FINAL
DECISION DOCUMENT
SOLID WASTE MANAGEMENT UNIT M-41
ENGINEER PROVING GROUND
AT FORT BELVOIR, VIRGINIA

Prepared for:

U.S. Army Environmental Command

Contract No. W91ZLK-05-D-0010
Task Order 0001

March 2010

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Prepared by:

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LIST OF ACRONYMS AND ABBREVIATIONS

amsl	above mean sea level
ANL	Argonne National Laboratory
AOPC	Area of Potential Concern
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act ("Superfund")
CFR	Code of Federal Regulations
COC	contaminant of concern
CY	cubic yard
EBS	Environmental Baseline Study
EPG	Engineer Proving Ground
FFS	Focused Feasibility Study
HI	hazard index
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
ISR	Investigation Summary Report
LUC	land use control
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priority List
O&M	operation and maintenance
PCB	polychlorinated biphenyl
RAO	remedial action objective
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RSL	regional screening level
SARA	Superfund Amendments and Reauthorization Act
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit

TOC	total organic carbon
TOX	total organic halides
TPH	total petroleum hydrocarbon
UAO	Unilateral Administrative Order
µg/dL	micrograms per deciliter
µg/L	micrograms per liter
USEPA	United States Environmental Protection Agency
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound

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1.0 DECLARATION

1.1 SITE NAME AND LOCATION

Solid Waste Management Unit (SWMU) M-41 (FTBL-65) is located on Engineer Proving Ground (EPG), Fort Belvoir, Virginia. The U.S. Army Garrison at Fort Belvoir includes the Main Post and EPG. EPG is an 820-acre tract of land 1.5 miles northwest of the Main Post (Figure 1). SWMU M-41 is located on the western portion of EPG near Range 1 (Figure 2).

EPG is currently called the Fort Belvoir North Area. For consistency with existing site documents, this Decision Document uses the original name of EPG.

1.2 STATEMENT OF BASIS AND PURPOSE

This Decision Document presents the Selected Remedy to address soil contamination at SWMU M-41 at EPG, Fort Belvoir, Virginia. Investigations at EPG are being conducted in accordance with the Unilateral Administrative Order (UAO) issued by the U.S. Environmental Protection Agency (USEPA) in September 2005 under Section 3013 of the Solid Waste Disposal Act, USEPA Docket No. Resource Conservation and Recovery Act (RCRA)-03-2005-0116AM. Remediation is being performed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), as implemented by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) regulations (40 Code of Federal Regulations [CFR] 300). Fort Belvoir and EPG are a non-National Priority List (NPL) installation.

The Army is the lead agency and provides funding for site clean-up activities at Fort Belvoir. The Army has adopted the term “Decision Document” for the documentation of remedial action decisions at non-NPL installations. A Decision Document is similar to the Record of Decision prepared to document the CERCLA remedy selection process for a NPL site. The information supporting the decision on this selected remedial action is contained in the Administrative Record for SWMU M-41. The USEPA Region 3 and the Virginia Department of Environmental Quality (VDEQ) concur with the selected remedial action presented herein.

1.3 ASSESSMENT OF THE SITE

SWMU M-41, located on the western portion of the EPG near Range 1 (Figure 2), includes a 1,000-gallon septic tank and leach field at Building 2075 (Figure 3). The septic system handled domestic wastewater produced by activities at Building 2075, which was reported to have been

used as an explosives handling facility until 1976. Currently, the site is not used, and the building has fallen into disrepair. The entire SWMU M-41 site is estimated to encompass 0.3 acres. While the majority of the samples collected during a series of investigations revealed limited impact from historical activities, samples collected from Trench 1, located adjacent to the building's southeast wall, and a sump near the building's easternmost corner contained elevated levels of arsenic, copper, cadmium, and lead.

1.4 DESCRIPTION OF THE SELECTED REMEDY

The remediation of SWMU M-41 is part of a comprehensive environmental investigation and remediation program being performed at EPG. The other SWMUs at EPG are considered separately and any necessary remedies for those sites will be presented in separate documents. The Selected Remedy for the site addresses the medium of concern (site soils) and is the final remedial action for SWMU M-41. Initially, the major components of the selected remedy, removal, and offsite disposal included the following:

1. Implementation of land use controls (LUCs) to ensure that the site use remains non-residential;
2. Clean-out of Trench 1;
3. Removal of the sump and metals-contaminated soil; and
4. Offsite disposal of the debris and soil in a properly licensed and operated landfill facility.

The removal action items (2 through 4) were completed in July 2009. Based on analysis of the July 2009 confirmation samples following the removal action, it was determined that the removal action had eliminated not just the potential health threat to non-resident receptors, but also the threat to hypothetical future resident receptors. Based on this new information, LUCs to restrict future land use at SWMU M-41 to non-residential purposes are not required. The elimination of LUCs represents a significant change that could have been reasonably anticipated based upon the information provided in the Proposed Plan. A detailed discussion of this change is presented in Section 2.14.

The response action selected was completed, after publication of the Proposed Plan for public comment and the 30-day public comment period. As described in Section 3.0 of this Decision Document, no oral or written comments were received during the public comment period. With the concurrence of USEPA Region 3 and VDEQ, the response action, described as Alternative 3 in Section 2.9 of this Decision Document, was completed prior to completion of this Decision Document.

The response action was necessary to protect public health and the environment from actual and threatened releases of hazardous substances into the environment.

1.5 STATUTORY DETERMINATIONS

The Selected Remedy for SWMU M-41 is protective of human health and the environment and complies with federal and state regulations that are applicable or relevant and appropriate to the

remedial action, are cost-effective, and utilize permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. In addition, the Selected Remedy attains the mandates of CERCLA Section 121, and to the extent practicable, the regulatory requirements of the NCP. The remedy does not satisfy the CERCLA statutory preference for treatment as a principal element for the remedy (40 CFR 300.430(a)(1)(iii)(A)). However, this element is not required because there are no principal threat wastes located at the site. Because the selected remedial action allows for unlimited use and unrestricted exposure, a statutory review of the protectiveness of the selected remedial action will not be required.

1.6 DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Document. Additional information can be found in the Administrative Record file for Fort Belvoir.

- Contaminants of concern (COCs) and their respective concentrations (Section 2.5.2).
- Baseline risk represented by the COCs (Section 2.7).
- Current and reasonably anticipated future land and resource use (Section 2.6).
- Potential land use that will be available at the Site as a result of the Selected Remedy (Section 2.9).
- Estimated capital costs, annual maintenance and performance costs, total present worth costs; and the number of years over which the remedy cost estimates are projected (Section 2.9).
- Key factors that led to selecting the remedy and how the selected remedy provides the best balance with respect to the balancing and modifying criteria (Section 2.12).
- Remedial goals established for COCs and the basis for those goals (Section 2.8).

1.7 AUTHORIZING SIGNATURE

John J. Strycula, Deputy

John J. Strycula
Colonel, US Army
Commanding

12/28/2010
Date

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2.0 DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND DESCRIPTION

The U.S. Army Garrison at Fort Belvoir is located in the Commonwealth of Virginia, 14 miles south of Washington, D.C. (Figure 1). EPG, an 820-acre tract of land 1.5 miles northwest of the Main Post of Fort Belvoir, is bounded by Interstate 95 on the east, by commercial properties to the south, and by residential properties on the west and north. Accotink Creek bisects EPG into areas identified as EPG East and EPG West. The layout of EPG is shown on Figure 2. Historically, EPG was used for testing a wide range of engineering equipment and supplies, such as methods and equipment for the deployment, detection, and neutralization of land mines, as wells as anti-intrusion and counter-barrier systems and techniques. SWMU M-41, located on the western portion of the EPG near Range 1, encompasses a 1,000-gallon septic tank and leach field at Building 2075 (Figure 3). The septic system handled domestic wastewater produced by activities at Building 2075, which was reported to have been used as an explosives handling facility until 1976. Currently, the site is not used and the building has fallen into disrepair. Based upon the Fort Belvoir Master Plan, the future intended land use for SWMU M-41 is industrial and/or administrative.

2.2 SITE HISTORY, ENFORCEMENT ACTIVITIES, AND INVESTIGATIONS

The following subsections provide summaries of the site history and investigations that have been conducted at SWMU M-41.

2.2.1 Site History

EPG was acquired by the U.S. Army in the early 1940s, and was occupied by the Fort Belvoir Research, Development, and Engineering Center. Historically, EPG was used for testing a wide range of engineering equipment and supplies. The testing and activities on the eastern portion of EPG included:

- construction, material handling, maintenance, railway, power generation, air compression, and bridging equipment;
- fuel, fuel handling and storage equipment;
- mobile water purification equipment, and waste and sewage structures; and
- climatic effects on paints, tactical sensors, and anti-mine systems and techniques.

