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December 3, 2014

Environmental Division

Mr. John Burchette
NPL/BRAC/Federal Facilities Branch
U.S. Environmental Protection Agency
1650 Arch Street
Philadelphia, PA 19103-2029

Dear Mr. Burchette:

This letter serves as notification that the November 2014 *Draft Interim Removal Action Report for OU-4 Areas of Concern 1 and 2 (Building 2286/2276 and Building 2250)* (Report), has been finalized. The U.S. Environmental Protection Agency approved the draft report without comment on November 10, 2014, the Maryland Department of the Environment (MDE) approved the Report on November 14, 2014, and the Architect of the Capitol (AOC) approved the Report on November 20, 2014. A new final cover for the report is dated December 2014 (enclosed). Copies of the Report have been furnished to Fran Coulters (U.S. Army Environmental Command), Sherry Deskins (AOC), Elisabeth Green (Maryland Department of the Environment), and the Fort Meade Restoration Advisory Board.

If you have any questions, please feel free to contact Ms. Denise Tegtmeyer at (301) 677-9559 or me at (301) 677-7999.

Sincerely,

Michael P. Butler for

George B. Knight, PG
Acting Program Manager, Installation Restoration Program
Directorate of Public Works-Environmental Division

Enclosure

ARCADIS

Imagine the result

FINAL Interim Removal Action Report for OU-4 Areas of Concern 1 and 2 (Buildings 2286/2276 and Building 2250)

Operable Unit 4
Fort George G. Meade, Maryland

December 2014

Keith Shepherd
Task Manager

John Cherry
Phase Manager

Tim Llewellyn
Project Manager

Final
Interim Removal Action Report for OU-4 Areas of Concern 1 and 2 (Buildings 2286/2276 and Building 2250)

Operable Unit 4
Fort George G. Meade, Maryland

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Date:
December 2014

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List of Acronyms and Abbreviations

µg/L	microgram per liter
µg/m^3	microgram per cubic meter
AOCs	Areas of Concern
ARCADIS	ARCADIS U.S., Inc.
Army	United States Army
AS	air sparge
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
g/L	grams per liter
EE/CA	Engineering Evaluation/Cost Analysis
FGGM	Fort George G. Meade
ft	feet or foot
GAC	Granular Activated Carbon
IDW	Investigation Derived Waste
IRAR	Interim Removal Action Report
IRAWP	Interim Removal Action Work Plan
IRP	Installation Restoration Program
ISCO	In-Situ Chemical Oxidation
lbs	pounds
LPA	Lower Patapsco Aquifer
LTM	Long-term Monitoring
MDE	Maryland Department of Environment
NCP	National Oil and Hazardous Substances Pollution Contingency Plan

NTCRA	Non-Time Critical Removal Action

List of Acronyms and Abbreviations continued

O&M	Operation and Maintenance
OU-4	Operable Unit 4
PCE	tetrachloroethene
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
PVC	Polyvinyl Chloride
RAB	Restoration Advisory Board
RAOs	Removal Action Objectives
RAR	Remedial Action Report
SAP	Sampling and Analysis Plan
SVE	soil vapor extraction
TCE	trichloroethene
USEPA	United States Environmental Protection Agency
VOCs	volatile organic compounds

Executive Summary

This Interim Removal Action Report (IRAR) summarizes the Non-Time Critical Removal Action (NTCRA) implemented at Fort George G. Meade (FGGM), Operable Unit 4 (hereinafter referred to as "the Site" or OU-4) to address elevated concentrations of volatile organic compounds (VOCs) in groundwater. An Engineering Evaluation/Cost Analysis (EE/CA) was conducted in June 2013 and evaluated remedial alternatives to address groundwater contamination at three separate areas of concern (AOCs): AOC 1 – Building 2286/ 2276, AOC 2 – Building 2250, and AOC 3 - the downgradient Lower Patapsco Aquifer (LPA) Study Area. Implementation of the NTCRA selected for Area of Concern 3 (LPA Study Area) was documented in a separate report, Interim *Removal Action Report for Area of Concern 3 (The Lower Patapsco Aquifer Study Area)* (ARCADIS U.S., Inc. [ARCADIS], 2014b) submitted under separate cover.

Subsequent to the alternatives analysis conducted in the EE/CA (ARCADIS, 2013a), an Action Memorandum authorizing the NTCRA at each AOC was approved and signed by the United States Army (Army) and United State Environmental Protection Agency (USEPA) on June 27, 2013 and August 22, 2013, respectively (Army, 2013). The Maryland Department of the Environment (MDE) also concurred on the selected removal action in a letter to the Army dated July 1, 2013. The action selected within the EE/CA for AOC 1 – Building 2286/Former Building 2276, was In-Situ Chemical Oxidation (ISCO) and Long-term Monitoring (LTM) of Groundwater, and AOC 2 – Building 2250 was Air Sparge/Soil Vapor Extraction (AS/SVE) with LTM of Groundwater.

An Interim Removal Action Work Plan (IRAWP; ARCADIS, 2013b) was developed to direct the implementation of the NTCRA at each AOC and was finalized in December 2013. An Addendum to the Interim Removal Action Work Plan was approved by the MDE on May 27, 2014 including a reduction in the analytical parameters analyzed as part of the National Pollution Discharge Elimination System permit equivalency sampling (no analysis for bacteriological and asbestos) as these analyses were deemed unnecessary given Site history.

The NTCRA at Building 2286/Former 2276 was implemented, in accordance with the IRAWP (ARCADIS, 2013b), in multiple mobilizations between May 2013 and June 2014 and consisted of the following components:

- Installation and development of 16 injection wells;

- Installation and development of two monitoring wells;
- Pre-construction injection pilot testing;
- On-Site storage, treatment, and discharge of groundwater generated during well installation and development activities;
- Off-Site disposal of soil cuttings and general refuse generated during installation of the injection and monitoring wells;
- Completion of baseline groundwater monitoring. Analytical results from the baseline groundwater monitoring event are summarized in the first Quarterly Operation and Maintenance Report (ARCADIS, 2014a), dated August 11, 2014;
- Injection of approximately 41,734 and 88,362 gallons of sodium persulfate at three injection wells at Former Building 2276 and nine injection wells at Building 2286, respectively; and
- Site restoration and demobilization.

The NTCRA at Building 2250 was implemented, in accordance with the IRAWP (ARCADIS, 2013b) in multiple mobilizations between August 2013 and March 2014 and consisted of the following components:

- Installation and development of nine SVE wells;
- Installation and development of 11 AS wells;
- On-Site storage, treatment, and discharge of groundwater generated during well installation and development activities;
- Off-Site disposal of soil cuttings and general refuse generated during installation of the AS/SVE wells;
- Trenching activities associated with the installation of the subsurface piping network connecting the on-Site transformer to the equipment trailer and the AS and SVE wells to the equipment trailer;

- Placement and completion of the pre-fabricated treatment trailer containing the AS blower, the SVE vacuum blower and associated knock-out tank, instrumentation and air flow controls, and piping manifolds;

- Completion of baseline groundwater monitoring. Analytical results from the baseline groundwater monitoring event are summarized in the first Quarterly Operation and Maintenance Report (ARCADIS, 2014a), dated August 11, 2014;

- Completion of startup/shakedown testing and operation of the AS/SVE system; and

- Site restoration and demobilization.

This IRAR documents construction completion for the actions conducted under the Non-Time Critical Removal Action at the OU-4 as outlined in the IRAWP (ARCADIS, 2013b), including installation and operation of the AS/SVE system at Building 2250, and installation of the full-scale ISCO injection network with sodium persulfate injection at Building 2286/Former Building 2276. This report confirms system construction is complete and the removal actions are operating as intended. Remedial Action Objectives and requirements for long-term operation, maintenance, and monitoring of the remedial system will be formalized under remedial authority in a separate OU-4 Record of Decision. Site Completion will be documented in a future Final Close Out Report after the groundwater response actions are successful and the site meets all criteria for Site Completion status, including: (1) all remedial decision documents have been completed and the selected remedy is consistent with Comprehensive Environmental Response, Compensation, and Liability Act, the National Oil and Hazardous Substances Pollution Contingency Plan, and USEPA policy and guidance; (2) all response actions have been completed (e.g., the cleanup levels associated with the response action(s) have been achieved) and appropriately documented in the Site file, and (3) all institutional controls are in place (USEPA, 2011).

1. Introduction

ARCADIS U.S. Inc. (ARCADIS) has been retained by the United States Army Environmental Command to perform Installation Restoration Program (IRP) activities at Fort George G. Meade (FGGM), located in Anne Arundel County, Maryland. This work is being conducted under a Performance Based Contract associated with the IRP at FGGM. The full scope of services for this contract is defined in Contract W91ZLK-05-D-0015: Task 0005.

The IRP activities at FGGM are conducted under the United States Army's (Army's) Defense Environmental Restoration Program and operate principally under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 and National Oil and Hazardous Substances Pollution Contingency Plan (NCP; 40 Code of Federal Regulations [CFR] 300). FGGM was placed on the National Priorities List on July 28, 1998. Coordination and input are provided by the United States Environmental Protection Agency (USEPA) Region III, and as appropriate, with other signatories of the FGGM Federal Facility Agreement, including the Architect of the Capitol and the Department of the Interior. Input and coordination from Maryland Department of the Environment (MDE) was also solicited.

The Engineering Evaluation/Cost Analysis (EE/CA) for Operable Unit 4 (hereinafter referred to as "the Site" or OU-4) and the Lower Patapsco Aquifer (LPA) Study Area was approved by USEPA, following the public comment period (ARCADIS, 2013a). An Action Memorandum documenting the selected Non-Time Critical Removal Action (NTCRA) for three separate areas of concern (AOCs) including AOC 1 Building 2286/ 2276, AOC 2 Building 2250, and AOC 3 the LPA Study Area was approved and signed by the Army and USEPA on June 27, 2013 and August 22, 2013, respectively (Army, 2013). The MDE also concurred on the selected removal actions in a letter to the Army dated July 1, 2013.

This Interim Removal Action Report (IRAR) has been prepared in accordance with USEPA 540-R-98-016, Office of Solid Waste and Emergency Response Directive 9320.2-22; Exhibit 2-5, (USEPA, 2011), and presents a description of the interim removal action implemented at AOC 1 – Building 2286/Former Building 2276 and AOC 2 – Building 2250. Implementation of the interim removal action at the LPA Study Area was documented in a separate report, Interim *Removal Action Report for Area of Concern 3 (The Lower Patapsco Aquifer Study Area)* (ARCADIS U.S., Inc. [ARCADIS], 2014b) submitted under separate cover.

An IRAWP (ARCADIS, 2013b) was developed to direct the implementation of the NTCRA at each AOC and was finalized in December 2013. An Addendum to the IRAWP was approved by the MDE on May 27, 2014.

Elevated concentrations of volatile organic compounds (VOCs), specifically tetrachloroethene (PCE), have been identified in the groundwater in AOC 1 (Building 2286/Former Building 2276). The observed concentrations of PCE in groundwater suggest the presence of a former contaminant source zone that has resulted in the presence of VOCs in this area above 1,000 micrograms per liter (µg/L). These areas were identified for remediation (PCE concentrations greater than 1,000 µg/L) through in-situ chemical oxidation (ISCO) injections using sodium persulfate. The removal action at Building 2286/Former 2276 was implemented in accordance with the IRAWP and included the following components:

- Installation and development of 16 injection wells;
- Installation and development of two monitoring wells;
- Pre-construction injection pilot testing;
- On-Site storage, treatment, and discharge of groundwater generated during well installation and development activities;
- Off-Site disposal of soil cuttings and general refuse generated during installation of the injection and monitoring wells;
- Completion of baseline groundwater monitoring, analytical results are summarized in the first Quarterly Operation and Maintenance Report (ARCADIS, 2014b), dated August 11, 2014;
- Injection of approximately 41,734 and 88,362 gallons of sodium persulfate at three injection wells at Former Building 2276 and nine injection wells at Building 2286, respectively; and Site restoration and demobilization.

Elevated PCE concentrations in groundwater suggest the presence of a second contaminant source zone near Building 2250. Similar to the Building 2286/Former Building 2276 area, Building 2250 was identified as a “source zone”, and targeted for remediation, as PCE concentrations greater than 1,000 µg/L were present. Air sparge/soil vapor extraction (AS/SVE) technology was implemented in this source area to achieve faster remediation of contaminant sources, thus mitigating the potential risk of VOC migration to the drainage ditch located adjacent to the building or under the

building foundation (as vapor). The removal action taken at Building 2250 was implemented, in accordance with the IRAWP (ARCADIS, 2013b) in multiple mobilizations between August 2013 and March 2014 and consisted of the following components:

- Installation and development of nine SVE points;
- Installation and development of 11 AS wells;
- On-Site storage, treatment, and discharge of groundwater generated during AS/SVE well installation and development activities;
- Off-Site disposal of soil cuttings and general refuse generated during installation of the AS/SVE wells;
- Trenching activities associated with the installation of the subsurface piping network connecting on-Site transformer to the equipment trailer and the AS and SVE wells to the equipment trailer;
- Placement and completion of the pre-fabricated treatment trailer containing the AS blower, the SVE vacuum blower and associated knock-out tank, instrumentation and air flow controls, and piping manifolds;
- Completion of baseline groundwater monitoring, analytical results are summarized in the first Quarterly Operation and Maintenance Report (ARCADIS, 2014b), dated August 11, 2014
- Completion of startup/shakedown testing and operation of the AS/SVE system; and
- Site restoration and demobilization.

2. Site Background

This section provides a brief summary of the Site background and the Removal Action Objectives (RAOs).

2.1 Site Location and History

FGGM is located midway between the cities of Baltimore, Maryland, and Washington D.C. in Anne Arundel County, Maryland, as shown in **Figure 1**. OU-4 is located in the southeast corner of FGGM and is bounded by Morrison Street, Huber Road, and Third Street to the north (with the inclusion of Building 2286 located north of Morrison Street); Rock Avenue to the south; Chisholm Avenue to the east; and Wilson Street to the west. The LPA Study Area refers to the portion of the LPA located downgradient and southeast of OU-4 and represents the confined aquifer that outcrops to the surface at OU-4. A Site location map depicting the OU-4 site boundaries and the LPA Study Area is provided as **Figure 2**.

Historic operations at OU-4 include commercial and light industrial activities conducted following the establishment of FGGM as an active military installation in 1917. OU-4 consists of various existing buildings, demolished buildings, and open grass areas. As depicted on **Figure 2**, many of the buildings are located within close proximity of each other and have comingled VOC plumes in groundwater. **Figures 3, 4, and 5** display the most recent PCE, trichloroethene (TCE), and carbon tetrachloride detections observed at each sampling location through 2013, respectively. Two AOCs have been identified as source areas: AOC 1 – Building 2286/Former Building 2276 and AOC 2 – Building 2250. AOC 1- Building 2286/Former Building 2276 has been identified as the source of the VOC contamination observed in the downgradient LPA Study Area (AOC 3). Detailed geological cross-sections for the OU-4/LPA Study Areas are provided in the Remedial Investigation/Feasibility Study (ARCADIS, 2014b). A brief description of each building is provided below:

Building 2286 was constructed in 1941 and operated as a paint and body shop from the mid-1980s through 2011. The building historically had two paint booths and various work stations associated with metal and glass work, welding, sanding and office space. Chemicals used during active building operations included paints, solvents, thinner, anti-freeze, acetylene, and argon gas cylinders. The building is currently used as warehouse/office space.

Former Building 2276 was located south of Building 2286 on the northeast corner of the intersection of Rock Avenue and Wilson Street. The building was constructed between 1910 and 1920 and was used as a furniture repair shop and warehouse.

Hazardous chemicals including paint thinners, adhesives, stains, and aerosols were used and stored at the former building. Active operations at Building 2276 ceased no later than 2001. The building was demolished in 2011 and the area is now an open grass area located adjacent to a new firing range recently constructed.

Building 2250 was constructed in 1941 and is located northeast of the intersection of Rock Avenue and Huber Road. Following its construction, Building 2250 operated as the post laundry facility. Dry cleaning operations were introduced in the 1960s and continued through 1991. PCE was a chemical solvent used during dry cleaning operations at the facility. The building is currently used as a recycling center.

2.2 Removal Action Objectives

The IRAWP RAOs, as stated in the EE/CA (ARCADIS, 2013a), are based on the potential risks associated with elevated VOC concentrations in groundwater at AOC 1(Building 2276/2286 and Building 2250) and sub-slab soil gas present at AOC 2 (Building 2250). Note that the Final OU-4 Record of Decision will identify the final remedy and remedial action objectives for OU-4, but the RAOs for the NTCRA at Building 2276/2286 and Building 2250 are as follows:

Building 2276/2286: Abate hot spot groundwater concentrations (e.g., greater than 1,000 µg/L total VOCs) of chlorinated solvents (PCE, TCE, and associated daughter products) in the vicinity of FGGM86-MW08 (Building 2286) and OU4-SB-08 (Former Building 2276) to (a) prevent potential exposure to nearby human populations via vapor intrusion into new/existing buildings; and (b) mitigate further degradation of the LPA drinking water aquifer due to continued contaminant migration from these hot spot areas toward off-post drinking water wells currently utilizing the LPA for potable water.

Building 2250: Abate elevated sub-slab gas concentrations detected above industrial sub-slab screening criteria for PCE (2,100 micrograms per meter cubed [$\mu g/m^3$]) in sub-slab samples from the northwest corner of Building 2250 and the immediate vicinity to abate potential exposure to human populations currently working in the building via vapor intrusion into the building. Abate hot spot (e.g., greater than 1,000 µg/L total VOC) groundwater concentrations of chlorinated solvents (PCE, TCE, and associated daughter products) in the vicinity of Versar-MW01, 02, and 03 to prevent potential exposure to nearby human populations from volatilization and vapor intrusion into the existing building and/or seepage into the adjacent intermittent stream bed.

3. Chronology of Events

This section discusses the chronology of events at OU-4 and the LPA Study Area leading to the NTCRA and the actions implemented to promote active communication between the communities affected by the NTCRA.

3.1 Chronology of Events

The following is a brief chronology of events associated with the removal action implemented at AOC 1, Building 2286/Former Building 2276 areas:

Date	Event
May 2013	Installation of pilot testing wells (OU4-IW13 and OU4-MW44).
June 2013	Approval of Final EE/CA and Action Memorandum.
June 2013	Pilot testing activities completed. Approximately 4,128 gallons of 40 grams per liter (g/L) sodium persulfate solution were injected into IW-13.
August 2013-March 2014	Well installation and development of (OU4-MW45, OU4-IW01 – OU4-IW12, and OU4-IW14 – OU4-IW16) using an “adaptive approach” for the full-scale injection and monitoring well network. There were four separate mobilizations to complete the installation of the well network (May 2013, August 2013, November 2013, and March 2014).
December 2013	Approval of Final IRAWP.
February 2014	Baseline groundwater sampling completed.
May 2014 – June 2014	Full-scale ISCO injections were completed. Approximately 130,096gallons of sodium persulfate at an average concentration of 19.5 g/L were injected into 12 injection wells.
June 2014	Completion of first follow-up Quarterly Performance Monitoring Event.

The following is a brief chronology of events associated with the removal action implemented at AOC 2, Building 2250 area:

Date	Event
August 2013	Installation and development of the AS/SVE well network (nine SVE wells and 11 AS wells).
November 2013 – December 2013	System construction activities including: Received and placed pre-fabricated system trailer, trench network installation, subsurface pipe install, connection to on-Site power transformer, and trench backfill.
February 2014	Baseline groundwater gauging and sampling completed.
February 2014 – March 2014	Startup and shakedown of the AS/SVE system. During system startup/shakedown it was noted that the well seal at AS-9 was blown. The well was over-drilled and re-installed on March 11, 2014.
June 2014	Completed modification to the AS/SVE system, which treats perched groundwater recovered in the knock-out tank using granulized activated carbon (GAC) and discharges to the ground surface.
June 2014	Completion of the first follow-up Quarterly Performance Monitoring Event. Also completed Site restoration including asphalt repairs along the areas disturbed by trenching activities.

3.2 Public Participation

In accordance with the NCP, public participation is required to promote active communication between the communities affected by the NTCRA at the Site. This public participation requirement of the NCP has been fulfilled by the Army in the following manner:

- Restoration Advisory Board (RAB) Meetings – Presentations were conducted at RAB meetings on March 21, 2013, and November 18, 2013, to provide details pertaining to implementation of the NTCRA and updates to the proposed schedule. RAB meetings provide an opportunity for community members (including elected RAB members) and representatives of government agencies to meet and exchange information about FGGM's environmental program.

