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Memorandum for Record

RE: Small Weapons Technical Memo to the Corrective Measures Implementation dated March 25, 2009

Please note that the Small Weapons Technical Memo to the Corrective Measures Implementation Plan dated March 25, 2009 is the first Tech Memo Addendum to the Final Corrective Measures Implementation Plan dated March 2007.

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Transmittal

To:	Mr. Stephan Cobb c/o Ms. Brandi Little	**VIA:**	FedEx
Address:	Alabama Department of Environmental Management 1400 Coliseum Blvd Montgomery, AL 36110		
Phone:	334.271.7739		
Date:	March 25, 2009		
From:	Gwen Tulley / Michelle Klomp		
Re:	~~Tech Memo for the~~ Final Corrective Measures Implementation Plan (Final CMI Plan), Former Small Weapons Repair Shop, Parcel 66(7), Former Fort McClellan, Anniston, Alabama dated March 2007		
Job #:	06.094.064.000	**Cc:**	

☐ **Urgent** ☐ **For Review** ☐ **Please Comment** ☑ **Please Reply** ☐ **As Requested**

Copies	Date	Item Transmitting
2	03/25/09	Tech Memo Addendum to the Final CMIP Small Weapons Repair Shop, Parcel 66(7), Former Ft McClellan, Anniston, AL dtd March 2007.

Dear Mr. Cobb:

On behalf of the McClellan Development Authority (MDA), Matrix Environmental Services, LLC (MES) is pleased to present this Addendum to the *Final Corrective Measures Implementation Plan (Final CMI Plan), Former Small Weapons Repair Shop, Parcel 66(7), Former Fort McClellan, Anniston, Alabama* dated March 2007. The attached addendum is submitted to document two revisions to the *Final CMI Plan.*

First, the timing of the submittal of the *Draft CMI Plan* for the Former Small Weapons Repair Shop happened to coincide with the issuance of the *Alabama Risk-Based Corrective Action Guidance Manual* (*ARBCA*) both dated May 2006. Site-Specific Screening Levels (SSSLs) with a 10^{-6} carcinogenic risk and 0.1 non-carcinogenic hazard were cited as the cleanup standards in the *Final CMI Plan*. As discussed in an October 2007 meeting between the Anniston-Calhoun County Fort McClellan Development Joint Powers Authority (JPA), the Alabama Department of Environmental Management (ADEM), and MES, and consistent with the ARBCA guidance, Risk-Based Target

Levels (RBTLs) (10^{-5} carcinogenic risk and 1 non-carcinogenic hazard) are actually the site wide cleanup standards appropriate for use at McClellan Due to the change of the site wide cleanup goals since the submittal and ADEM concurrence with the approach presented in the *Final CMI Plan*, the cleanup standards for the constituents of concern at the Site have been appropriately updated in the attached addendum.

Secondly, the *Final CMI Plan* proposed an in-situ soil treatment technology using anhydrous quicklime and treatment of groundwater via in-situ chemical oxidation by injecting Fenton's reagent. A soil treatment pilot study was successfully performed in the contaminant source area on June 21, 2007. Groundwater monitoring conducted at the site following the soil treatment pilot study has shown that the pilot study had a secondary effect resulting in decreases in the groundwater contaminant concentrations. Decreased groundwater contaminant concentrations coupled with the revised cleanup standards (RBTLs) has led us to re-evaluate the need of in-situ chemical oxidation by injection of Fenton's reagent. Specifically, it is believed that RBTLs in groundwater can be achieved by combining the planned full-scale soil treatment technology of the plume area with a less aggressive, more appropriate, and less expensive chemical oxidation reagent and reagent delivery system to achieve the RBTLs in the groundwater.

Finally, the MDA is the successor to the JPA. In its August 22, 2008 order dissolving the JPA, the Circuit Court of Calhoun County charged Calhoun County with "administering all funds and fiscal operations" and taking action concerning the development of Fort McClellan. The Order specifically states: "It is the intent and effect of this Order to place the County in the position that the JPA has maintained to this point. Nothing in this Order shall affect any contract heretofore entered into by the entity formerly known as the JPA. ... Nothing in this Order is intended to, nor shall it, impede, stall or disrupt the present development or environmental remediation of Fort McClellan or any contract or subcontract...." Previous references in the *Final CMI Plan* to the JPA shall now reference the MDA.

Two hardcopies and one electronic copy have been submitted for your review. If you have questions regarding the attached Addendum to the *Final CMI Plan*, please contact me at (256) 847-0780.

Sincerely,

Matrix Environmental Services, LLC

Michelle M. Klomp

Michelle M. Klomp, P.E.
McClellan Onsite Project Manager

CC: Mr. Robin Scott, MDA (transmittal letter)
Ms. Miki Schneider, MDA (one electronic copy)
Ms. Lisa Holstein, U.S. Army (1 paper copy and one electronic copy)
Mr. Steven Young, MES (transmittal letter)
Denver Project File, MES (one paper copy and one electronic copy)
Anniston Project File, MES (one paper copy and one electronic copy)

1 Introductory Summary

In March of 2007, Matrix Environmental Services (MES) submitted the *Final Corrective Measures Implementation Plan (Final CMI Plan) for the Former Small Weapons Repair Shop, Parcel 66(7)* (MES, 2007a) (Site) to the Alabama Department of Environmental Management (ADEM). ADEM acknowledged the approach presented in the *Final CMI Plan* in a letter dated August 29, 2007.

The timing of the submittal of the *Draft CMI Plan* (MES, 2006a) for this Site happened to coincide with the issuance of the *Alabama Risk-Based Corrective Action Guidance Manual*(ADEM, 2006) (*ARBCA*) both dated May 2006. Site-Specific Screening Levels (SSSLs) with a 10^{-6} carcinogenic risk and 0.1 non-carcinogenic hazard were cited as the cleanup standards in the *Draft CMI Plan*. As discussed in an October 2007 meeting between the Anniston-Calhoun County Fort McClellan Development Joint Powers Authority (JPA), ADEM, and MES, and consistent with the ARBCA guidance, Risk-Based Target Levels (RBTLs) (10^{-5} carcinogenic risk and 1 non-carcinogenic hazard) are actually the site-wide cleanup standards appropriate for use at McClellan. On August 22, 2008, the Circuit Court of Calhoun County issued an order dissolving the JPA and charging Calhoun County with "administering all funds and fiscal operations" and taking action concerning the development of McClellan. The order transferred the JPA's responsibilities for the development and environmental remediation of McClellan to Calhoun County. Calhoun County has assumed these responsibilities as the McClellan Development Authority (MDA).

The *Final CMI Plan* proposed *in situ* soil treatment using anhydrous quicklime and treatment of groundwater via in-situ chemical oxidation by injecting Fenton's reagent. A soil treatment pilot study was successfully performed in the contaminant source area on June 21, 2007. Groundwater monitoring conducted at the site following the soil treatment pilot study has shown that the pilot study had a secondary effect resulting in decreases in groundwater contaminant concentrations.