The testing on the western portion of EPG included:

- methods and equipment for the deployment, detection, and neutralization of land mines;
- anti-intrusion and counter-barrier systems and techniques; and
- tactical sensors and anti-mine systems and techniques.

The highest level of activity at EPG occurred during the 1940s to the mid-1950s. Commercial and residential encroachment in the vicinity of EPG in the 1960s and 1970s contributed to the

reduction of testing activities at the facility. In 1989, the Research, Development, and Engineering Center turned the property back over to Fort Belvoir. Since 1989, Fort Belvoir has used or leased only a few select buildings on the entire 820 acre EPG property.

2.2.2 Enforcement Activities

In September 2005, the USEPA issued Fort Belvoir a UAO under Section 3013 of the Solid Waste Disposal Act (i.e. the RCRA), 42 United States Code Section 6934. Section 3013 grants USEPA the authority to require an investigation by the respondent to evaluate threats posed by the presence of hazardous waste (as defined in the statute, RCRA Section 1004(5), versus the regulatory definition under Subtitle C) at the site. All investigation work completed at EPG subsequent to September 2005 is to be conducted in accordance with the requirements outlined in this UAO.

2.2.3 Site Investigations

SWMU M-41 was identified in the *Environmental Baseline Study for the Engineer Proving Ground, Fort Belvoir, Virginia, Volume 1: Phase I, Scope Definition, and Phase II, Environmental Survey* (Argonne National Laboratory, 1990). The purpose of this study was to identify potentially contaminated sites that should be further investigated. The Environmental Baseline Study (EBS) included collection of five soil samples from three borings, a sump sediment sample, and a sump water sample. The sump sample collected during the EBS was located 65-70 feet northeast of Building 2075, and appears to have been associated with the leach field. The sample locations are shown on Figure 4. All soil samples were analyzed for total metals, total organic carbon (TOC), and total organic halides (TOX). Two of the soil samples were also analyzed for oil and grease. The sump sediment and water samples were analyzed for metals, TOX, and total petroleum hydrocarbons (TPH), and the sump sediment sample was also analyzed for TOC.

In fall 2006, soil, groundwater, surface water, and sediment samples were collected from SWMU M-41 and analyzed for metals, explosives, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and pesticides. The soil and sediment samples were also analyzed for polychlorinated biphenyls (PCBs). The sample locations are shown on Figure 5. The purpose of this Phase I investigation was to assess whether historical use of Building 2075 had resulted in contamination of the surrounding area. The Phase I data was presented in an Investigation Summary Report (ISR) (Tetra Tech, 2007). The data are summarized in Section 2.5.2.

The Phase I ISR recommended that additional soil and groundwater sampling be completed at SWMU M-41. The Phase II investigation, conducted in fall 2007, included:

- installation and sampling of five permanent monitoring wells;
- collection of five subsurface soil samples;
- sampling of groundwater from monitoring well MW01;
- collection of four composite surface soil samples;
- collection of soil samples from Trench 1 and Trench 2; and
- collection of one soil sample from the sump near the building.

The sample locations are shown on Figure 5. The sump sampled during Phase II, located approximately 15 feet from Building 2075, was a 3.6-foot by 3.6-foot concrete structure filled with leaves and other vegetative debris. All Phase II samples were analyzed for metals and explosives. The subsurface soil, sump soil, trench soil, and groundwater samples were also analyzed for VOCs and SVOCs. The data were presented in a Phase II ISR (Tetra Tech, 2008). The Phase II data are summarized in Section 2.5.2.

The Phase II ISR recommended no action for the groundwater, and removal of the sump and soil at Trench 1. This recommendation was supported by the Final Focused Feasibility Study (FFS) completed in April 2009 (HGL, 2009).

2.3 COMMUNITY PARTICIPATION

The Army solicited public comment on the preferred remedial alternative. A Proposed Plan for SWMU M-41 was released to the public at the following repositories:

Kingstowne Library	Lorton Library
6500 Landsdowne Centre	9520 Richmond Highway
Alexandria, VA 22315-5011	Lorton, VA 22079-2124
Telephone: 703-339-4610	Telephone: 703-339-7385

A thirty (30) day public comment period occurred from May 22, 2009 to July 6, 2009. The Army published a notice of availability of the proposed plan in *The Washington Post-Extra*, the *Mt. Vernon Voice*, and the *Fairfax County Times.*

2.4 SCOPE AND ROLE OF THE RESPONSE ACTION

The U.S. Army has organized work to date at EPG Fort Belvoir into SWMUs and Areas of Potential Concern (AOPCs). This Decision Document describes the rationale for the Selected Remedy to address the contaminated soil at SWMU M-41. The Selected Remedy for SWMU M-41 will be the final CERCLA action for soil at the Site. As described in Section 2.14, the remedial action is complete and all site-related COCs in soil have been removed to levels that no longer present an unacceptable risk to human health or the environment.

2.5 SITE CHARACTERISTICS

2.5.1 Physical Setting

The majority of EPG has a gently rolling topography, cut by steep slopes associated with the narrow stream valley of Accotink Creek. Land elevations across EPG range between 200 and 300 feet above mean sea level (amsl). The western and eastern halves of EPG contain sizable upland flat areas to which the majority of testing and training activities were limited. The western portion of EPG is largely undeveloped, covered mostly by a mature deciduous forest. The eastern portion of EPG was developed by the Army for various training and support uses. However, formerly cleared areas on the property have become largely overgrown with young pines. SWMU M-41 is situated on the western portion of EPG. Topography around SWMU M-41 is relatively flat, with elevations between 200 and 210 feet amsl.

The most significant drainage feature near the site is Accotink Creek. SWMU M-41 is located approximately 3,000 feet east of Accotink Creek. A smaller tributary to Accotink Creek is located 700 feet northeast of the site, and an intermittent stream is located 25 feet to the east. The majority of surface water runoff follows the gently sloping surficial topography toward the southeast and the local tributary. The 100-year floodplain through EPG rises to an elevation of approximately 150 feet amsl in the vicinity of Accotink Creek. Based on this elevation, SWMU M-41 is not located within the 100-year flood plain.

EPG is located near the northeastern-trending physiographic boundary (known as the Fall Line) that separates the eastern edge of the Appalachian Piedmont Upland Province and the western edge of the Atlantic Coastal Plain Province. SWMU M-41 is located in the transition zone between the Coastal Plain Province and the Piedmont Province on the western portion of EPG. The Piedmont Province consists primarily of Precambrian metamorphic and Cambrian igneous rock formations, whereas the Coastal Plain consists of an eastward thickening wedge of unconsolidated sediments of gravel, sand, silt, and clay from the Cretaceous to Tertiary periods. Due to the irregularity of the Fall Line, formations from both provinces can be found within the boundaries of EPG.

Across EPG, groundwater is typically encountered 10 to 20 feet below ground surface (bgs). Groundwater flow for the unconfined, uppermost-saturated layer (water table aquifer) typically follows the surficial topography. However, where Coastal Plain sediments exist, local flow patterns can be affected by the heterogeneous nature of the unconsolidated fluvial-deltaic sediments. Groundwater may become perched in lenses within these unconsolidated sediments. Within the crystalline rocks or saprolite of the Piedmont Province, groundwater flow is largely controlled by the density and orientation of fracture and fault systems existing within the rock formations. The orientation of these systems is highly variable on a local scale.

On the western portion of EPG, soils of the Fairfax-Beltsville-Appling Association overlie both Coastal Plain sediments and crystalline rocks. This group consists mostly of well-drained to moderately well-drained soils on high Coastal Plain terraces that have formed from fluvial material and from the residuum (saprolite) of granitic gneiss. The Fairfax (silt loam), Beltsville (silt loam), and Appling (gritty loam) soils all occupy broad upland ridges.

2.5.2 Nature and Extent of Contamination

The analytical data collected during the EBS, Phase I, and Phase II investigations are summarized in the paragraphs below. The locations of samples collected are presented on Figures 4 and 5.

The EBS data revealed limited metals and TOX contamination throughout the sampled media (soil, sediment, and water), and the presence of TPH in the sump water. Sediment and surface water data collected during the Phase I investigation indicate limited contamination in these media. Explosives, VOCs, and PCBs were not detected in the sediment samples. Several SVOCs and pesticides were detected in the sediment samples. Explosives and pesticides were not detected in the surface water samples. One VOC, methylene chloride, and one SVOC, caprolactam, were detected in surface water samples at low concentrations.