- Public Comment Period – A public notice was published in the Capital Gazette (a local newspaper) on September 11, 2013 announcing the availability of the EE/CA

for public review and comment during the public comment period from September 11 to October 11, 2013.

- Information Repositories – The Administrative Record for the Site including the EE/CA and other supporting documents pertaining to OU-4 and the LPA Study Area is located at two information repositories established by FGGM. The repositories are accessible in accordance with the American Disabilities Act, have copy facilities, and are available to the community during normal business hours. Information repositories are maintained at the following locations: Anne Arundel County Public Library – West County Library (1325 Annapolis Road, Odenton, Maryland 21113) and the Fort Meade Environmental Division office (4215 Roberts Avenue, Suite 320, Fort Meade, Maryland). A Fact Sheet (**Appendix A** detailing the removal actions taken across the OU-4/LPA Study Areas was kept on-site during construction activities. Additional project information was made available to the public on Fort Meade's Environmental Management System website at www.ftmeade.army.mil/environment.

- A newspaper publication regarding the Interim Removal Actions taken in the OU-4 and LPA Study Areas was published on June 12, 2014. Further, numerous planning meetings and/or project schedule status updates were provided to building tenants in AOC 1 – Asymmetric Warfare Group and AOC 2 – Directorate of Public Works and Melwood in an effort to minimize impacts to daily operations caused from implementation of the Interim Removal actions.

4. Non-Time Critical Removal Action Implementation

The following sections discuss the implementation of the NTCRA at AOC 1 and 2 in accordance with the IRAWP (ARCADIS, 2013b).

4.1 Permitting and Compliance

The implementation of the NTCRA was conducted under CERCLA; therefore, per Section 300.400(e) of the NCP, 40 CFR Section 300.400(e), no federal, state, or local permits were required for on-Site activities provided that the substantive requirements of these permits were met. For Source Area 1 – Building 2286/Former Building 2276, a Rule Authorization Request was submitted to MDE on December 13, 2013 for completion of the ISCO injections in support of the groundwater restoration activities in this area. The Rule Authorization Request was approved by MDE on January 14, 2014. Both letters are included in **Appendix B**.

For the drilling of all injection and monitoring wells installed at Building 2286, Former Building 2276, and Building 2250, State of Maryland Well Permits were issued by the Anne Arundel County Health Department.

No other permits or permit equivalencies were necessary for implementation of the NTCRA at these locations.

4.2 Mobilization and General Site Preparation

Implementation of the NTCRA at Building 2286/Former Building 2276 and Building 2250 was conducted in multiple mobilizations (i.e., drilling, trenching/construction, baseline groundwater monitoring, pilot testing ISCO injections, and system startup/shakedown. Prior to each mobilization, site preparation was conducted as appropriate for each task. In general, site preparation consisted of establishment of staging areas, mobilizing equipment and materials, and installing safety protection devices as necessary (e.g., traffic controls, fencing, signs, cones, and markers).

At Building 2250, excavation, pipe placement, and backfilling the trenches occurred in quick succession to minimize disruption to vehicle traffic. This minimized the need for extensive soil erosion and sediment controls, though soil stockpiles were covered with sheeting during the work activities. As previously mentioned, numerous planning meetings and/or project schedule status updates were provided to building tenants in AOC 2 in an effort to minimize impacts to daily operations caused from implementation of the Interim Removal actions.

4.3 Utility Clearance

Prior to initiation of intrusive activities, utility clearance using at least three lines of evidence was conducted and included current Miss Utility of Maryland notifications, a utility locate conducted by a private utility locator, and a desktop review of available Site drawings. Additionally, a FGGM dig permit was obtained prior to the initiation of intrusive activities and was updated, as necessary, for the duration of the project. **Appendix C** documents damage that occurred to a corrugated metal storm water pipe during trenching activities at Building 2250. The damaged section of rusted pipe was replaced prior to backfilling the trench.

4.4 ISCO Injections (Building 2286/Former Building 2276)

The following subsections summarize completion of the pilot and full-scale ISCO injections at Building 2286/Former Building 2276. A Site map is provided on **Figure 6**.

4.4.1 Pilot Study

A pilot study was conducted at the Former Building 2276 area to evaluate site-specific conditions associated with ISCO and to establish preliminary design and performance criteria for full-scale implementation. Injection well OU4-IW13 and monitoring well OU4-MW44 were installed on May 15, 2013 to support implementation of the pilot study. The pilot study was conducted on June 18 - 21, 2013. Approximately 4,130 gallons of sodium persulfate solution at an approximate concentration of 40 g/L was delivered to the aquifer via direct injection into OU4-IW13. Well construction details are summarized in **Table 1**. Well construction diagrams, well development logs, and Maryland Well Permits are provided in **Appendix D1** and field forms associated with the pilot study are provided in **Appendix D2**.

Two groundwater samples were collected from both OU4IW13 and OU4MW44 during pilot testing: (1) a sample collected from each well prior to implementation of the pilot study on June 6, 2013 and (2) a sample from each well collected approximately three weeks after completion of the pilot study on July 10, 2013. Groundwater samples were sent to Shealy Environmental Services located in West Columbia, South Carolina and were submitted for VOCs analysis via USEPA Method 8260. A significant decrease in VOC concentrations was exhibited at OU4-IW13 and OU4-MW44 following pilot testing activities. The initial concentration of PCE observed at OU4-MW44 was 1,300 µg/L. Following the pilot study, PCE at OU4-MW44 decreased below its Maximum Contaminant Level of 5 µg/L and was detected at a concentration of 0.98 µg/L. The complete analytical results are presented in **Table 2. Figure 7** displays PCE, TCE,

and cis-1,2-dichloroethene concentrations detected across the Study Area. Analytical lab reports from the pilot study (OG11006 and OK05003) are provided in **Appendix E**.

In addition to the pilot study, a treatability study was conducted in August 2013 to further evaluate the implementation of ISCO injections to VOC contamination (i.e., PCE, TCE, and cis-1,2-dichloroethene) in the Building 2286/Former Building 2276 AOC. The bench-scale treatability study was performed at ARCADIS' Treatability Laboratory located in Durham, North Carolina. The results of the treatability study indicated that ISCO injections, using a solution containing 20 g/L of sodium persulfate with ambient activation, would effectively treat groundwater in this AOC. The complete results of the treatability study are presented in the IRAWP (ARCADIS, 2013b).

4.4.2 Well Installation

In accordance with the IRAWP (ARCADIS, 2013b), OU4-IW01 through OU4-IW09, and OU4IW12 were installed in the Building 2286 area with 10 foot (ft) screened intervals constructed between 25 – 35 ft below ground surface (bgs). OU4-IW10, OU4-IW11, OU4-IW13 through OU4-IW16, OU4-MW44, and OU4-MW45 were installed in the vicinity of the Former Building 2276 area with 10 ft screened intervals constructed between 30 – 40 ft bgs utilizing a hollow stem auger drill rig. Well installation of 16 injection wells and two monitoring wells was conducted in four separate mobilizations occurring from May 2013 to March 2014 by a Maryland licensed driller with oversight from an ARCADIS geologist. The location and depth of each injection well was determined based on an evaluation of expedited analytical results from groundwater samples collected following well installation. The analytical results supporting this adaptive design are presented in **Table 2** and **Figure 7**. Analytical lab reports from the pilot study (OG11006 and OK05003) are provided in **Appendix E**. With the exception of the wells comprising the pre-construction injection pilot study (i.e., OU4-IW13 and OU4-MW44), soil lithology was logged within the screened interval by ARCADIS field personnel. Well development was conducted between 24 and 48 hours following well installation to ensure removal of fine grained sediments from the well screen. Soil boring logs, well construction diagrams, and well development logs are provided in **Appendix D1**

Investigation derived waste (IDW) generated during well installation activities (i.e., soil cuttings and purged groundwater) is discussed in Section 4.6. Well construction details are provided in **Table 1** and well locations are presented on **Figure 6**. Due to on-going construction and grading in the vicinity of the Building 2286 well network, the 10 injection wells (OU4-IW01 – OU4-IW09, and OU4-IW12) installed were not completed with a flush mount well vault. Following completion of final grading, the wells will be completed and surveyed by a Maryland licensed surveyor.

4.4.3 Baseline Sampling

The baseline groundwater sampling event was completed on February 20, 2014. Groundwater samples were collected from five monitoring wells FGGM86-MW07, FGGM86-MW08, OU4-MW01, OU4-MW44, and OU4-MW45 and analyzed for VOCs via USEPA Method 8260B, redox sensitive metals including (aluminum, arsenic, beryllium, cadmium, chromium, copper, iron, lead, manganese, nickel, sodium, and zinc via USEPA Method 6010, hexavalent chromium via USEPA Method SM-3500-Cr, and sulfate via USEPA Method 300.0. Sodium persulfate samples were also collected and analyzed using field test kits from wells located within the injection areas (FGGM86-MW07, FGGM86-MW08, OU4-MW44, and OU4-MW45). Analytical results from the baseline groundwater monitoring event are summarized in the first Quarterly Operation and Maintenance Report (ARCADIS, 2014a), dated August 11, 2014. Long-term monitoring will continue as presented in the IRAWP (ARCADIS, 2013b) and quarterly O&M Reports. It should be noted that the Semi-annual Sampling Program (see Table 6 of the IRAWP, ARCADIS, 2013b) includes a broader network of monitoring wells across AOC 1 and was completed in August 2014. Injection and monitoring well locations are provided on **Figure 6**.

4.4.4 Full-scale Injection Event

The MDE approved the injection of sodium persulfate on January 14, 2014; the approval letter is provided in **Appendix B**. Injections were conducted between May 15 and June 6, 2014 by ARCADIS field personnel. A summary of injection quantities and selected wells is provided in **Table 3**. Approximately 130,096 gallons (23,583 lbs.) of an un-activated sodium persulfate solution were injected into 12 of the 16 injection wells as depicted on **Figure 6.** The target sodium persulfate concentration used during the full-scale injection was 20 g/L. As alkaline activation was not deemed necessary during the first full-scale injection event, the use of sodium hydroxide was not necessary. During the injection event, daily clean water flushes were performed at the end of each day resulting in a total volume of approximately 2,624 gallons (see **Table 3**). In accordance with the RAOs and the approved IRAWP (ARCADIS, 2013b), injections targeted wells with 1,000 µg/L total VOCs or greater based on expedited sampling discussed in Section 4.4.2.

Adjacent monitoring well (FGGM86-MW08 and OU4-MW44) were utilized to monitor water quality parameters, water levels, and visual observations of breakthrough of the injection solution during the injections. Additionally, grab samples were collected periodically and analyzed using field test kits for sodium persulfate to confirm the delivery of the injection solution. The average sodium persulfate concentration in the injection solution was 19.5 g/L and confirmed through periodic sampling using field test

kits. Injection logs, dose response well monitoring logs, and field notes including the results of monitoring conducted during the injection event are provided in **Appendix D3**. In accordance with the IRAWP (ARCADIS, 2013b), additional full-scale injection rounds are anticipated at nine-month intervals, though the number of injections and time between events will be based on performance monitoring observations.

4.5 Air Sparge and Soil Vapor Extraction Implementation (Building 2250)

The following subsections summarize the installation of the AS/SVE system at Building 2250.

4.5.1 Well Installation

In accordance with the IRAWP (ARCADIS, 2013b), nine SVE points and 11 AS points were installed at Building 2250 utilizing direct push drilling technology in August 2013 by a Maryland licensed driller with oversight from an ARCADIS geologist. AS-01 through AS-11 were constructed with 2 ft screened intervals installed between 13 – 15 ft bgs. SVE-01 through SVE-09 were constructed with 5 ft screened intervals installed between 5 – 10 ft bgs. All AS and SVE well locations were finished with flush mount protective manholes set in concrete pads. Soil lithology was logged at each location by ARCADIS field personnel. AS wells containing water were developed between 24 and 48 hours following well installation.

IDW generated during well installation activities (i.e., soil cuttings and purged groundwater) is discussed in Section 4.6. Well construction details are provided in **Table 4** and well locations are presented on **Figure 8**. Soil boring logs, well construction diagrams, and well development logs are provided in **Appendix F1**.

4.5.2 Baseline Groundwater Sampling

The baseline groundwater sampling event was completed on February 4, 2014. Groundwater samples were collected from five monitoring wells MW1-VERSAR – MW5-VERSAR and analyzed for VOCs via USEPA Method 8260B. Analytical results from the baseline groundwater monitoring event are summarized in the first Quarterly Operation and Maintenance Report (ARCADIS, 2014a), dated August 11, 2014. Long-term monitoring will continue as presented in the IRAWP (ARCADIS, 2013b) and quarterly O&M Reports. Monitoring well locations are provided on **Figure 8**.

4.5.3 Trenching Operations

Intrusive work activities (trench excavation and backfill) associated with the installation of the AS/SVE system were initiated on November 6, 2013 and completed on November 25, 2013. The trench network was installed using a backhoe. In certain areas to the North of Building 2250, a concrete saw was required to remove thick slab across one section of the trench. Soil was excavated from the trench and stockpiled onsite while the AS/SVE piping was installed. On November 18, 2013, remnants of an old discarded burn barrel were recovered during trench excavation activities behind Building 2250. FGGM Environmental was notified and the discarded burn barrel was deemed non-hazardous and disposed of accordingly. Following installation of the soil gas and ambient air conveyance piping the stockpiled soil was used to backfill the trench. A stone aggregate was also used to backfill on top of the soil until final asphalt repairs were made in June 2014 (discussed in Section 4.8) The subsurface piping infrastructure installed for the conveyance of soil gas from the SVE wells to the treatment system was 4-inch Schedule 40 polyvinyl chloride (PVC). The subsurface piping installed for the conveyance of ambient air from the system to the air sparge wells was 1-inch Schedule 80 PVC. All subsurface piping was installed by ARCADIS personnel at depths of approximately 3 ft bgs and wrapped with tracer wire to facilitate identification during future utility locate procedures

4.5.4 Treatment Building Completion

The AS/SVE treatment system was pre-fabricated by H2K Technologies, Inc. in accordance with the design specifications presented in the IRAWP (ARCADIS, 2013b). The complete system was delivered within its housing trailer to the Site on November 4, 2013 and was leveled and secured in the area north of Building 2250 (see **Figure 8**). Following installation of the subsurface piping infrastructure including electrical conduit supplying power from the on-Site transformer, the conveyance piping associated with the AS/SVE wells and power supply were connected to the appropriate connections on the treatment system building. Two large traffic barricades were placed in front of the AS/SVE system trailer to prevent possible damage from vehicular traffic in the area,

4.5.5 System Start-Up and Shake Down

The AS/SVE containment system startup/shakedown was initiated the week of February 10, 2014. Initial startup/shakedown testing was conducted throughout February and March 2014 and included the following components:

- Limited startup testing on one or more extraction and sparge wells;

- Full scale system startup including optimization of operating parameters (i.e., vacuum strength, air flow, and pressure); and

- Collection and analysis of one influent air sample.

An influent air sample was collected on February 12, 2014 and submitted to ALS Environmental Services for the analysis of VOCs via USEPA Method TO-15. Ten VOCs were detected in the influent sample, including PCE which was detected at 700 micrograms per cubic meter (µg/m^3). Analytical results confirm that VOC emissions from the SVE blower are below levels that require treatment on the discharge stack. Total VOC concentrations (796.5 µg/ m^3) and operational air flow rate (~76 cubic feet per minute) on the system equates to approximately 0.002 pounds (lbs)/hour total VOC emissions. Emissions above 0.5 lbs/hour warrant treatment on the discharge stack, and the analytical results/air flow calculations for system operation confirm VOC discharge concentrations well below that. This air emissions data was provided to the Army on April 8, 2014. The analytical laboratory report (P1400562) is provided in **Appendix E.** System startup field forms are presented in **Appendix F2**.

During system startup and shakedown activities, the well seal at AS-9 failed. Air was observed surfacing around the well pad during system operation. As a result, AS-9 was over-drilled and reconstructed on March 11, 2014 and screened from 10- 12 ft bgs.

4.5.6 System Operation and Water Collection

During operation of the SVE system, water moisture from soil vapor captured by the SVE system is collected in a knockout tank located in the system equipment trailer. During the first three months of operation, when approximately 45 gallons of water accumulated in the tank, a high-level switch would shut the system down, requiring regular visits to manually drain and containerize the water. In June 2014, a water sample from the knockout tank was analyzed for VOCs and PCE was detected at 24 µg/L. The analytical Laboratory Report (PD09013) for the characterization sample is included in Appendix E An automated system was designed and installed to pump water from the knockout tank, treat it by pumping through a GAC vessel, and discharge to the ground surface at a flow rate between 1-2 GPM. The Surface Discharge of Treated Water Collected in the Air Sparge/Soil Vapor Extraction System – Building 2250 letter sent to MDE is provided in Appendix G1. The MDE approved the ground surface discharge on June 9, 2014 pending confirmatory analysis of condensate influent and effluent (Appendix G2). The initial analysis report (PF17003, Appendix D) showed no PCE detection in the effluent, but contained other detections likely due to cross-contamination from PVC glue during retrofitting of the system. The drainage and discharge system will become fully operational following future condensate analysis

showing PCE levels below the MCL and no detections of other non-site related VOCs in the effluent. Through August 2014, no water collected in the knock-out tank so there was no active treatment or discharge to the ground surface. Future O&M reports will document treatment and discharge volumes for this system, as well as analytical data from quarterly water samples.

4.6 Investigation Derived Waste

IDW generated during implementation of the NTCRA at AOC 1 and AOC 2 includes the following:

- Groundwater generated during well installation and development activities;
- Soil cuttings and general refuse generated during well installation; and
- Water accumulated from the AS/SVE knockout tank.
- Construction debris including aggregate and soil generated during asphalt repairs at Building 2250.

In an effort to reduce the amount of IDW transported and disposed of off-Site, a portion (~600 gallons) of the groundwater generated during installation and development of the ISCO injection and monitoring wells at Building 2286/Former Building 2276 and the AS/SVE wells at Building 2250 was temporarily containerized in frac tanks, pumped through a temporary treatment system in the LPA Study Area comprised of GAC vessels, and gradually infiltrated to the ground surface.

Drill cuttings remaining in the frac tank following discharge of the groundwater were characterized, deemed acceptable, and transported to a bermed area in the LPA Study Area predominately used for dewatering horizontal drilling soil cuttings generated during the LPA removal action. In addition to the water treated and discharged to the ground surface, 19 55-gallon drums of groundwater generated during the final well installation and development mobilization at the Building 22876/Former Building 2276 area were also containerized, labeled, profiled, and transported off-site for disposal.

Soil cuttings and general refuse generated during well installation at Building 2286/Former Building 2276 and system installation at Building 2250 were containerized in 55-gallon drums, labeled, profiled, and transported off-Site for disposal. Laboratory Analytical Report (OH23012) is provided in **Appendix E**. Waste manifests are also provided in **Appendix H**.

4.7 Implementation of Long-term Monitoring

Following completion of full-scale injections at Building 2286/Former Building 2276 and installation of the AS/SVE system at Building 2250, long-term monitoring (LTM) of groundwater and Long-term Operation of the AS/SVE system were implemented at the OU-4 Study Area in accordance with the monitoring program developed in the IRAWP (ARCADIS, 2013b) and the O&M Manual developed for the AS/SVE system (**Appendix I**). LTM data including baseline sampling and well gauging results will be presented in quarterly monitoring reports submitted under separate cover. The first Quarterly Operation and Maintenance Report (ARCADIS, 2014b), was submitted on August 11, 2014. Additional follow up ISCO injections are planned and will be scheduled following review of analytical results collected during follow up quarterly sampling events completed in 2014. The IRAWP (ARCADIS, 2013b) includes proposed schedules for the follow up ISCO injections, quarterly performance monitoring, and semi-annual groundwater monitoring.

4.8 Site Restoration and Demobilization

Final Site restoration was completed in June 2014. These activities were limited to asphalt and concrete repairs and limited reseeding at Building 2250 and pressure washing of a concrete pad utilized for the mixing/staging area during the full scale ISCO injections detailed in Section 4.4.4. Upon completion of the on-going construction and grading activities associated with the Asymmetric Warfare Group Headquarters complex in AOC 1, the 10 injection wells in this area will be finalized with flush mount manhole covers. Completion of the manhole covers will be documented in follow up quarterly O&M Reports.

