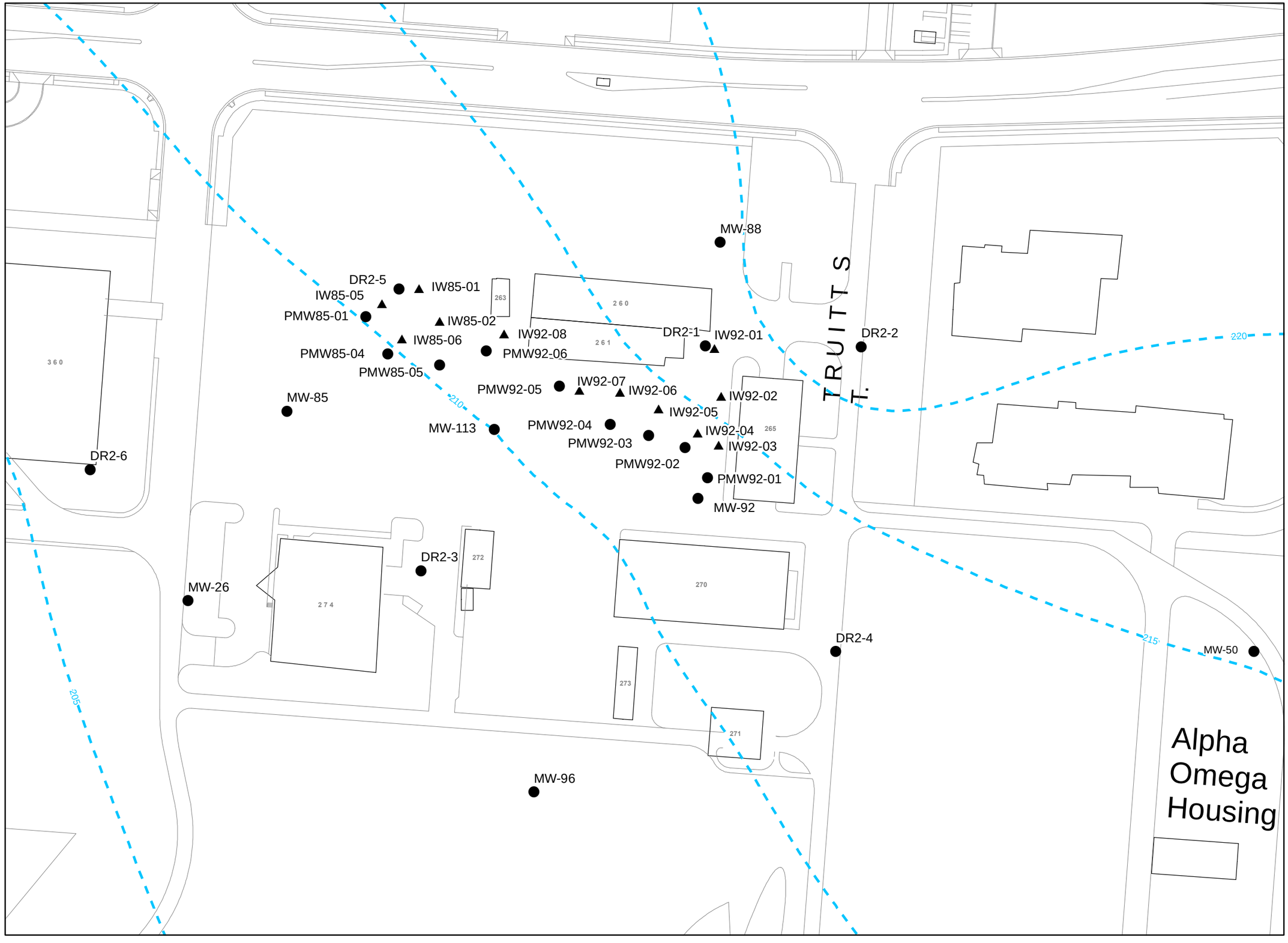
Projection: NAD 1927 StatePlane Tennessee
Units: Feet

0 25 50 100
Feet

Installation Location
Memphis, Tennessee

Date: October 2011
Edition: Rev 0

HDR



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N
W E
S

Figure 3

WELL LOCATIONS - TTA-2

EBT SYSTEM
ABANDONMENT
WORK PLAN

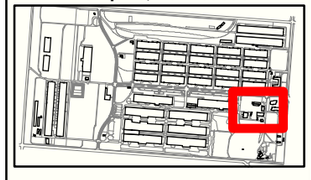
MAIN INSTALLATION
DEFENSE DEPOT
MEMPHIS, TENNESSEE

▲ Injection Well
● Monitoring Well
Potentiometric surface of the Fluvial Aquifer 5-ft. contour

Projection: NAD 1927 StatePlane Tennessee
Units: Feet

0 25 50 100 150
Feet

Installation Location
Memphis, Tennessee



Date: October 2011
Edition: Rev 0

HDR

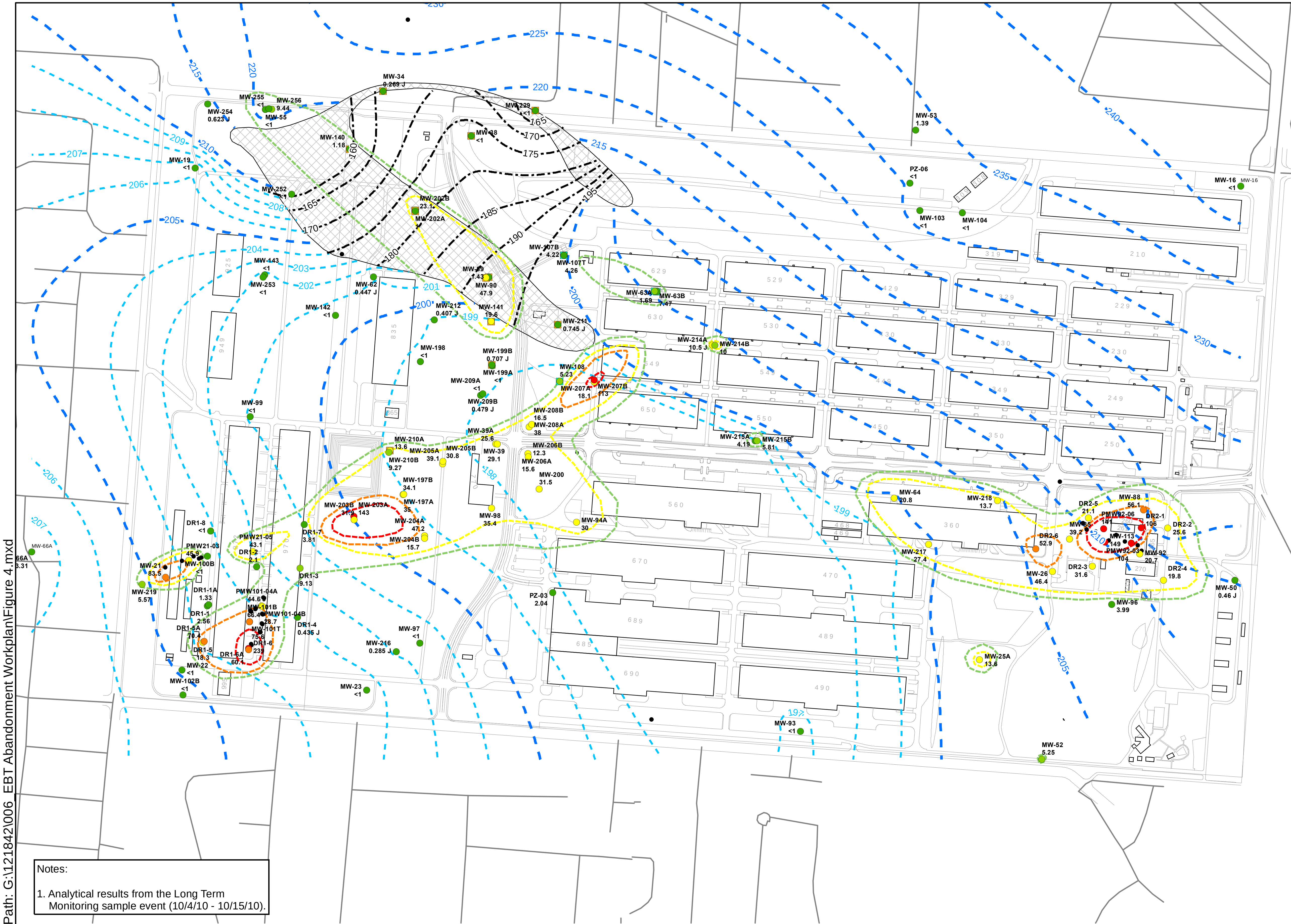


Figure 4

PCE ISOPLETH MAP, OCTOBER 2010

EBT SYSTEM ABANDONMENT WORK PLAN

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

Date: October 2011
Edition: Rev 0

Figure 5

TCE ISOPLETH MAP, OCTOBER 2010

EBT SYSTEM
ABANDONMENT
WORK PLAN

MAIN INSTALLATION
DEFENSE DEPOT
MEMPHIS, TENNESSEE

Legend

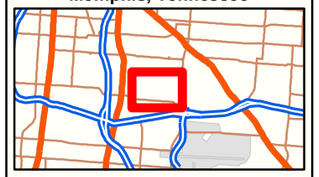
TCE Ranges
ug/L
- 0 - 5
- 5 - 10
- 10 - 50
- 50 - 100
- 100 - 300

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 2011
Edition: Rev 0

HDR

Notes:

1. Analytical results from the Long Term Monitoring sample event (10/4/10 - 10/15/10).

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Appendix A

Selected Work and Test Procedures from QAPP

SOP 1 – General Procedures for Field Personnel
SOP 2 – Well Abandonment
SOP 3 – Groundwater Sample Collection
SOP 5 – Sample Control and Documentation
SOP 6 – Sample Packing and Shipping
SOP 7 – Equipment Decontamination

STANDARD OPERATING PROCEDURE 1 - GENERAL PROCEDURES FOR FIELD PERSONNEL

Lead Organization: Department of the Army (DA)

Preparing Organization: HDR

SOP Approved by: Field Team Leader: Kevin Sedlak

Project QA Officer: Lynn Lutz

Project Manager: Tom Holmes

1.0 PURPOSE AND SUMMARY

This Standard Operating Procedure (SOP) provides guidance for the general field practices to be followed during field activities at DDMT; review is mandatory prior to the start of each field event. This SOP provides general guidance; the project-specific work plan must be reviewed for specific project requirements.