Pesticides and PCBs were not detected in Phase I soil samples. Phase II samples were not analyzed for these compounds. Limited explosives contamination, in the form of octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), were reported in Phase I and Phase II samples. The highest VOC, SVOC, and metals detections were observed in the sump and Trench 1 samples. The maximum arsenic concentration (190 milligrams per kilogram [mg/kg]) and lead concentration (3,030 mg/kg) were observed in the sump sample and Trench 1 sample, respectively. Data for samples collected at other locations indicated limited presence of VOCs and SVOCs, and the presence of metals at concentrations consistent with expected background levels.

During the Phase I investigation, naphthalene and bis(2-ethylhexyl)phthalate were each detected in one groundwater sample at a low concentration. No pesticides were detected in the groundwater samples. Several explosives were detected in the sample from well M41-MW01. No explosives were detected in the samples from wells M41-MW02 and M41-MW03.

The Phase II investigation included sample collection from well M41-MW01 in addition to the sampling of newly-installed permanent monitoring wells. The second sample from well M41-MW01 was non-detect for all explosives. 2,6-Dinitrotoluene was detected in the sample from well M41-MW07 at a concentration of 0.24 micrograms per liter (µg/L). Samples from other wells had no explosives detections. Several SVOCs were detected at concentrations less than 10 µg/L, with the exception of the maximum bis(2-ethylhexyl)phthalate detection (20 µg/L). Some VOCs were reported in one or two samples. The maximum VOC detection was 2-butanone at 200 µg/L.

In summary, soil contamination consisting primarily of the metals arsenic and lead was found at Trench 1 and the adjacent sump.

2.6 CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

The highest level of activity at EPG occurred during the 1940s to the mid-1950s. Commercial and residential growth in the vicinity of EPG in the 1960s and 1970s contributed to the reduction of testing activities at the facility. In 1989, the Research, Development, and Engineering Center turned the property back over to Fort Belvoir (IT Corp, 1990). There are currently no activities on-going at SWMU M-41. Activities have not occurred at SWMU M-41 since 1976. Based upon the Fort Belvoir Master Plan, the future intended land use for SWMU M-41 is industrial and/or administrative.

2.7 SITE RISKS

The Phase I and Phase II ISRs included a comparison of the analytical results to risk screening values. These values were the EPA Region 3 Risk-Based Concentrations (RBCs) and Industrial Soil RBCs for soil and sediment detections, and the Tap Water RBCs and maximum contaminant levels (MCLs) for groundwater and surface water detections. These screening levels represent concentrations that have been deemed protective of human health.

All sediment and surface water detections were less than their respective screening values, indicating that the chemicals in these media do not pose a threat to human health.

The Phase I groundwater sample from well M41-MW01 contained 2-amino-4,6-dinitrotoluene and 4-amino-2,6-dinitrotoluene at a concentration greater than the Tap Water RBC. During Phase II, these compounds were not detected in the well. In the Phase II groundwater samples, detections of manganese, benzo(a)anthracene, 1,2-diphenylhydrazine, and bis(2-ethylhexyl)phthalate exceeded either their respective tap water RBC or MCL. Based on the prevalence of manganese at other Fort Belvoir sites, the Phase II ISR concluded that the RBC exceedance for this analyte was not significant. The single detection of benzo(a)anthracene at an estimated concentration of 0.032 µg/L only slightly exceeded the tap water RBC of 0.03 µg/L. 1,2-Diphenylhydrazine was detected in one groundwater sample, and was not detected in the soil samples. The bis(2-ethylhexyl)phthalate concentration in two samples exceeded the MCL. One sample was collected from monitoring well M41-MW01, which had been nondetect for bis(2-ethylhexyl)phthalate the previous year. Bis(2-ethylhexyl)phthalate, a plasticizer, is a common laboratory contaminant. The Final Phase II ISR (Tetra Tech, 2008) concluded that the groundwater exceedances of RBCs and/or MCLs were not significant.

In the Phase I soil samples one arsenic detection exceeded the Residential Soil and Industrial Soil RBCs, but the concentration was consistent with background conditions. During the Phase II investigation, the arsenic results for the sump and Trench 1 samples exceeded the Industrial Soil RBC, the Residential Soil RBC, and expected background levels. All other arsenic detections were at concentrations consistent with expected background levels. The Trench 1 lead detection exceeded both its industrial soil and residential RBCs, while the lead detection in the sump exceeded the residential RBC. Lead detections in the other soil samples were less than RBCs. In the Trench 1 sample, cadmium, copper, and benzo(a)anthracene exceeded their Residential Soil RBCs, indicating a potential risk to a hypothetical future resident receptor. The Final Phase II ISR (Tetra Tech, 2008) recommended removal of the sump and Trench 1.

To confirm that the site-related chemicals in the sump and Trench 1 soil posed potential unacceptable risk to human health, the FFS quantified potential risks associated with soil in and around these two structures. Consistent with the screening against the Residential Soil RBCs, site-related chemicals (arsenic, lead, copper, and cadmium) in the sump and Trench 1 soils were found to pose an unacceptable risk to the potential future resident. In addition, arsenic and lead in the sump and Trench 1 soil posed an unacceptable risk to future non-residential receptors (industrial worker and construction worker).

2.8 REMEDIAL ACTION OBJECTIVES

The remedial action objectives (RAOs) for the soil at SWMU M-41 are goals that have been developed to achieve protection of human health. Initially, the following RAOs were established for the SWMU M-41 soils, based on the anticipated restricted industrial land use for the site:

- **RAO 1**: Limit current and future use of SWMU M-41 to non-residential purposes.
- **RAO 2**: Prevent exposure of non-residential receptors to arsenic in soil at concentrations above background levels that would result in a target organ hazard index (HI) greater than 1.

- **RAO 3**: Prevent exposure of non-residential receptors to lead-contaminated soils that would result in a fetal blood concentration greater than 10 micrograms per deciliter (µg/dL).

The COCs under the non-residential land use scenario for the SWMU M-41 soil are arsenic and lead. To achieve the above RAOs, remedial goals for these COCs were developed based on Applicable or Relevant and Appropriate Requirements (ARARs) and other readily available information. Since completion of the original investigations, the USEPA Region 3 RBCs have been replaced by the Oak Ridge National Laboratory Regional Screening Levels (RSLs). Therefore, the Industrial Soil RSLs were used as the basis for the remedial goals. These RSLs provide chemical concentrations that are protective of human health under a non-residential land use scenario. The Industrial Soil RSL for arsenic is 1.6 mg/kg. This concentration is on the low end of the range of site background concentrations (0.36 mg/kg – 7.26 mg/kg). In accordance with CERCLA, it is not necessary to remediate a site to less than background levels. Accordingly, the remedial goal for arsenic was established as a not-to-exceed value of 7.26 mg/kg, the maximum arsenic concentration of the background data set. In addition, the distributions of the site arsenic data set and background arsenic data set will be compared for similarity with a nonparametric statistical test.

The industrial soil screening value for lead is 800 mg/kg (http://epa.gov/superfund/lead/almfaq.htm#screening). This screening value is identified as the remedial goal for lead, and represents a not-to-exceed value.

Figure 6 shows the former area of remedial goal exceedances. In July 2009 the removal action was completed, as described in Alternative 3, Section 2.9, and confirmation samples were collected following completion of the sump/Trench 1 removal. The analytical results demonstrated that the removal action resulted in attainment of conditions protective of human health under an unrestricted land use (Table 1, Figure 7). All arsenic detections were consistent with background concentrations. All lead detections were less than the Residential Soil screening value of 400 mg/kg and were consistent with background concentrations. The cadmium and copper detections were substantially less than their respective Residential Soil RSL. In addition, the cadmium concentrations were consistent with background values (background data were not available for copper). **Based on these data, the removal effort achieved RAO 2 and RAO 3, and RAO 1 to maintain non-residential land use is no longer required.**

Table 1
July 2009 Confirmation Sample Results

	Arsenic (mg/kg)	Qual	Cadmium (mg/kg)	Qual	Copper (mg/kg)	Qual	Lead (mg/kg)	Qual
Regional Screening Level (RSL) (1)	**7.26**		**70**		**3,100**		**400**	
Confirmation Sample IDs								
BM41-SSC1	1.7	J	0.2	UL	24	L	8	J
BM41-DUP01-070909	2.8	J	0.1	J	29	L	16	J
BM41-SSC2	6.3	J	0.15	J	56	L	24	J

BM41-SSC3	4	J	0.085	J	14	L	14	J
BM41-SSC4	5.5	J	0.17	J	79	L	29	J
BM41-SSC5	1.8	J	0.041	J	6.6	L	8	J
BM41-SSC6	4.5	J	0.42	J	77	L	19	J
BM41-SSC7	1.8	J	0.19	UL	7.9	L	7.7	J
BM41-SSC8	3	J	0.37	UL	29	L	12	J
BM41-SSC9	3.8	J	0.062	J	38	L	13	J

Note: all samples collected on July 7th 2009

Key:
Samples analyzed by TestAmerica in Chicago, IL
1. September 2008 Residential Soil RSL Table or, in the case of arsenic, the Fort Belvoir background concentration.
Qual = Qualifier
J = The associated value is an estimated quantity.
UL = The analyte was not detected, and the reported quantitation limit is probably higher than reported.
L = The analyte is present. The reported value may be biased low. The actual value is expected to be higher than reported.
mg/kg = milligram per kilogram

2.9 DESCRIPTION OF ALTERNATIVES

Remedial alternatives evaluated for SWMU M-41 include the following:

ALTERNATIVE 1 – NO ACTION

Estimated Capital Cost: $0
Estimated Operation and Maintenance (O&M) Cost: $0
Estimated Periodic Cost: $0
Estimated Total Present Worth Cost: $0
Estimated Construction Timeframe: None

CERCLA requires evaluation of a No Action alternative. The No Action alternative is included to serve as a baseline for comparison with the other alternatives. Under the No Action alternative, the SWMU M-41 sump and Trench 1 soil would be left as is.