5. Deviations from Interim Removal Action Work Plan

The NTCRA was conducted in accordance with the IRAWP (ARCADIS, 2013b), with minor exception. Deviations are described in additional detail where appropriate within this report and are listed below for reference purposes:

- Proposed well OU4MW46 – The IRAWP proposed installation of an additional monitoring well at Building 2286, OU4MW46 displayed on Figure 15 of the IRAWP. Limited access due to on-going construction activities in the Building 2286 area prevented the installation of this well before the full-scale injection event. OU4IW-08 will serve as a replacement monitoring well for the Building 2286 injection area as this well was not included in the injection program.

- Adjustments to the Performance Monitoring and Semi-annual Monitoring programs (i.e. well sampling network) presented in the IRAWP (ARCADIS, 2013b) were made and may evolve over the duration of the LTM program. Current monitoring schedules will be included with each quarterly and annual O&M report submittal.

- Schedule – The removal action, as specified in the remedial design, was anticipated to be conducted over a six-month duration. However, due to weather complications and unforeseen site conditions, including delayed access for full-scale ISCO injections due to construction at the Asymmetric Warfare Group Headquarters, the removal action was conducted over a 12-month period (June 2013 to June 2014).

- AS/SVE modification - Due to the unforeseen collection of perched groundwater in the SVE system knock-out tank, a modification to the AS/SVE system was installed including a GAC water treatment component that discharges treated water to the ground surface for gradual infiltration.

6. Performance Standards and Construction Quality Control

This section discusses the standards used to successfully ensure health and safety and to implement the removal action.

6.1 Health and Safety

All field activities performed at the Site were conducted in accordance with the Site Wide Health and Safety Plan (ARCADIS, 2010a) and internal health and safety procedures.

6.2 Construction Quality Control

All sampling was conducted in accordance with the approved Site Wide Sampling and Analysis Plan (SAP; ARCADIS, 2010b) and the Site Wide Quality Assurance Project Plan (QAPP; ARCADIS, 2010c).Quality assurance (QA) is defined as the overall system for assuring the reliability of data generated. The system provides independent verification that the established quality control (QC) measures are implemented by project participants in a manner that ensures the integrity of the environmental sampling and analysis activities. The Site-Wide QAPP (ARCADIS, 2010c) provides further details on requirements of the QA/QC program. All sampling (e.g., IDW sampling, influent and effluent treatment system samples) was conducted in accordance with the approved SAP (ARCADIS, 2010b) and the Site Wide QAPP (ARCADIS, 2010c).

7. Final Inspection

A final Site inspection was conducted on June 13, 2014 following Site restoration activities with representatives from FGGM and ARCADIS. A photo log documenting the remedial actions completed at the Site including Site restoration is provided as **Appendix J**. The following punch list items were noted and promptly addressed following the Site inspection:

- Additional asphalt repair around AS-9;
- Installed replacement manhole lids at AS-5 and AS-6. Vehicular traffic (i.e. heavy maintenance trucks) drove over two manholes which caused the lid to fracture, as a result new lids were installed;
- Replacement of a missing bolt on the manhole cover at SVE-3;
- Placement of grass seed at SVE-1; and
- Replacement of a cracked portion of concrete near the trench installed to connect to the on-Site power transformer.

8. Site Contact Information

Listed below are the contact persons for this project.

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9. References

ARCADIS U.S., Inc. (ARCADIS). 2010a. Health and Safety Plan for the Performance Based Acquisition at Fort George G. Meade. Final. October 2010.

ARCADIS. 2010b. Final Site Wide Sampling and Analysis Plan, Fort George G. Meade, Maryland. March.

ARCADIS. 2010c. Final Quality Assurance Project Plan, Fort George G. Meade, Maryland. March.

ARCADIS. 2013a. Engineering Evaluation/Cost Analysis for Operable Unit 4, Fort George G. Meade, Maryland. Final. June 2013.

ARCADIS. 2013b. Interim Removal Action Work Plan for Operable Unit 4, Fort George G. Meade, Maryland. Final. June 2013.

ARCADIS. 2014a. First Quarter Operation and Maintenance Report (January 1, 2014 – March 31, 2014) Operable Unit 4.Lower Patapsco Aquifer, Fort George G. Meade, Maryland. Final. August 2014,

ARCADIS. 2014b. Interim Removal Action Report for Area of Concern 3 (The Lower Patapsco Aquifer Study Area), Fort George G. Meade, Maryland. Draft. May 2014.

ARCADIS. 2014c. Remedial Investigation/Feasibility Study Operable Unit 4, Fort George G. Meade, Maryland. Draft Final. July 2014.

United States Army. 2013. Action Memorandum for Operable Unit 4, Fort George G. Meade, Maryland. Final. July 2013.

United States Environmental Protection Agency. 2011. Close Out Procedures for National Priority List Sites. Office of Emergency and Remedial Response, Directive 9320.2-22. May 2011.

Tables

Table 1
Building 2276/2286 - Well Construction Details
Interim Removal Action Report for OU-4 Areas of Concern 1 and 2
Operable Unit 4, Lower Patapsco Aquifer Study Area
Fort George G. Meade, Maryland

Well ID	Installation Date	Screened Interval (ft bgs)	Screen Length (ft)	Screen Slot Size (inches)	Casing Diameter (inches)	Well Casing Construction
Injection Wells						
Building 2276						
OU4IW10	8/21/2013	30 - 40	10	0.020	2	Schedule 40 PVC
OU4IW11	8/27/2013	30 - 40	10	0.020	2	Schedule 40 PVC
OU4IW13	5/15/2013	30 - 40	10	0.020	2	Schedule 40 PVC
OU4IW14	8/21/2013 - 8/22/2013	30 - 40	10	0.020	2	Schedule 40 PVC
OU4IW15	8/22/2013 - 8/23/2013	30 - 40	10	0.020	2	Schedule 40 PVC
OU4IW16	8/22/2013 - 8/23/2013	30 - 40	10	0.020	2	Schedule 40 PVC
Building 2286						
OU4IW01	3/6/2014	25 - 35	10	0.020	2	Schedule 40 PVC
OU4IW02	11/4/2013	25 - 35	10	0.020	2	Schedule 40 PVC
OU4IW03	11/5/2013	25 - 34.25	9.25	0.020	2	Schedule 40 PVC
OU4IW04	11/7/2013	25 - 35	10	0.020	2	Schedule 40 PVC
OU4IW05	11/4/2013	25 - 35	10	0.020	2	Schedule 40 PVC
OU4IW06	11/5/2013	25 - 34.96	9.96	0.020	2	Schedule 40 PVC
OU4IW07	11/7/2013	25-35	10	0.020	2	Schedule 40 PVC
OU4IW08	11/6/2013	25 - 35	10	0.020	2	Schedule 40 PVC
OU4IW09	11/7/2013	25-35	10	0.020	2	Schedule 40 PVC
OU4IW12	3/6/2014	25 - 35	10	0.020	2	Schedule 40 PVC
Monitoring Wells						
Building 2276						
OU4MW44	5/15/2013	30 - 40	10	0.010	2	Schedule 40 PVC
OU4MW45	8/22/2013 - 8/23/2013	30 - 40	10	0.010	2	Schedule 40 PVC

Notes:

1. Due to on-going construction in the vicinity of Building 2286, newly installed injection and monitoring wells in this area have not been furnished with well vaults. Following completion of final grading, new wells will be completed and northing and easting coordinates and top of casing elevations will be surveyed.

ft - feet
ft bgs - feet below ground surface
PVC - polyvinyl chloride

Table 2
ISCO Monitoring Analytical Results
Interim Removal Action Report for OU-4 Areas of Concern 1 and 2
Operable Unit 4, Lower Patapsco Aquifer Study Area
Fort George G. Meade, Maryland

		Location	FMOU4-IW02	FMOU4-IW03	FMOU4-IW04	FMOU4-IW05	FMOU4-IW05	FMOU4-IW06	FMOU4-IW07	FMOU4-IW08	FMOU4-IW09	FMOU4-IW10	FMOU4-IW11	FMOU4-IW13	FMOU4-IW13	FMOU4-IW13	FMOU4-IW14	FMOU4-IW15	FMOU4-IW16	FMOU4-MW44	FMOU4-MW44	FMOU4-MW45
		Date	11/4/2013	11/5/2013	11/7/2013	11/4/2013	11/4/2013	11/5/2013	11/7/2013	11/6/2013	11/7/2013	8/22/2013	8/28/2013	6/6/2013	6/6/2013	7/10/2013	8/22/2013	8/23/2013	8/23/2013	6/6/2013	7/10/2013	8/23/2013
		Type	N	N	N	FD	N	N	N	N	N	N	N	N	FD	N	N	N	N	N	N	N
Analyte	**CAS**	**Units**																				
1,1,1,2-Tetrachloroethane	630-20-6	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
1,1,1-Trichloroethane	71-55-6	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 SU	< 0.50 U	< 0.50 U
1,1,2,2-Tetrachloroethane	79-34-5	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
1,1,2-Trichloroethane	79-00-5	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
1,1-Dichloroethane	75-34-3	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
1,1-Dichloroethene	75-35-4	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
1,1-Dichloropropene	563-58-6	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
1,2,3-Trichlorobenzene	87-61-6	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
1,2,3-Trichloropropane	96-18-4	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 SU	< 0.50 U	< 0.50 U
1,2,4-Trichlorobenzene	120-82-1	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
1,2,4-Trimethylbenzene	95-63-6	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
1,2-Dibromo-3-chloropropane	96-12-8	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
1,2-Dibromoethane	106-93-4	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 SU	< 0.50 U	< 0.50 U
1,2-Dichlorobenzene	95-50-1	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
1,2-Dichloroethane	107-06-2	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
1,2-Dichloropropane	78-87-5	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
1,3,5-Trimethylbenzene	108-67-8	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
1,3-Dichlorobenzene	541-73-1	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
1,3-Dichloropropane	142-28-9	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
1,4-Dichlorobenzene	106-46-7	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
2,2-Dichloropropane	594-20-7	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 SU	< 0.50 U	< 0.50 U
2-Butanone	78-93-3	µg/L	< 50 U	< 10 U	< 500 U	< 100 U	< 100 U	< 100 U	< 200 U	< 10 U	< 100 U	< 50 U	< 200 U	< 50 U	< 50 U	< 10 U	< 100 U	< 10 U	< 50 U	< 50 U	**210**	< 10 U
2-Chlorotoluene	95-49-8	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
4-Chlorotoluene	106-43-4	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
4-Methyl-2-Pentanone	108-10-1	µg/L	< 50 U	< 10 U	< 500 U	< 100 U	< 100 U	< 100 U	< 200 U	< 10 U	< 100 U	< 50 U	< 200 U	< 50 U	< 50 U	< 10 U	< 100 U	< 10 U	< 50 U	< 50 U	< 10 U	**0.68 J**
Acetone	67-64-1	µg/L	< 100 U	< 20 U	< 1000 U	< 200 U	< 200 U	< 200 U	< 400 U	**4.7 J**	< 200 U	**8.3 J**	< 400 U	**2.8 J**	**2.2 J**	**6.5 J**	**5.0 J**	< 10 U	< 50 U	< 100 U	**240**	**4.6 J**
Benzene	71-43-2	µg/L	< 25 U	< 5.0 U	< 250 SU	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
Bromobenzene	108-86-1	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
Bromodichloromethane	75-27-4	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	**1.1**	**0.59**
Bromoform	75-25-2	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
Bromomethane	74-83-9	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
Carbon Disulfide	75-15-0	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
Carbon Tetrachloride	56-23-5	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
CFC-11	75-69-4	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
CFC-12	75-71-8	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
Chlorobenzene	108-90-7	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
Chlorobromomethane	74-97-5	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
Chlorodibromomethane	124-48-1	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	**0.34 J**
Chloroethane	75-00-3	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
Chloroform	67-66-3	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	**0.21 J**	< 50 U	**1.1**	< 2.5 U	< 25 U	**8.7**	**1.7**
Chloromethane	74-87-3	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	**0.18 J**	< 0.50 U
cis-1,2-Dichloroethene	156-59-2	µg/L	**40**	**9.7**	**670**	**370**	**390**	**190**	**160**	**180**	**200**	**14 J**	**100**	**62**	**63**	**33**	**52**	**9.8**	**14**	**63**	< 0.50 U	**14**
cis-1,3-Dichloropropene	10061-01-5	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
Cymene	99-87-6	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
Dibromomethane	74-95-3	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
Dichloromethane	75-09-2	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
Ethylbenzene	100-41-4	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
Hexachloro-1,3-butadiene	87-68-3	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
Isopropylbenzene	98-82-8	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
m,p-Xylene	ARC-mpXyl	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
Methyl N-Butyl Ketone	591-78-6	µg/L	< 50 U	< 10 U	< 500 U	< 100 U	< 100 U	< 100 U	< 200 U	< 10 U	< 100 U	< 50 U	< 200 U	< 50 U	< 50 U	< 10 U	< 100 U	< 10 U	< 50 U	< 50 U	< 10 U	< 10 U
Methyl-tert-butylether	1634-04-4	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
Naphthalene	91-20-3	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
N-Butylbenzene	104-51-8	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
N-Propylbenzene	103-65-1	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
o-Xylene	95-47-6	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
sec-Butylbenzene	135-98-8	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
Styrene (Monomer)	100-42-5	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
tert-Butylbenzene	98-06-6	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
Tetrachloroethene	127-18-4	µg/L	**390**	**150**	**4000**	**2700**	**2500**	**1500**	**1400**	**410**	**1200**	**260**	**1000**	**1200**	**1200**	**360**	**880**	**100**	**260**	**1300 S**	**0.98**	**170**
Toluene	108-88-3	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
Total Xylenes	1330-20-7	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
trans-1,2-Dichloroethene	156-60-5	µg/L	< 25 U	< 5.0 U	< 250 U	**2.1 J**	< 50 U	< 50 U	< 100 U	**2.3 J**	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	**5.2**	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
trans-1,3-Dichloropropene	10061-02-6	µg/L	< 25 U	< 5.0 U	< 250 U	< 50 U	< 50 U	< 50 U	< 100 U	< 5.0 U	< 50 U	< 25 U	< 100 U	< 25 U	< 25 U	< 0.50 U	< 50 U	< 0.50 U	< 2.5 U	< 25 U	< 0.50 U	< 0.50 U
Trichloroethene	79-01-6	µg/L	**31**	**9**	**430**	**220**	**240**	**130**	**120**	**74**	**120**	**5.9 J**	**45 J**	**22 J**	**22 J**	**8.7**	**21 J**	**3.1**	**5.6**	**23 J**	< 0.50 U	**4.5**
Vinyl chloride	75-01-4	µg/L	< 10 U	< 2.0 U	< 100 U	< 20 U	< 20 U	< 20 U	< 40 U	< 2.0 U	< 20 U	< 10 U	< 40 U	< 10 U	< 10 U	< 0.50 U	< 20 U	< 0.50 U	< 2.5 U	< 10 U	< 0.50 U	< 0.50 U

Values exceeding the applicable report limits are boldfaced.
µg/L - microgram per liter
FD - Field Duplicate
J - Indicates an estimated result. Result is less than laboratory reporting limits.
U - Indicates that the analyte was analyzed but not detected above the detection limit.

Table 3
Building 2276/2286 - Injection Summary
Interim Removal Action Report for OU-4 Areas of Concern 1 and 2
Operable Unit 4, Lower Patapsco Aquifer Study Area
Fort George G. Meade, Maryland

Injection Well	Sodium Persulfate Solution Injected (gal)
Building 2276	
OU4IW11	13,088
OU4IW13[1]	18,976
OU4IW14	13,798
Building 2286	
OU4IW01	7,931
OU4IW02	10,333
OU4IW03	10,326
OU4IW04	8,366
OU4IW05	14,496
OU4IW06	13,845
OU4IW07	7,339
OU4IW09	8,562
OU4IW12	7,164
Total:	134,224

Notes:

[1] - Includes 4,128 gallons injected during pilot testing activities completed in June 2013.

Full-scale injections were completed May 15 - June 6, 2014 by ARCADIS field personnel.

Approximately 2,624 gallons of water was used during the injection event to perform daily clean water flushes of the injection manifolds and hosing.

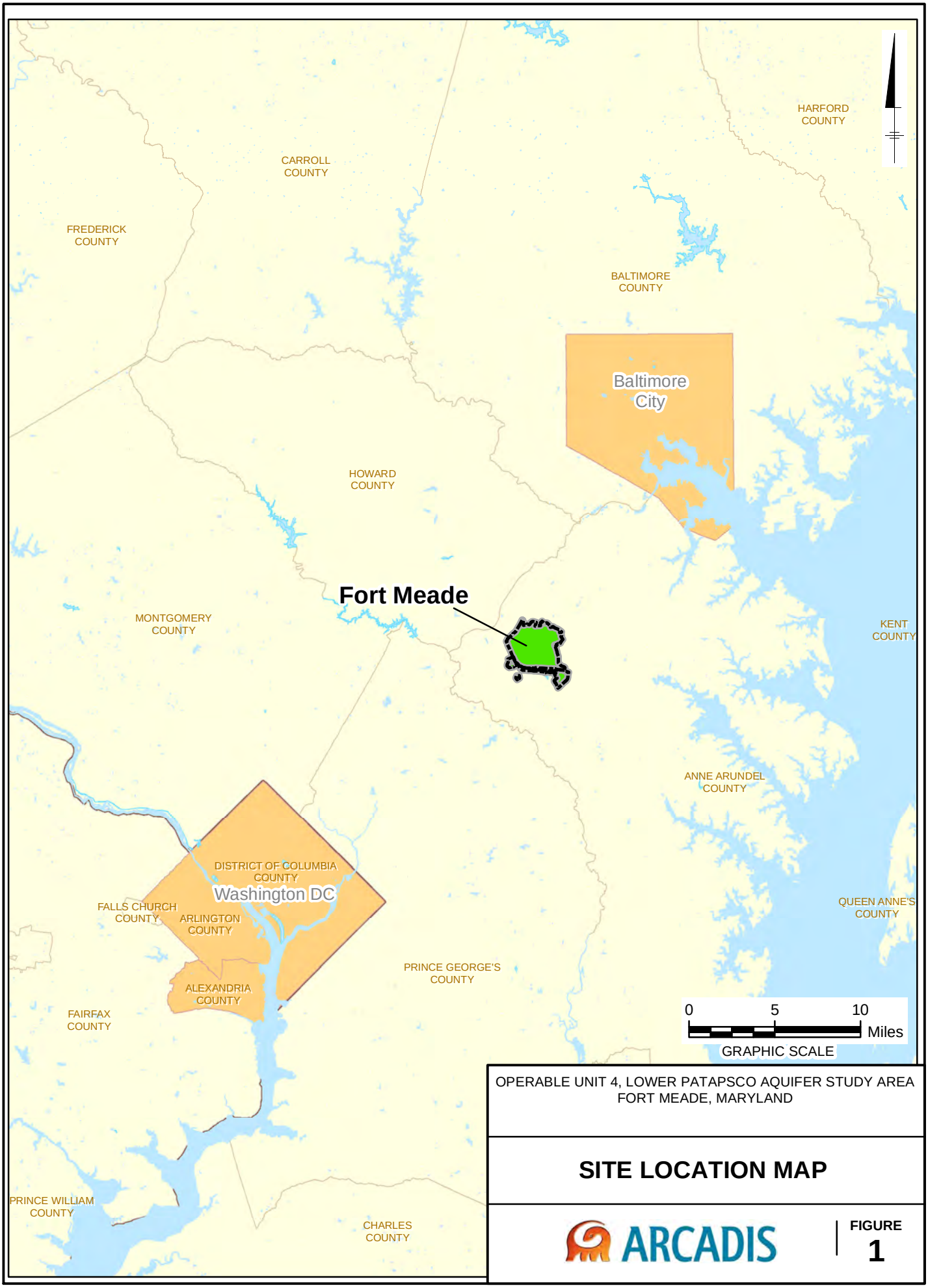
gal - gallons

Table 4
Building 2250 - Well Construction Details
Interim Removal Action Report for OU-4 Areas of Concern 1 and 2
Operable Unit 4, Lower Patapsco Aquifer Study Area
Fort George G. Meade, Maryland