2.0 HEALTH AND SAFETY

Each individual assigned to field work must participate in the HDR Medical Monitoring Program, must have taken the OSHA 40-Hour course (updated with the 8-Hour OSHA Refresher, when necessary), and must be certified as able to wear respiratory protection.

Each individual is required to have read and understood the HASP for the specific project activity. Upon arrival at the site, each person shall sign the acknowledgement sheet confirming their review of the HASP. Personal protective equipment (PPE) and other provisions for site safety requirements are discussed in the project specific Health and Safety plan.

All equipment will only be used by properly trained personnel. In particular, evaluation and repair of remediation systems (air sparge and soil vapor extraction) will only be performed by personnel familiar with the systems. Proper tools will be made available to each employee as necessary. Any questions should be addressed to the Field Team Leader.

3.0 PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

Field activities will be directed by a Field Team Leader (FTL), a mid- or senior level environmental professional (engineer, geologist or scientist) with experience in performing and directing the planned activities. Field staff will be junior to mid-level environmental professionals or environmental technician.

Field work will be conducted by persons with experience in performing the planned activities. At least one person on each team will have a current certification in first aid and CPR.

The FTL will provide direction to field staff to ensure work is performed in accordance with the project documents (QAPP, project work plan and SOPs). The field staff will carefully review the project documents, conduct the work as planned, seek direction from the FTL when questions or problems arise, and carefully complete field documentation.

4.0 EQUIPMENT AND SUPPLIES

The required equipment and supplies will be identified in the SOPs for the specific field activities to be performed and in the project work plan. Field activities should not proceed until the proper tools and equipment are available and in good working order.

Each team will have use of a truck/van during field activities. An initial safety check should be performed at the start of each shift to confirm the vehicle is in good working condition. The vehicle should then be checked daily for damage or required maintenance.

5.0 PROCEDURE

5.1 Start-Up Activities

5.1.1 Office

Prior to leaving the office for field work, personnel will perform the following actions:

The Project Manager (PM) will assign a Field Team Leader (FTL) to direct field activities and coordinate with project personnel. Task specific responsibilities of the FTL will be addressed in the appropriate SOP; general responsibilities include;

- Review project work plan, Health and Safety Plan (HASP), and Quality Assurance Project Plan (QAPP).
- Work with PM to properly staff the field activity
- Coordinate sampling activities with the project chemist and analytical laboratory
- Confirm availability and condition of DDMT-owned equipment and order additional equipment/supplies for delivery prior to the start of each event.
- Prepare field forms and other documentation for the planned event.

- If work is to be subcontracted, review the subcontract agreement, work plan, and HASP.
- Confirm that field staff have Driver's License (or other picture identification) and current OSHA Certification in their possession prior to leaving the office.

5.1.2 Field

After arrival on site, but prior to commencement of operations, the following activities will be performed:

- Complete equipment and supply checklists and verify that required documentation and equipment for field activities are on site.
- Review condition of DDMT-owned and rental equipment; inventory field supplies and laboratory-provided sampling supplies.
- Review locations for planned field activities for hazards, determine requirements for site preparation and clearance, and select location for the storage of purge and decontamination waters.
- Conduct team safety meetings as required by the HASP.
- Conduct team review of the project documents including SOPs to be utilized.
- Complete the Field Event Startup Report and submit to PM (Attachment 1-1).

5.2 Field Operations

Field staff responsibilities are project-specific. At a minimum, the field personnel are required to

1. Field activities will be documented in a log book for each team and in field records as required by the work plan or SOPs. At minimum, the log book will describe general activities performed, date and time, personnel and weather conditions. Additional information will be recorded in the log book if other field records are not used.
2. For field measurements, the following additional information will be required:
    - The numerical value and units of each measurement
    - The identity of and calibration results for each field instrument
3. Complete required data collection/sample control forms (e.g., Chain-of-Custody, Field Sampling Report, etc.).
4. Communicate with the PM regarding site conditions and out of scope work to be performed.

5. Perform following activities daily before leaving the site:

    - Decontaminate and check condition of field equipment.
    - Provide log books and other field documentation to FTL for review
    - Properly dispose of trash, debris and used PPE.
    - Make arrangements for shipment of samples (if applicable) and follow-up with the analytical laboratory to confirm samples arrived in good condition.
    - Complete activity-specific field reports as required by applicable SOPs.
    - Complete the Daily Field Report and submit to PM (Attachment 1-2).

5.3 Closeout

Upon the completion of field activities, the FTL will view each site to verify the area has been cleared and restored as closely as possible to its prior condition. Trash will be removed from the site, and surface damage, including ruts caused by vehicles, will be repaired.

Confirm all equipment is accounted for and properly decontaminated and in good working condition. Notify FTL if repairs are needed. Properly package and ship all rental equipment to the vendor. When shipping equipment, use the proper HDR EOC FedEx number and insure the package for the cost of the equipment. Follow manufacturer's instructions on long and short term storage when storing government and/or HDR EOC equipment.

Rental trucks should be fueled and returned to the rental company as soon as possible. HDR EOC leased trucks should also be fueled and cleaned prior to storing at the shop.

Work areas should be cleaned with tools and equipment properly stored.

The FTL will make a final check of all logbooks and other field records to ensure there are no blanks or missing data and the entries are legible.

The FTL will complete Field Event Closeout Report and submit to PM (Attachment 1-3).

6.0 DATA AND RECORDS MANAGEMENT

All field forms and log book entries will be scanned and copied project folder on the "Z" drive within one week of the field event completion. All photographs taken during the field event will be uploaded along with a typed photograph log (date, project and subject) to the "Z" drive. The photographs will then be erased from the camera. All original forms will be stored on site in Memphis in the filing cabinet in the proper folder labeled for the project. The PM, project chemist and project administrator will be sent a link for the data.

7.0 QUALITY CONTROL AND QUALITY ASSURANCE

All work will be performed in accordance with the QAPP, the specific work plan, and applicable SOPs. All field activities will be recorded in the log books in sufficient detail to reconstruct the events. No erasures or mark outs will be made on field forms or log books. A single line will be used to strike out errors and will be annotated with the initials and date of the editor.

8.0 REFERENCES

None.

Attachment 1-1

Field Event Startup Report

Prepared by: Date:

Event Name:

Project-Activity Number:

Summary of Planned Event:

Planned Performance Period: _____to_____

Project Documents - Title, Date

Work Plan:

Health and Safety Plan:

Other SOPs – List number/revision and title:

Field Event Staffing

Position	Name	OSHA Cert. (Y/N)	First Aid/ CPR (Y/N)	Driver's License (Y/N)	Proj. Plans reviewed (Y/N)	Experience (Hi-Med-Low-None)
Field Team Leader						

Attachment 1-1

DDMT Field Equipment

Name/Use	Mfr./Model No.	Condition	Calibration Req'd.(Y/N)	Calibration supplies	Other supplies (batteries, etc.)

Rental Equipment

Name/Use	Mfr./Model No.	Condition	Calibration Req'd.(Y/N)	Calibration supplies	Other supplies (batteries, etc.)

Lab-provided Sampling Supplies

Sample Type	Number	Supplies

Additional Tools/Supplies

Camera
Field forms (list):
Sample supplies (list):
Water/Ice cooler
Sample cooler

Attachment 1-1

Final Check

1. All required equipment/tools received and condition checked

Yes ___ No ___ Comment:

2. Initial equipment calibration completed

Yes ___ No ___ Comment:

3. Vehicles inspected

Yes ___ No ___ Comment:

4. Field locations reviewed

Yes ___ No ___ Comment:

5. Weather forecast checked

Yes ___ No ___ Comment:

6. Staff documents (OSHA, DL) checked

Yes ___ No ___ Comment:

7. Review of project plans confirmed and activities discussed

Yes ___ No ___ Comment:

8. Initial Safety Meeting held and HASP signed

Yes ___ No ___ Comment:

Attachment 1-2

Daily Field Report

Project Number/Activity:	**Date:**
Project Name:	**Field Team Leader:**
Brief Work Description:	

Weather:	**Temp:**

Previous Day's Samples received at laboratory – Y / N Comment:

Time	Description

Page __ of __

Attachment 1-2

Name/Organization of Field Staff, Subcontractors and Site Visitors	

Samples Collected
Team 1:
Team 2:
Team 3:

Problems or Deviations from Work Plan

Tasks to be completed next working day

_____ _____ _____

Name **Signature** **Date**

Page __ of __

Attachment 1-3

Field Event Close-Out Report

Prepared by: Date:

Event Name:

Project-Activity Number:

Performance Period: _____to_____

Field Team Leader:

Field Staff:

Summary of Completed Event:

Field problems and/or changes from planned activities:

Change in number/type of samples collected:

Health and Safety problems/Injuries:

Attachment 1-3

Close-out Checklist

1. Log book and field forms scanned and originals placed in project file

Yes ___ No ___ Comment:

2. Equipment/tools decontaminated

Yes ___ No ___ Comment:

3. Rental equipment shipped to supplier

Yes ___ No ___ Comment:

4. Rental vehicles returned

Yes ___ No ___ Comment:

5. DDMT equipment and tools properly stored

Yes ___ No ___ Comment:

6. List damaged equipment

Yes ___ No ___ Comment:

7. Replacement supplies ordered

Yes ___ No ___ Comment:

8. Field locations inspected and trash/debris removed

Yes ___ No ___ Comment:

9. Field shop/office cleaned

Yes ___ No ___ Comment:

STANDARD OPERATING PROCEDURE 2 – WELL ABANDONMENT

Lead Organization: Department of the Army (DA)

Preparing Organization: HDR

SOP Approved by: Field Team Leader: Kevin Sedlak

Project QA Officer: Lynn Lutz

Project Manager: Tom Holmes

1.0 PURPOSE AND SUMMARY

This Standard Operating Procedure (SOP) provides guidance for well abandonment at DDMT. The project-specific work plan must be reviewed for specific project requirements.

After it has been determined that a well used for groundwater or vapor monitoring, soil vapor extraction or other purpose is no longer needed, it will be abandoned. Wells are recommended for abandonment for the following reasons:

- The objectives have been achieved and the well is no longer needed.
- The well is determined to have been constructed improperly.
- The well has been vandalized or damaged.

2.0 HEALTH AND SAFETY

General Information on Health and Safety requirements are provided in SOP 1. Each individual is required to have read and understood the HASP for the specific project activity and signed the acknowledgement sheet confirming their review.