Decreased groundwater contaminant concentrations coupled with the revised cleanup standards (RBTLs) warrant a reevaluation of the need for in-situ chemical oxidation by injection of Fenton's reagent. Specifically, it is believed that the approved McClellan RBTLs in groundwater can be achieved by combining the planned full-scale soil treatment technology of the plume area with a less aggressive, more appropriate, and less expensive chemical oxidation reagent and reagent delivery system.

This Addendum to the *Final CMI Plan* is submitted to describe the revision of cleanup standards and proposed groundwater technology modifications.

2 Constituents of Concern

The following sections discuss the RFI constituents of concern (COCs), Corrective Action COCs, and COC distribution in impacted media.

2.1. RFI COCs

A summary of the human health RFI constituents of concern (COCs) identified during the RFI, as well as the maximum detected concentrations (MDCs), incremental lifetime cancer risk (ILCR), and hazard index (HI), are presented in Table 1. The RFI COCs were calculated with an ILCR greater than 10^{-6} by comparing values to the site-specific screening levels (SSSLs). The site and the area immediately surrounding the site are paved with asphalt, therefore, ecological habitat at Parcel 66(7) is very limited. Because there are very limited complete exposure pathways for ecological receptors, the RFI concluded that the COCs in the soil at Parcel 66(7) did not pose an unacceptable risk to the ecosystem. The evaluation and identification of the RFI COCs are explained in greater detail in the *Final RFI* (MES, 2006b). Media-specific RFI COCs include:

- Groundwater: Six volatile organic compounds (VOCs) and two metals were identified as human health RFI COCs exceeding SSSLs in groundwater at the Site.

- Surface Soil: Vinyl Chloride exceeded the residential SSSL and was identified as a human health RFI COC in surface and depositional soil.

- Subsurface Soil: No human health RFI COCs were identified in subsurface soil at the Site.

2.2. Corrective Action COCs

In the RFI, COCs with an ILCR greater than 10^{-6} or a noncarcinogenic HI greater than or equal to 1 for the residential receptor were identified. Future land use as light industrial is planned for the former Small Weapons Repair Shop. Residential receptors will not be present at the Site. The following section describes how the Corrective Action COCs were chosen.

The *Alabama ARBCA*, allows a cumulative carcinogenic risk of 10^{-5} for remediation, and a noncarcinogenic cumulative hazard index of less than or equal to 1. Therefore, RBTLs are based on a 10^{-5} risk. Based on the proposed future land use of the Site (light industrial), use of groundskeeper exposure scenario is appropriate. Furthermore, the groundskeeper exposure scenario is considered appropriate as groundwater at the Site will not be used as a drinking water source. The groundskeeper exposure scenario RBTLs are more stringent than the construction worker exposure scenario RBTLs and therefore also protective for potential future construction workers onsite.

Chemical-specific RBTLs were calculated for use as goals to achieve the Site Corrective Action Objectives that were established using the *ARBCA*. The *ARBCA* provides a risk-based approach for the assessment of the cumulative risk at the Site, and the development and selection of appropriate numerical RBTLs for COCs in groundwater.

It should be noted that the chemical-specific RBTLs cited herein are goals to be used in the determination of whether groundwater at the Site has achieved a protection of an ILCR of less than 10^{-5}.

For the purposes of the CMI Plan, the RFI COCs exceeding the RBTLs for the groundskeeper exposure scenario were identified as the Corrective Action COCs. Table 2 compares the RFI COCs to the groundskeeper RBTLs. The constituents considered Corrective Action COCs are:

- cis-1,2-dichloroethene (991 µg/L)
- Trichloroethene (TCE) (205 µg/L)
- Vinyl chloride (3.86 µg/L)

Using SSSLs, the CMIP identified vinyl chloride as a COC in surface soil. However, when soil concentrations are compared to RBTLs, no Corrective Action COCs were identified for surface or subsurface soil.

2.3. Distribution of COCs

The greatest concentrations of COCs exceeding RBTLs in the residuum and transition groundwater zones are near the southern and western footprint of former Building 335, proximal to the sanitary sewer system where it was suspected that TCE was disposed during routine operations. Specifically, Corrective Action COC concentrations in the following four groundwater monitoring wells exceeded the groundskeeper RBTLs (shown in Figure 1 and Table 3):

- Residuum groundwater zone: PPMP-66-MW02, PPMP-66-MW06,
- Transition groundwater zone: PPMP-66-MW23, and PPMP-66-MW24

Only groundwater in the residuum and transition zones exceeded RBTLs, and there are no indications that groundwater in bedrock at the site is a concern from a corrective measures perspective. The surface extent of the impacted area is restricted to an area of approximately 480 square yards (sy).

3 Corrective Action Objectives and Performance Standards

This section presents the Corrective Action Objectives and performance standards for the corrective measures which will be undertaken for contaminated groundwater at the Site.

Corrective Action Objectives identified for contaminated groundwater at the Site include:

- Select a Corrective Action protective of human health and the environment that is consistent with reuse of Small Weapons Repair Shop for light industrial purposes.
- Prevent and control any further releases of contaminants to groundwater by addressing residual soil impacts.
- Limit exposure to on-Site contaminated groundwater.
- Reduce the concentrations of cis-1,2-dichloroethene, TCE, and VC to achieve an ILCR of less than 10^{-5} and a non-carcinogenic HI less than 1 for potential human receptors at the Site.
- Establish realistic milestones, decision point rules, and performance criteria to achieve the performance standards established for the Corrective Action and to demonstrate the reduction of risk over time.

4 Predesign Testing Activities

4.1. Building Assessment, Abatement, and Demolition

Prior to soil and groundwater remediation at the Site, Buildings 335 and 336 needed to be removed. Building removal included a hazardous materials survey, hazardous materials abatement, and building demolition. A hazardous materials survey was performed by Geosyntec Consultants in January 2007 (Geosyntec, 2007). The survey, which will be included in the Final Corrective Measures Evaluation Report (CMER), cited several items requiring abatement and disposal prior to building demolition, including:

- Asbestos containing material
- Lead based paint
- Miscellaneous liquids contained in pails, containers, and a 55-gallon drum.

These items were abated from the building and properly disposed of by Spectrum Environmental Services during February 2007. Following the abatement of the hazardous materials within Buildings 335 and 336, both buildings were demolished. Scrap metal was recycled and construction and demolition debris was disposed at the onsite Industrial Landfill, Parcel 175(5).

4.2. Anhydrous Quicklime Pilot Study

A soil pilot study was performed in June 2007 to confirm the effectiveness of *in situ* anhydrous quicklime (CaO) treatment, the CMIP-selected technology, on site-specific geology and contaminant concentrations. An 18-foot by 21-foot area, which amounted to approximately 10 percent of the impacted groundwater area, was blended with five percent anhydrous quicklime to a depth of five feet. A soil sample collected from the treated material was analyzed for VOCs and exhibited non-detect results for chlorinated solvents.