Well ID	Installation Date	Screened Interval (ft bgs)	Screen Length (ft)	Screen Slot Size (inches)	Casing Diameter (inches)	Well Casing Construction
Air Sparge Wells						
AS-1	8/19/2013 - 8/20/2013	13 -15	2	0.010	2	Schedule 40 PVC
AS-2	8/19/2013 - 8/20/2013	13 -15	2	0.010	2	Schedule 40 PVC
AS-3	8/19/2013 - 8/20/2013	13 -15	2	0.010	2	Schedule 40 PVC
AS-4	8/19/2013 - 8/20/2013	13 -15	2	0.010	2	Schedule 40 PVC
AS-5	8/19/2013 - 8/20/2013	13 -15	2	0.010	2	Schedule 40 PVC
AS-6	8/19/2013 - 8/20/2013	13 -15	2	0.010	2	Schedule 40 PVC
AS-7	8/19/2013 - 8/20/2013	13 -15	2	0.010	2	Schedule 40 PVC
AS-8	8/19/2013 - 8/20/2013	13 -15	2	0.010	2	Schedule 40 PVC
AS-9[1]	3/11/2014	10 -12	2	0.010	2	Schedule 40 PVC
AS-10	8/19/2013 - 8/20/2013	13 -15	2	0.010	2	Schedule 40 PVC
AS-11	8/19/2013 - 8/20/2013	13 -15	2	0.010	2	Schedule 40 PVC
Monitoring Wells						
SVE-1	8/13/2013 - 8/14/2013	5 - 10	5	0.010	4	Schedule 40 PVC
SVE-2	8/13/2013 - 8/14/2013	5 - 10	5	0.010	4	Schedule 40 PVC
SVE-3	8/13/2013 - 8/14/2013	5 - 10	5	0.010	4	Schedule 40 PVC
SVE-4	8/13/2013 - 8/14/2013	5 - 10	5	0.010	4	Schedule 40 PVC
SVE-5	8/13/2013 - 8/15/2013	5 - 10	5	0.010	4	Schedule 40 PVC
SVE-6	8/13/2013 - 8/15/2013	5 - 10	5	0.010	4	Schedule 40 PVC
SVE-7	8/13/2013 - 8/15/2013	5 - 10	5	0.010	4	Schedule 40 PVC
SVE-8	8/13/2013 - 8/15/2013	5 - 10	5	0.010	4	Schedule 40 PVC
SVE-9	8/13/2013 - 8/15/2013	5 - 10	5	0.010	4	Schedule 40 PVC

Notes:
[1] - AS-9 was over-drilled and reinstalled on March 11, 2014.
ft - feet
ft bgs - feet below ground surface
PVC - polyvinyl chloride

Figures



OPERABLE UNIT 4, LOWER PATAPSCO AQUIFER STUDY AREA
FORT MEADE, MARYLAND

SITE LOCATION MAP

ARCADIS

FIGURE
1

CITY: MPLS DIV/GROUP: IM DB: MG
FORT GEORGE G. MEADE
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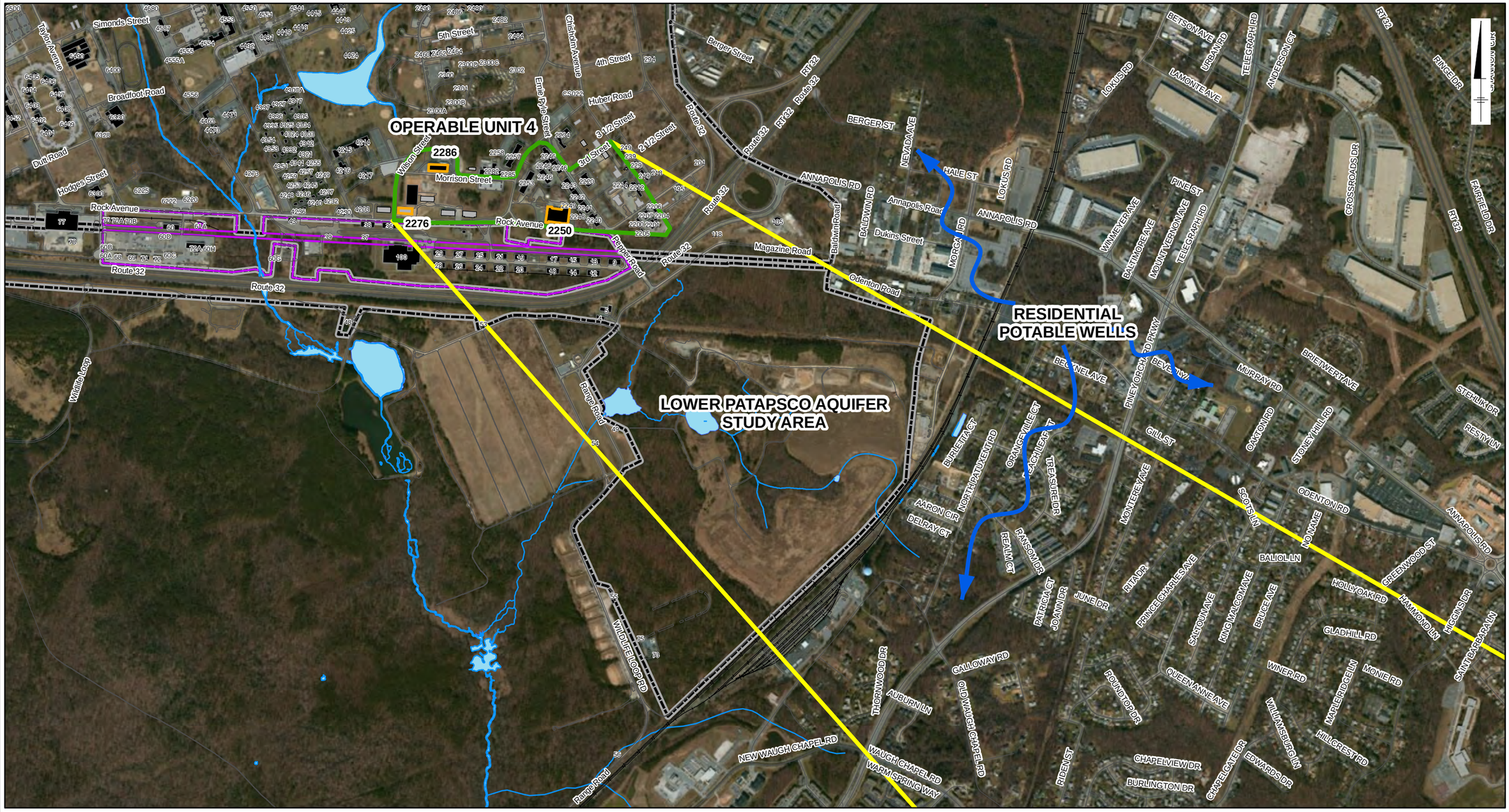

LEGEND:

- ROADS
- RAILROAD
- DEMOLISHED STRUCTURES
- EXISTING STRUCTURES
- AREA OF CONCERN
- STREAM
- SURFACE WATER
- ARCHITECT OF THE CAPITOL PROPERTY BOUNDARY
- INSTALLATION BOUNDARY
- OU4 BOUNDARY
- LOWER PATAPSCO AQUIFER STUDY AREA

NOTE:

11/5/2011 AERIAL IMAGE: ARCGIS BASEMAP IMAGERY SERVICE ACCESSED 5/8/2014.

OPERABLE UNIT 4, LOWER PATAPSCO AQUIFER STUDY AREA
FORT MEADE, MARYLAND

OPERABLE UNIT 4 AND LOWER PATAPSCO AQUIFER STUDY AREA

ARCADIS

FIGURE
2

CITY: MPLS DIV/GROUP: IM DB: MG LD: KS
FORT MEADE
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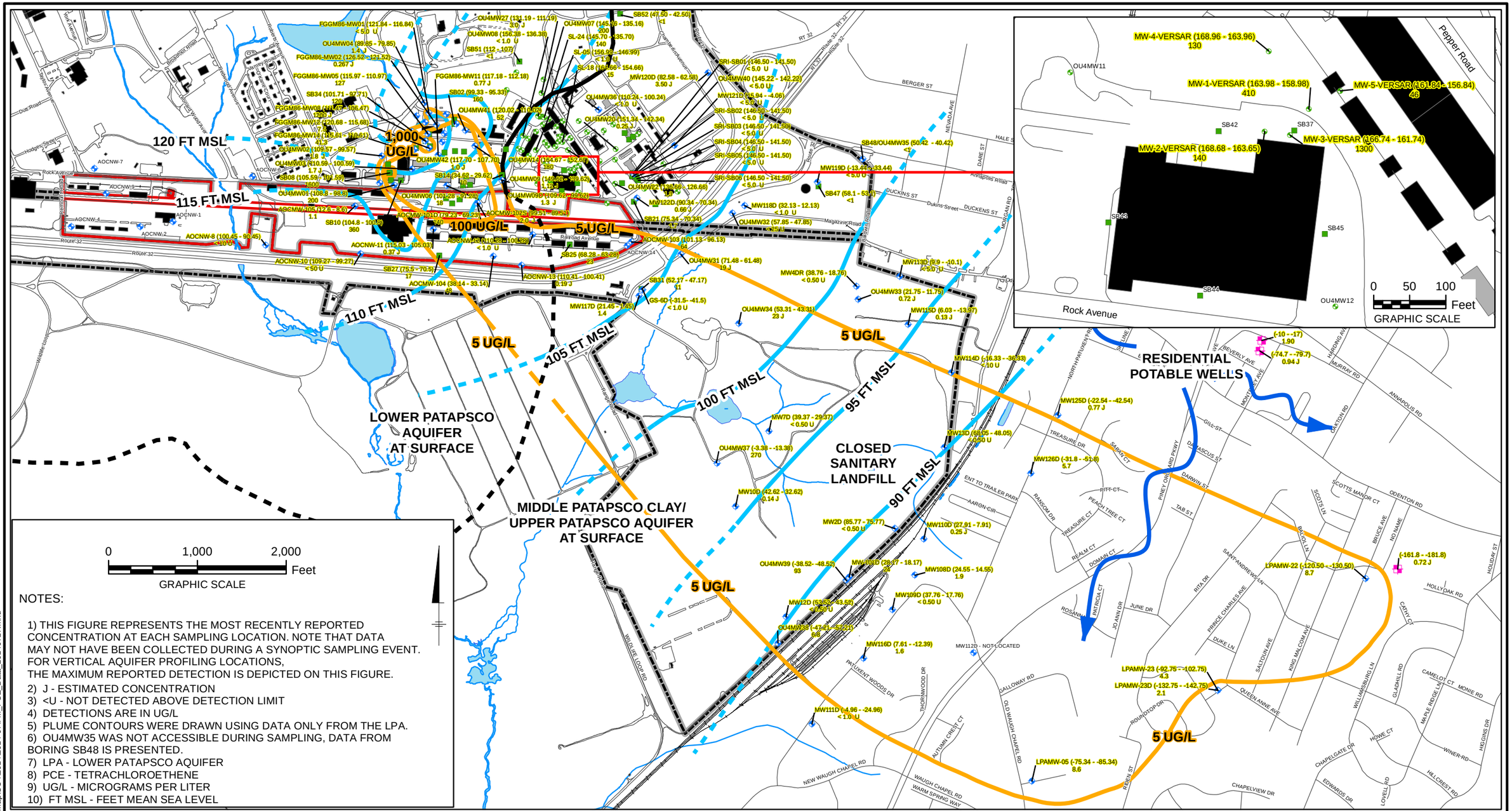

NOTES:

1) THIS FIGURE REPRESENTS THE MOST RECENTLY REPORTED CONCENTRATION AT EACH SAMPLING LOCATION. NOTE THAT DATA MAY NOT HAVE BEEN COLLECTED DURING A SYNOPTIC SAMPLING EVENT. FOR VERTICAL AQUIFER PROFILING LOCATIONS, THE MAXIMUM REPORTED DETECTION IS DEPICTED ON THIS FIGURE.
2) J - ESTIMATED CONCENTRATION
3) <U - NOT DETECTED ABOVE DETECTION LIMIT
4) DETECTIONS ARE IN UG/L
5) PLUME CONTOURS WERE DRAWN USING DATA ONLY FROM THE LPA.
6) OU4MW35 WAS NOT ACCESSIBLE DURING SAMPLING, DATA FROM BORING SB48 IS PRESENTED.
7) LPA - LOWER PATAPSCO AQUIFER
8) PCE - TETRACHLOROETHENE
9) UG/L - MICROGRAMS PER LITER
10) FT MSL - FEET MEAN SEA LEVEL

LEGEND:

- MIDDLE PATAPSCO AQUIFER WELL (163.98 - 158.98) MONITORING WELL SCREEN INTERVAL (FEET MEAN SEA LEVEL) 41.3 - PCE DETECTION
- LOWER PATAPSCO AQUIFER WELL (21.45 - 1.45) MONITORING WELL SCREEN INTERVAL (FEET MEAN SEA LEVEL) 2400 - PCE DETECTION
- BORING LOCATION (42.62 - 32.62) VERTICAL INTERVAL FROM WHICH DATA WERE COLLECTED (FEET MEAN SEA LEVEL)
- RESIDENTIAL WELL
- ROADS
- RAILROAD
- DEMOLISHED STRUCTURES
- EXISTING STRUCTURES
- STREAM
- SURFACE WATER
- ARCHITECT OF THE CAPITOL PROPERTY BOUNDARY
- INSTALLATION BOUNDARY
- MID-PATAPSCO CLAY CONTACT DASHED WHERE INFERRED
- LPA PCE CONTOUR (UG/L)
- LPA GROUNDWATER ELEVATION CONTOUR DASHED WHERE INFERRED
- WATER LEVEL CONTOUR DATA COLLECTED 2/2013

OPERABLE UNIT 4
FORT MEADE, MARYLAND

OPERABLE UNIT 4
LOWER PATAPSCO AQUIFER STUDY AREA
PCE DETECTIONS IN THE MIDDLE AND LOWER PATAPSCO AQUIFER

ARCADIS

FIGURE
3

CITY: MPLS DIV/GROUP: IM DB: MG LD: KS
FORT MEADE
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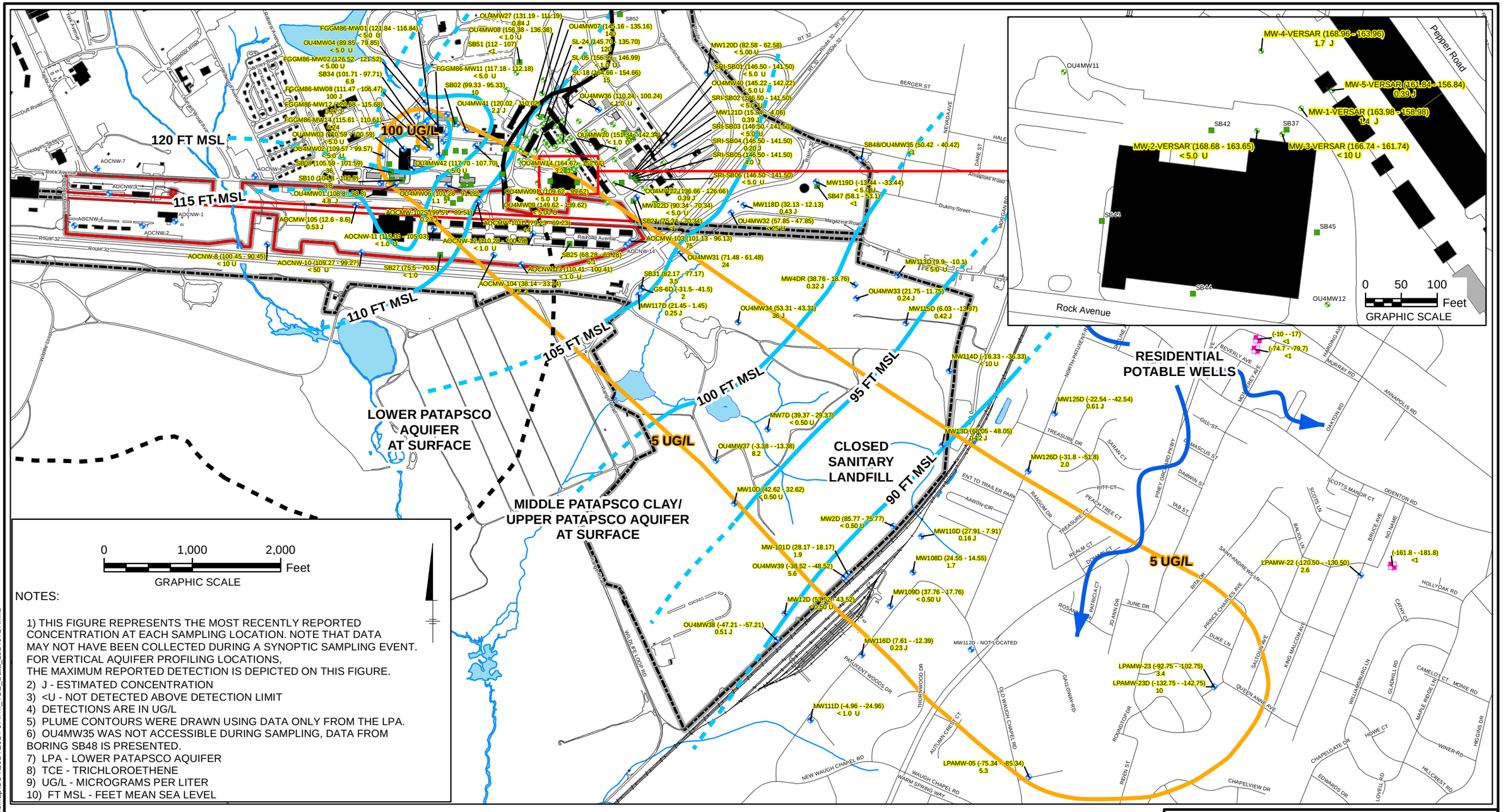


NOTES:

1) THIS FIGURE REPRESENTS THE MOST RECENTLY REPORTED CONCENTRATION AT EACH SAMPLING LOCATION. NOTE THAT DATA MAY NOT HAVE BEEN COLLECTED DURING A SYNOPTIC SAMPLING EVENT. FOR VERTICAL AQUIFER PROFILING LOCATIONS, THE MAXIMUM REPORTED DETECTION IS DEPICTED ON THIS FIGURE.
2) J - ESTIMATED CONCENTRATION
3) <U - NOT DETECTED ABOVE DETECTION LIMIT
4) DETECTIONS ARE IN UG/L
5) PLUME CONTOURS WERE DRAWN USING DATA ONLY FROM THE LPA.
6) OU4MW35 WAS NOT ACCESSIBLE DURING SAMPLING, DATA FROM BORING SB48 IS PRESENTED.
7) LPA - LOWER PATAPSCO AQUIFER
8) TCE - TRICHLOROETHENE
9) UG/L - MICROGRAMS PER LITER
10) FT MSL - FEET MEAN SEA LEVEL

LEGEND:

- MIDDLE PATAPSCO AQUIFER WELL (163.98 - 158.98) MONITORING WELL SCREEN INTERVAL (FEET MEAN SEA LEVEL) 41.3 - TCE DETECTION
- LOWER PATAPSCO AQUIFER WELL (21.45 - 1.45) MONITORING WELL SCREEN INTERVAL (FEET MEAN SEA LEVEL) 2400 - TCE DETECTION
- BORING LOCATION (42.62 - 32.62) VERTICAL INTERVAL FROM WHICH DATA WERE COLLECTED (FEET MEAN SEA LEVEL)
- RESIDENTIAL WELL
- ROADS
- RAILROAD
- DEMOLISHED STRUCTURES
- EXISTING STRUCTURES
- STREAM
- SURFACE WATER
- ARCHITECT OF THE CAPITOL PROPERTY BOUNDARY
- INSTALLATION BOUNDARY
- MID-PATAPSCO CLAY CONTACT DASHED WHERE INFERRED
- LPA TCE CONTOUR (UG/L)
- LPA GROUNDWATER ELEVATION CONTOUR DASHED WHERE INFERRED WATER LEVEL CONTOUR DATA COLLECTED 2/2013