Health and safety concerns for well abandonment include the use of rotating equipment (i.e. grout mixer and pump), exposure to Portland cement and the weight of the bags of cement. Portland cement exposure can cause the caustic burns on skin and the inhalation hazards include caustic and silica hazards to the lungs and mucus membranes. Portland cement is usually delivered in 94 pound bags and should be a 2-man lift or smaller bags should be used. Some wells may be located in areas with vehicular traffic and/or biological threats such as spiders, fire ants, snakes, and wasp nests.

3.0 PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

Field activities will be directed by the Field Team Leader (FTL), a mid- or senior level environmental professional (engineer, geologist or scientist) with experience in performing and directing the planned activities. Well abandonment will be supervised by a junior to mid-level geologist or an environmental technician with oversight by a Tennessee Licensed Geologist; field staff will have experience in well abandonment and a current certification in first aid and CPR. Well abandonment will be conducted by a Tennessee-licensed well driller and crew with appropriate experience and familiar with applicable regulations. If a fork lift is used for this task, the operator will have the proper OSHA training for forklift operation.

4.0 EQUIPMENT AND SUPPLIES

The required equipment and supplies will be identified in the work plan for the specific field activities to be performed. Field activities should not proceed until the proper tools and equipment are available and in good working order.

Usual equipment/supplies for well abandonment will include: a photoionization detector (PID), water level and measuring tapes, nitrile gloves, camera, and containers for contaminated water. Equipment to be provided by the well driller includes grout mixer, grout pump, bleach, Portland cement, bentonite.

Field staff will have use of a truck/van during field activities. An initial safety check should be performed at the start of each shift to confirm the vehicle is in good working condition. The vehicle should then be checked daily for damage or required maintenance.

5.0 PROCEDURE

5.1 Start-Up Activities

5.1.1 Office

The Project Manager (PM) will assign a Field Team Leader (FTL) to direct field activities and coordinate with project personnel. General responsibilities are described in SOP 1. Task specific responsibilities include:

- Arrange site access with DRC, tenants and/or offsite property owners.

- Check for updates to Tennessee Department of Environment and Conservation (TDEC) or Memphis-Shelby County Health Department (MSCHD) regulations for well abandonment. The regulations can be obtained at: http://www.shelbycountytn.gov.
- Obtain MSCHD well abandonment permits if the wells are off DDMT property.
- Obtain well location maps, boring logs and well installation diagrams for wells to be abandoned and add installation data to the Well Abandonment Records (Attachment 2-1)
- Estimate quantities of bentonite to seal the screened interval and grout to fill the casing.
- Review the driller's subcontract agreement, work plan, and HASP.
- Schedule time and location for the initial meeting with driller and field staff to review project information and begin work.

5.1.2 Field

After arrival on site, but prior to commencement of operations, the following activities will be performed:

- Complete equipment and supply checklists and verify that required documentation and equipment for field activities are available.
- Determine requirements for site preparation and clearance, and select location for the placement of the decontamination area, storage of decontamination, and excess grout.
- View locations of the wells to be abandoned and confirm the well IDs are clearly marked.
- Conduct site set up activities to include posting of signage (if applicable) and delineation of work zones as required in the HASP.
- Calibrate field equipment.

5.2 Field Operations

Well abandonment activities will be documented in a log book, in field records as required by the work plan and by completing the Well Abandonment Record (Attachment 2-1). At minimum, the log book will describe general activities performed, date and time, personnel and weather conditions.

To properly abandon a well, the surface completion (concrete pad and protective casing) should be removed and the well filled with a cement/bentonite grout from the bottom. Current regulations do not require removal of the well casing. Procedures for well abandonment are as follows:

1. Confirm the correct well is being abandoned by checking the well ID on the well pad or protective casing.
2. Measure the total depth of the well and compare with depth from the well installation diagram to confirm that no obstructions were present that might interfere with placement of the tremie pipe and grout.
3. Pour one half gallon of chlorine bleach into each well
4. Add sufficient bentonite to absorb water in the screened interval.
5. Prepare cement/bentonite grout (94 pounds of neat Type 1 Portland cement, 4 pounds of bentonite powder and up to 8 gallons of potable water).
6. Place grout from the bottom to the top of the well casing using a pressure tremie pipe until undiluted grout is visible at the surface; keep the side-discharge tremie pipe approximately 1 foot below the grout surface.
7. Contain water displaced by the grout for testing and disposal.
8. Allow grout to settle for at least 48 hours and top off well casing with concrete.
9. Remove surface completions (manholes, pads, and bollards) for disposal as solid waste.
10. Restore ground surface consistent with surrounding area. At wells developed areas, the concrete well pads can be left in place; manhole covers to be removed and manholes filled with concrete.

The following activities will be performed daily before leaving the site:

- Decontaminate and check condition of field equipment.
- Provide log books and other field documentation to FTL for review
- Properly dispose of trash, debris and used PPE.
- Secure the site and all equipment/materials.
- Prepare daily report(s) as required by work plan and SOP 1 and submit report to the PM.

5.3 Closeout

Upon the completion of field activities, the FTL will view each well abandonment site to verify the area has been cleared and restored as closely as possible to its prior condition. Trash will be removed from the site, and surface damage, including ruts caused by vehicles, will be repaired.

The FTL will complete Field Event Closeout Report in accordance with SOP 1.

FTL and PM will prepare well abandonment report to comply with the Memphis Shelby County Well construction code (Section 9).

6.0 DATA AND RECORDS MANAGEMENT

All field forms and log book entries will be scanned and copied project folder on the "Z" drive within one week of the field event completion. All photographs taken during the field event will be uploaded along with a typed photograph log (date, project and subject) to the "Z" drive. The photographs will then be erased from the camera. All original forms will be stored on site in Memphis in the filing cabinet in the proper folder labeled for the project. The PM, project chemist and project administrator will be sent a link for the data.

7.0 QUALITY CONTROL AND QUALITY ASSURANCE

All work will be performed in accordance with the QAPP, the specific work plan, and applicable SOPs. All field activities will be recorded in the log books in sufficient detail to reconstruct the events. No erasures or mark outs will be made on field forms or log books. A single line will be used to strike out errors and will be annotated with the initials and date of the editor.

8.0 REFERENCES

None.

Attachment 2-1

WELL ABANDONMENT RECORD

DRILLER: _____ TN LICENSE NO. _____

Well ID:	Use of Well:	
Installation Data		
Date installed:	Northing:	Easting:
Grnd Elev (ft, msl):	TOC elev (ft, msl):	Diameter (in):
Riser length (ft):	Screen length (ft):	Total Depth (ft, btoc):
Completion: Flush __ Stick-up __ Bollards __		
Abandonment		
Date:	Time - Start:	Time - Finish:
Total depth measured (ft, btoc)		
Disinfectant/Bleach: Type	Vol (gal):	
Bentonite (screen): Type	Vol (lb):	
Grout: Cement Type Bentonite Type Water (gallons):	Vol (lb): Vol (lb):	
Site Restoration Date:	Concrete top-off (cu. ft)	
Summary: Add comments for difference between installed and measured depth, obstructions found, deviations from standard procedure, wellhead restoration, etc.		

Well ID:	Use of Well:	
Installation Data		
Date installed:	Northing:	Easting:
Grnd Elev (ft, msl):	TOC elev (ft, msl):	Diameter (in):
Riser length (ft):	Screen length (ft):	Total Depth (ft, btoc):
Completion: Flush __ Stick-up __ Bollards __		
Abandonment		
Date:	Time - Start:	Time - Finish:
Total depth measured (ft, btoc)		
Disinfectant/Bleach: Type	Vol (gal):	
Bentonite (screen): Type	Vol (lb):	
Grout: Cement Type Bentonite Type Water (gallons):	Vol (lb): Vol (lb):	
Site Restoration Date:	Concrete top-off (cu. ft)	
Summary: Add comments for difference between installed and measured depth, obstructions found, deviations from standard procedure, wellhead restoration, etc.		

STANDARD OPERATING PROCEDURE 3 – GROUNDWATER SAMPLE COLLECTION

Lead Organization: Department of the Army (DA)

Preparing Organization: HDR

SOP Approved by: Field Team Leader: Kevin Sedlak

Project QA Officer: Lynn Lutz

Project Manager: Tom Holmes

1.0 PURPOSE AND SUMMARY

This Standard Operating Procedure (SOP) provides guidance for groundwater sample collection at DDMT. The project work plan must be reviewed for specific requirements.

2.0 HEALTH AND SAFETY

General Information on Health and Safety requirements are provided in SOP 1. Each individual is required to have read and understood the HASP for the specific project activity and signed the acknowledgement sheet confirming their review.

Health and safety concerns for groundwater sampling include the use of lead-acid batteries with bladder pumps and contact with contaminated groundwater. Many of the wells are located in or near streets and parking lots with vehicular traffic; field staff should wear vests with reflective stripes or other high visibility clothing while sampling. Some wells may be located in areas with biological threats such as spiders, fire ants, snakes, and wasp nests; the wells should be checked for hazards before starting.

3.0 PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

Groundwater sampling will be directed by a Field Team Leader (FTL), a mid- or senior level environmental professional (engineer, geologist or scientist) with appropriate experience. Field staff will be junior to mid-level environmental professionals or environmental technicians overseen by a Tennessee Licensed Geologist. Sampling will be performed by two-person teams and at least one person on each team will have a current certification in first aid and CPR.

4.0 EQUIPMENT AND SUPPLIES

The required equipment and supplies will be identified in the work plan for the specific field activities to be performed. Field activities should not proceed until the proper tools and equipment are available and

in good working order. Usual equipment/supplies for a groundwater sampling will include: a photoionization detector (PID), nitrile gloves, pump controller, compressor, water quality meter, and a water level indicator tape, well sample forms, camera, and purge water containers.

Each team will have use of a truck/van during field activities. An initial safety check should be performed at the start of each shift to confirm the vehicle is in good working condition. The vehicle should then be checked daily for damage or required maintenance.

5.0 PROCEDURE

5.1 Start-Up Activities

5.1.1 Office

The Project Manager (PM) will assign a Field Team Leader (FTL) to direct field activities and coordinate with project personnel. General responsibilities are described in SOP 1. Task specific responsibilities include:

- Coordinate sampling activities with the project chemist (PC) and analytical laboratory; prepare a sampling plan detail listing the wells and sample bottles for planned analyses. Schedule shipment of laboratory-supplied sample containers and equipment for arrival prior to the start of sampling.
- Confirm availability and condition of DDMT-owned equipment and order additional equipment/supplies for delivery prior to the start of sampling event.
- Obtain well location maps and prepare tables showing screened interval and previous water level measurements to confirm planned sample depths
- Prepare field forms and other documentation for the planned event.
- Schedule time and location for the initial meeting with field staff to review project information and begin work.