ALTERNATIVE 2: SOIL COVER

Estimated Capital Cost: $71,700
Estimated O&M Cost: $80,500
Estimated Periodic Cost: $47,000
Estimated Total Present Worth Cost: $199,200
Estimated Construction Timeframe: 2-4 weeks

This alternative includes:

- Implementation of LUCs to ensure that the site use remains non-residential;
- Implementation of LUCs to protect the soil cover from intrusive activities;
- Clean-out of Trench 1 adjacent to the building, and placement of the material beneath the cover;
- Demolition of the sump;

- Placement of a 2-foot soil cover across the area of soil contamination and demolished sump; and
- Annual O&M to ensure cover integrity.

After delineating the area to be covered, the vegetation in the remediation area would be removed. The sump would be demolished and its debris would be crushed and incorporated into the soils in the area to be covered. The contents of Trench 1 would be removed and placed in the area to be covered. Trench 1 would be pressure-washed and the wash water disposed offsite at an appropriate facility following waste characterization. To provide a base for the cover, the contaminated area would be graded and compacted. The soil cover would consist of an 18-inch layer of clean fill topped with six inches of topsoil. The clean fill would be compacted to minimize the potential for subsidence with time. The cover would be sloped and the area surrounding the cover would be graded to allow for drainage of stormwater away from the cover. To allow room for the slope, the concrete apron adjacent to the building would be demolished, and its debris placed beneath the cover. The soil cover and area affected by construction activities would be re-vegetated. To ensure the integrity of the soil cover, LUCs would be implemented to limit intrusive activities.

Long-term cover inspection and maintenance would be required. For the cost analysis, O&M would continue for a period of 30 years. O&M would include semi-annual inspections, repair of eroded areas, and re-seeding. Completion of CERCLA 121(c) reviews (5-year reviews) to document the protectiveness of the soil cover would be required.

ALTERNATIVE 3: REMOVAL AND OFF-SITE DISPOSAL

Estimated Capital Cost: $68,700
Estimated O&M Cost: $0
Estimated Periodic Cost: $0
Estimated Total Present Worth Cost: $68,700
Estimated Construction Timeframe: 2-4 weeks

Under this alternative, the sump would be demolished, and the contaminated soil and material associated with Trench 1 and the sump would be excavated. After waste characterization, the excavated soil and material would be disposed in an appropriate offsite disposal facility, the selection of which would be based on the waste characterization data. Because Trench 1 would remain in place, this structure would be pressure-washed to remove any particles that remain on the concrete surface. The wash water would be drummed, characterized, and disposed offsite in the appropriate disposal facility based on the waste characterization data. It is assumed that the volume of soil and debris (Trench 1 contents, sump contents, sump) is 10 cubic yards (CY). Delineation sampling and/or confirmation sampling would be used to confirm attainment of remedial goals within the remediation area. Following excavation, the area would be backfilled with clean fill, compacted, graded, and seeded to return the area to its pre-excavation conditions.

During preparation of the FFS, it was assumed that the sump and Trench 1 contents would meet the definition of hazardous waste, and that the sump debris and excavated soil would meet the definition of non-hazardous waste. Subsequent waste characterization data demonstrated that the

sump contents, Trench 1 contents, and associated contaminated soil met the definition of a non-hazardous waste.

As described in Sections 1.4 and 2.8, July 2009 confirmation samples demonstrated that the removal action resulted in site conditions protective of human health under an unrestricted land use scenario. Accordingly, this remedial alternative no longer requires establishment of LUCs to restrict future land use. Because the FFS assumed that the SWMU M-41 LUCs would be implemented as part of EPG-wide LUCs to restrict land use across the entire EPG, the FFS did not include separate costs for these LUCs.

This alternative would not require O&M.

2.10 COMPARATIVE ANALYSIS OF ALTERNATIVES

Nine criteria are used to evaluate the different remediation alternatives individually and against each other in order to select a remedy. A comparative analysis of the alternatives against the nine evaluation criteria was performed in detail in the FFS. A tabular summary and narrative discussion are presented below.

Table 2
Comparison of Remedial Alternatives

Criteria for Evaluation of Alternatives	Alternative 1 No Action	Alternative 2 Soil Cover	Alternative 3 Removal and Offsite Disposal
1. Overall Protection of Human Health and the Environment	Not Protective	Protective	Protective
2. Compliance with ARARs	Does not comply with ARARs	Complies with ARARs	Complies with ARARs
3. Long-term Effectiveness and Permanence	Not permanent or effective in the long-term	With proper maintenance, will provide a long-term effective and permanent remedy	Has the highest degree of long-term effectiveness and permanence
4. Reduction of Toxicity, Mobility, or Volume	No reduction	No reduction in toxicity or volume, but will reduce mobility.	No reduction in toxicity or volume. Greatest reduction in mobility.
5. Short-term Effectiveness	No short-term impacts.	Potential for short-term risks that can be mitigated with standard engineering controls, training, and personnel protective equipment.	Potential for short-term risks that can be mitigated with standard engineering controls, training, and personnel protective equipment.
6. Implementability	Readily implementable	Readily implementable	Readily implementable
7. Cost Capital O&M – 30 years Present Worth	$0	$199,200	$68,700
8. USEPA and State Acceptance	The USEPA and State would not accept the no action alternative.	The USEPA and State have indicated their concurrence with Alternative 3.	The USEPA and State have indicated their concurrence with Alternative 3.
9. Community Acceptance	No comments were received during the Public Comment Period.	No comments were received during the Public Comment Period.	No comments were received during the Public Comment Period.

Alternative 1, No Action, would fail the threshold criteria of protection of human health and compliance with ARARs. While both Alternatives 2 and 3 would meet these criteria, Alternative 3 would provide a higher degree of protection than Alternative 2. Of the two alternatives that meet both threshold criteria, Alternative 3 offers the highest degree of long-term effectiveness and permanence, and reduction in contaminant mobility. Both alternatives would be readily implemented, but Alternative 2 would require long-term maintenance to ensure the protectiveness of the remedy. Alternative 2 has the highest total present worth cost. For this alternative, annual and periodic costs contribute substantially to its total present worth cost. Implementation of Alternative 2 would leave Fort Belvoir with future financial liability for the site. For Alternative 3, all costs are incurred during the construction phase. Of the two alternatives that meet the threshold criteria, Alternative 3 provides the highest degree of long-term effectiveness at the lowest cost.

2.11 PRINCIPAL THREAT WASTES

The NCP establishes an expectation that USEPA will use treatment to address the principal threats posed by a site whenever practicable. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Data indicate that there are no principal threat wastes at SWMU M-41.

2.12 SELECTED REMEDY

The selected remedy at SWMU M-41 is Alternative 3, Removal and Offsite Disposal. This alternative was selected over the other alternatives because it provides the best balance in order to achieve reasonable protection of human health and compliance with ARARs. It provides the highest degree of long-term effectiveness and permanence for protection of human health at the lowest cost. Implementation of the preferred alternative will meet the RAOs listed in Section 2.8.

Based on currently available information, the preferred alternative meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria.

2.13 STATUTORY DETERMINATIONS

The preferred alternative satisfies the following statutory requirements of CERCLA §121(b): 1) be protective of human health and the environment; 2) comply with ARARs; 3) be cost-effective; and 4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

2.14 DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for the site was released for public comment on May 22, 2009. The Proposed Plan identified removal and offsite disposal with LUCs as the Preferred Alternative for remediation. No comments were received during the public comment period.