Following the soil treatment pilot study, groundwater monitoring (November 2007) showed that the pilot study had a secondary effect resulting in decreases in the groundwater contaminant concentrations, as shown in Figure 1. Decreased groundwater contaminant concentrations coupled with the revised cleanup standards (RBTLs) has led to the re-evaluation for the need of *in situ* chemical oxidation by injection Fenton's reagent. Specifically, the RBTLs in groundwater should be achievable by treating the impacted groundwater plume area with a full-scale soil treatment using anhydrous quicklime to remove residual COCs in the soil that provide a source to the plume. As an additional polishing step, full-scale soil treatment of the plume area can be coupled with a less aggressive, more appropriate, and less expensive chemical oxidation reagent and reagent delivery system to achieve the cleanup objectives in the groundwater.

5 Design Basis for Revised Remedy/Corrective Action

The soil impacts do not exceed the RBTLs. However, groundwater Corrective Action COC concentrations in the soil may still act as a source to the groundwater. Therefore, the footprint of the impacted groundwater plume will be addressed in a two-step process with the *in situ* anhydrous quicklime treatment that demonstrated success in the pilot study, followed by chemical oxidant application.

5.1. Anhydrous Quicklime

Prior to excavation activities for the full-scale soil treatment, the extents of the anhydrous quicklime treatment area will be staked and marked. Treatment will be performed by mixing quicklime with impacted soil at a ratio of approximately five percent quicklime by volume. The quicklime will be added in-place and blended using a hydraulic excavator, or equivalent equipment, until a homogenous mixture is obtained. It is estimated the target treatment zone will consist of a 12-yard by 40-yard area encompassing the impacted groundwater plume and extending to bedrock at a depth of approximately 15 feet below ground surface. The treated material will amount to approximately 2,000 cubic yards of soil. Since soil does not exceed construction worker or groundskeeper RBTLs, soil samples will not be collected for analysis, rather visual inspection of the material within the excavator bucket and at the perimeter of the excavation will determine the actual extent of treatment zone.

5.2. Potassium Permanganate

The groundwater remediation program recommended in this CMI Plan Addendum uses *in situ* chemical oxidation technology by applying potassium permanganate ($KMnO_4$). *In situ* chemical oxidation introduces chemical oxidants into the vadose zone and/or groundwater to oxidize organic contaminants. Complete reduction to carbon dioxide and water is the desired endpoint of the chemical oxidation process.

Typically, a one percent to five percent potassium permanganate solution is prepared onsite from potassium permanganate crystals delivered in bulk to the site. The most common oxidant delivery methods involves the injection of oxidant solution, however direct application of solid potassium permanganate, below the water table, during excavation of a source area can be used to deliver the reagent to the contaminant plume.

Mass loading for permanganate was calculated using Carus Corporation's proprietary spreadsheet, shown in Table 4. Treatment area volume, geologic parameters, and oxidant reaction variables were entered into the spreadsheet. The groundskeeper RBTL was used for the average contaminant concentration, because the permanganate will be used as a polishing step following anhydrous quicklime treatment of the target area. Using the values shown in Table 4, an estimated 1,782 pounds of permanganate reagent is required for the site-specific conditions.

5.3. Permits

5.3.1. Erosion Control

The area of disturbed soil anticipated during corrective measures is not expected to exceed one acre. Therefore, the only erosion control permit required is a local City of Anniston land disturbance permit. Erosion control measures include silt fences, check dams, and other measures as necessary. Silt fences remain in place until a satisfactory stand of grass is established. Erosion control measures are regularly inspected to maintain effective erosion and sedimentation control.

5.3.2. Air Discharge

The Air Division administers ADEM's Air Pollution Control Program and also the delegable provisions of the Clean Air Act, the federal law that regulates air emissions from stationary and mobile sources. ADEM has adopted the National Primary and Secondary Ambient Air Quality Standards which apply to contaminants which are not expected to be directly created during corrective measures at the Site (sulfur oxides, particulate matter, carbon monoxide, ozone, nitrogen dioxide, and lead).

Certain substances have also been specifically designated as Hazardous Air Pollutants (HAPs) by the Federal government (40 CFR 61 [EPA, 2003]). Of the contaminants found at the Site, TCE and vinyl chloride have been designated as HAPs. The other VOC is regulated as part of an overall emissions limitation by ADEM through a permitting process. The Air Division of ADEM does not regulate organic emissions for facilities with a potential VOC emission rate of less than 100 tons/year as specified in the ADEM Air Division regulations concerning the Control of Organic Emissions (335-3-6). Conservative calculations, found in Appendix A, using the Site's maximum detected VOC concentration in groundwater during May of 2008 of 4000 ug/L and assuming that maximum dissolved groundwater concentration and respective theoretical sorbed soil concentration required for a dissolved concentration of that extent and magnitude exists throughout the entire impacted groundwater plume result in a maximum annual emission of 0.0000173 tons. Therefore, the treatment of contaminated groundwater at the Site is not expected to produce emissions exceeding the 100 tons/year threshold, thereby precluding the applicability of these regulations.

Fugitive dust is regulated under ADEM Administrative Code Rule 335-3-4, which requires that demolition, construction, and materials handling activities be conducted while taking "reasonable precautions to prevent particulate matter from becoming airborne." These reasonable precautions, as they apply to the proposed Corrective Action at the Site include the use of water or chemicals as required for control of dust during remediation activities so that no visible emissions are evident beyond the Site boundary.

6 Performance, Compliance, and Monitoring Plan

The Corrective Measures will be implemented to treat groundwater containing VOCs in excess of the Corrective Action Objectives and to reduce the size of the contaminant plume at the Site.

Figure 2 illustrates the decision process during the Corrective Measures implementation. It describes the decisions performed at each step of Corrective Measure implementation including the criteria necessary for transitioning to each step presented. The process will include:

- Anhydrous quicklime and potassium permanganate treatment
- Monitored Natural Attenuation (MNA) – Monitoring the natural biological and chemical processes naturally decreasing the COCs concentrations.
- Long Term Monitoring (LTM) – Monitoring the concentrations of COCs to confirm concentrations remain less than RBTL cleanup goals and do not rebound following the completion of Corrective Measure implementation.
- Land Use Controls (LUCs) – If necessary, deed restrictions on permitted activities at the site will be implemented.

6.1. PERFORMANCE AND COMPLIANCE MONITORING

The monitoring program outlined in this section has been implemented to provide data to evaluate the long-term performance of the Corrective Measures. MNA and LTM under the Performance, Compliance and Monitoring Plan (PCMP) include collecting groundwater levels and groundwater quality samples at selected wells.

Baseline conditions for both groundwater quality and groundwater levels have been established with monitoring data collected at the Site prior to remediation. The baseline conditions are those against which the performance of the Corrective Measures will continue to be assessed.

During Corrective Measures implementation, the PCMP is used to assess treatment effectiveness and efficiency in complying with the Corrective Action Objectives. The PCMP will be used for a period of time after treatment to verify that groundwater quality continues to meet cleanup goals, and that the Corrective Action is complete.

Groundwater level monitoring and water quality monitoring are discussed below.