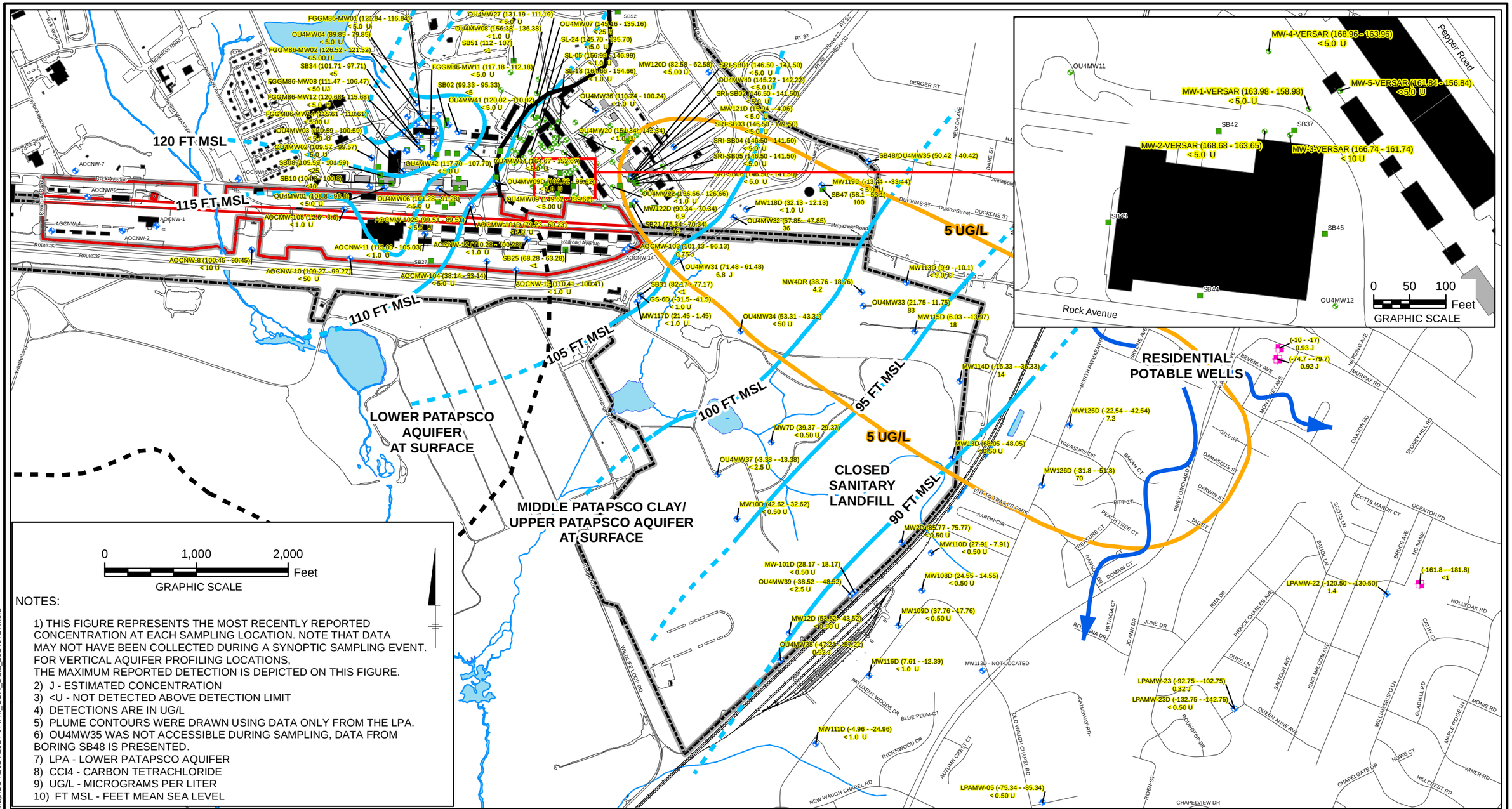
OPERABLE UNIT 4
FORT MEADE, MARYLAND

OPERABLE UNIT 4
LOWER PATAPSCO AQUIFER STUDY AREA
TCE DETECTIONS IN THE MIDDLE AND LOWER PATAPSCO AQUIFER

ARCADIS

FIGURE
4

CITY: MPLS DIV/GROUP: IM DB: MG LD: KS
FORT MEADE
Path: Z:\GISPROJECTS_ENV\Fort_Meade\ArcMap\OU4\2014\2014-07\FM_TCE_Data_20140717.mxd



NOTES:

1) THIS FIGURE REPRESENTS THE MOST RECENTLY REPORTED CONCENTRATION AT EACH SAMPLING LOCATION. NOTE THAT DATA MAY NOT HAVE BEEN COLLECTED DURING A SYNOPTIC SAMPLING EVENT. FOR VERTICAL AQUIFER PROFILING LOCATIONS, THE MAXIMUM REPORTED DETECTION IS DEPICTED ON THIS FIGURE.
2) J - ESTIMATED CONCENTRATION
3) <U - NOT DETECTED ABOVE DETECTION LIMIT
4) DETECTIONS ARE IN UG/L
5) PLUME CONTOURS WERE DRAWN USING DATA ONLY FROM THE LPA.
6) OU4MW35 WAS NOT ACCESSIBLE DURING SAMPLING, DATA FROM BORING SB48 IS PRESENTED.
7) LPA - LOWER PATAPSCO AQUIFER
8) CCI4 - CARBON TETRACHLORIDE
9) UG/L - MICROGRAMS PER LITER
10) FT MSL - FEET MEAN SEA LEVEL

LEGEND:

- MIDDLE PATAPSCO AQUIFER WELL (163.98 - 158.98) MONITORING WELL SCREEN INTERVAL (FEET MEAN SEA LEVEL) 41.3 - CCI4 DETECTION
- LOWER PATAPSCO AQUIFER WELL (21.45 - 1.45) MONITORING WELL SCREEN INTERVAL (FEET MEAN SEA LEVEL) 2400 - CCI4 DETECTION
- BORING LOCATION (42.62 - 32.62) VERTICAL INTERVAL FROM WHICH DATA WERE COLLECTED (FEET MEAN SEA LEVEL)
- RESIDENTIAL WELL
- ROADS
- RAILROAD
- DEMOLISHED STRUCTURES
- EXISTING STRUCTURES
- STREAM
- SURFACE WATER
- ARCHITECT OF THE CAPITOL PROPERTY BOUNDARY
- INSTALLATION BOUNDARY
- MID-PATAPSCO CLAY CONTACT DASHED WHERE INFERRED
- LPA CCI4 CONTOUR (UG/L)
- LPA GROUNDWATER ELEVATION CONTOUR DASHED WHERE INFERRED
- WATER LEVEL CONTOUR DATA COLLECTED 2/2013

OPERABLE UNIT 4
FORT MEADE, MARYLAND

OPERABLE UNIT 4
LOWER PATAPSCO AQUIFER STUDY AREA
CCI4 DETECTIONS IN THE MIDDLE AND LOWER PATAPSCO AQUIFER

ARCADIS

FIGURE
5

CITY: MPLS DIV/GROUP: IM DB: MG LD: KS
FORT MEADE
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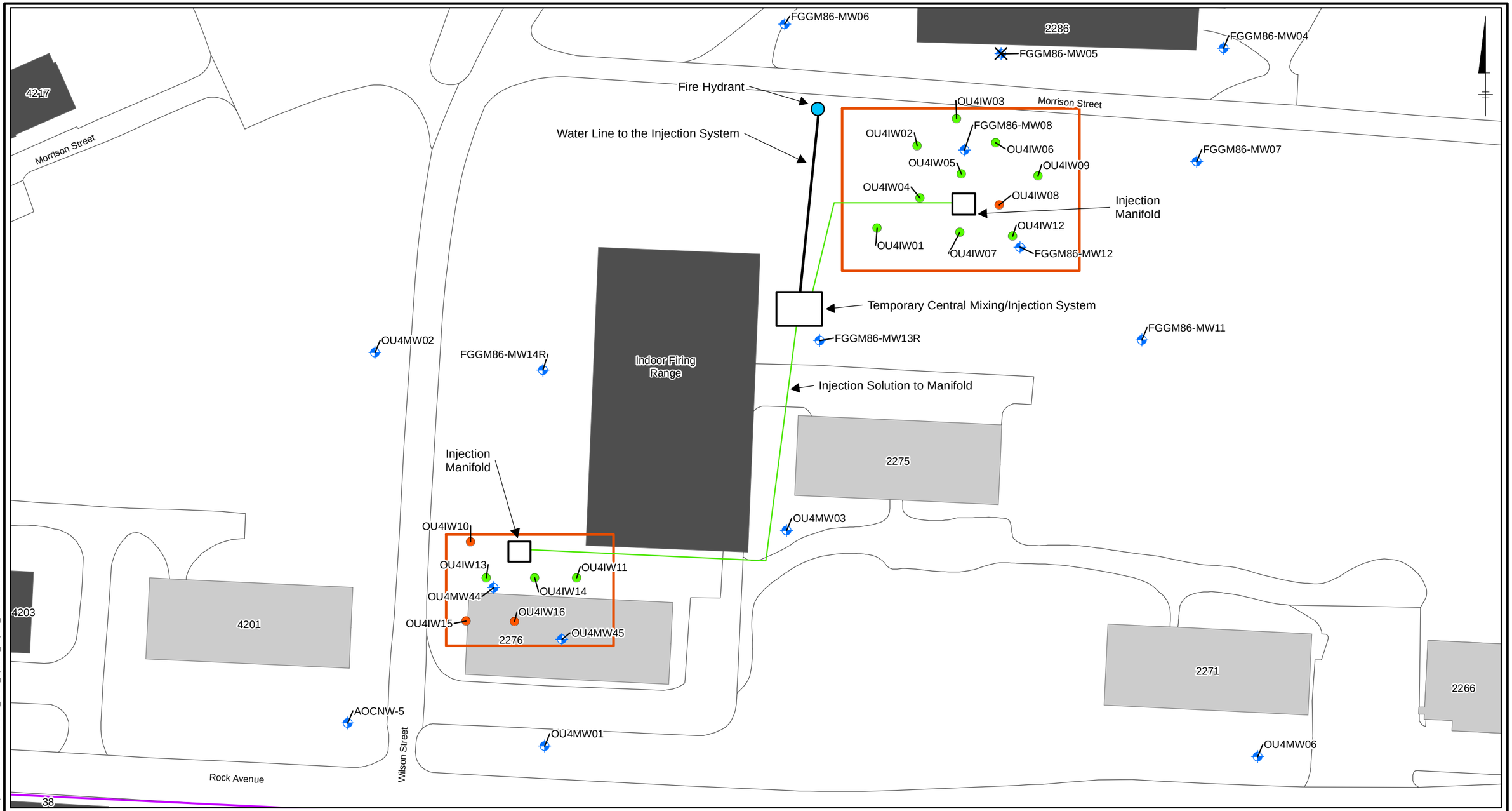

LEGEND:

- INJECTION WELL INCLUDED IN MAY-JUNE 2014 INJECTION EVENT
- INJECTION WELL NOT INCLUDED
- MONITORING WELL
- NOT LOCATED
- ROADS
- TARGET REMEDIATION AREA
- ARCHITECT OF THE CAPITOL PROPERTY BOUNDARY
- DEMOLISHED STRUCTURES
- EXISTING STRUCTURES

0 80 160 Feet

GRAPHIC SCALE

NOTES:

1) THE LOCATION AND EXTENT OF SITE FEATURES PRESENTED HEREON ARE APPROXIMATE.
2) FGGM86-MW13R AND FGGM86-MW14R LOCATIONS ARE APPROXIMATE

OPERABLE UNIT 4
FORT MEADE, MARYLAND
INTERIM REMEDIAL ACTION WORK PLAN

BUILDING 2286/2276
ISCO SYSTEM LAYOUT

ARCADIS

FIGURE
6

CITY: MPLS DIV/GROUP: 40 DB: MG LD: BE PM: TL
FT. MEADE (GP09MEAD.C000)
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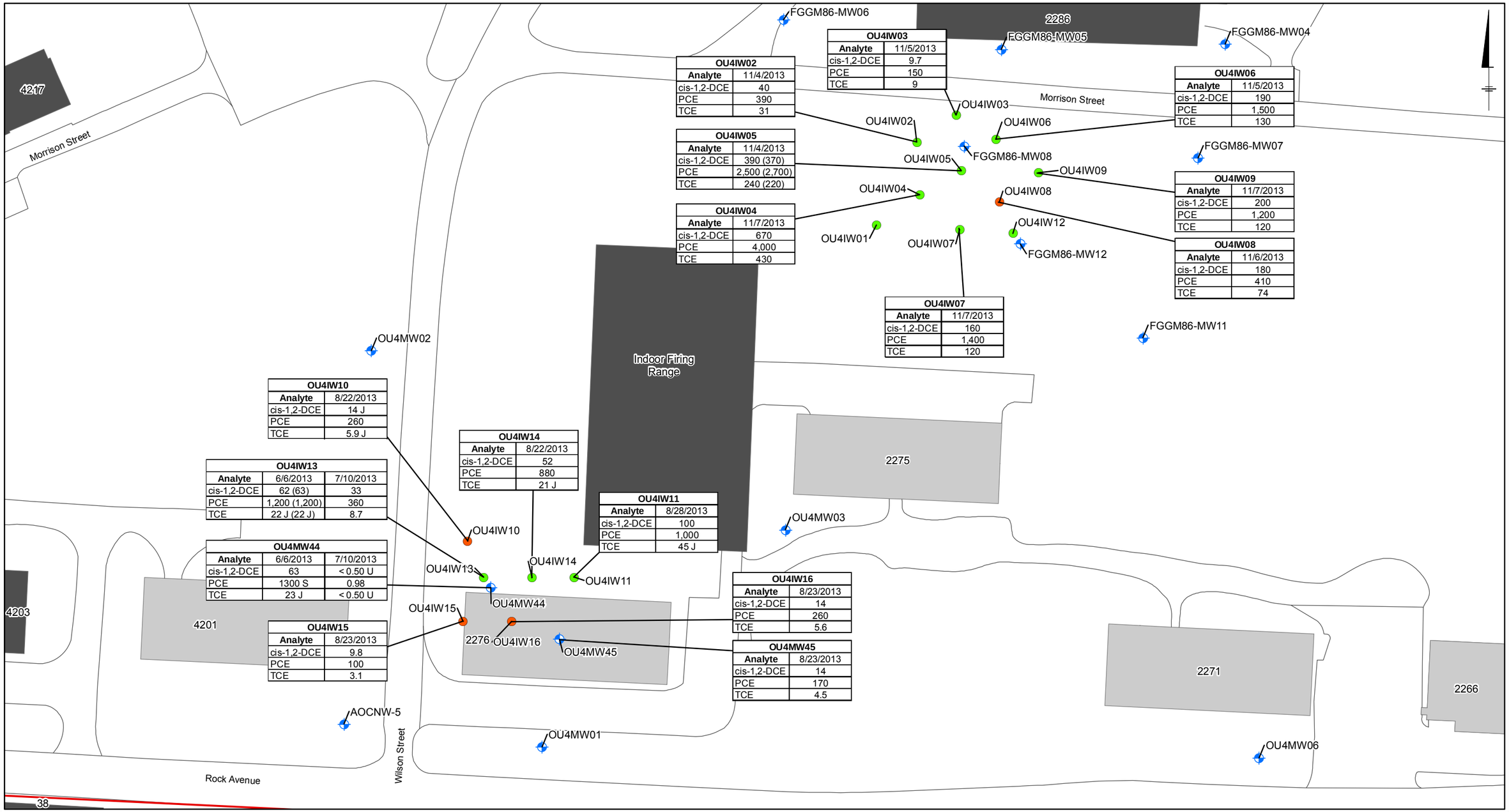

OU4IW02	
Analyte	11/4/2013
cis-1,2-DCE	40
PCE	390
TCE	31

OU4IW03	
Analyte	11/5/2013
cis-1,2-DCE	9.7
PCE	150
TCE	9

OU4IW06	
Analyte	11/5/2013
cis-1,2-DCE	190
PCE	1,500
TCE	130

OU4IW05	
Analyte	11/4/2013
cis-1,2-DCE	390 (370)
PCE	2,500 (2,700)
TCE	240 (220)

OU4IW09	
Analyte	11/7/2013
cis-1,2-DCE	200
PCE	1,200
TCE	120

OU4IW04	
Analyte	11/7/2013
cis-1,2-DCE	670
PCE	4,000
TCE	430

OU4IW08	
Analyte	11/6/2013
cis-1,2-DCE	180
PCE	410
TCE	74

OU4IW07	
Analyte	11/7/2013
cis-1,2-DCE	160
PCE	1,400
TCE	120

OU4IW10	
Analyte	8/22/2013
cis-1,2-DCE	14 J
PCE	260
TCE	5.9 J

OU4IW14	
Analyte	8/22/2013
cis-1,2-DCE	52
PCE	880
TCE	21 J

OU4IW13		
Analyte	6/6/2013	7/10/2013
cis-1,2-DCE	62 (63)	33
PCE	1,200 (1,200)	360
TCE	22 J (22 J)	8.7

OU4IW11	
Analyte	8/28/2013
cis-1,2-DCE	100
PCE	1,000
TCE	45 J

OU4MW44		
Analyte	6/6/2013	7/10/2013
cis-1,2-DCE	63	< 0.50 U
PCE	1300 S	0.98
TCE	23 J	< 0.50 U

OU4IW16	
Analyte	8/23/2013
cis-1,2-DCE	14
PCE	260
TCE	5.6

OU4IW15	
Analyte	8/23/2013
cis-1,2-DCE	9.8
PCE	100
TCE	3.1

OU4MW45	
Analyte	8/23/2013
cis-1,2-DCE	14
PCE	170
TCE	4.5

LEGEND:

- INJECTION WELL INCLUDED IN MAY-JUNE 2014 INJECTION EVENT
- INJECTION WELL NOT INCLUDED
- MONITORING WELL
- ROADS
- ARCHITECT OF THE CAPITOL PROPERTY BOUNDARY
- DEMOLISHED STRUCTURES
- EXISTING STRUCTURES

0 80 160 Feet
GRAPHIC SCALE

NOTES:

1) THE LOCATION AND EXTENT OF SITE FEATURES PRESENTED HEREON ARE APPROXIMATE.
2) ALL GROUNDWATER ANALYTICAL RESULTS ARE PRESENTED IN MICROGRAMS PER LITER.
3) U - INDICATES THAT THE ANALYTE WAS ANALYZED BUT NOT DETECTED ABOVE THE DETECTION LIMIT.
4) J - INDICATES AN ESTIMATED RESULT.
5) PCE - TETRACHLOROETHENE
6) TCE - TRICHLOROETHENE
7) CIS-1,2-DCE - CIS-1,2-DICHLOROETHENE

OPERABLE UNIT 4, LOWER PATAPSCO STUDY AREA
FORT MEADE, MARYLAND

BUILDING 2276/2286
GROUNDWATER ANALYTICAL DESIGN DATA

ARCADIS

FIGURE
7

CITY: MPLS DIV/GROUP: 40 DB: MG LD: BE PM: TL
FT. MEADE (GP09MEAD.C000)
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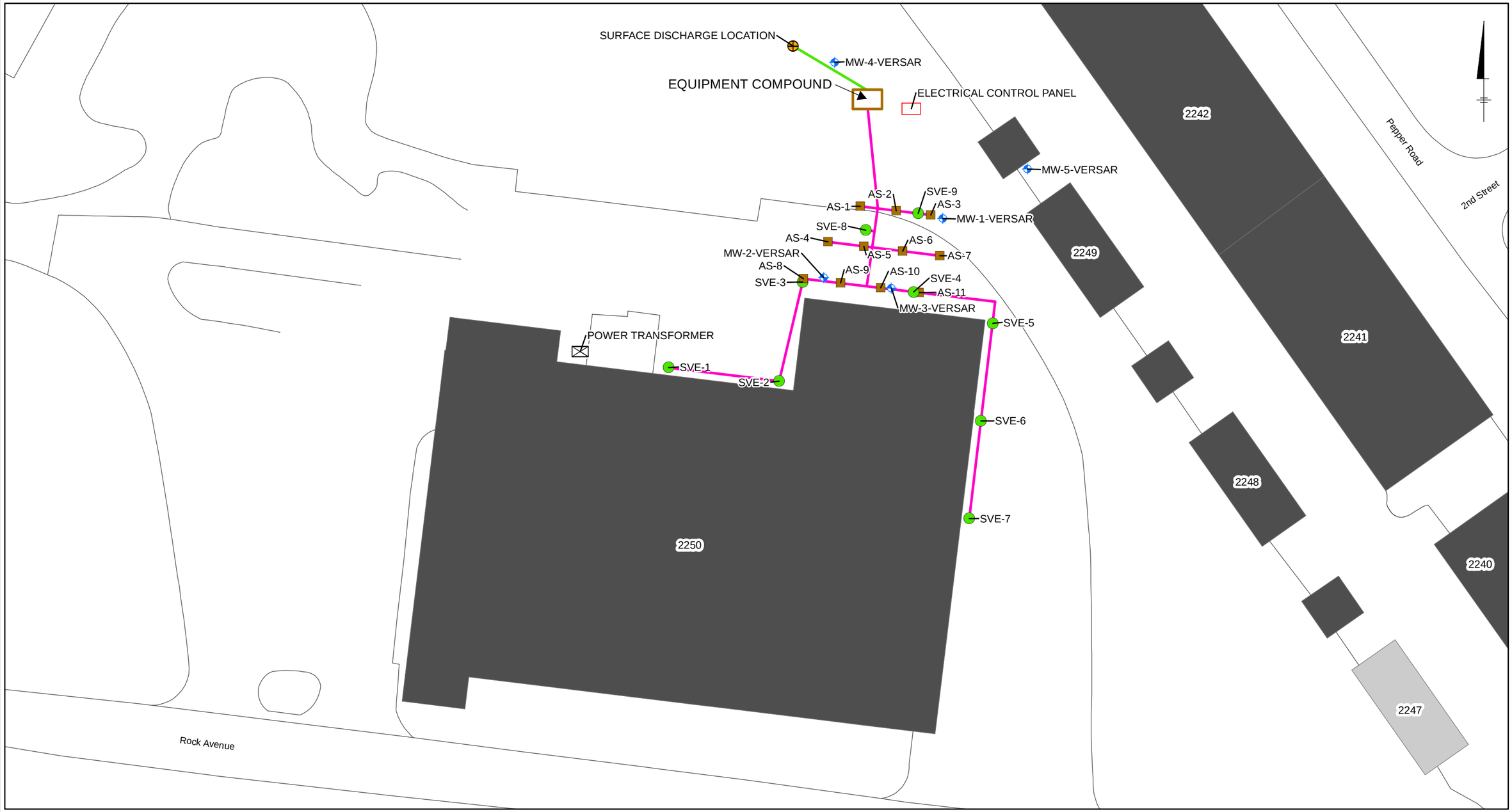


LEGEND:

- SOIL VAPOR EXTRACTION (SVE) WELL
- AIR SPARGE (AS) WELL
- MONITORING WELL (MW)
- SURFACE DISCHARGE LOCATION
- SUBSURFACE PIPING
- ABOVE SURFACE PIPING
- ROAD/CURB
- DEMOLISHED STRUCTURES
- EXISTING STRUCTURES
- 2250 - BUILDING NUMBER
- ELECTRICAL CONTROL PANEL
- POWER TRANSFORMER

0 50 100 Feet
GRAPHIC SCALE

NOTE:
1. THE LOCATION AND EXTENT OF SITE FEATURES PRESENTED HEREON ARE APPROXIMATE.