In July 2009, soil and sump removal was completed at SWMU M-41. Confirmation samples were collected from the remediation area following removal actions. The data demonstrate that the Selected Remedy attained a higher degree of contaminant removal, and corresponding reduction in risk, than required by the original RAOs. The analytical data demonstrated that background concentrations for arsenic, cadmium, and lead were achieved. In addition, lead, cadmium, and copper detections were substantially less than their respective human health risk-based screening values. Based on these data, LUCs to restrict future land use are not required for the Selected Remedy.

The elimination of LUCs represents a significant change that could reasonably have been anticipated through the information provided in the original Proposed Plan. Specifically:

1. Section 2.2.3 of the Proposed Plan indicated that "Soil contamination at SWMU M-41 is limited to Trench 1 and the sump." The reader can conclude from this statement that:

   - The contamination is not widespread, and
   - the extent of contamination is defined by physical structures.

2. Section 5.0 of the Proposed Plan indicates that "In accordance with CERCLA, it is not necessary to remediate a site to less than background levels." Background is defined in Section 10.0 of the Proposed Plan as natural conditions or conditions not related to the site. The reader can conclude from this statement that:

   - Removal of contamination would return the site to background conditions.
   - Background conditions do not require a remedy.

3. Section 4.0 of the Proposed Plan indicates that "The Phase I and Phase II ISRs included a comparison of the analytical results to risk screening values. . . These screening levels represent concentrations that have been determined to be protective of human health." A reader can conclude from this information that:

   - Removal of contamination in excess of human health-based screening values will achieve conditions that do not pose a threat to human health.

4. Section 4.0, the Proposed Plan notes that all analytes detected in sediment and surface water were observed at concentrations less than their screening values. The Proposed Plan closes out these media with no action. A reader can conclude that:

   - Contaminant concentrations less than health-based screening values do not require remediation.

5. The Preferred Alternative in the Proposed Plan consists of sump removal, soil removal, and Trench 1 pressure-washing. A reader can infer that:

   - Depending on how much soil is excavated and the condition of Trench 1, this alternative has the potential to remove all contamination.

In summary, based on the information provided in the Proposed Plan, a reader could anticipate that the remedy had the ability to return the site to background conditions (i.e., remove all contamination, as occurred with respect to arsenic, cadmium, and lead) or to achieve conditions that are deemed protective of human health under unrestricted land uses (as occurred with respect to copper). The reader could also anticipate that background conditions or conditions deemed protective of human health would not require additional remediation or treatment.

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3.0 RESPONSIVENESS SUMMARY

The public participation requirements set out in the NCP at 40 CFR 300.435(c)(2)(ii) have been met for SWMU M-41. The National Oceanic and Atmospheric Administration provided a letter to state that no listed species are known to occur in or near the site, and that no consultation pursuant to Section 7 of the Endangered Species Act of 1973, as amended, is required.

No oral or written comments were received during the public comment period that extended from May 22, 2009 through July 6, 2009.

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4.0 REFERENCES

Argonne National Laboratory (ANL), 1990. Environmental Baseline Study for the Engineer Proving Ground, Fort Belvoir, Virginia, Volume 1: Phase I, Scope Definition, and Phase II, Environmental Survey.

Tetra Tech, 2007. Investigation Summary Report, Solid Waste Management Unit (SWMU) M-41 at Engineer Proving Ground.

Tetra Tech, 2008. Phase II, Environmental Investigation Summary Report, Solid Waste Management Unit (SWMU) M-41 at Engineer Proving Ground.

HydroGeoLogic, 2009. Focused Feasibility Study, Solid Waste Management Unit M-41 Engineer Proving Ground at Fort Belvoir, VA.

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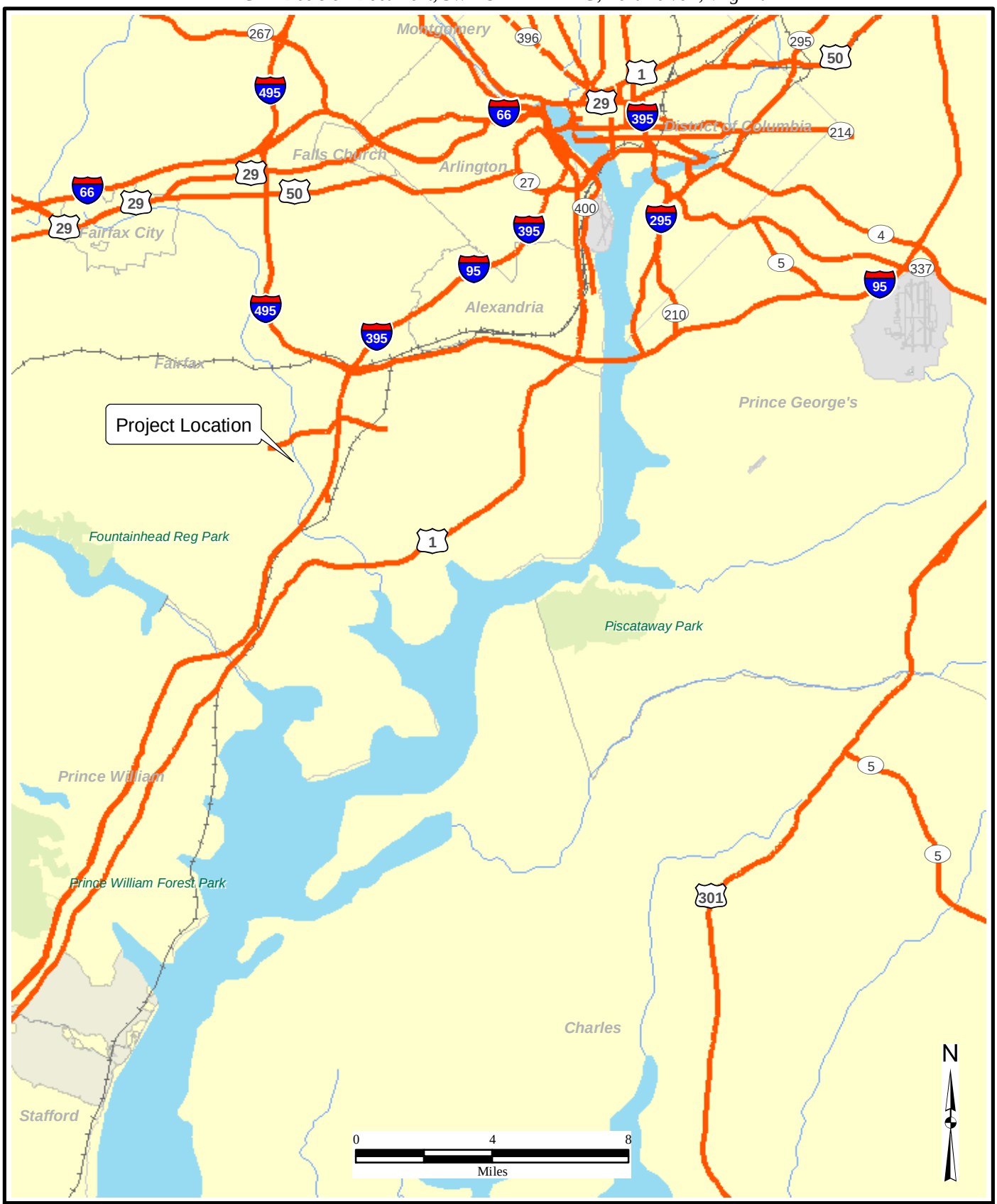
FIGURES



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Reg_Loc.mxd
06/26/09 PD
Map Source: ESRI Data