6.1.1. Groundwater Level Monitoring

The primary objective for monitoring groundwater levels is to assess the effectiveness of Corrective Measures in removing the COCs from the groundwater. Table 5 lists the monitoring wells from which groundwater levels will be collected during the monitoring program. These wells were selected for the monitoring network to provide groundwater level data to calculate groundwater flow direction through the area of impacted groundwater. Well location information, measurement methods and frequency of groundwater data collection for the Site are discussed below.

Well Locations and Screen Depths
Figure 1 shows the locations of the monitoring wells from which groundwater levels will be collected during the monitoring program. As shown on the figure, wells are designated as residuum, transition, or bedrock wells.

Table 6 presents a summary of the completion details for the wells to be used as part of this Corrective Action monitoring program. Information listed in the table includes well location coordinates, ground and top of casing elevations, depth of well, elevation of screen midpoint and screen interval.

Measurement Methods
Groundwater levels will be measured according to Section 5 of the *Installation Wide Sampling and Analysis Plan* (*SAP*) (MES, 2004).

Measurement Frequency
Groundwater level data will be collected from the wells listed in Table 5 concurrently with the groundwater quality sampling discussed in Section 6.1.2.

6.1.2. Water Quality Monitoring

Water quality will be monitored to evaluate and to assess the long-term performance of the Corrective Actions in reducing contaminant concentrations. The information collected can also be used to determine when the cleanup of the plume is complete.

Table 5 lists the monitoring wells/locations from which water quality data will be collected during compliance monitoring. These wells were selected for the monitoring network to provide groundwater data to monitor COC concentrations within and around the perimeter of the area of impacted groundwater. The locations, sampling and analytical methods and frequency of water quality data collection for the Site are discussed below.

Sample Locations
Figure 1 shows the wells or locations from which water quality data will be collected during compliance monitoring.

Sampling and Analysis Methods
Groundwater quality samples to be collected under this program are analyzed for Corrective Action COCs listed in Section 2.2. These Corrective Action COCs will be analyzed by Method SW8260B. The reporting limits for Method SW8260B are presented in the *Quality Assurance Project Plan* (*QAP*) (MES, 2007b). Monitoring wells will be sampled according to Section 5 of the *SAP*.

Quality control procedures for groundwater quality sample collection activities are outlined in the *SAP*. Compliance monitoring water quality samples will be prepared, handled and transported according to procedures outlined in Section 5 of the *SAP*. Procedures for the decontamination of sampling equipment are also presented in the *SAP*.

Sampling Frequency
At the end of the first month following remediation and monitoring well replacement, MNA will be evaluated as groundwater quality samples are collected on a quarterly basis from the wells identified in Table 5. Following four consecutive quarterly groundwater monitoring events showing COC concentration reduction, the groundwater sampling frequency will be revised to semi-annual sampling for LTM. After two consecutive semi-annual monitoring events with COC concentrations less than RBTLs, a No Further Action (NFA) request will be filed with ADEM and following NFA concurrence, groundwater quality monitoring will be terminated. If necessary, LUCs will be implemented during the NFA application process.

7 EVALUATING SYSTEM PERFORMANCE

Corrective Measure performance will be evaluated on an annual basis with the results presented in an annual CMER. The annual evaluation report includes an interpretation of data trends and presents recommendations.

Achieving Corrective Action Objectives is demonstrated using groundwater quality data collected during sampling events. Water quality data collected at groundwater monitoring wells is used to evaluate contaminant concentration changes over time. The contaminant concentration trends are assessed at each well, and the aerial distribution of the contaminant plume is mapped;

these maps are presented in the annual CMER. Declining contaminant concentration trends, reduction of contaminant mass within the plume, and shrinking aerial plume extent will indicate progressing groundwater cleanup at the site.

Within 90 calendar days following attainment of cleanup levels/goals as outlined in the Cleanup Agreement (CA) and the approved CMI Plan, the MDA shall submit to the ADEM a Final Report of Corrective Measures (FRCM). The FRCM shall contain a certification by the MDA and an independent professional engineer registered in the State of Alabama that all remedial measures required by the CA and the approved CMI Plan have been completed. The FRCM shall outline any procedures and schedules for dismantling of corrective measures systems, groundwater monitoring systems, removal of land use controls, and any other remedial systems/controls required by the CA or the approved CMI Plan.

8 REFERENCES

ADEM. 2006. *Alabama Risk-Based Corrective Action Guidance Manual (ARBCA)*. May.

EPA. 2003. CFR Title 40: Protection of Environment, Chapter 61: National Emission Standard for Hazardous Air Pollutants. July.

ESE, Inc. 1998. *Final Environmental Baseline Survey, Fort McClellan, Alabama*, prepared for the U.S. Army Environmental Center, Aberdeen Proving Ground, Maryland. January.

IT Corporation. 1998. *Final Site-Specific Field Sampling Plan Attachment for the Site Investigation at the Former Ordnance Motor Repair Area, Parcels 75(7), 41(7), 42(7), 5(7), 6(7), and 66(7), Fort McClellan, Calhoun County, Alabama.* December.

_____. 2002a. *Remedial Investigation Report Small Weapons Repair Shop, Parcel 66(7).* May.

_____. 2002b. *Focused Feasibility Study Small Weapons Repair Shop, Parcel 66(7).* November.

Geosyntec Consultants. 2007. *Hazardous Materials Survey, Pre-Demolition Survey, Buildings 335 & 336*. January.

MES. 2004. *Draft Installation-Wide Sampling and Analysis Plan* prepared for the Anniston Calhoun County, Fort McClellan Development Joint Powers Authority. January.

_____. 2006a. *Draft Corrective Measures Implementation Plan for Small Weapons Repair Shop, Parcel 66(7)*. May.

_____. 2006b. *Final Resource Conservation and Recovery Act Facility Investigation for Small Weapons Repair Shop, Parcel 66(7)*. February.

_____. 2007a. *Final Corrective Measures Implementation Plan for Small Weapons Repair Shop, Parcel 66(7)*. March.

_____. 2007b. *Quality Assurance Project Plan, Revision 1* prepared for the Anniston Calhoun County, Fort McClellan Development Joint Powers Authority July.

TABLES

Table 1: Summary of Human Health RFI COCs and SSSLs
Small Weapons Repair Shop, Parcel 66(7), McClellan, Anniston, Alabama

Groundwater RFI COCs	MDC	RS cancer ILCR	RS noncancer HI	SSSLs RS	SSSLs GS	SSSLs CW
VOCs (µg/L)						
1,1-Dichloroethene	300	--	0.393	76.4	480	12000
1,2-Dichloroethane	0.69	1.54E-06	--	0.448	3.08	76.9
Cis-1,2-Dichloroethene	1600	--	10.3	15.5	99.1	2480
Trans-1,2-Dichloroethene	130	--	0.423	30.7	195	4863
Trichloroethene	13000	3.39E-03	142	3.83	20.5	513
Vinyl Chloride	110	1.20E-03	2.37	0.0918	0.386	9.65
Metals (mg/L)						
Cobalt	0.109	--	0.035	0.0313	0.203	5.06
Nickel	0.0646	--	0.206	0.0313	0.202	5.06