OPERABLE UNIT 4, LOWER PATAPSCO AQUIFER STUDY AREA
FORT MEADE, MARYLAND

BUILDING 2250 AIR SPARGE/SOIL VAPOR EXTRACTION SYSTEM LAYOUT

ARCADIS

FIGURE
8

CITY: MPLS DIV/GROUP: 40 DB: MG LD: BE PM: TL
FT. MEADE (GP09MEAD.C000)
Path: Z:\GISPROJECTS_ENV\Fort_Meade\ArcMap\OU4\2014\2014-10\OU4_Bldg2250_SVE_AS_Layout_20141027.mxd

Appendix A

Operable Unit 4 Fact Sheet (on CD)

FACT SHEET

Fort George G. Meade, Maryland

Groundwater Cleanup Remedies at Operable Unit 4 and Lower Patapsco Aquifer

April 2014

Overview

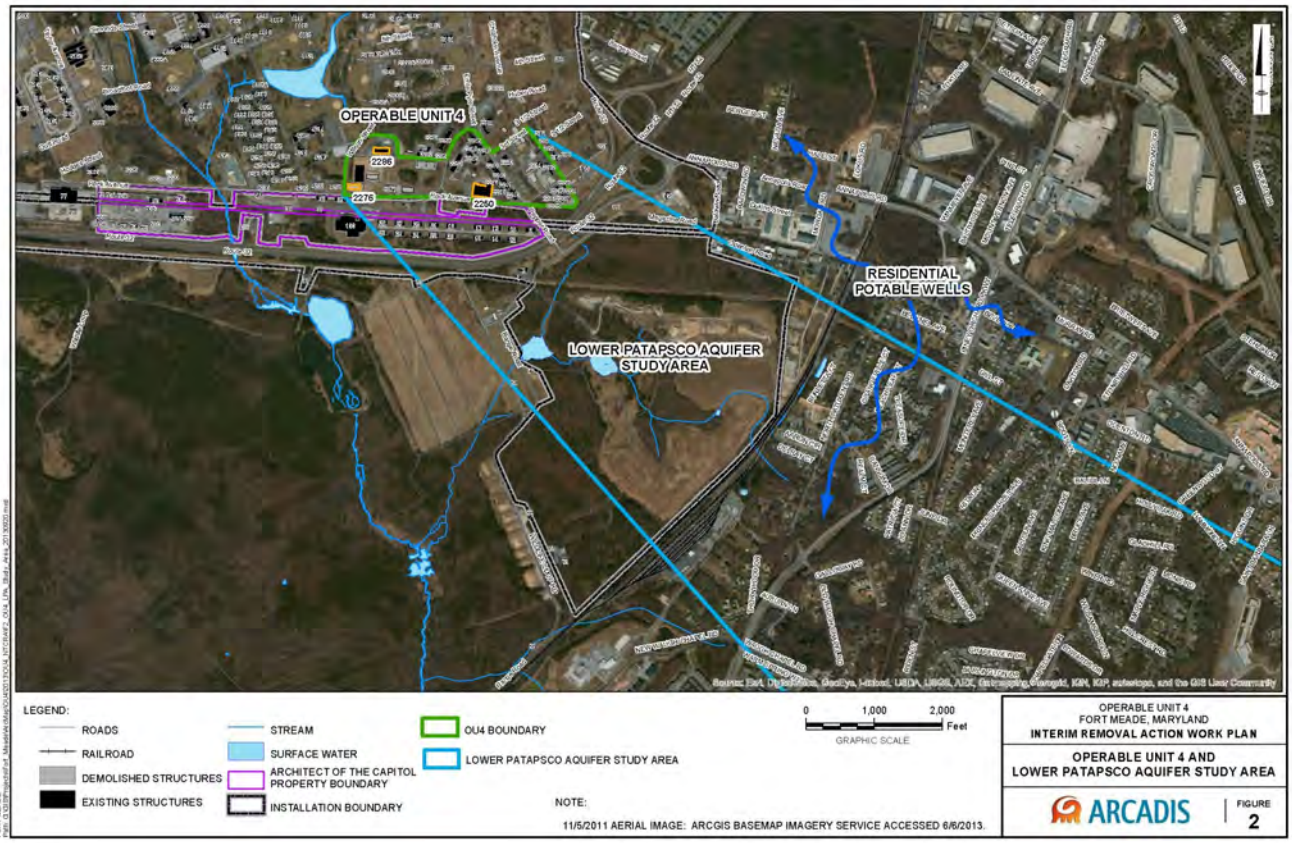
The U.S. Army at Fort George G. Meade recently began installing several groundwater cleanup remedies at a part of the installation designated as Operable Unit 4 and in the Lower Patapsco Aquifer. This fact sheet provides background information on the groundwater investigations in this area and the actions being taken.

Background on Operable Unit 4 Groundwater

The Army, in cooperation with the U.S. Environmental Protection Agency, Maryland Department of the Environment, and Anne Arundel County Department of Health, has been conducting an investigation of groundwater in the southeastern portion of Fort Meade (see map below), an area referred to as Operable Unit 4 or OU4. OU4 is bordered by Chisholm Avenue, Rock Avenue, Wilson Street, and Huber Road.

An area of groundwater in an underground formation, the Lower Patapsco Aquifer, has been impacted by historic activities at Fort Meade. This groundwater migrates several thousand feet beyond Fort Meade toward the town of Odenton, MD. Trichloroethene (TCE), tetrachloroethene (PCE), and carbon tetrachloride (CCl_4) have been detected in this groundwater. These chemicals are industrial solvents used for cleaning and degreasing metals, to dry clean fabrics, and as an ingredient in paint removers, spot removers and pesticides.

Some private off-post wells have been impacted, and the residents notified. While the levels of solvents detected in these wells do not exceed the standard set by EPA, the Army is providing bottled water while investigations continue to residents who use their wells as their drinking water source. Drinking water on Fort Meade is not impacted. **Homes and businesses on public water are not affected by the solvents.**



Army Taking Interim Actions While Comprehensive Studies Continue

In the fall of 2013, the Army released for public comment an Engineering Evaluation/Cost Analysis which proposed taking interim actions at three areas while the comprehensive environmental studies continue. A detailed work plan was then developed and approved which outlined how the actions will be constructed and implemented. Taking action now will address areas considered to be sources of the solvents and help mitigate the contamination in the aquifer. In January 2014, the Army began implementing the actions at the following three areas:

Area 1: Groundwater Near Building 2286 and Former Building 2276. At Area 1, the Army will be injecting an oxidant into the groundwater through a series of injection wells. The oxidant will break down the solvents into less toxic compounds and eventually into water and carbon dioxide. Workers will be wearing protective equipment, such as face masks, when they prepare the oxidant.

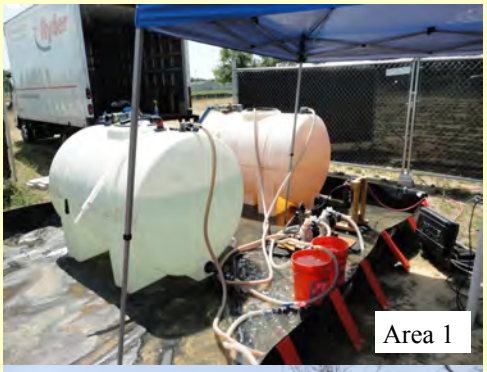
Area 2: Groundwater Near Building 2250. Building 2250 was the location of a former large industrial dry cleaning operation which resulted in high concentrations of PCE in the groundwater. The Army has constructed and is operating an air-sparge and soil vapor extraction system which will remove the solvents.

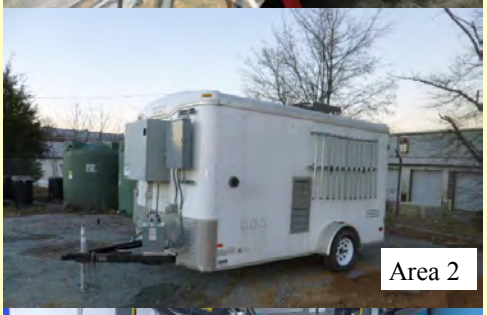
Area 3: Lower Patapsco Aquifer. The Army has installed and is operating a hydraulic containment system which will address the groundwater heading off Fort Meade in a southeasterly direction. The groundwater will be captured, treated, and re-injected as clean water back into the aquifer at 150 feet or deeper.

The Army will be sampling and monitoring the groundwater to ensure the remedies are working effectively.

Final Record of Decision Planned for 2015

Once the Army has completed all the investigations of the Operable Unit 4 area, it will summarize those investigations and any additional actions needed in a Proposed Plan. The Army will hold a 30-day public comment period on the Proposed Plan. The Army and the US Environmental Protection Agency will then sign a Record of Decision documenting the final plan for the site. In addition to ongoing maintenance and inspections, all Records of Decisions





Photos of the treatment systems

Additional Information Available

Fact sheets for TCE, PCE, and CCl_4 are available from the Agency for Toxic Substances and Disease Registry at www.atsdr.cdc.gov/toxfaqs/index.asp. The Anne Arundel County Department of Health can also assist with health questions at 410-222-7398.

Additional project information is available on Fort Meade's Environmental Management System web site at www.ftmeade.army.mil/environment (click on the link for Clean-Up Program and then "Program Sites"). Fort Meade has established an information repository which contains various documents available for the public's review at Anne Arundel County Library, West County Branch, or Fort Meade's Environmental Division (please call 301-677-9559 to make arrangements to review the documents at the Environmental Division office).

This project and other environmental projects are discussed at meetings of Fort Meade's Restoration Advisory Board. These meetings are held approximately every other month, typically the third Thursday at 7 p.m.. Meetings are announced in local papers and on the Fort Meade web site (www.ftmeade.army.mil/environment; click on the link for RAB). Interested community members are always welcome at the meeting and to consider applying to be a Board member.

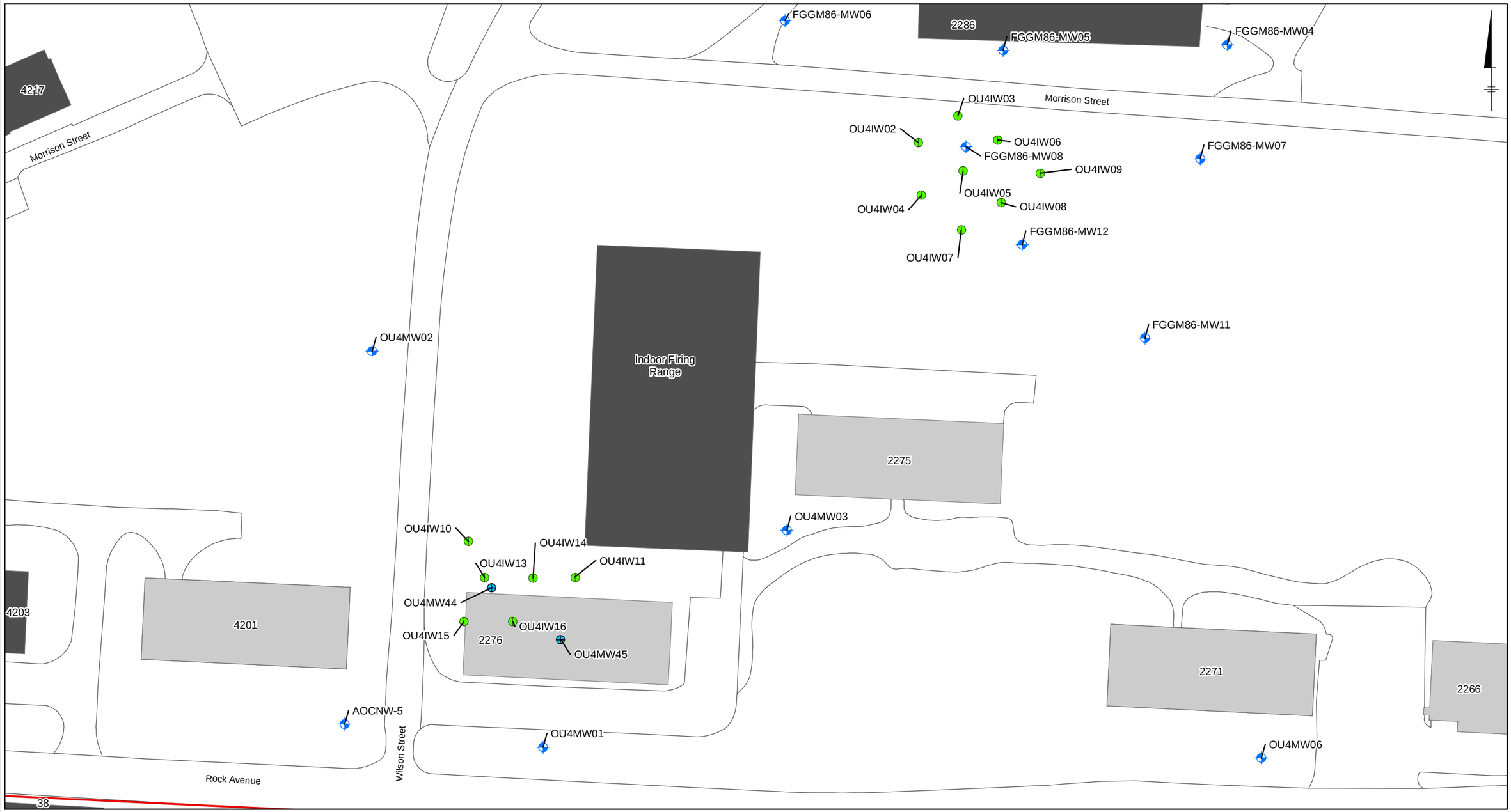
Contact Information

- **Fort Meade Public Affairs Office:** 301-677-1361
- **US Environmental Protection Agency:** John Burchette, Project Manager, 215-814-3378
- **Maryland Department of the Environment:** Lis Green, Project Manager, 410-537-3346 or Public Affairs, 410-537-3003

Appendix B

Injection Consent Letter from MDE (on CD)

Figures



LEGEND:

- MONITORING WELL
- INJECTION WELL
- LPA WELL
- ROADS
- ARCHITECT OF THE CAPITOL (AOC) PROPERTY BOUNDARY
- DEMOLISHED STRUCTURES
- EXISTING STRUCTURES

0 80 160 Feet

GRAPHIC SCALE

OPERABLE UNIT 4
FORT MEADE, MARYLAND
INTERIM REMOVAL ACTION WORK PLAN

BUILDING 2286/2276
SITE PLAN

ARCADIS

FIGURE
1

CITY: MPLS DIVGROUP: 40 DB: MG LD: BE PM: TL
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Appendix C

Utility Strike Report (on CD)

Appendix D

Building 2276/2286 Field Forms (on CD)

D1 Soil Boring, Well Construction, Development Logs, State of Maryland Well Permits

D2 Pilot Study Field Forms

D3 Full-Scale Injection Logs

Appendix G

Building 2250 Surface Discharge Letters (on CD)

G1 Surface Discharge of Treated Water Collected in the Air Sparge/Soil Vapor Extraction System – Building 2250 Letter

G2 Surface Discharge of Treated Water Collected in the Air Sparge/Soil Vapor Extraction System – MDE Approval Letter

Appendix H

Investigation Derived Waste
Manifest (on CD)

Appendix I

Operation and Maintenance Manual (on CD)

ARCADIS

Infrastructure · Water · Environment · Buildings

Imagine the result

Fort Meade AS/SVE Remedial System Operation and Maintenance Manual

Christopher Spooner, P.E.
Senior Engineer, MD44234

John Cherry
Phase Manager

Tim Llewellyn
Project Manager

AS/SVE Remedial System Operation and Maintenance Manual
Fort Meade, MD

Prepared for:
US Army

Prepared by:
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Tel 410 987 0032
Fax 410 987 4392

Our Ref.:
GP09MEADE.OU41

Date:
November 2014

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2.1.4 Pressure Regulator 3

2.1.5 Header 3

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2.1.8 Temperature Gauges 4

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Figure 2 Building 2250 Air Sparge and Vapor Extraction Well Details

Figure 3 Air Sparge/Soil Vapor Extraction Trenching Cross Section

Figure 4 Air Sparge/Soil Vapor Extraction System Manifold Connection Details

Appendices

A H2K O&M Document, Process and Instrumentation Diagram and Equipment Cut Sheets

B O&M Checklist

1. Introduction

ARCADIS has prepared this Air Sparge and Soil Vapor Extraction System Operation and Maintenance Manual (AS/SVE O&M Manual) to meet the requirements of the performance contract issued by the United States (U.S.) Army Contracting Agency, Contract W91ZLK-05-D-0015. This AS/SVE O&M Plan documents the AS/SVE system requirements and procedures for operation and maintenance. This AS/SVE O&M Manual also specifies the field documentation and quality assurance/ quality control requirements for the performance monitoring program.

The AS/SVE treatment system is comprised of one trailer for extraction of soil vapors and injection of air. The system was constructed to operate year-round and is designed to treat groundwater impacted with chlorinated solvents.

2. System Components

The layout of system components for the system trailer is provided in a stand-alone O&M manual provided by H2K Technologies of Corcoran, MN (equipment vendor) (**see Appendix A**). Manufacturer's specifications, instruction sheets and process and instrumentation diagrams are also included in **Appendix A**. The following text provides short summaries of the main components of the system, including common problems, preventative maintenance, and necessary information for proper operation of the system.

2.1 Air Sparge System

The compressed air system consists of a pressure blower, ambient heat exchanger, and associated filtration devices. The system was designed to provide capacity for the current configuration of 11 air sparge wells operating in 3 separate zones (**Figure 1**). The system is designed to provide 46 standard cubic feet per minute (scfm) at pressures up to 15 pounds per square inch (psi). **Figure 2** provides details illustrating the construction of a wellhead completion. The AS/SVE Trench cross section is provided as **Figure 3**. The AS/SVE system manifold connection details are displayed on **Figure 4.**

The air sparge conveyance piping consists of individual 1-inch pipes to each air sparge well. The air sparge piping is buried approximately 24-30 inches below ground surface. All flow controls are located inside the equipment trailer. Pressure gauges are present on both the air line inside the trailer and at each well head.

2.1.1 Pressure Blower

The pressure blower is a 7.5-horsepower (hp) Gast Model 6606-P104, a rotary vane compressor (B-100) with cast iron housing and carbide vane construction.

Physical inspection and maintenance of the blower is required every two weeks and includes checking the oil level, belt tension, air filter condition, and conducting any additional scheduled maintenance. Each of these items is indicated on the O&M checklist included in **Appendix A.** Long term maintenance procedures and a maintenance schedule for the blower are provided in the blower manual in **Appendix A**.

2.1.2 Heat Exchanger

The heat exchanger is located on top of the building and acts using ambient air. It is a copper tube aluminum finned passive element.