HGL HydroGeoLogic, Inc

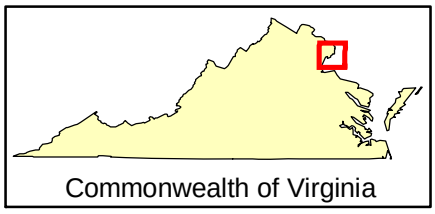
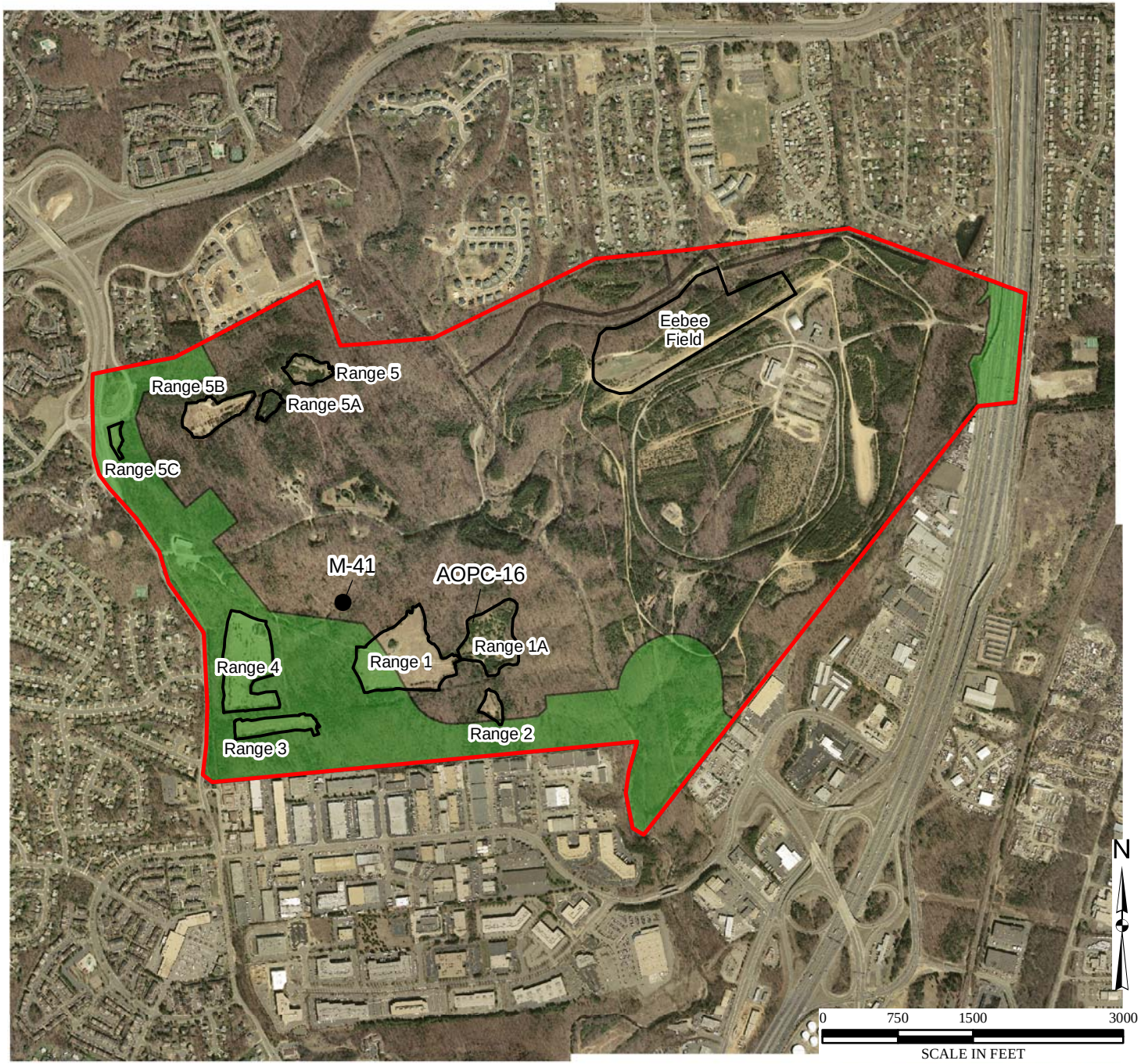


Figure 1
General Site Location



HGL—Decision Document,
SWMU M-41—EPG, Fort Belvoir, Virginia

Figure 2
Location of SWMU M-41 within EPG

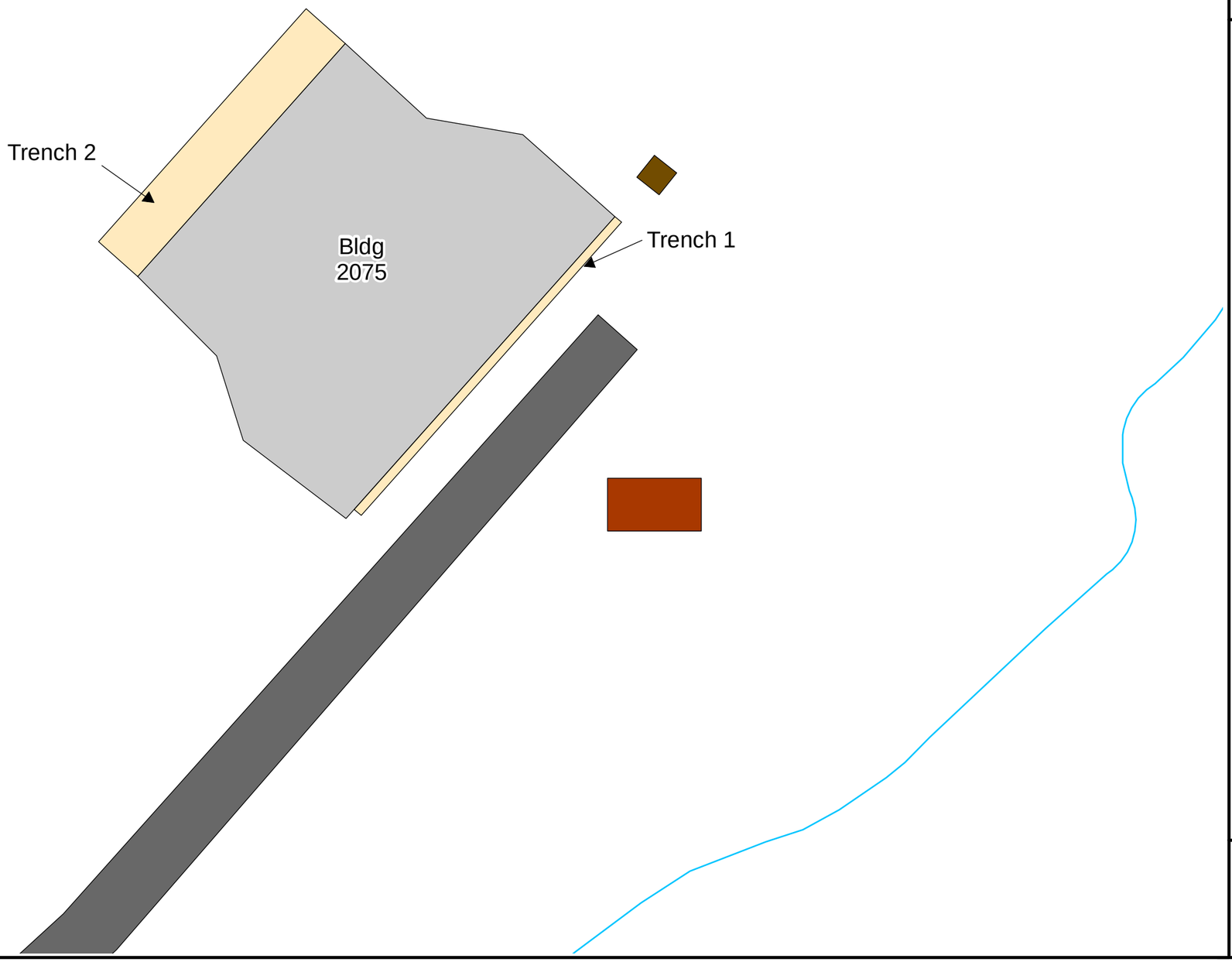
Legend

- SWMU
- Installation Boundary
- EPG Right of Way
- EPG Range

Y:\AE10\Ft_Belvoir\AE10\TO_01
2009-06_SWMU_M-41_Decision_Doc
EPG_Area_Overview.mxd
08/04/09 BF
Source: USACE,
USGS National Map, 2002

HGL HydroGeoLogic, Inc

Figure 3
Layout of SWMU M-41



Legend

- Stream
- Unpaved Road
- Building
- Trench
- Sump
- Septic Tank

N

0 15 30
SCALE IN FEET

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2009-06_SWMU_M-41_Decision_Doc
SWMU-41_layout.mxd
06/26/09 PD
Source: HGL GIS Database,
Phase II Environmental Investigation Summary Report, SWMU M-41, TetraTech, 2008