Surface Soil RFI COCs	MDC	RS cancer ILCR	RS noncancer HI	SSSLs RS	SSSLs GS	SSSLs CW
Vinyl Chloride (µg/kg)	2300	2.63E-06	--	876	3950	48400

Notes:
COC = Constituent of concern
CW = Construction Worker
GS = Groundskeeper
HI = Hazard index
ILCR = Incremental lifetime cancer risk 10^{-6}
MDC = maximum detected concentration from *Final RFI* (MES, 2006b)
RFI = Resource Conservation Recovery Act Facility Investigation
RS = Residential
SSSL = Site-Specific Screening Level (10^{-6} risk)
VOC = Volatile organic compound
µg/L = micrograms per liter
mg/L = milligrams per liter
µg/kg = micrograms per kilogram

For this CMI Plan Addendum, the RFI COC list and ILCRs / HIs may vary slightly from the *Final RFI* due to using revised SSSLs to calculate ILCRs and HIs, as per the *Alabama Risk-Based* Corrective Action Guidance Manual (ARBCA). Also per the ARBCA, the MDCs for this addendum were used to calculate ILCRs and HIs for groundwater, instead of the exposure point concentration (EPC) as used in the *Final RFI* .

Table 2: RFI COCs and RBTLs
Small Weapons Repair Shop, Parcel 66(7),
McClellan, Anniston, Alabama

Groundwater RFI COCs	MDC	GS RBTL	CW RBTL
VOCs (µg/L)			
1,1-Dichloroethene	300	4800	120000
1,2-Dichloroethane	0.69	30.8	769
Cis-1,2-Dichloroethene	1600	991	24800
Trans-1,2-Dichloroethene	130	1950	48630
Trichloroethene	13000	205	5130
Vinyl Chloride	110	3.86	96.5
Metals (mg/L)			
Cobalt	0.109	2.03	50.6
Nickel	0.0646	2.02	50.6

Surface Soil RFI COCs RFI COCs	MDC	GS RBTL	CW RBTL
Vinyl Chloride (µg/kg)	2300	39500	484000

Notes:
COC = Constituent of concern
CW = Construction Worker
GS = Groundskeeper
MDC = maximum detected concentration from *Final RFI* (MES, 2006b)
RBTL = Risk-Based Target Level (10^{-5} Risk)
RFI = Resource Conservation Recovery Act Facility Investigation
VOC = Volatile organic compound
µg/L = micrograms per liter
mg/L = milligrams per liter
µg/kg = micrograms per kilogram

RFI COC MDC exceeds GS or CW RBTL = Corrective Action COC

Table 3: Corrective Action COCs in Groundwater - 2004 RFI Results Compared to 2007 and 2008 Results
Small Weapons Repair Shop, Parcel 66(7), McClellan, Anniston, Alabama

GW CA COCs Residuum Wells	GS RBTL	CW RBTL	PPMP-66-MW02 5/13/2004	PPMP-66-MW02 11/7/2007	PPMP-66-MW02 5/21/2008	PPMP-66-MW06 5/17/2004	PPMP-66-MW06 11/5/2007	PPMP-66-MW06 5/19/2008
Cis-1,2-Dichloroethene	991	2.48E+04	36	210	130	1600	810	700
Trichloroethene	205	5130	74	480	27	***13000***	2900	3900
Vinyl Chloride	3.86	96.5	***110***	***100***	71	10	26	26

GW CA COCs Residuum Wells	GS RBTL	CW RBTL	PPMP-66-MW16 5/13/2004	PPMP-66-MW16 11/7/2007	PPMP-66-MW18 5/20/2008	PPMP-66-MW21 5/12/2004	PPMP-66-MW21 11/7/2007	PPMP-66-MW21 5/20/2008
Cis-1,2-Dichloroethene	991	2.48E+04	--	--	--	--	--	--
Trichloroethene	205	5130	--	--	4.6	--	--	--
Vinyl Chloride	3.86	96.5	0.26 J	0.57 J	--	0.48 J	2.7	0.92 J

GW CA COCs Transition Wells	GS RBTL	CW RBTL	PPMP-66-MW23 5/13/2004	PPMP-66-MW23 11/7/2007	PPMP-66-MW23 5/21/2008	PPMP-66-MW24 5/17/2004	PPMP-66-MW24 11/5/2007	PPMP-66-MW24 5/20/2008
Cis-1,2-Dichloroethene	991	2.48E+04	--	110	75	130	290	260
Trichloroethene	205	5130	--	89	290	5000	2500	4000
Vinyl Chloride	3.86	96.5	9.2	16	20	1.2	16	11

GW CA COCs Bedrock Wells	GS RBTL	CW RBTL	PPMP-66-MW11 5/20/2008	PPMP-66-MW12 5/17/2004	PPMP-66-MW12 11/5/2007	PPMP-66-MW12 5/20/2008	PPMP-66-MW13 5/20/2008
Cis-1,2-Dichloroethene	991	2.48E+04	--	--	--	--	--
Trichloroethene	205	5130	--	5.1	7.9	--	--
Vinyl Chloride	3.86	96.5	0.29 J	0.21 J	0.47 J	0.38 J	0.41 J

Notes:

CA = Corrective Action — Result > GS RBTL (shaded)

COC = Constituent of concern — ***Result > CW RBTL***

CW = Construction Worker

GS = Groundskeeper

GW = Groundwater

RBTL = Risk-Based Target Level

RFI = Resource Conservation Recovery Act Facility Investigation

-- = analyte concentration was either nondetect or less than the site-specific screening levels (SSSLs)

J = Lab flag: Estimated value; analyte is positively identified but the concentration is less than the reporting limit (RL) but greater than the method detection limit (MDL).

Results in micrograms per liter (µg/L)

Table 4: Carus Corporation's Permanganate Calculator
Small Weapons Repair Shop, Parcel 66(7), McClellan, Anniston, Alabama

	Estimates	Units	
Treatment Area Volume			
Length	**120**	ft	[Estimated extent of impacted groundwater]
Width	**36**	ft	
Area	4320	sq ft	
Thickness	**10**	ft	[Groundwater at 5' bgs, bedrock at 15' bgs]
Total Volume	1600	cu yd	
Soil Characteristics/Analysis			
Porosity	**30**	%	[Table 43 in CW Fetter's *Applied Hydrogeology, 3rd Ed*]
Total Plume Pore Volume	96948	gal	
Avg Contaminant Conc	**0.205**	ppm	[TCE Groundskeeper RBTL]
Mass of Contaminant	0.17	lb	
PNOD	**5**	g/kg	[Carus Default]
Effective PNOD	**5**	%	[Carus Default]
Effective PNOD Calculated	0.25		
PNOD Oxidant Demand	1188	lb	
Avg Stoichiometric Demand	**1**	lb/lb	[Carus Default]
Contaminant Oxidant Demand	0.17	lb	
Theoretical Oxidant Demand	1188.17	lb	
Confidence Factor	**1.5**		[Carus Default]
Calculated Oxidant Demand	1782.248787		
Amount of RemOx S ISCO Reagent Estimated		**1,782 pounds**	

Notes:
PNOD - Permanganate Natural Oxidant Demand

Table 5: Plume Area Well Monitoring Network
Small Weapons Repair Shop, Parcel 66(7), McClellan, Anniston, Alabama

Residuum Groundwater Monitoring Wells	Transition Groundwater Monitoring Wells	Bedrock Groundwater Monitoring Wells
PPMP-66-MW02* PPMP-66-MW06* PPMP-66-MW16 PPMP-66-MW18*	PPMP-66-MW17 PPMP-66-MW23* PPMP-66-MW24*	PPMP-66-MW08

*These wells within the soil treatment target area will require replacement following completion of Corrective Actions.