2.1.3 Filtration

Air filtration on the system is used to remove particulate matter that may be in the airstream. The filter element is located within the housing and is easily replaceable. Replacement of the filter is recommended every 3 months, upon visual inspection of the filter element.

2.1.4 Pressure Regulator

The pressure regulator is used to reduce the pressure delivered from the compressor to a usable value. The downstream pressure requirement is estimated between 15-18 psi for the required air flow rates in each sparge zone. Therefore the pressure regulator should be set at approximately 20 psi.

2.1.5 Header

The distribution header incorporates a steel pipe manifold to divide the wells into three zones (1 through 3). The main airline leads to three solenoid valves – each one located on the galvanized steel piping run. The solenoids are operated on a timed basis to send air to a specified zone for a specified amount of time. The timers are located inside the main control panel. After each zone is energized, a rest timer is also available to pause the system before air is delivered to the next zone. Zone sequencing can also be changed for future modifications to the system but, at this time, should progress in order from 1 to 3 for to maximize treatment efficiency of the system and prevent creating preferential flow paths. Rest timers can also be used to reduce the overall operating time per day.

2.1.6 Flow Meters

Individual flow meters located on the separate zone manifolds are variable area flow meters. The flow meters are Rotameter flow meters with scales of 2-20 scfm (FE-201). The pressure at these flow meters calls for a correction to scfm from direct read flow rates (direct read cfm). Because the direct-read flow meters read the actual flow rate in

cfm, the flow meter value needs to be corrected for the compressed air pressure. The following formula will convert direct read cfm to scfm:

$$Q_{scfm} = Q_{acfm} * \sqrt{\frac{P}{14.7}}$$

Where:

Q_{scfm} = Flow rate corrected to standard pressure (scfm)

Q_{acfm} = Flow rate as read at flow meter (cfm)

P = Pressure immediately after the flow meter (psi)

Fine-grained sands or silt can accumulate between the float and guide, causing the flow meter to fail to operate properly. This problem is easily fixed by disassembling the unit and cleaning off the guides. Unions are provided on either end of the flow meters for easy removal for cleaning or replacement.

2.1.7 Pressure Gauges

Pressure gauges are located in line after the compressor and on each individual flow meter. Pressure gauges on the flow meters should be used in converting the flow as measured in the flow meter (cfm) to flow at standard pressure (scfm).

2.1.8 Temperature Gauges

Two temperature gauges (TI-100 and TI 101) are installed to monitor the operation of the compressor and the ambient air heat exchanger (**Appendix A**). TI-100 is located on the airline downstream of the compressor, and TI-101 is located downstream of the ambient heat exchanger. These serve as checks for the effluent air temperature and should not exceed 120 degrees Fahrenheit. An abnormal rise in temperature at this location signifies that the compressor needs maintenance. Common problems causing an increase in effluent air temperature include a low oil level, a blocked air inlet or cooling air pathway, or inadequate ventilation in the air sparge room.

2.1.9 Heating and Ventilation

An explosion proof ventilation fan with inlet and outlet louvers and a thermostat was provided to keep the air sparge side of the trailer cool in the summer, as well as an

electrical heater for the winter. The ventilation fan is located on the wall inside the system trailer. The ventilation fan evacuates air from the trailer, and a floor grate is provided for ambient air entry into the trailer. The system thermostat should be set at approximately 85 degrees Fahrenheit. The room temperature is read by a thermocouple providing a 4 to 20 milli-Amperes (mA) signal.

The trailer has a heater and a thermocouple. The thermocouple should be set to operate the heater when the room temperature goes below approximately 45 degrees Fahrenheit.

2.2 SVE System

2.2.1 Flow Meters

A Dwyer DS-300 pitot tube with differential pressure gauge and look-up chart is provided for the SVE system.

The formula for conversion of inches of water to CFM is given below. A conversion chart is provided in **Appendix A**. The equation for calculating flow is below.

$$Q\ (CFM) = 128.8\ x\ K\ x\ D^2\ x\ \sqrt{\frac{P\ x\ \Delta P}{(T+460) x\ Ss}}$$

Where:

ΔP=Differential pressure expressed in inches of water column
Q=Flow expressed in CFM
K=Flow coefficient
D=Inside diameter of line size expressed in inches
P=Static Line pressure (psia)
T=Temperature in degrees Fahrenheit (plus 460= °Rankine)
p=Density of medium in pounds per square foot
S_s=Sp Gr at 60 °F (15.6 °C)

The blower effluent (TI-100) airstream temperature is monitored with direct-reading temperature gauges mounted in the system piping. The temperature gauge is located on the exhaust line inside the trailer, and requires manual reading during system visits. The effluent line also has a temperature switch and a high temperature alarm. The temperature should be no more than 160 degrees Fahrenheit.

2.2.2 Pressure Gauges and Switches

Three pressure gauges are located on the SVE influent line (PI-100, PI-103 and PI-104). Pressure switch (PS-100) is located at the influent to the trailer, and will shut the system down if SVE influent vacuum falls below approximately 20-inches of water.

2.2.3 Filtration

The system is equipped with a 1.5 inch in-line air filter. The in-line filter is located between the blower and knockout tank to prevent particulate matter from entering and damaging the blower. The filters are designed to capture particles having a diameter greater than 10 microns. These filters should be checked quarterly to be certain that air flow is not impaired.

2.2.4 Blower

A 3-hp Roots URAI model 33 blower (B-200) (Model 3BA1600) is used to apply a vacuum in the vadose zone. The blower is capable of providing 110 icfm flow at 125 inches of water column.

2.2.5 Heating and Ventilation

An explosion proof fan with inlet and outlet louvers and a thermostat was provided to keep the trailer cool in the summer, as well as an electrical heater for the winter. The system thermostat should be set at approximately 85 degrees Fahrenheit. The room temperature is read by a thermocouple providing a 4 to 20 milli-Amperes (mA) signal.

The trailer has a heater and a thermocouple providing a 4 to 20 milli-Amperes (mA) signal. The thermocouple should be set to operate the heater when the room temperature goes below approximately 45 degrees Fahrenheit.

2.2.6 Moisture Separator Auto-Pump Out

Due to significant amount of water recovery, an auto pump out system was installed on the SVE moisture separator. This system is not shown on the PID in **Appendix A**, but is included in **Appendix B** along with equipment specifications for the system. A 55-gallon granular activated carbon vessel is used as polishing step for water from the SVE system moisture separator. The treated water is discharged to the ground surface in an area located adjacent to the system trailer.

The float switches for the moisture separator control the auto pump out switch. There is a normally open low level switch which will turn the pump on and off. When water is collected in the moisture separator, the float switch, when activated, will turn the pump on. The pump will turn off when the float falls.

2.3 Controls

2.3.1 Electrical Components

All electrical components inside the SVE portion of the system trailer are Class 1, Division 2, Group D rated with exterior considered non-classified beyond 3' from any opening per National Electrical Code (NEC) article 500 table 515. An emergency stop button is provided inside the SVE portion of the trailer near the entrance.

2.3.2 Control Panel

The control panel is equipped with two-position switches (hand/off/auto) for the operation of the system blower, and air sparge controls. The switches should be in the auto position during normal operation. The system should be operated in hand mode only for troubleshooting or inspection of the system. The control panel is controlled by relay logic. The panel wiring diagrams are included in **Appendix A**. The system is programmed to shut the SVE system down for alarm conditions including a high moisture separator water level, low vacuum and high temperature. The system is also programmed to shut the AS system down for high pressure conditions. The air sparging system is designed with a fail-safe that only allows it to operate when the SVE system is also operating to prevent migration of vapors.

2.3.3 Shutdown Notification

The system is equipped to call designated phone numbers when an alarm condition is initiated.

The high water-level alarm is caused by the collection of water in the SVE moisture separator (SEP100). The SVE moisture separator operates with an automatic drain system. When this alarm is triggered the system will shut down to prevent water from spilling out of the liquid storage reservoirs.

A broken pipe, severed or worn tubing, or blockage of a pipe or air filter can cause the low vacuum alarm to engage. The low vacuum alarm is equipped with a 10-second time delay. The delay is necessary to allow the vacuum blower enough time to build

vacuum in the lines during start-up prior to engaging the vacuum alarm. The low vacuum alarm is only enabled when the SVE blower is in the “Auto” position, and a run signal is generated by the auxiliary contact on the blower motor starter. The vacuum switch is located on the main header entering the building before the moisture separator.

3. Operations & Maintenance and System Performance Monitoring

To ensure optimal operation of the AS and SVE system regular O&M and performance monitoring will be completed on the remediation system during its operation. The O&M, equipment maintenance, and performance monitoring schedule for the system is presented in **Appendix A**.

A log sheet will be filled out completely during each O&M visit to the site. O&M will be completed weekly, or as necessary based on system performance. The following activities will be conducted and recorded during each O&M event.

3.1 Air Sparge System O&M

3.1.1 Flow Rates

The flow rate from each air sparge well will be recorded by a direct reading of the FE-201 Rotameter flow meters. During each visit, the valves will be adjusted so that all wells have targeted flow rates. Targeted flow rates are between 5-10 scfm. However, due to the geology, these target flow rates may not be achievable at all wells. The flow rate to each AS well should be maximized without exceeding the set injection pressures. The flow rate is adjusted by turning the valve on each vertical flow meter.

The total flow rate for the AS system will be recorded on the appropriate field log.

3.1.2 Gauge Readings

Pressure and temperature readings will be collected at specific locations. Temperature gauges are permanently affixed to system piping.

- Pressure - Standard pressure readings will be recorded at the air compressor, after the silencer and at each individual airline flowmeter.
- Temperature - Temperature will be monitored on the main line after the blower and after the ambient heat exchanger. The temperature will be monitored by a direct reading of temperature gauges mounted in system piping.

3.1.3 Pressure Blower Inspection

Pressure blower (B-100) inspections should be completed every visit. Compressor inspections should consist of oil level readings, air filter inspection, belt tension adjustment, and compressor hour records.

3.1.4 Amperage Readings

Collection of amperage readings on the air compressor can be collected to monitor the performance of the equipment. Routine monitoring of amperage readings is not required, and only needs to be done when troubleshooting operation of the equipment should a fault occur.

3.2 Soil-Vapor Extraction System O&M

3.2.1 Flow Rates

The air flow rate of the influent should be measured from the Dwyer pitot tube flow meter. The make-up air flow rate (FI-300) on the SVE system, if any, will be recorded. The make-up air flow rate should be set to reach a target vacuum level of 35-40 inches of water prior to the knockout tank (SP-001A/B).

3.2.2 Gauge Readings

Vacuum, pressure, and temperature readings will be collected at specific locations. Temperature gauges are permanently affixed to system piping. Vacuum readings can be obtained using a magnehelic gauge attached to sample ports located throughout the system piping.

- Vacuum - Vacuum measurements in the SVE well will be collected using the sample port (¼-inch ball valves) located on the line. Vacuum measurements will also be collected downstream of the SVE blower (B-100).
- Temperature - The blower effluent temperature will be monitored by a direct reading of temperature gauges mounted in system piping.

3.2.3 Amperage Readings

Collection of amperage readings on the SVE blower motor can be collected to monitor the performance of the equipment. Routine monitoring of amperage readings is not

required, and only needs to be done when troubleshooting operation of the equipment should a fault occur.

3.3 System Operation Field Set Points

Item	ID	Value	Units
Equipment Trailer			
Exhaust Fan Thermostat	Wall	85	°F
Heater Thermostat	Wall	45	°F
Soil Vapor Extraction			
SVE Line Flow rate	Header	70-90	cfm, direct read
SVE Line Vacuum	SP	30-40	" H_2O
Vacuum at Air Water Seperator Tank	PI-103	<15	" H_2O
Vacuum Low Alarm Set Point*	Pressure Switch	20	" H_2O
Blower Effluent Temperature*	TI-100	150	°F
Air Sparge			
Temperature After Blower	TI-100	120	°F
Regulator Pressure Set Point*	---	20	PSI
Timer Drain (on time)	---	3	seconds
Timer Drain (off time)	---	25	minutes
Zone Operation Time	HMI Screen	40	minutes
Zone Stop Time	HMI Screen	3	minutes
Compressor Total Flow	HMI Screen	<46	scfm
Individual Air Line Flow Rate	---	0-10	cfm, direct read
Individual Air Line Pressure	---	0-18	PSI

*Indicates alarm condition that will result in phone notification.

3.4 O&M Reporting

Following each O&M event, O&M personnel shall send completed, scanned copies of the O&M forms to representatives at ARCADIS U.S. Inc. The O&M data will be reviewed and filed.

3.5 System Air Samples

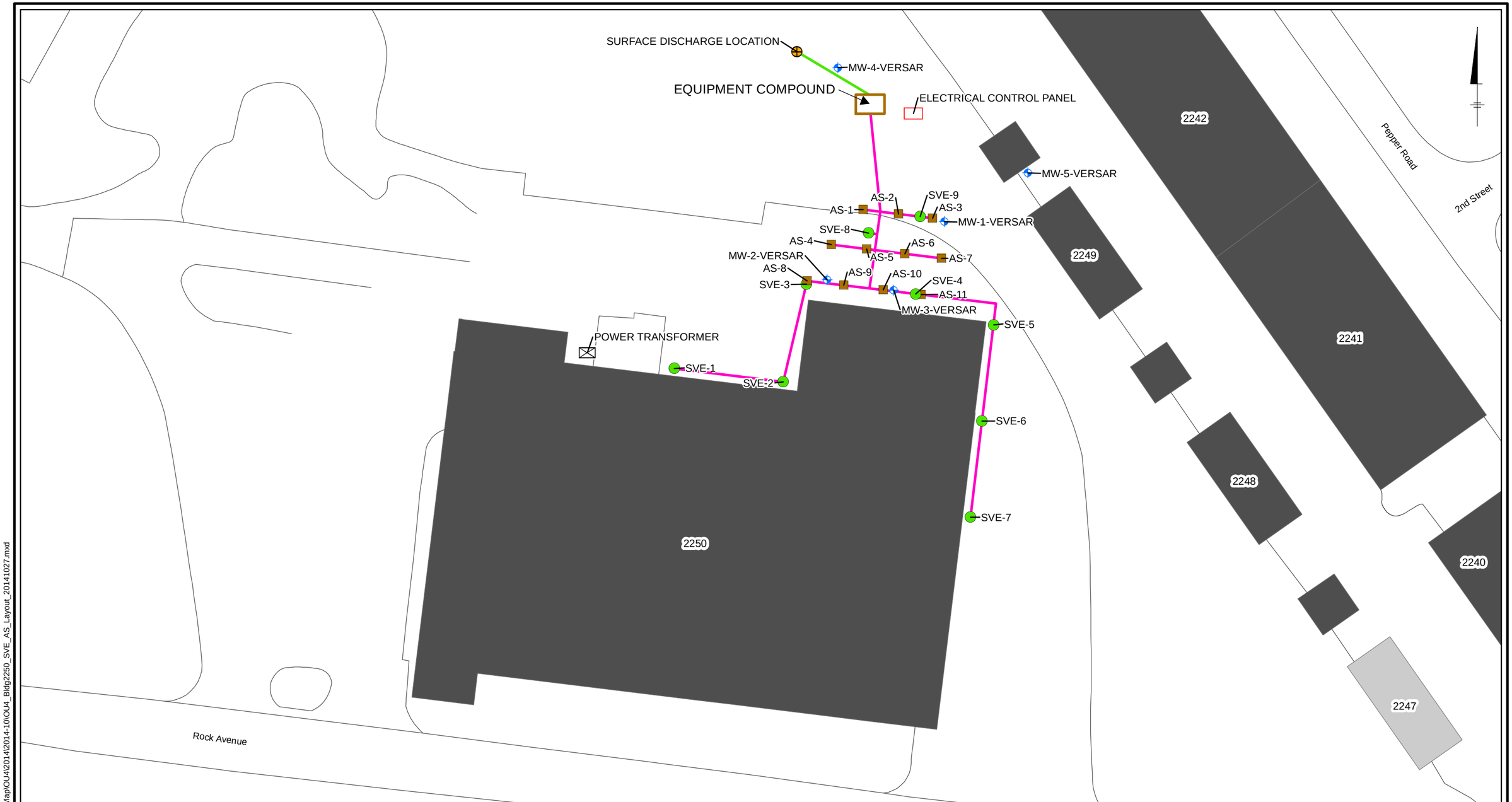
System air samples will be collected from the effluent air stream line. A single air sample shall be collected quarterly to monitor exhaust air from the system. Samples will be collected in a summa canister and sent to ALS Environmental in Simi Valley, California for analysis of VOCs via EPA method TO-15 using GC/MS full scan.

4. Contacts and Project Communication

The following communications should be completed by field staff completing O&M should an emergency, operation issues, or questions arise during field events:

Project Manager	Tim Llewellyn	410-987-0032
Phase Manager	John Cherry	410-923-7763
Task Manager	Keith Shepherd	410-987-0032
Engineering/O&M	Christopher Spooner	703-465-4225
Installation Contact	Denise Tegtmeyer	301-677-9559

Figures



LEGEND:

- SOIL VAPOR EXTRACTION (SVE) WELL
- AIR SPARGE (AS) WELL
- MONITORING WELL (MW)
- SURFACE DISCHARGE LOCATION
- SUBSURFACE PIPING
- ABOVE SURFACE PIPING
- ROAD/CURB
- DEMOLISHED STRUCTURES
- EXISTING STRUCTURES
- 2250 - BUILDING NUMBER
- ELECTRICAL CONTROL PANEL
- POWER TRANSFORMER

0 50 100 Feet
GRAPHIC SCALE

NOTE:
1. THE LOCATION AND EXTENT OF SITE FEATURES PRESENTED HEREON ARE APPROXIMATE.