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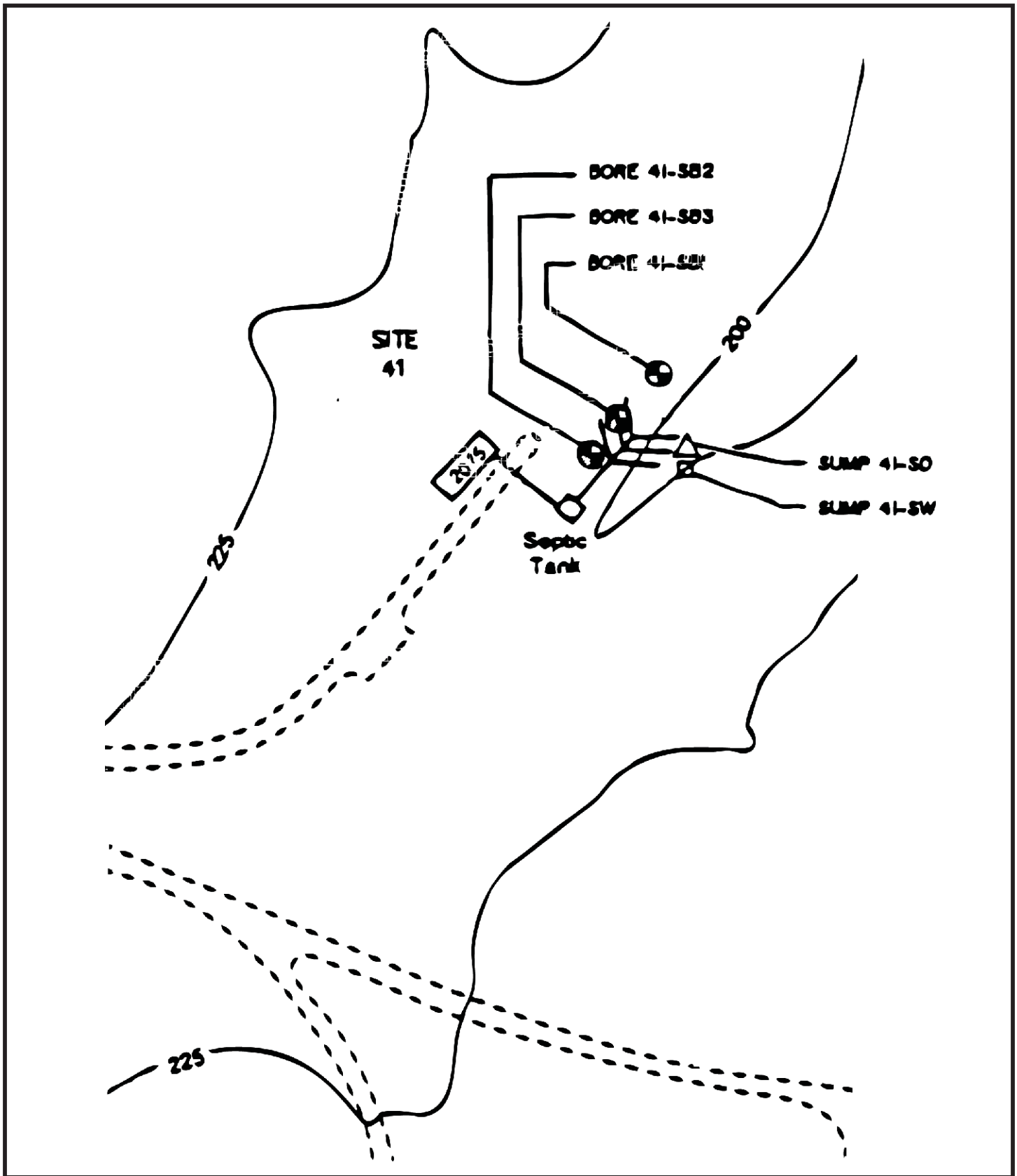


Y:\AE10\Ft_Belvoir\AE10\TO_01\
2009-06_SWMU-41_Decision_Doc\Sample_Locs.cdr
06/26/09 PD
Source: Final Environmental Baseline Study,
Argonne National Laboratory, 1990

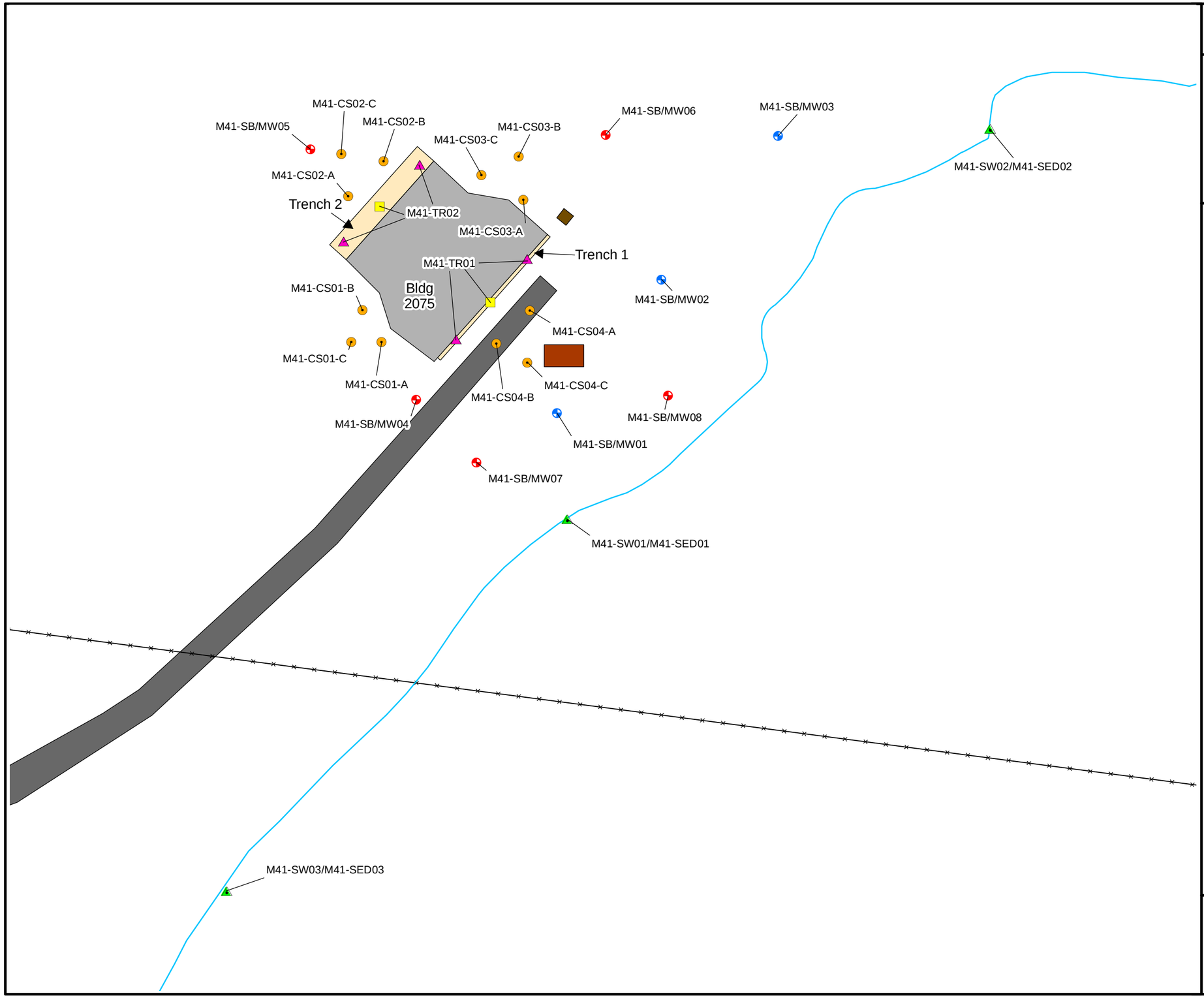
HGL HydroGeoLogic, Inc

Legend

- Soil Boring Sample Location
- Sediment Sample Location
- Surface Water Sample Location

Figure 4
Sample Locations,
EBS, SWMU M-41

Figure 5
SWMU M-41
Sample Locations,
Phase I and Phase II Investigation



Legend

- Soil Boring/Monitoring Well
- Composite Surface Sample
- Composite Trench Sample
- Composite Trench/ Discrete Volatile Sample
- Sump Sample
- Surface Water/Sediment Sample
- M41-SB/MW05 Sampling Point Identification
- Stream
- Unpaved Road
- Building
- Trench
- Sump
- Septic Tank