Table 6: Groundwater Monitoring Program Well Construction Information
Small Weapons Repair Shop, Parcel 66(7), McClellan, Anniston, Alabama

Well Location	Well Type	Northing	Easting	Ground Surface Elevation (ft)	Top of Casing Elevation (ft)	Well Depth (ft bgs)	Screen Length (ft)	Screened Interval Top Elevation (ft)	Screened Interval Bottom Elevation (ft)	Mid Point of Screened Interval (ft)
PPMP-66-MW01	residuum	1171564	671362	780	782	24	15	771	756	764
PPMP-66-MW02	residuum	1171598	671451	781	780	24	15	772	757	764
PPMP-66-MW03	residuum	1171450	671544	781	781	29	20	772	752	762
PPMP-66-MW04	residuum	1171852	671549	780	782	24	15	773	758	765
PPMP-66-MW05	residuum	1171665	671530	781	780	29	20	772	752	762
PPMP-66-MW06	residuum	1171556	671518	781	781	29	20	772	752	762
PPMP-66-MW07	residuum	1171623	671599	782	782	30	20	773	753	763
PPMP-66-MW08	bedrock	1171612	671449	781	781	75	10	720	710	715
PPMP-66-MW09	bedrock	1171439	671553	781	781	75	20	729	709	719
PPMP-66-MW10	bedrock	1171866	671548	780	782	75	20	728	708	718
PPMP-66-MW11	bedrock	1171685	671550	781	781	85	20	718	698	708
PPMP-66-MW12	bedrock	1171557	671510	781	780	75	10	717	707	712
PPMP-66-MW13	bedrock	1171622	671583	782	782	75	10	720	710	715
PPMP-66-MW14	residuum	1171522	671574	782	782	23	15	774	759	767
PPMP-66-MW15	residuum	1171515	671473	780	780	13	10	778	768	773
PPMP-66-MW16	residuum	1171623	671428	781	781	13	10	777	767	772
PPMP-66-MW17	transition	1171561	671564	781	781	20	10	771	762	766
PPMP-66-MW18	residuum	1171560	671551	781	781	15	10	776	767	772
PPMP-66-MW19	bedrock	1171560	671558	781	781	75	10	716	707	712
PPMP-66-MW20	bedrock	1171667	671516	781	781	81	10	711	701	706
PPMP-66-MW21	residuum	1171623	671434	782	780	15	10	777	767	772
PPMP-66-MW22	transition	1171631	671430	782	781	25	10	767	757	762
PPMP-66-MW23	transition	1171596	671453	782	781	30	10	762	752	757
PPMP-66-MW24	transition	1171556	671515	782	781	35	10	757	747	752

FIGURES

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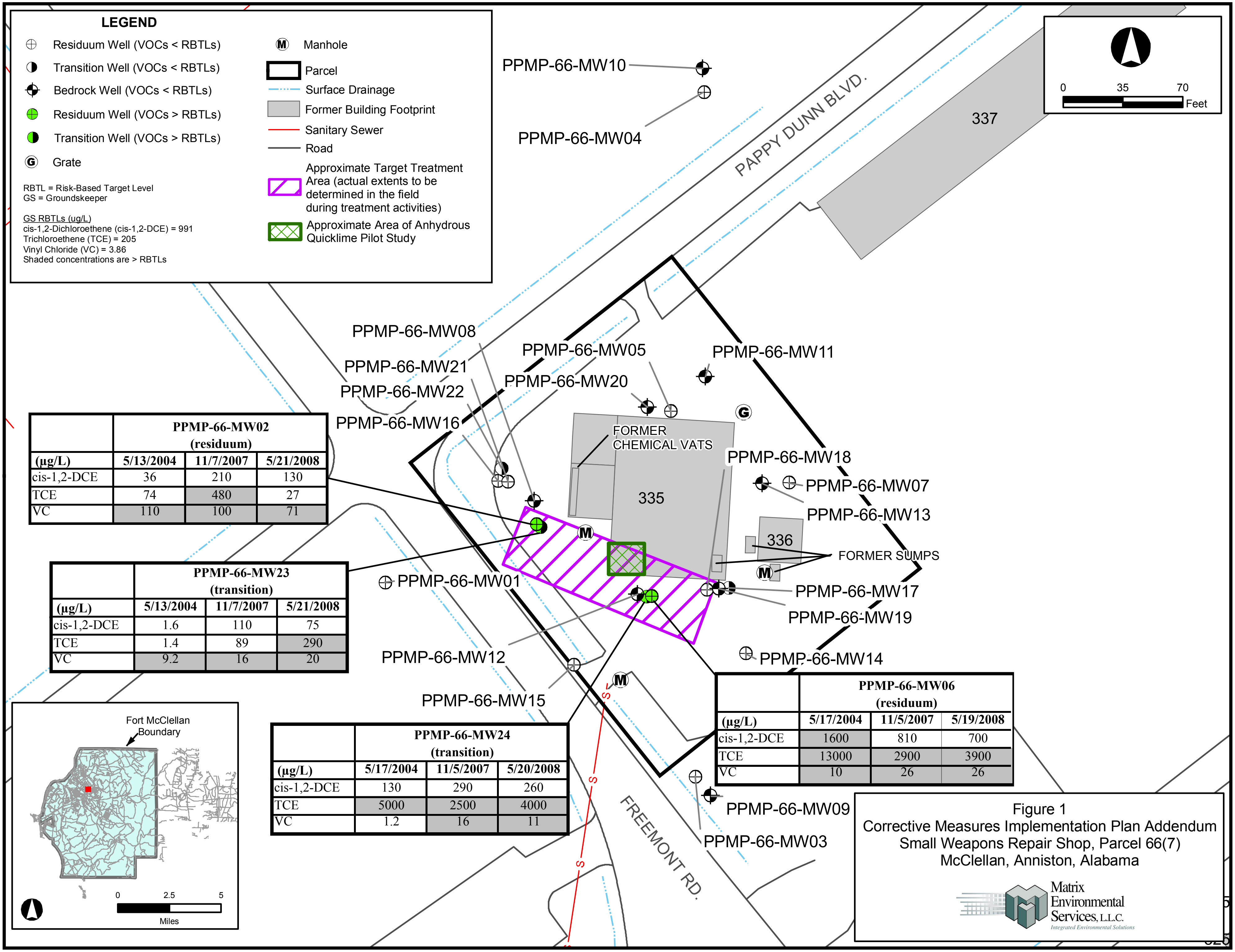