5.1.2 Field

After arrival on site, but prior to commencement of operations, the following activities will be performed:

- Complete equipment and supply checklists and verify that required documentation and equipment for field activities are on site.
- Review condition of DDMT-owned and rental equipment; inventory field supplies.

- View well locations and confirm the well IDs are clearly marked.
- Review locations for planned field activities for hazards. Determine requirements for site preparation and clearance, and select location for storage of decontamination and purge waters. Confirm sufficient storage capacity for wastewater.
- Confirm the location and length of the screened interval and the total depth of the well to be sampled if not equipped with a dedicated pump or a diffusion bag.
- Conduct site set up activities to include posting of signage (if applicable) and delineation of work zones as required in the HASP.
- Calibrate field equipment.
- Review sampling activities and assignments with field staff.

5.2 Field Operations

Field records will be prepared in accordance with SOP 5 – Sample Control and Documentation. Each sampling site will be characterized by the following factors:

- Location of work
- Weather conditions: rainfall, temperature, and wind direction
- Ongoing activities that may influence or disrupt sampling efforts
- Accessibility to the sampling locations (e.g., rough terrain, fallen trees, flooding, etc.)

5.2.1 Water Level Sweep

Prior to sampling, a water level sweep will be made at listed monitoring wells to produce an accurate potentiometric map. The FTL will prepare the list of wells from the current work plan for review by the PM. An example list is provided in Attachment 3-1.

1. Determine if the water level probes are working properly by using two or more in one well to confirm the same depth is measured. If the depths differ by more than 0.1 feet, determine which one is malfunctioning and replace it for the project.
2. Using the water level sweep list proceed to the wells requiring water level readings. Confirm the well location by checking the well ID on the pad.
3. Inspect the area around the well for hazards, then remove the well box lid and the well cap.

4. Turn the water level indicator on and slowly lower it into the well until it alerts to the water level.
5. Bring up the probe slowly until the beeping stops and slowly lower it again until it beeps do this three times and record the average level recorded. All readings should be taken from an area marked on top of the casing; if no mark is present, use the north side of the casing.
6. Put the cap and lock back on the well casing and then close the well box. At this time assess the well condition record any cracks in the pad, missing bolts, missing caps, etc.
7. Decontaminate the water level probe before proceeding to the next well. The decontamination procedure for the water level indicator is: Hand wash the calibrated tape and probe with Alconox solution (or equivalent) and rinse with deionized (Reagent Grade II) water.

5.2.2 Water Quality Measurements

Field measurements of groundwater physical parameters are used for groundwater sampling and for independent measurements during remedial actions. The field equipment will be properly calibrated per manufacturer's instructions; calibrations will be made at the start of the day after lunch and at the end of the day. The calibrations will be checked during the day if abnormal measurements are observed.

Field measurements will be made with a YSI 650 MDS or similar multi-probe device with flow-through cell. Flow cells add efficiency to low flow purging and field sampling applications, when it is impossible or undesirable to place a sonde in the well. Calibration procedures for the YSI 650 MDS are provided in the operations manual.

Groundwater samples will be collected when water quality indicators of pH, specific conductivity, and turbidity stabilize. Readings will be taken every 5 to 10 minutes and recorded on the Sample Collection Data sheet (Attachment 3-2). Stabilization is achieved after three successive readings are within ± 0.1 for pH, ± 3% for specific conductance, and <20 NTU for turbidity. Temperature will also be measured and recorded, but will not be used as a stabilization parameter. Sampling may begin once the well has stabilized. If stabilization does not occur or turbidity cannot be reduced below 20 NTU, the FTL should be contacted for direction.

5.2.3 Sample Collection Procedures

Groundwater samples may be collected from monitoring and injection wells, or piezometers. In most cases, dedicated bladder pumps and passive diffusion bags (PDBs) are used for sampling. In some wells a

portable bladder or a disposable bailer will be used. Decontamination of portable pumps is required prior to each use in accordance with SOP 7.

Sampling will be performed no less then 24 hours after well development is completed. Observations made during sample collection will be recorded in the logbook and on a monitoring well purge and sampling form. The following initial steps will be followed before collecting groundwater samples in the field.

1. Locate the well to be sampled, confirm well ID and record the condition of the well.
2. Determine concentration of organic vapors every time a well cap is removed to measure a water level or to collect a sample. Caution shall be used when opening each well to avoid fumes which may have accumulated and to prevent foreign materials from entering the well.
3. Measure the water level from the measuring point to the nearest 0.01 foot and record the measurement in the field logbook or the Sample Collection Data sheet (Attachment 3-2)
4. Water levels will generally be measured before and during sampling. For wells with dedicated pumps, water levels will be measured ONLY if the water is above the top of the pump. DO NOT pull the pump to measure the water level. The water level probe should be carefully lowered down the well to minimize disturbance.
5. Decontaminate the water-level indicator and tape prior to each use. The decontamination procedure for the water level indicator is: Hand wash the calibrated tape and probe with Alconox solution (or equivalent) and rinse with deionized (Reagent Grade II) water.
6. DO NOT measure the total depth of the well prior to sampling. Well depth should be obtained from well logs. Measuring to the bottom of the well casing may cause re-suspension of settled solids.

5.2.3.1 Sampling using a Disposable Bailer

Wells will be sampled with bailers where necessary due to small diameter casing in piezometers and slow recharge or thin saturated layer in wells. New disposable bailers will be used for sampling. Purging and sampling will be conducted in a manner that minimizes the agitation of sediments in the well and formation; equipment will not be allowed to free fall into a well.

The sampling protocol will be as follows for the collection of groundwater samples using a disposable Teflon bailer:

1. Measure the static water level prior to purging using a decontaminated electronic water level indicator. The probe of the water level indicator will be lowered into the well bore and the water level will be recorded.

2. Attach the Teflon coated stainless steel leader rope to the bailer and polypropylene (or nylon) rope to the Teflon coated rope. Lower the bailer into the well, until it contacts the water surface. Allow the bailer to sink and fill with a minimum of water surface disturbance. Slowly withdraw the bailer from the well, preventing the bailer and bailing line from touching the ground.

3. The well should be purged until a minimum of three well volumes is removed from the well, and the water quality indicators of pH, specific conductivity, and turbidity stabilize. Readings will be taken every 5 to 10 minutes and recorded on the well purge form (Attachment 4.4). Stabilization is achieved after three successive readings are within ± 0.1 for pH, ± 3% for specific conductance, and <20 NTU for turbidity. Temperature will also be measured and recorded, but will not be used as a stabilization parameter. Sampling may begin once the well has stabilized. If stabilization does not occur or turbidity cannot be reduced below 20 NTU, the field team leader should be contacted for direction.

4. If the well is purged dry, a sample will be collected as soon as sufficient recharge has occurred and within 24 hours. Temperature, specific conductance, turbidity and pH will also be measured and recorded; however, stabilization of these parameters is not required.

5. After water quality indicators stabilize or the well recharges, collect samples by pouring the water from the bailer into the appropriate sample containers. This process will be repeated as necessary to fill each container.

6. Collect the samples to be analyzed for volatile organics first, leaving zero headspace. Proceed with the collection of samples for the remaining analyses, collecting the more volatile parameters first.

7. Wells should be sampled in order of increasing contamination (i.e. - samples that are expected to be least contaminated will be collected before those that are more highly contaminated).

8. After samples have been collected, replace the well cap and lock the security casing.

9. Place samples into the cooler with ice, record samples in the logbook and scan the samples into the computer.

10. Record field conditions, any problems encountered during sampling, and sample appearance in the field logbook and include the information in the Daily Field Report (SOP 1, Attachment 1-2).

5.2.3.2 Sampling Using a Bladder Pump

The sampling protocol will be as follows for the collection of groundwater samples using a stainless steel/Teflon bladder pump:

1. Slowly and carefully lower the pump inlet to, or slightly above, the screened interval where representative groundwater flow is expected. In cases where the entire screen is not saturated, place the pump inlet near the middle of the saturated screen, keeping in mind the limitations stated below. Many wells have dedicated bladder pumps in the well where the pump has been placed near the middle of the saturated screen.
2. DO NOT place pump inlet less than 2 feet above the bottom of the well, as this may cause the mobilization of bottom sediments. If saturated screen length is 2 feet or less, collect sample using disposable bailer.
3. Allow at least 1 foot of water above the inlet so there is little risk of entrainment or air in the sample.
4. Begin purging the well at a rate of 200 to 500 mL/minute. All purge water will be containerized as IDW. The appropriate purge rate will be determined by monitoring groundwater drawdown. Drawdown should not exceed 0.1 meter (4 inches).
5. The discharge during purging and sampling should flow with minimal turbulence or agitation.
6. The water level should stabilize and the pump rate should allow water to recharge the well so that little or no water level drawdown is observed. Adjust discharge rate to limit excessive drawdown.
7. Record groundwater level frequently until water level stabilization occurs. After stabilization, measure water levels at regular intervals.
8. If drawdown is greater than 0.1 meter (4 inches), decrease the discharge rate of the pump and repeat discharge and water level measurements. Repeat until the water level stabilizes to closely match the recharge rate. Record pumping rates and depths to water on the Sample Collection Data sheet (Attachment 3-2).
9. An in-line multi-probe flow-through cell will be used to monitor the indicator parameters so as not to expose the water to the atmosphere prior to measurement. During purging, water quality indicator parameters [pH, redox potential (ORP), turbidity, specific conductivity, and dissolved oxygen (DO)] will be measured every 5-10 minutes until the parameters have stabilized.

Measurement should be recorded on the well purge form (Attachment 4.4) A minimum of 5 sets of water quality indicator parameters should be recorded.

10. Stabilization is achieved after three successive readings are within ± 0.1 for pH, ± 10 mV for ORP, ± 5% for specific conductance, ± 10% for DO, and <20 NTU for turbidity. Temperature will also be measured and recorded, but will not be used as a stabilization parameter. Sampling may begin once the well has stabilized.
11. Specific conductance and DO usually take the longest to stabilize. Fifteen minutes to 1.5 hours of purging at the recommended purge rate may be required to reach stabilization. Stabilized purge indicator trends are generally obvious and follow either an exponential or asymptotic change to stable parameter values during purging. The above stabilization guidelines are provided as estimates and will not be appropriate for use in all circumstances.
12. The pump will not be turned off between the purging and sampling processes.
13. If stabilization does not occur or turbidity is >20 NTU after two hours of purging, the field team leader should be contacted for direction.