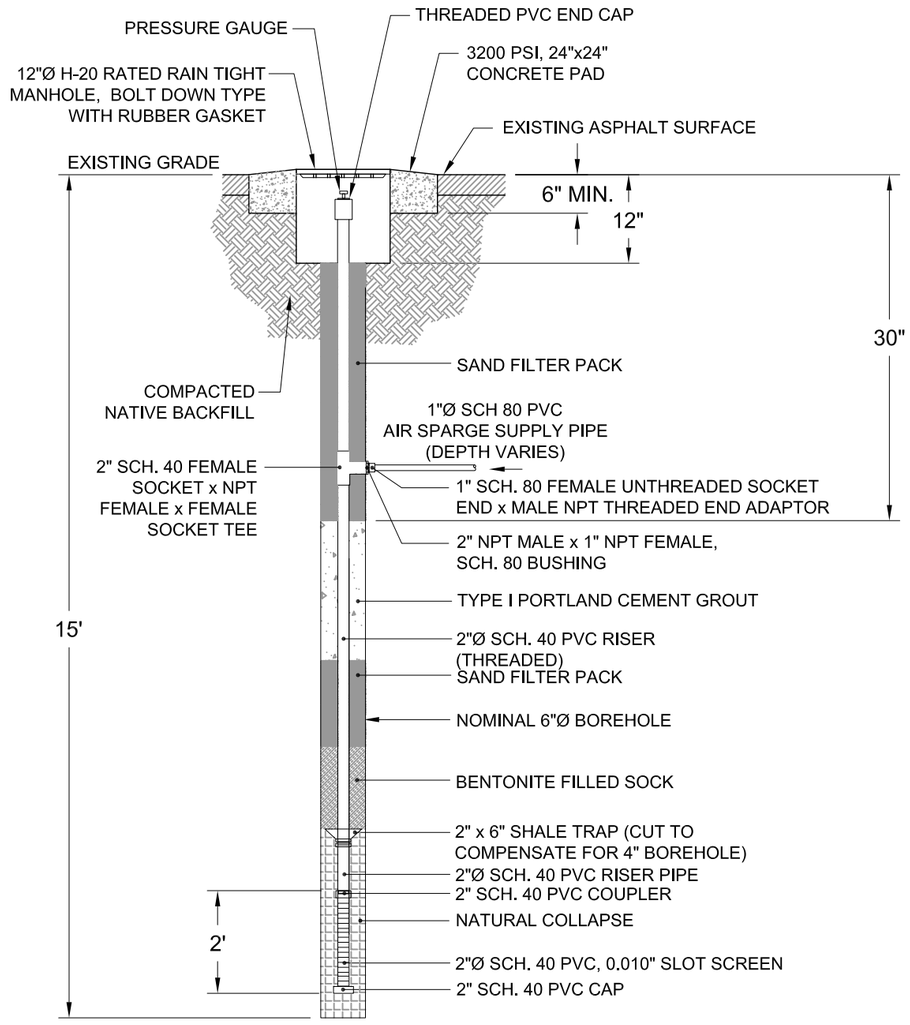
OPERABLE UNIT 4, LOWER PATAPSCO AQUIFER STUDY AREA
FORT MEADE, MARYLAND

BUILDING 2250 AIR SPARGE/SOIL VAPOR EXTRACTION SYSTEM LAYOUT

ARCADIS

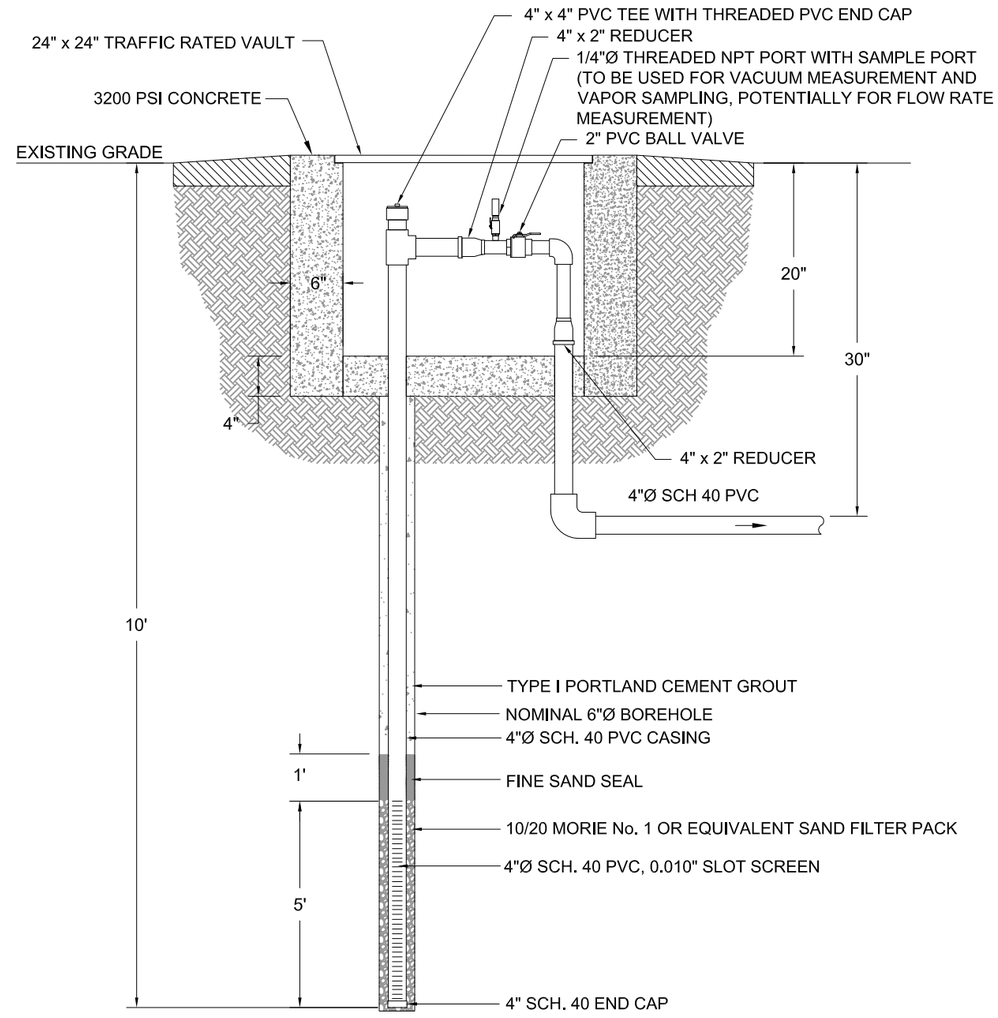
FIGURE
1

CITY: MPLS DIV/GROUP: 40 DB: MG LD: BE PM: TL
FT. MEADE (GP09MEAD.C000)
Path: Z:\GISPROJECTS_ENV\Fort_Meade\ArcMap\OU4\2014\2014-10\OU4_Bldg2250_SVE_AS_Layout_20141027.mxd



AIR SPARGE WELL (TYP. OF 11)

NOT TO SCALE



SOIL VAPOR EXTRACTION WELL (TYP. OF 9)

NOT TO SCALE

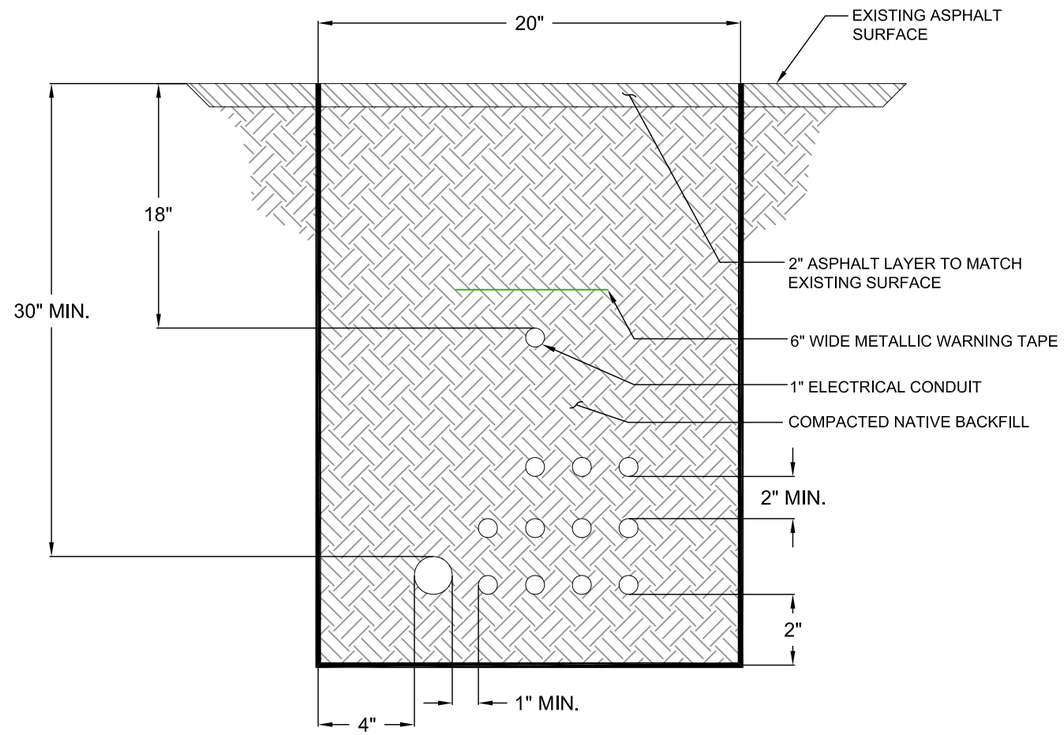
OPERABLE UNIT 4
FORT GEORGE G. MEADE. MARYLAND

BUILDING 2250
AIR SPARGE AND VAPOR EXTRACTION WELL DETAILS

ARCADIS

FIGURE
2

CITY:Tampa DIV/GROUP:ENVSER /1 DB:M. Vives LD:M. Vives PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\PROJECTS\Fort Meade\CADD\GP09MEAD_OU41_GC001_RAPMOD.dwg LAYOUT: 19 SAVED: 9/11/2013 11:36 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: BLACKGRAY-THIN.CTB PLOTTED: 9/11/2013 11:39 AM BY: OBERLANDER, ROSEANNE



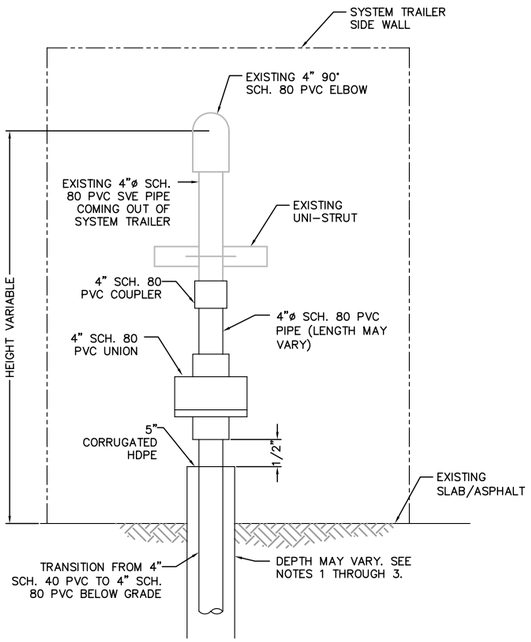
OPERABLE UNIT 4
FORT GEORGE G. MEADE. MARYLAND

AIR SPARGE/SOIL VAPOR EXTRACTION TRENCHING CROSS SECTION

ARCADIS

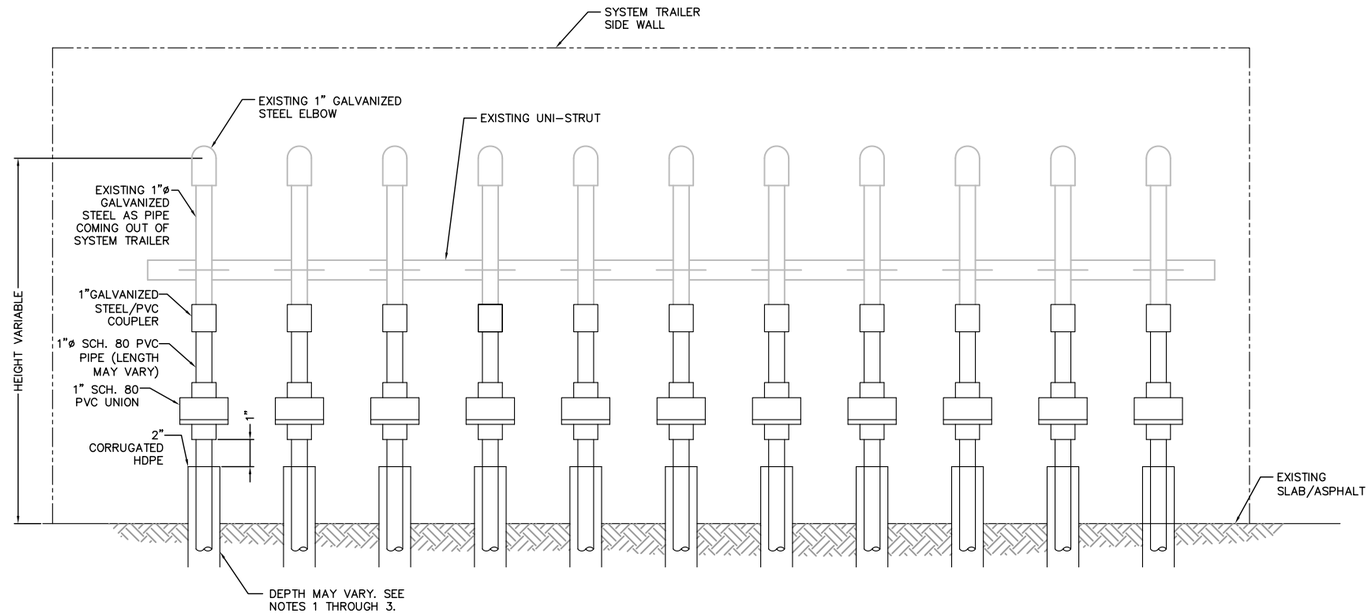
FIGURE
3

CITY:Tampa DIV/GROUP:ENVSER /1 DB:M. Vives LD:M. Vives PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\PROJECTS\Fort Meade\CADD\GP09MEAD_OU41_GC001_RAPMOD.dwg LAYOUT: 20 SAVED: 9/11/2013 11:40 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: BLACKGRAY-THIN.CTB PLOTTED: 9/11/2013 11:40 AM BY: OBERLANDER, ROSEANNE



SVE ABOVEGROUND PIPING CONNECTION DETAIL

NOT TO SCALE



AS ABOVEGROUND PIPING CONNECTION DETAIL

NOT TO SCALE

OPERABLE UNIT 4
FORT GEORGE G. MEADE, MARYLAND

AIR SPARGE/SOIL VAPOR EXTRACTION MANIFOLD CONNECTION DETAILS

ARCADIS

FIGURE
4

CITY:Tampa DIV/GROUP:ENV-SER /1 DB:M. Vives LD:M. Vives PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\PROJECTS\Fort Meade\CADD\GP09MEAD_OU41_GC001_RAPMOD.dwg LAYOUT: 21 SAVED: 9/11/2013 11:40 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: BLACKGRAY-THIN.CTB PLOTTED: 9/11/2013 11:41 AM BY: OBERLANDER, ROSEANNE

Appendix A

H2K O&M Document, Process and Instrumentation Diagram and Equipment Cut Sheets

Appendix B

O&M Checklist

Table 1
Table of Routine Maintenance Activities for Air Sparge/Soil Vapor Extraction System
Fort Meade, Maryland

Task	Completed (Date/Initials)	Note
Every Visit		
Check for leaks from pipes and fittings. Repair and replace as necessary		
Record flow rates and pressure at individual AS/SVE wells. Record temperature, vacuum and pressure at gauges on lines.		
LGAC Filters: 1. Inspect for leaks. 2. Confirm differential pressure is not elevated, if elevated, backwash carbon vessels as described in equipment manual. 3. Check for trapped air by opening upper vent valve and allowing a small amount of liquid to flow out. 4. Inspect discharge stream, if carbon is present in discharge stream shut down the system and contact the system Engineer.		
Pressure Blower Inspection (B-100): Inspect and record oil level Inspect air filter Adjust belt tension Record hour readings		
Vaccum Blower Inspection (B-200): Inspect and record oil level Inspect air filter Adjust belt tension Record hour readings		
Moisture Separator Pump: 1. Inspect for leaks. 2. Confirm inlet pressure is below Engineers recommendation		
Weekly		
Vacuum Blower (B-200): Check oil by opening lower side plug to see if there is enough oil. Grease blower bearings with NLGI #2.		
Monthly		
Vacuum Blower (B-200): Change oil (non-detergent SAE 40 oil or equivalent synthetic) after first 1000 hours, monthly thereafter. Check belt tension and wear.		
Pressure and Vacuum Blowers (B-100 and 200): The inlet air filters should be check monthly and cleaned as necessary.		
Quarterly		
Solenoid and Motorized Valves: Inspect and confirm correct operation.		
Flow Meters: Confirm are clear and free of debris, remove and flush as necessary.		
Level Switches: Confirm there is no solids build up and floats can move freely. Confirm that activated alarms function when switched.		
Semi-Annually		
Pressure Blower (B-100): Inspect vane for wear according to pressure blower operation sheet.		
Annually		
Pressure Blower (B-100): Grease motor with NLGI #2. Disassemble and inspect impeller housing.		
Vaccum Blower: Grease motor with NLGI #2.		

Table 1
Table of Routine Maintenance Activities for Air Sparge/Soil Vapor Extraction System
Fort Meade, Maryland

Task	Completed (Date/Initials)	Note
As Needed		
Moisture Separator: Clean and replace inlet filter and demister when differential pressure across filter exceeds 15" H_2O. Clean sump, site glass, pump down switch.		
Pressure Blower (B-100): Clean/replace inlet filters (depending on air quality condition, minimum recommended frequency - monthly). Flush compressor (necessary if changing filter does not improve performance).		
Safety Equipment Checklist		
* Please check the following safety equipment's onsite if available.		
- Eye wash expired (Y / N) _____		
- Fire extinguishers Monthly inspection complete & tag initialed? (Y/ B)		
Last yearly inspection? _____		
- First aid kit expired (Y / N)		

ARCADIS
Infrastructure, buildings, environment, communications

Table 2
MULTIPLE WELL MEASUREMENTS

Date:

Well No.	Time	DTW	Vacuum	DO	Remarks
MW-1-Versar					
MW-1-Versar					
MW-1-Versar					
MW-1-Versar					
MW-2-Versar					
MW-2-Versar					
MW-2-Versar					
MW-2-Versar					
MW-3-Versar					
MW-3-Versar					
MW-3-Versar					
MW-3-Versar					
MW-4-Versar					
MW-4-Versar					
MW-4-Versar					
MW-4-Versar					

Notes:

Table 3
Operation and Maintenance Field Sheet
Building 2250
Fort George G. Meade, MD

Date _____ **Personnel** _____

System Operation (On/Off)	VES	AS
On Arrival		
On Deparature		

VES Blower

Operating Hours _____ Hrs
Vacuum _____ "H_2O
Air flow _____ "scfm"
Discharge Temp _____ ^oF

Moisture Separator

Water level _____ inches
Emptied ☐ Yes ☐ No
Fresh Air Bleed Valve _____ % Open
_____
_____

AS Compressor

Operating Hours _____ Hrs
Pressure _____ psi
Air flow _____ "scfm"
Discharge Temp _____ ^oF
Pre-Heat Exchanger Temp _____ ^oF
Electric Meter Reading _____ hours

Auto-Pump Out

Discharge Total: _____ gallons

Comments: _____

Sampling: Air (EPA-TO-15), Discharge Water (8260B)

Well ID	**Airflow (cfm)**	**Pressure/Vacuum (psi)/("H_2O)**	**Comments**	
SVE-1	--			
SVE-2	--			
SVE-3	--			
SVE-4	--			
SVE-5	--			
SVE-6	--			
SVE-7	--			
SVE-8	--			
SVE-9	--			
AS-1				
AS-2				
AS-3				
AS-4				
AS-5				
AS-6				
AS-7				
AS-8				
AS-9				
AS-10				
AS-11				

PID/OVA Readings

Location	Unfiltered	Filtered	Net	Sample Date/Time
TOTAL Effluent				

Building 2250 Emissions
Project#:
2/12/2014

	Day 1
Total Air Flow (SCFM)	
Total Vacum (in H2O)	
TOTAL System Emissions (lbs/day)	
Zone 1 System Emissions (lbs/day)	
Zone 2 System Emissions (lbs/day)	

EMISSIONS RATE CALCULATION:

lb/day VOC = (Conc.) X (Mass Conversion) X (Flowrate) X (Flowrate Conversion)

lb/day VOC = (conc.)(1g/1000mg)(1lb/453g)(1m^3/35.3 ft^3)(flowrate)(60min/hr)(24hr/day)

Appendix J

Photo Log (on CD)

Interim Removal Action Report for OU-4 Areas of Concern 1 and 2 (Buildings 2286/2276 and Building 2250)

Operable Unit 4
Fort George G. Meade, Maryland

Photo 1: Soil core recovery at AS-2.
Date: August 26, 2013
Location Taken: AS-2.
Direction Facing: **Southwest**

Photo 2: Air Sparge well construction.
Date: August 19, 2013
Location Taken: AS-4.
Direction Facing: Southeast

Photo 3: Trench and piping install for AS/SVE system.

Date: November 7, 2014

Location Taken: North of Building 2250.

Direction Facing: Southeast

Photo 4: Trench for pipe network for the AS/SVE system.

Date: November 7, 2013

Location Taken: North side of Building 2250.

Direction Facing: North

Photo 5: Drilling activities for the installation of AS-9.
Date: March 24, 2014
Location Taken: AS-9.
Direction Facing: West

Photo 6: Work area following trench backfill.
Date: April 4, 2014
Location Taken: Near entrance gate.
Direction Facing: Southeast

Photo 7: AS/SVE system trailer.
Date: December 3, 2013
Location Taken: North of Building 2250.
Direction Facing: Northeast

Photo 8: Back of Building 2250 following site restoration (asphalt repairs).
Date: April 7, 2014
Location Taken: North of Building 2250.
Direction Facing: West

Photo 9: Set up for ISCO pilot study.
Date: June 20, 2013
Location Taken: OU4IW-13
Direction Facing: Southeast

Photo 10: Split spoons collected at OU4IW-02.
Date: November 4, 2013
Location Taken: OU4IW-02
Direction Facing: N/A

Photo 11: Drilling activities at OU4IW-07.
Date: November 11, 2013
Location Taken: OU4IW-07.
Direction Facing: Southeast

Photo 12: Completed well OU4IW-05.
Date: November 7, 2013
Location Taken: OU4IW-05.
Direction Facing: North

Photo 13: Set up for full-scale ISCO injections at AOC 1.

Date: May 27, 2014

Location Taken: Adjacent to 2286 well network.

Direction Facing: Southeast

Photo 14: ISCO delivery manifold or injections at Building 2286 well network.

Date: June 2, 2014

Location Taken: Building 2286 well network.

Direction Facing: East

Photo 16: Well head during ISCO injections at OU4IW-16.
Date: May 22, 2014
Location Taken: OU4IW-16
Direction Facing: West

Photo 15: Concrete pad utilized for ISCO injections following power washing activities.
Date: June 11, 2014
Location Taken: Adjacent to 2286 well network.
Direction Facing: South