	PPMP-66-MW02 (residuum)		
(µg/L)	5/13/2004	11/7/2007	5/21/2008
cis-1,2-DCE	36	210	130
TCE	74	480	27
VC	110	100	71

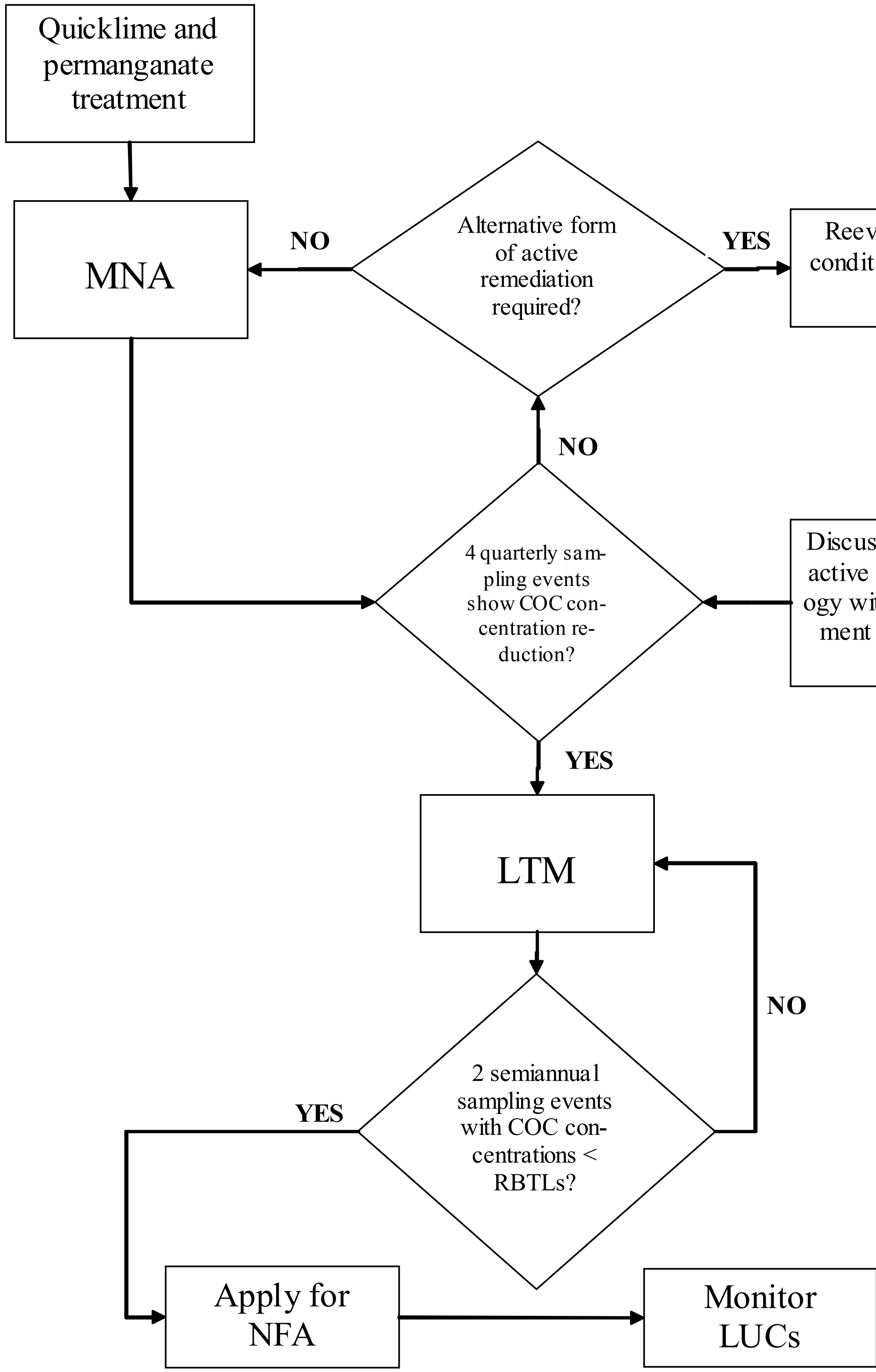
	PPMP-66-MW23 (transition)		
(µg/L)	5/13/2004	11/7/2007	5/21/2008
cis-1,2-DCE	1.6	110	75
TCE	1.4	89	290
VC	9.2	16	20

	PPMP-66-MW24 (transition)		
(µg/L)	5/17/2004	11/5/2007	5/20/2008
cis-1,2-DCE	130	290	260
TCE	5000	2500	4000
VC	1.2	16	11

	PPMP-66-MW06 (residuum)		
(µg/L)	5/17/2004	11/5/2007	5/19/2008
cis-1,2-DCE	1600	810	700
TCE	13000	2900	3900
VC	10	26	26

Figure 1
Corrective Measures Implementation Plan Addendum
Small Weapons Repair Shop, Parcel 66(7)
McClellan, Anniston, Alabama

Matrix Environmental Services, L.L.C.
Integrated Environmental Solutions



Notes:
ADEM - Alabama Department of Environmental Management
COC - Constituent of Concern
LTM - Long-Term Monitoring
LUC - Land Use Control
MNA - Monitored Natural Attenuation
NFA - No Further Action
RBTL - Risk-Based Target Level

Figure 2
Corrective Measures Decision Process
Flow Chart
Small Weapons Repair Shop, Parcel 66(7)
McClellan
Anniston, Alabama

Matrix Environmental Services, L.L.C.
Integrated Environmental Solutions

APPENDIX A
VOC EMISSIONS CALCULATION

Appendix A
Small Weapons Repair Shop VOC Emissions Calculation

Using conservative assumptions for groundwater concentrations, soil concentrations, and hydrogeologic parameters to calculate a theoretical volatile organic compound (VOC) emission during groundwater treatment at Small Weapons Repair Shop is included herein. Theoretical mass of trichloroethene (TCE) is calculated for groundwater using the maximum detected concentration onsite as the homogenous concentration throughout the site. Theoretical mass of TCE for soil is calculated using the soil-water partition coefficient, K_d, to determine the soil concentration required to produce a dissolved concentration throughout the plume equal to the maximum detected concentration onsite.