Groundwater samples will be collected by gently filling the sample bottles with minimum turbulence once equilibrium is established. Lower the flow rate to 100 mL/minute and collect the parameters in the following order:

- VOCs (no headspace)
- Methane, Ethane, Ethene (no headspace)
- Carbon Dioxide (no headspace)
- TOC (no headspace)
- Sulfide (no headspace)
- Anions
- Alkalinity
- Metals (total and dissolved)
- Field Parameters (ferrous iron and carbon dioxide)

5.2.3.3 Sampling Using a Passive Diffusion Bag Sampler

Select groundwater samples will be collected for VOC analyses using passive diffusion bag (PDB) sampling. A typical PDB sampler consists of a low-density polyethylene tube closed at both ends and filled with deionized water. It is positioned in the well at the desired target depth by attaching it to

weighted line, or a fixed object. The water within the bag is then allowed to equilibrate with the ambient groundwater (at least two weeks) before being retrieved. The sampler water is then decanted into 40 mL volatile organic analysis (VOA) vials and sent to the lab for analysis. Detailed procedures for using PDB samplers in wells can be found in "User's Guide for Polyethylene-Based Passive Diffusion Bag Samplers to Obtain Volatile Organic Compound Concentrations in Wells" (USGS, 2001). The following is a generalized summary of PDB sampling:

1. The top and bottom of the PDB sampler will be attached to 3/16" polyester or similar non-buoyant rope strong enough to support the weight of the sampler and subject to minimal stretch. The PDB will be suspended within the well screen at selected depths based on the measured total depth and location of the screen. Weights will be attached to the bottom of the sampler to keep it in place in the well. The sampler will be allowed to equilibrate for at least two weeks before being carefully retrieved with the attached line and the sample collected.
2. After the equilibration period, the PDBs will carefully be withdrawn from the well and inspected. Any evidence of algae or other coatings on the bag or tears in the membrane will be noted in the field book. If there are tears, the sample will be rejected.
3. The contents of the intact bag will then be transferred to pre-preserved VOA vials causing as little agitation of the sample as possible.

5.3 Closeout

Perform following activities daily before leaving the site:

- Decontaminate and check condition of field equipment.
- Provide log books and other field documentation to FTL for review
- Properly dispose of trash, debris and used PPE.
- Make arrangements for shipment of samples (if applicable) and follow-up with the analytical laboratory to confirm samples arrived in good condition in accordance with SOPs 5 and 6.
- Complete the Daily Field Report (SOP 1, Attachment 1-2) and submit to PM.

Upon the completion of groundwater sampling activities, the FTL will check the sample locations to check that trash was removed from the site and any damage repaired.

Confirm all equipment is accounted for and properly decontaminated and in good working condition. Properly package and ship all rental equipment to the vendor.

Rental trucks should be fueled and returned to the rental company as soon as possible. HDR EOC leased trucks should also be fueled and cleaned prior to storing at the shop.

Work areas should be cleaned with tools and equipment properly stored.

The FTL will make a final check of all logbooks and other field records to ensure there are no blanks or missing data and the entries are legible.

The FTL will complete Closeout Report (SOP 1, Attachment 1-3) and submit to PM.

6.0 DATA AND RECORDS MANAGEMENT

All field forms and log book entries will be scanned and copied project folder on the "Z" drive within one week of the field event completion. All photographs taken during the field event will be uploaded along with a typed photograph log (date, project and subject) to the "Z" drive. All original forms will be stored on site in Memphis in the filing cabinet in the proper folder labeled for the project. The PM and project chemist will be sent a link for the data.

7.0 QUALITY CONTROL AND QUALITY ASSURANCE

All work will be performed in accordance with the QAPP, the specific work plan, and applicable SOPs. All field activities will be recorded in the log books in sufficient detail to reconstruct the events. No erasures or mark outs will be made on field forms or log books. A single line will be used to strike out errors and will be annotated with the initials and date of the editor.

8.0 REFERENCES

None.

Attachment 3-1

Water Level Measurement and Well Assessment Record

Sample Event:_____

Well I.D	Previous Measurement 3/30/2011 Depth to Water (ft, btoc)	Depth to Water (ft, btoc)	Date	Well Assessment
MW-003	63.56			
MW-004	71.00			
MW-005	75.49			
MW-006	58.96			
MW-007	63.60			
MW-008	59.68			
MW-010	-			
MW-013	69.39			
MW-014	72.17			
MW-015	64.90			
MW-028	54.45			
MW-031	65.50			
MW-032	-			
MW-033	52.04			
MW-037	-			
MW-042	52.89			
MW-043	116.05			
MW-044	50.81			
MW-045	54.51			
MW-051	39.22			
MW-054	75.83			

Attachment 3-2

Water Sample Collection Sheet

Site Name:_____Project No.:_____

Sample No.:_____ Well ID.:_____

Date/Time Collected:_____ Personnel:_____

Sample Method: _____

Sample QC: Duplicate Yes No Duplicate Sample ID:_____

MS/MSD: Yes No

Well Purging Data (Fill In All Blanks)

Depth Of Sample Collection (ft, btoc) _____

Date: _____ Depth To Water (ft, btoc) _____

Time Completed _____ Total Purge _____ Units_____

Field Measurements: Fill In All Blanks

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

Flow Rate_____

General Comments:

_____

_____

STANDARD OPERATING PROCEDURE 5 – SAMPLE CONTROL AND DOCUMENTATION

Lead Organization: Department of the Army (DA)

Preparing Organization: HDR

SOP Approved by: Field Team Leader: Kevin Sedlak

Project QA Officer: Lynn Lutz

Project Manager: Tom Holmes

1.0 PURPOSE AND SUMMARY

This Standard Operating Procedure (SOP) provides guidance for sample control and identification, data recording, and proper completion of Chain-of-Custody (COC) forms.

2.0 HEALTH AND SAFETY

General Information on Health and Safety requirements are provided in SOP 1. Each individual is required to have read and understood the HASP for the specific project activity and signed the acknowledgement sheet confirming their review.

Health and safety concerns for sample handling include potential for exposure to contaminants and injury from breakage of sample containers. Contamination levels at DDMT are relatively low but care should be taken to avoid exposure. Sample containers should be handled carefully; nitrile gloves and safety glasses should be used.

3.0 PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

Sample control activities will be directed by the Field Team Leader (FTL), a mid- or senior level environmental professional (engineer, geologist or scientist) with experience in sampling activities. The field staff, environmental professionals or technicians, are responsible for proper sample handling and documentation of the sample collection.

4.0 EQUIPMENT AND SUPPLIES

The field staff will use a pen with blue or black waterproof ink to record field activities and document sample handling. A laptop computer with laboratory-provided software may also be used for sample documentation.

5.0 PROCEDURE

Proper field sampling and documentation help ensure sample authenticity and data integrity. These procedures describe sample collection documentation and sample handling, tracking, and custody procedures to ensure that sample integrity and custody are maintained.

If the computer is being used to scan the samples as they are collected the data recorded by the computer should be checked for correctness. The date and time on the computer should be checked prior to scanning of any samples. The sample label should be completed when the sample is collected. If the samples are being collected and a hand written COC will be used all information should be recorded in a log book as to the type of sample, date and time collected and number of sample containers. The COC can then be filled out back at the field office in a quiet environment with out disturbances to avoid errors. The number of sample containers on the COC should be physically checked against the number of containers collected. Once this is confirmed the sample crew can properly store the samples for shipment.

5.1 Start-Up Activities

5.1.1 Office

The FTL will work with the project chemist (PC) to:

- Prepare the sampling plan detail (Attachment 5-1)
- Coordinate with the analytical laboratory and ensure that sample forms including chain of custody forms and custody seals are shipped to the site.

5.1.2 Field

After arrival on site, but prior to commencement of operations, the FTL will confirm that required documentation and equipment for field activities are on site.

5.2 Field Operations

5.2.1 Sample Identification

Individual samples will be identified by a unique alphanumeric code (also referred to as a sample ID number or field number) which will be written on the sample label and recorded on the COC form. The sample ID will include the location and sampling event as described in Section 2.3.2 of the QAPP.

Additional information to be written on the label includes sample ID, time and date of sample, sampler's initials, and the analytical methods to be performed, as described in Section 5.2.3 of this SOP.

Field Quality Control (QC) samples to be collected at DDMT include trip blanks, rinsate blanks, field (ambient) blanks, and field duplicates. The ID for trip blanks, rinsate blanks and field blanks will consist of the prefix TB, RB or FB, respectively, followed by a number, followed by the sampling event, as shown below:

TB-1-ODPM-9	first Trip Blank for event ODPM-9
TB-2-ODPM-9	second Trip Blank for event ODPM-9
RB-1-ODPM-9	Rinsate Blank for event ODPM-9
FB-1-ODPM-9	Field Blank for event ODPM-9

Matrix spike and matrix spike duplicate samples will also be collected. The ID for these samples will consist of the location ID, followed by the sampling event, followed by the suffix MS or MSD, as shown below:

MW-164-ODPM-9-MS	Matrix Spike sample for well MW-164
MW-164-ODPM-9-MSD	Matrix Spike Duplicate sample for well MW-164

The identity of field duplicate samples will be concealed from the laboratory by using a consecutively numbered duplicate identifier, followed by the sampling event, as shown below:

DUP-1-ODPM-9	first field duplicate for event ODPM-9
DUP-2-ODPM-9	second field duplicate for event ODPM-9

The location of field duplicates will be recorded on the sampling plan detail (SPD) and field notebook. The final SPDs will be maintained in the project file and copies will be kept at the on-site field office. At the end of the sampling event, the FTL will send the PM and PC the final SPD with changes to field duplicate or MS/MSD sample IDs, additional blanks collected, and any other changes.

5.2.2 Field Documentation

5.2.2.1 Logbook

The logbook is a written record of sampling activities to be completed in the field during sampling. The purpose is to document field conditions or procedural exceptions that may aid in the analysis of data generated from sampling activities. The log book will have with sequentially numbered pages and information will be recorded in blue or black waterproof ink. The recorder will sign and date each page.

Information pertaining to environmental conditions at the site during the field investigation will be noted in the field log book for each day. The following information will be recorded for each activity:

1. Activity
2. Location
3. Date and time
4. Weather conditions

For field sampling activities, the following information will be recorded, if a sampling form is not used:

1. Sample type and sampling method
2. The identity of each sample and the depth(s) from which it was collected
3. Sample description (e.g., color, odor, clarity)
4. Identification of sampling devices used
5. Identification of sampling conditions that might affect the representativeness of a sample (i.e., refueling operations, damaged casings)

5.2.2.2 Daily Field Reports

Each day the FTL will prepare a Daily Field Report (SOP 1, Attachment 1-2). The report will include daily weather, time and description of field activities, samples collected, and any problems or changes in scope that occurred that day. The report also lists field staff, subcontractors and site visitors observing field activities.