Mass in Groundwater

Assumptions

- Maximum TCE concentration of 4000 ug/L in MW24 from May 2008 sampling event is homogenous throughout all impacted groundwater onsite.
- Footprint of impacted groundwater area is 480 yd^2 (12 yd x 40 yd)
- Depth from top of water table to bedrock is 3.3 yd (10 ft, top of the water table is located 5 ft below ground surface [bgs] and bedrock is located 15 ft bgs)
- Soil Porosity, ϕ=30% (Table 43 in C.W. Fetter's *Applied Hydrogeology, 3rd Ed.*)

Calculations

Using the assumed footprint of impacted groundwater and the proposed treatment depth from the top of the water table to bedrock, the volume of impacted soil matrix can be calculated:

$$V_{soil\ matrix} = A_{soil\ matrix} \times depth_{soil\ matrix}$$

$$V_{soil\ matrix} = 480\ yd^2 \times 3.3\ yd \times \frac{27\ ft^3}{yd^3} = 42{,}768\ ft^3 \text{ of impacted saturated soil matrix}$$

Only the pore space of the soil matrix contains groundwater. Using the assumed 30% soil porosity, ϕ, the volume of impacted groundwater within the impacted soil matrix can be calculated:

$$V_{gw} = V_{soil\ matrix} \times \phi$$

$$V_{gw} = 42{,}768\ ft^3\ soil\ matrix \times \frac{7.48\,gal\ soil\ matrix}{ft^3\ soil\ matrix} \times \frac{0.30\,gal\ groundwater}{gal\ soil\ matrix} = 95{,}971\,gal\ groundwater$$

Using the maximum TCE concentration ($[TCE]_{gw}$) of 4000 ug/L for the entire volume of impacted groundwater and converting the units to ton/gal, yields:

$$[TCE\ ]_{gw} = \frac{4{,}000\ \ \mu g\ TCE}{L\ water} \times \frac{3.79\ L\ water}{gal\ \ water} \times \frac{kg\ TCE}{1x10^{12}\ \ \mu g\ TCE} \times \frac{ton\ TCE}{907\ \ kg\ TCE} = \frac{1.67\ \ x\,10^{-11}\ ton\ \ TCE}{gal\ \ water}$$

Multiplying the maximum concentration of TCE by the volume of groundwater impacted yields the mass of TCE dissolved in groundwater ($m_{TCE\ in\ gw}$) (*Note calculated mass is theoretical, as most of the impacted groundwater has levels of TCE less than the maximum onsite concentration found in MW24*):

$$m_{TCE\,in\,gw} = [TCE]_{gw} \times V_{gw}$$

$$m_{TCE\ in\ gw} = \frac{1.67\ x\,10^{-11}\,ton\ TCE}{gal\ \ water} \times 95{,}971\ gal\ \ water\ = 1.60\ x10^{-6}\ tons\ TCE$$

$$m_{TCE\ in\ gw} = 0.00000160\ \ tons\ TCE$$

Mass in Soil

Assumptions

- Maximum TCE concentration of 4000 ug/L in MW24 from May 2008 sampling event is homogenous throughout all impacted groundwater.
- Footprint of impacted groundwater area is 480 yd^2 (12 yd x 40 yd)
- Depth from top of water table to bedrock is 3.3 yd (10 ft, top of the water table is located 5 ft bgs and bedrock is located 15 ft bgs)
- Soil Porosity, ϕ=30% (Table 43 in C.W. Fetter's *Applied Hydrogeology, 3^{rd} Ed.*)
- TCE Octonol-Water Partition Coefficient: $\log(K_{OW}) = 2.42$ (Table 3-7 in J.R. Mihelcic's *Fundamentals of Environmental Engineering*)
- Fraction Organic Carbon in soil is 1%: foc=0.01 (Page 106 in of J.R. Mihelcic's *Fundamentals of Environmental Engineering*)
- Soils with a relatively high fraction organic carbon (>0.1%) are shown to have a closely correlated soil-water partition coefficients normalized to organic carbon (K_{OC}) and an octonol-water partition coefficient (K_{OW}). Assume K_{OC}=K_{OW}. (Page 106 in of J.R. Mihelcic's *Fundamentals of Environmental Engineering*)
- Assume soil bulk density, (ρ_b)=100 lb/ft^3 (Table 10.2 in D.M. Nielson's *Practical Handbook for Ground-Water Modeling*)

Calculations

First solve for the soil-water partition coefficient, K_d.

$$if\ K_d = K_{OC} \times foc;\ and\ K_{OC} = K_{OW};$$

$$then\ K_d = K_{OW} \times foc$$

$$K_d = (10^{2.42}) \times (0.01) = 2.63 \frac{L}{kg}$$

Next, K_d can be used with the maximum TCE groundwater concentration of 4000 ug/L to determine the soil concentration necessary to result in that TCE concentration in the groundwater. (*Note: the 4000 ug/L is used only to illustrate a conservative VOC emissions scenario. This groundwater concentration is not homogenous throughout the impacted groundwater volume, and the resulting calculated soil concentration is a theoretical scenario resulting from conservative assumptions and is not representative of actual TCE soil concentrations onsite.)*

$$[TCE]_{soil} = [TCE]_{gw} \times K_d$$

$$[TCE]_{soil} = \frac{4{,}000\ \mu g\ TCE}{L\ water} \times \frac{2.63\ L\ water}{kg\ soil} = \frac{1.05x10^4\ \mu g\ TCE}{kg\ soil}$$

The mass of soil (m_{soil}) theoretically impacted under this scenario with conservative assumptions can be calculated using the volume of impacted soil matrix, the soil bulk density (ρ_b), and the porosity (ϕ) as follows:

$$m_{soil} = Area_{plume} \times depth_{plume} \times \rho_b \times (1-\phi)$$

$$m_{soil} = 480\, yd^2 \times 3.3\, yd \times \frac{27\ ft^3}{yd^3} \times \frac{100\, lb}{ft^3} \times \frac{kg}{2.2\, lb} \times (1-0.30) = 1.36x10^6\ kg\ soil$$

Mass of TCE ($m_{TCE\ in\ soil}$) can be calculated by multiplying the mass of theoretically impacted soil with the theoretical TCE concentration in the soil ($[TCE]_{soil}$) :

$$m_{TCE\,in\,soil} = m_{soil} \times [TCE]_{soil}$$

$$m_{TCE\,in\,soil} = 1.36x10^6\ kg\ soil \times \frac{1.05x10^4\ \mu g\ TCE}{kg\ soil} \times \frac{kg\ TCE}{1x10^{12}\ \mu g\ TCE} \times \frac{ton\ TCE}{907\ kg\ TCE} = 1.57x10^{-5}\ ton\ TCE$$

$$m_{TCE\,in\,soil} = 0.0000157\, ton\, TCE$$

Conclusions

Therefore, if the entire volume of impacted groundwater had a concentration equal to the localized maximum concentration in MW24 and there was a 100 percent conversion of dissolved TCE in groundwater to volatilized TCE during the treatment process, the mass of TCE theoretically emitted would amount to 0.00000160 tons.

Furthermore, the theoretical soil concentration that would be required to produce a 4000 ug/L concentration can be calculated using the TCE soil-water partition coefficient. If there were a 100 percent conversion of theoretically sorbed TCE in the soil to volatilized TCE during the treatment, the mass of TCE theoretically emitted would amount to 0.0000157 tons.

Adding the masses of TCE theoretically emitted from both sorbed and dissolved phases under ideal 100 percent phase transfer conditions amounts to 0.0000173 tons TCE. The Air Division of the Alabama Department of Environmental Management (ADEM) does not regulate organic emissions for facilities with a potential VOC emission rate of less than 100 tons/year as specified in the ADEM Air Division regulations concerning the Control of Organic Emissions (335-3-6). Therefore, the maximum anticipated VOC emission from soil treatment is significantly less than the permit requirement of 100 tons and no permit for VOC emissions is required.