5.2.2.3 Photographs

Photographs taken for the purpose of project documentation will be noted in the field logbook. The sequential number of the photograph, photographer, date, time, location, description, and orientation of the photograph will be recorded in the logbook as the photographs are taken. The photographs and documentation will be loaded on the Z-Drive.

5.2.3 Sample Labels/Tags

Sample labels will be filled out for each sample with an indelible pen. The label will be protected from water and solvents with clear label protection tape. Any change in the pre-prepared label information will be initialed by the sampler.

5.2.3.1 Labels for Groundwater Samples

Pre-printed labels from the laboratory for groundwater sampling events contain the following information:

- Sample ID
- Preservative
- Date the bottle was prepared
- Matrix
- Tests
- Laboratory name
- Bar code

The sample collector will write in the following information:

- Date of collection
- Time of collection
- Name or initials of collector

5.2.3.2 Sample Tags for Air Samples

Sample tags from the laboratory for air sampling events contain the following information:

- Laboratory name, address, phone number and fax number

The sample collector will write in the following information:

- Client name (HDR EOC)
- Sample ID
- Analysis (TO-15)
- Date and time of sample collection
- Sampler's initials
- Comments

5.2.4 Sample Custody

Sample custody is a part of a quality field or laboratory operation. Custody of a sample is defined as:

1. Having physical possession

2. Being in view, after being in possession
3. Having possession, then being placed in a secure area
4. Being maintained in a secure area by the person who had possession last

These custody practices will be observed in the field. They will be performed according to the procedures described in the following subsections.

5.2.4.1 COC Records

A hand-written three-part chain of custody (COC) will be fully completed, in triplicate. The first two pages will accompany the cooler to the laboratory, and the bottom copy will be retained in the files at the field office after it is scanned into the computer file.

A computer-generated COC will have one copy printed that will accompany the cooler to the laboratory. The data used to generate the COC will be transmitted via E-mail to the laboratory and a PDF copy of the COC will be saved on the computer in the sampling file.

The information specified on the COC record will contain the same level of detail found in the site log book, with the exception that on-site measurement data will not be recorded. The custody record will include at least the following information:

- Name of person collecting the samples
- Date samples were collected
- Type of sampling conducted (composite/grab)
- Location of sampling station (including the site location)
- Number and type of containers used
- Signature of the HDR EOC person relinquishing samples to a non-HDR EOC person (such as a FedEx agent), with the date and time of transfer noted, and the cooler designation.
- Airbill Number

If samples will require rapid turnaround in the laboratory because of project time constraints or analytical concerns such as extraction time or sample retention period limitations, these constraints will be noted in the remarks section of the custody record. The FTL or designee will contact the laboratory to confirm the turnaround time can be achieved. The computer generated COC is for use with Microbac Laboratories only. Other laboratories will provide COCs for use.

It is not practicable to seal the sample coolers or cartons at a FedEx office; they will be sealed beforehand. The custody record will, therefore, have the signature of the relinquishing field technician, but the "relinquished to" box will not be filled in.

The duplicate custody record will then be placed in a plastic bag, taped to the underside of the cooler lid, and the cooler closed. COCs for air samples will be included in the carton. The container will be tightly bound with filament tape. Finally, custody seals will be signed by the individual relinquishing custody and affixed in such a way that the cooler or carton cannot be opened without breaking the seals.

The original and duplicate custody records and the airway bill or delivery note together constitute a complete record. The FTL will email a copy of the airbill and the COC to the PC, who will maintain the custody records as part of the analytical data file.

Custody Seals: Custody seals will be preprinted, adhesive-backed seals designed to break if disturbed. Sample shipping containers (coolers, cardboard boxes, etc., as appropriate) will be sealed in as many places as necessary to ensure security. Seals will be signed and dated before application.

Laboratory custody procedures are described in the laboratory sample handling and storage SOPs L3 and L4, included in Appendix C of the QAPP.

5.3 Closeout

Before leaving the site daily, the following procedures will be performed by on-site personnel:

- Maintain custody of samples, maintaining them as specified for the analyses to be performed.
- Prepare samples for shipment to the laboratory.
- Complete the COC forms.
- Contact the laboratory to inform them that samples will be shipped and also remind them of any special requirements for the sample analyses.
- Verify completion of logbook, ensuring that required information has been recorded.

Upon the completion of sample collection and shipment copies of the COCs will be scanned and sent to interested parties to include the project manager and chemist. The FedEx tracking numbers will be checked each day to confirm the samples were delivered and the laboratory will be contacted to check on problems with the samples or COCs.

6.0 DATA AND RECORDS MANAGEMENT

All field forms, COCs, and log book entries will be scanned and copied project folder on the "Z" drive within one week of the field event completion. All original forms will be stored on site in Memphis in the filing cabinet in the proper folder labeled for the project. The PM and project chemist will be sent a link for the data.

7.0 QUALITY CONTROL AND QUALITY ASSURANCE

Work will be performed in accordance with the QAPP, the specific work plan, and applicable SOPs. Field activities will be recorded in the log books in sufficient detail to reconstruct the events and forms provided with the SOP will be completed. No erasures or mark outs will be made on field forms or log books. A single line will be used to strike out errors and will be annotated with the initials and date of the editor.

8.0 REFERENCES

None.

Attachment 5-1

SAMPLE PLAN DETAIL

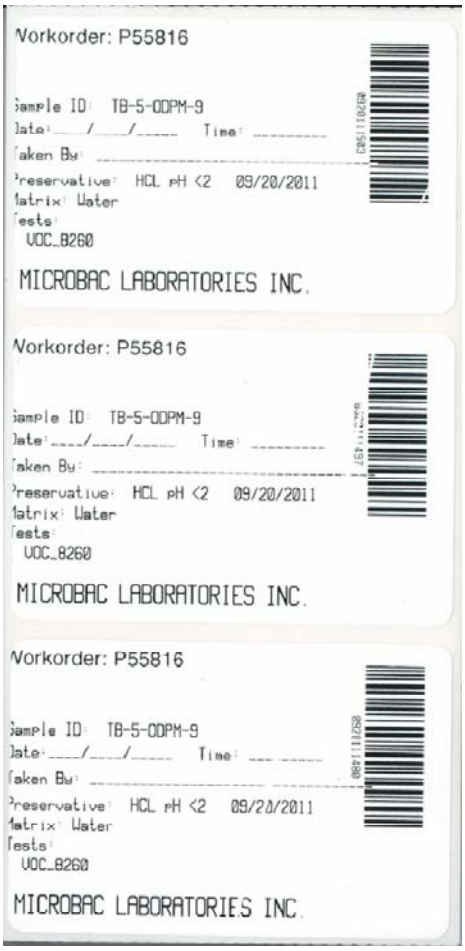
SAMPLING PLAN DETAIL (OFF DEPOT PM WELLS September 2011) - ODPM-9

Parameter	**VOCs**
Method	**8260B**
Container	**40 mL VOA**
Preservative	**HCl to pH<2**
	Cool to 4°C

#	Well ID	Sample ID	Additional	No. of Containers
1	MW-54	MW-54-ODPM-9		3
2	MW-70	MW-70-ODPM-9		3
3	MW-76	MW-76-ODPM-9		3
4	MW-77	MW-77-ODPM-9		3
5	MW-79	MW-79-ODPM-9	DUP-1	3
6	MW-148	MW-148-ODPM-9		3
7	MW-149	MW-149-ODPM-9		3
8	MW-150	MW-150-ODPM-9		3
9	MW-151	MW-151-ODPM-9		3
10	MW-152	MW-152-ODPM-9		3
11	MW-155	MW-155-ODPM-9		3
12	MW-157	MW-157-ODPM-9		3
13	MW-158	MW-158-ODPM-9		3
14	MW-158A	MW-158A-ODPM-9		3
15	MW-159	MW-159-ODPM-9	DUP-2	3
16	MW-160	MW-160-ODPM-9		3
17	MW-161	MW-161-ODPM-9		3
18	MW-162	MW-162-ODPM-9		3
19	MW-163	MW-163-ODPM-9		3
20	MW-164	MW-164-ODPM-9		3
20	MW-164	MW-164-ODPM-9-MS	MS	3
20	MW-164	MW-164-ODPM-9-MSD	MSD	3
21	MW-165	MW-165-ODPM-9		3
22	MW-165A	MW-165A-ODPM-9		3
23	MW-166	MW-166-ODPM-9		3
24	MW-166A	MW-166A-ODPM-9		3
25	MW-241	MW-241-ODPM-9		3
26	MW-242	MW-242-ODPM-9		3
27	MW-243	MW-243-ODPM-9		3
28	MW-244	MW-244-ODPM-9		3
29	MW-245	MW-245-ODPM-9		3
30	MW-246	MW-246-ODPM-9		3
31	RB	RB-ODPM-9		3
32	DUP-1	DUP-1-ODPM-9		3
33	DUP-2	DUP-2-ODPM-9		3
34	TB-1	TB-1-ODPM-9		3
35	TB-2	TB-2-ODPM-9		3

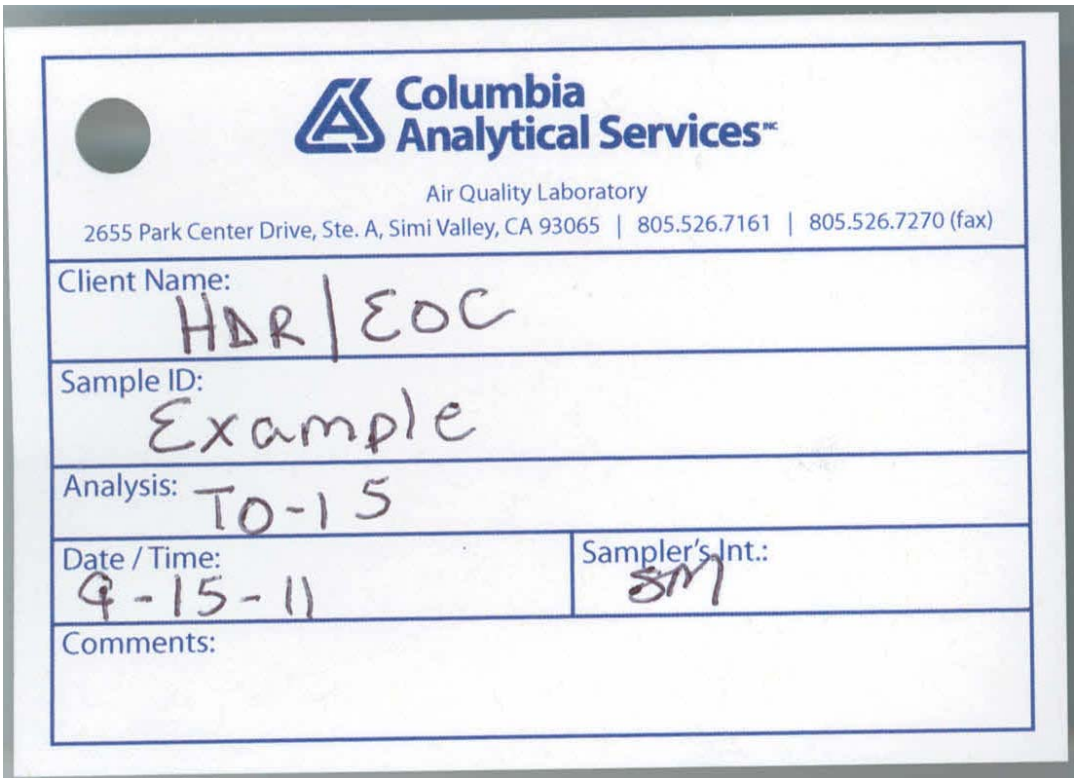
Attachment 5-2

SAMPLE LABELS FOR GROUNDWATER SAMPLES



Attachment 5-3

SAMPLE LABELS FOR AIR SAMPLES



Attachment 5-4

MICROBAC CHAIN OF CUSTODY FORM (COMPUTER)

Microbac

Chain of Custody
Chain #: 1001
Printed at : 04/26/2011 08:46

Barcode	Client ID	Tests	Collect Date	Beg. Depth	End. Depth	Notes
~~0420111~~	~~MW-91-ODLB-3~~	~~VOC_8260~~	~~04/25/2011 10:09~~	91 4/26		
~~0420112~~	~~MW-91-ODLB-3~~	~~VOC_8260~~	~~04/25/2011 10:09~~	91 4/26		
~~0420113~~	~~MW-91-ODLB-3~~	~~VOC_8260~~	~~04/25/2011 10:09~~	91 4/26		
0420111	04/25/11-TB-1-ODPM-8	VOC_8260	04/25/2011 10:09			
0420112	04/25/11-TB-1-ODPM-8	VOC_8260	04/25/2011 10:09			
0420113	04/25/11-TB-1-ODPM-8	VOC_8260	04/25/2011 10:09			
0420114	DUP-1-ODPM-8	VOC_8260	04/25/2011 11:32			
0420115	DUP-1-ODPM-8	VOC_8260	04/25/2011 11:32			
0420116	DUP-1-ODPM-8	VOC_8260	04/25/2011 11:32			
0420117	MW-250-ODPM-8	VOC_8260	04/25/2011 10:30			
0420118	MW-250-ODPM-8	VOC_8260	04/25/2011 10:30			
0420119	MW-250-ODPM-8	VOC_8260	04/25/2011 10:30			
04201110	MW-251-ODPM-8	VOC_8260	04/25/2011 10:42			
04201111	MW-251-ODPM-8	VOC_8260	04/25/2011 10:42			
04201112	MW-251-ODPM-8	VOC_8260	04/25/2011 10:42			
04201113	MW-54-ODPM-8	VOC_8260	04/25/2011 11:32			
04201114	MW-54-ODPM-8	VOC_8260	04/25/2011 11:32			
04201115	MW-54-ODPM-8	VOC_8260	04/25/2011 11:32			
04201116	MW-70-ODPM-8	VOC_8260	04/25/2011 13:23			
04201117	MW-70-ODPM-8	VOC_8260	04/25/2011 13:23			
04201119	MW-70-ODPM-8-MS	VOC_8260	04/25/2011 13:23			
04201120	MW-70-ODPM-8-MS	VOC_8260	04/25/2011 13:23			
04201122	MW-70-ODPM-8-MSD	VOC_8260	04/25/2011 13:23			
~~04201123~~	~~MW-70-ODPM-8-MSD~~	~~VOC_8260~~	~~04/25/2011 13:23~~	KS 4/26		
04201125	MW-76-ODPM-8	VOC_8260	04/25/2011 13:07			
04201126	MW-76-ODPM-8	VOC_8260	04/25/2011 13:07			
04201127	MW-76-ODPM-8	VOC_8260	04/25/2011 13:07			
04201128	MW-77-ODPM-8	VOC_8260	04/25/2011 13:14			
04201129	MW-77-ODPM-8	VOC_8260	04/25/2011 13:14			
04201130	MW-77-ODPM-8	VOC_8260	04/25/2011 13:14			
04201131	MW-79-ODPM-8	VOC_8260	04/25/2011 11:17			
04201132	MW-79-ODPM-8	VOC_8260	04/25/2011 11:17			

Microbac OVD 221000014398
Received: 04/27/2011 12:55
By: BRENDA GREENWALT
(signed)

Barcode	Client ID	Tests	Collect Date	Beg. Depth	End. Depth	Notes
04201133	MW-79-ODPM-8	VOC_8260	04/25/2011 11:17			

Samples Collected on: 04/25/2011 by jbsperry
(signed)

Attachment 5-4

MICROBAC CHAIN OF CUSTODY FORM (HAND))

COC No. A 23953

158 Starlite Drive
Marietta, OH 45750

Microbac

CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

Company Name:	
Project Contact:	Contact Phone #:
Turn Around Requirements:	Location:
Project ID:	
Sampler (print):	Signature:

Program
☐ CWA
☐ RCRA
☐ DOD
☐ AFCEE
☐ Other ____________

Sample I.D. No.	Comp	Grab	Date	Time	Matrix*	NUMBER OF CONTAINERS	Hold																TOTAL # (LAB USE)	ADDITIONAL REQUIREMENTS

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)
Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Remarks:	

*Water (W), Soil (S), Solid Waste (SD), Unknown (X)

Page ________ of________

Attachment 5-5

COLUMBIA ANALYTICAL SERVICES CHAIN OF CUSTODY FORM

Columbia Analytical Services™

2655 Park Center Drive, Suite A
Simi Valley, California 93065
Phone (805) 526-7161
Fax (805) 526-7270

Air - Chain of Custody Record & Analytical Service Request

Page _____ of _____

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10 Day-Standard

CAS Project No.

Company Name & Address (Reporting Information)	Project Name	CAS Contact:	Analysis Method		Comments e.g. Actual Preservative or specific instructions
	Project Number				
Project Manager	P.O. # / Billing Information				
Phone / Fax					
Email Address for Result Reporting	Sampler (Print & Sign)				

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Canister ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code #- FC #)	Canister Start Pressure "Hg	Canister End Pressure "Hg/psig	Sample Volume			

Report Tier Levels - please select
Tier I - (Results/Default if not specified) ____
Tier II (Results + QC) ____
Tier III (Data Validation Package) 10% Surcharge ____
Tier V (client specified) _____

EDD required Yes / No
Type: _____

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Time:	
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Time:	Cooler / Blank Temperature ____ °C

STANDARD OPERATING PROCEDURE 6 – SAMPLE PACKING AND SHIPPING

Lead Organization: Department of the Army (DA)

Preparing Organization: HDR

SOP Approved by: Field Team Leader: Kevin Sedlak

Project QA Officer: Lynn Lutz

Project Manager: Tom Holmes

1.0 PURPOSE AND SUMMARY

The purpose of this Standard Operating Procedure (SOP) is to provide guidance for packing and shipping environmental samples to the laboratory for analysis. The goals for sample packing and shipping are that: 1) the integrity of the sample is maintained, and 2) no exposure to the sample contents occurs during transit. These goals should be met regardless of the method by which the samples were shipped.

Samples will usually be shipped as either environmental samples or as hazardous materials based on the expected contaminant concentrations. While the concentration of constituents in the sample is not generally known prior to shipment of the sample, inferences can be made based on the site location and knowledge of past activities, observations during collection, and past sample results. Hazardous materials are generally considered to be samples of highly contaminated media collected at or near an observed release and can consist of pure product or a mixture. Environmental samples are generally media with low-level contamination.

Relevant regulations include Department of Transportation (DOT) regulations for ground transportation (49 CFR) and the International Air Transport Association (IATA) regulations for air transportation. Common carriers (e.g., FedEx, and UPS etc.) must abide by these regulations. This SOP provides specific guidance on how to package and ship samples to achieve the stated objectives and remain in compliance with shipping regulations. If field personnel are unsure regarding current shipping regulations, they will immediately contact the selected carrier (e.g., FedEx, UPS, etc.) for guidance.

2.0 HEALTH AND SAFETY

General Information on Health and Safety requirements are provided in SOP 1. Each individual is required to have read and understood the HASP for the specific project activity and signed the acknowledgement sheet confirming their review.

Health and safety concerns for sample shipment include potential for exposure to contaminants and injury from breakage of sample containers. Contamination levels at DDMT are relatively low but care should be taken to avoid exposure. Sample containers should be handled carefully; nitrile gloves and safety glasses should be used.

3.0 PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

Sample packing and shipping activities will be directed by the Field Team Leader (FTL), a mid- or senior level environmental professional (engineer, geologist or scientist) with experience in sampling activities. Field staff, environmental professionals or technicians, are responsible for proper sample handling and compliance with these guidelines.

4.0 EQUIPMENT AND SUPPLIES

The required equipment and supplies will consist of ice chests from the laboratory, clear tape, filament tape, gallon size Ziploc bags, trash bags custody seals, bubble bags, cushion for bottom of cooler, and FedEx handle label hangers.

5.0 PROCEDURE

5.1 Start-Up Activities

5.1.1 Office

The FTL will work with the project chemist (PC) to:

- Ensure that sufficient sample containers, shipping containers/coolers and packing material are shipped to the site based on the analytical parameters, total number of samples and average number of samples to be collected per day.
- Develop guidelines on the number/type of samples per shipper based on sample type and past analytical results (i.e. VOCs in one cooler to limit the number of trip blanks needed and samples from high concentration wells packed in separate cooler to prevent cross contamination)
- Coordinate sample shipments to ensure laboratory personnel will be available to receive the samples if weekend or holiday shipments are planned.

5.1.2 Field

After arrival on site, but prior to commencement of operations, the FTL will confirm that the required sample containers, sample coolers, packing material and ice are available on-site.

5.2 Field Operations

On specific projects, protocols for sample shipment will be specified in the work plan. This SOP provides general guidelines for sample packing and shipping.

- Samples will be shipped to the laboratory by an overnight courier service.
- Samples will not remain on site for more than 24 hours after collection, unless samples were collected on a weekend or there were not enough samples to make a shipment. These samples will be stored in the refrigerator at 4°C in a locked office until the next shipment.
- Glass sample containers will be placed inside sealed plastic bubble wrap bags or wrapped in bubble wrap and placed in plastic bags as a precaution against cross-contamination due to leakage or breakage.
- Sample bottles will be placed in coolers in a manner to limit the breakage and/or leakage during shipment. All coolers will have a bottom cushion placed in prior to placing the samples in the cooler.
- Segregate highly contaminated samples, if known, by placement in a separate cooler or in separate plastic zip-lock bags.
- All coolers will have the drain plug taped closed, if present.
- Sufficient ice in plastic bags (double-bagged) will be placed in the coolers to keep the samples at 4°C throughout shipment.
- Chain of Custody documents (COCs) will be placed in zip-lock bags and taped to the inside lid of each cooler.
- Coolers lids will be secured by wrapping with filament tape.
- The air bill tie will be secured to the handle of the cooler for the shipment label.
- Place Fragile and perishable stickers on all coolers. If shipping for Saturday delivery, place multiple Saturday Delivery stickers on each cooler and contact the laboratory to confirm receiving staff will be present.

- Confirm arrangements with the laboratory point-of-contact for Saturday delivery samples so that hold times and/or sample preservation are not compromised.

Custody seals will be used for sample shipments in accordance with SOP 5, Sample Control and Documentation. Custody seals are adhesive labels that are placed in such a manner that they will be visibly disturbed upon opening the shipping container or cooler. The seals will be initialed and dated upon placement. Upon receipt at the laboratory, the sample custodian will note the condition of custody seals and will also check the sample temperature, recording these items on the laboratory receipt form.

5.3 Closeout

Before leaving the site daily, the following procedures will be performed by the FTL or designated field staff:

- Ensure that the sample transport containers are properly packed and are in compliance with DOT and IATA regulations.
- Complete the Sample Handling, Packing & Shipping Checklist (Attachment 6-1).

6.0 DATA AND RECORDS MANAGEMENT

All field forms and log book entries will be scanned and copied project folder on the "Z" drive within one week of the field event completion.

7.0 QUALITY CONTROL AND QUALITY ASSURANCE

Work will be performed in accordance with the QAPP, the specific work plan, and applicable SOPs. The Sample Handling, Packing & Shipping Checklist will be completed each day that samples are shipped. No erasures or mark outs will be made on the checklist. A single line will be used to strike out errors and will be annotated with the initials and date of the editor.

8.0 REFERENCES

None.

Attachment 6-1

SAMPLE HANDLING, PACKING & SHIPPING CHECKLIST

When preparing samples for shipment to the laboratory, complete this checklist to ensure that samples, documents, and materials are properly packed in the sample shipper.

Sample Event: _____

Date: _____

PROJECT SAMPLES

□ All samples, duplicates, MS/MSDs, equipment blanks, ambient blanks, and trip blanks should be included in the cooler that are listed on the COC.

□ Verify that the proper number of bottles with appropriate preservative(s) were collected for each sample

□ Verify that samples were checked for pH (except volatile samples)

DOCUMENTS

□ **Chain-of-Custody (COC)** generated for *each* cooler

□ COC reviewed for completeness, including appropriate signature(s) and date(s), and include the **courier tracking/shipping number** on the COC

□ **COC** placed in a Ziploc bag and taped to the underside of the cooler lid

□ **Custody seals** placed on the front and back of each cooler.

PACKING MATERIALS

□ Ice is "double-bagged" and is sufficient to maintain a temperature of 4◦C

□ Glass bottles placed in a bubble bag to prevent breakage and leakage

□ Highly contaminated samples (if known) placed together

□ **Trip blank** placed in each cooler that contains samples for VOC analyses at beginning of day

□ All VOC samples placed in same cooler to minimize the number of trip blanks,

□ Each cooler contains a **temperature blank**

Comments: (special handling or delivery requirements, highly contaminated samples, etc.)

_____

_____

Number of coolers shipped: _____

Checklist Completed By: _____ Date: _____

Note: Place the completed checklist in the project file with the associated COCs and airbill.

STANDARD OPERATING PROCEDURE 7 –EQUIPMENT DECONTAMINATION

Lead Organization: Department of the Army (DA)

Preparing Organization: HDR

SOP Approved by: Field Team Leader: Kevin Sedlak

Project QA Officer: Lynn Lutz

Project Manager: Tom Holmes

1.0 PURPOSE AND SUMMARY

This Standard Operation Procedure (SOP) provides guidance for proper decontamination of equipment used in sampling and collection of equipment rinsates to evaluate effectiveness of decontamination procedures.

2.0 HEALTH AND SAFETY

General Information on Health and Safety requirements are provided in SOP 1. Each individual is required to have read and understood the HASP for the specific project activity and signed the acknowledgement sheet confirming their review.

Health and safety concerns for equipment decontamination include exposure to contaminants from sampling equipment. Nitrile gloves and safety glasses should be used during decontamination.

3.0 PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

Sampling equipment decontamination and rinsate sample collection will be directed by the Field Team Leader (FTL), a mid- or senior level environmental professional (engineer, geologist or scientist) with experience in equipment decontamination and sampling activities. The field staff, environmental professionals or technicians, are responsible for following these procedures and seeking direction from the FTL when questions or problems arise.

4.0 EQUIPMENT AND SUPPLIES

The required equipment and supplies will consist of Alconox soap, deionized water (DI), tap water, paper towels, foil, and sample containers.

5.0 PROCEDURE

Proper equipment decontamination will prevent cross-contamination of samples due to residual contamination from previous sample locations and spread of contamination via sampling equipment. Proper decontamination also supports the legal defensibility of data generated during RA-O and LTM activities.

Decontamination procedures will be evaluated by the collection of equipment rinsates. These samples consist of reagent water collected from final rinse of sampling equipment after the decontamination procedure has been performed. The samples are analyzed with the environmental sample to assess the adequacy of the decontamination performed.

5.1 Start-Up Activities

5.1.1 Office

The FTL will confirm that sufficient equipment and supplies are available at the site based on the number of samples and estimated field days.

5.1.2 Field

After arrival on site, but prior to commencement of operations, the FTL will confirm that decontamination supplies and equipment are available on site and review procedures with field staff.

5.2 Field Operations

5.2.1 Decontamination Area

The location of the decontamination area, used primarily for larger pieces of equipment, will be determined in consultation with subcontractor personnel. The decontamination pad will include a sump lined with 6-mil polyethylene sheeting to collect the decontamination water. The sump will be constructed by either excavating a small area to create a depression or by elevating the edges of the sheeting. Existing concrete pads with containment areas can be used for large equipment like drill rigs. Small handheld equipment will be decontaminated in 5-gallon buckets to contain the water.

5.2.2 Decontamination Water Source

Tap water from the municipal water treatment system will be used as a rinse in the decontamination procedure. The FTL will be responsible for coordinating with the subcontractor personnel to secure an adequate supply of potable water for decontamination procedures. If large quantities of water are to be used the subcontractor will rent a water meter from Memphis Light Gas and Water (MLGW). For smaller amounts, the shop water hose can be used.

5.2.3 Decontamination Procedures

The required decontamination procedure for large pieces of equipment such as drill rigs, auger flights, and drilling and well casing is:

1. Wash the external surface of equipment or materials with high pressure hot water and Alconox or equivalent, and scrub with brushes if necessary until all visible dirt, grime, grease, oil, loose paint, rust flakes, etc., have been removed from the equipment.
2. Air dry.
3. Decontamination waste water will be stored at the site and analyzed prior to disposal.

The required decontamination procedure for sampling equipment except the water level indicator probe is:

1. Wash and scrub with Alconox solution (or equivalent).
2. Double tap water rinse.
3. Rinse with American Society for Testing and Materials (ASTM) Type II Reagent - Grade Water
4. Wrap in oil free aluminum foil for transport.

During water level sweeps and measurements in low-flow sampling, the water level tape and indicator in contact with groundwater will be decontaminated before initial use and before moving to a new location. The decontamination procedure for the water level indicator is:

1. Hand wash the calibrated tape and probe with Alconox solution (or equivalent).
2. Rinse with deionized (Reagent Grade II) water.

5.2.4 Equipment Rinsate Collection

When non-dedicated sampling equipment is used, the equipment will be decontaminated before initial use and after each sample is collected. An equipment rinsate sample will be collected for equipment type (bladder pump or bailer). At least one equipment rinsate will be collected for each sampling protocol (i.e. soil sampling, bladder pumps used for groundwater sampling) during each week of sampling. Equipment rinsate samples will be collected to be representative of field decontamination procedures.

Sampling Equipment: Equipment rinsates will be obtained from decontaminated bladder pumps, bailers, stainless steel split-spoons, hand augers, and stainless steel bowls with ASTM Type II water or better.

The equipment rinsate protocol will be as follows:

a. Label Sample Container - Label the sample container as outlined in SOP 5 – Sample Control and Documentation.

b. Collect Sample - After sample collection equipment has been decontaminated as described above, an equipment rinsate will be collected. ASTM Type II water (or better) will be poured over and through the sampling equipment into a cleaned stainless steel bowl (preferably the equipment and bowl to be used on a specifically identifiable sample location). The collected water will be poured into the appropriate sample container. Repeat the process as necessary to fill each container to the required volume. Vials for volatile analysis and bottles for total organic carbon (TOC) analysis will be completely filled, leaving no air space above the liquid portion (to minimize volatilization). Check that the Teflon on the Teflon- lined silicone septum is toward the sample in the caps and secure the cap tightly. If semi-volatile compounds are to be sampled for, collect these samples next. Proceed to the collection of samples for the remaining analyses. Be careful of all pre-preserved bottles. If acids are present, open the bottle downwind and away from the body.

c. Custody, Handling and Shipping - Complete the procedures as outlined in SOP 5 – Sample Control and Documentation and SOP 6 - Sample Packing and Shipping.

5.3 Closeout

Before leaving the site daily, the following procedures will be performed by the FTL or designated field staff:

- Confirm all equipment is decontaminated and properly stored all equipment.

- Add decontamination water to the wastewater storage tank
- Note equipment decontamination activities and rinsate sample collection on the Daily Field Report (SOP 1, Attachment 1-2).

6.0 DATA AND RECORDS MANAGEMENT

All field forms and log book entries will be scanned and copied project folder on the "Z" drive within one week of the field event completion.

7.0 QUALITY CONTROL AND QUALITY ASSURANCE

Work will be performed in accordance with the QAPP, the specific work plan, and applicable SOPs.

8.0 REFERENCES

None.