N

0 15 30 60
SCALE IN FEET

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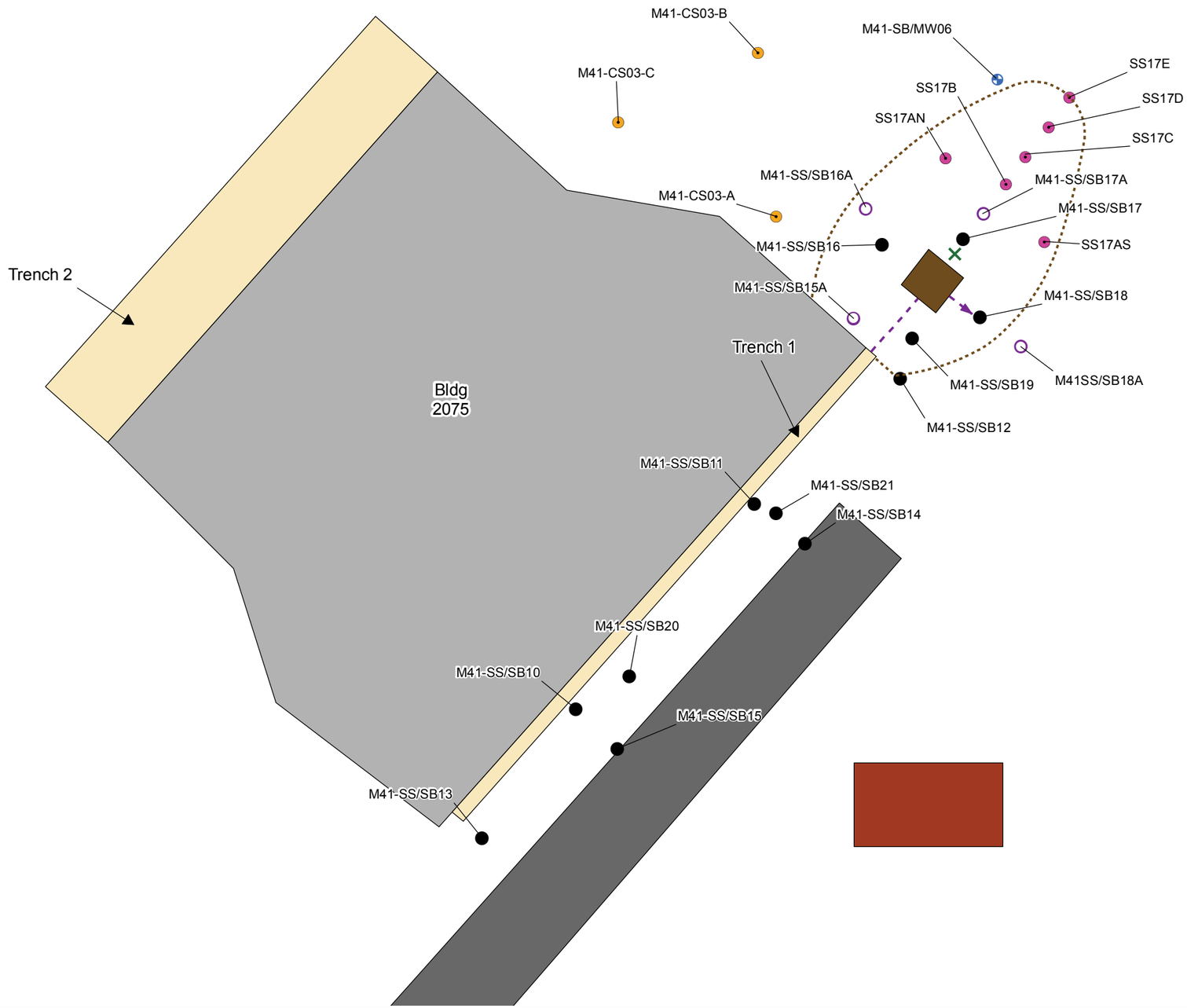
06/26/09 PD
Source: HGL GIS Database,
Phase II Environmental Investigation Summary Report, SWMU M-41, TetraTech, 2008

HGL HydroGeoLogic, Inc

Figure 6
Remediation Area



Legend

- November 2008 Sample Location
- February and March 2009 Step-Out Sample Location
- Composite Surface Sample
- Monitoring Well
- January 2009 Step-Out Sample Location
- Sump Discharge Point
- Approximate Location of Pipe
- Remediation Area
- Unpaved Road
- Building
- Trench
- Sump
- Septic Tank

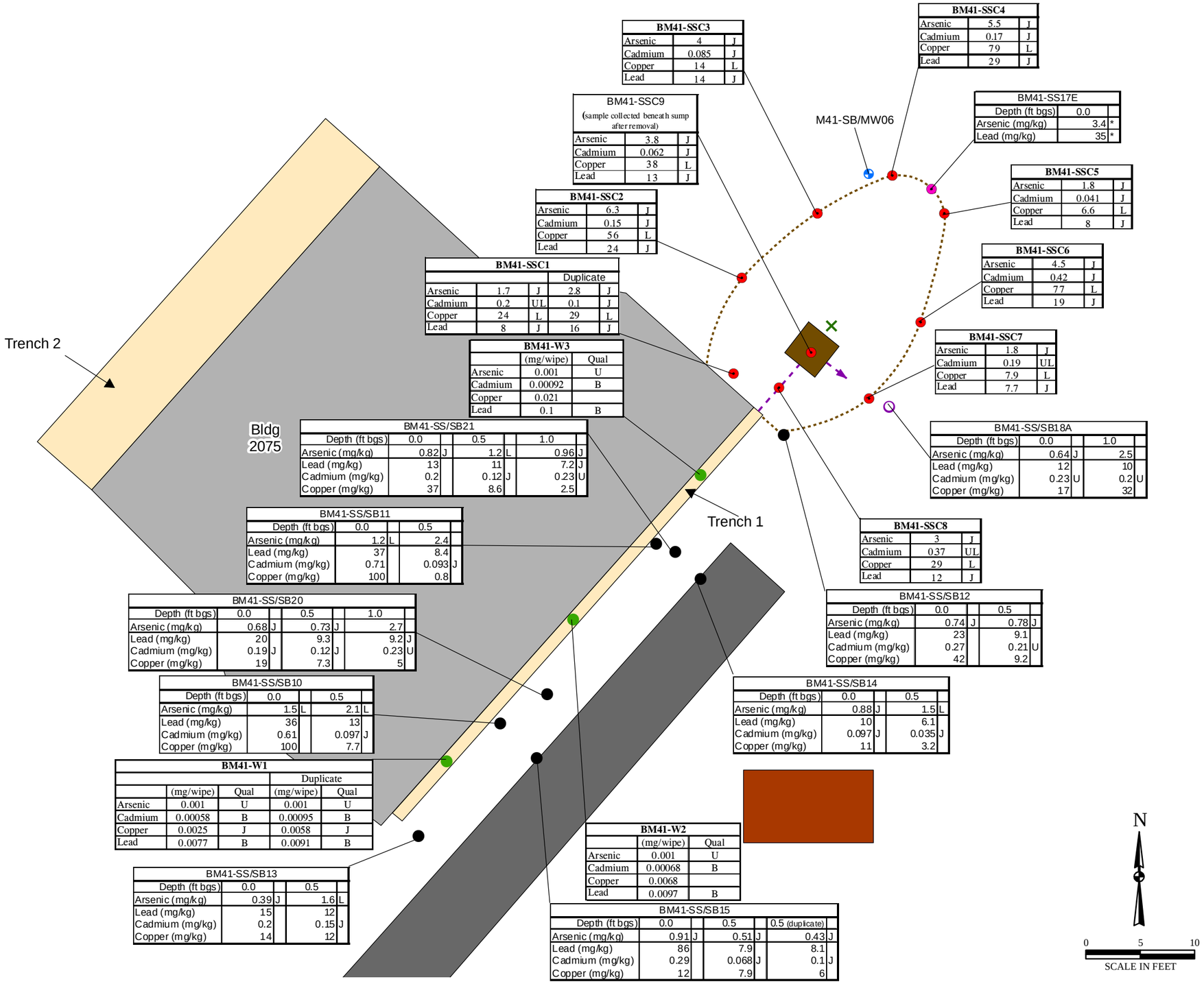
N

0 5 10
SCALE IN FEET

Y:\Ft_Belvoir\AE10\TO_01\2009-06_SWMU-M41_Decision_Doc
SWMU-41_expected_removal_area.mxd
08/04/09 BF
Source: HGL GIS Database,
Phase II Environmental Investigation Summary Report, SWMU M-41, TetraTech, 2008

HGL HydroGeoLogic, Inc

Figure 7
July 2009
Confirmation Sample Results



BM41-SSC3		
Arsenic	4	J
Cadmium	0.085	J
Copper	14	L
Lead	14	J

BM41-SSC4		
Arsenic	5.5	J
Cadmium	0.17	J
Copper	79	L
Lead	29	J

BM41-SSC9 (sample collected beneath sump after removal)		
Arsenic	3.8	J
Cadmium	0.062	J
Copper	38	L
Lead	13	J

BM41-SS17E		
Depth (ft bgs)	0.0	
Arsenic (mg/kg)	3.4	*
Lead (mg/kg)	35	*

BM41-SSC5		
Arsenic	1.8	J
Cadmium	0.041	J
Copper	6.6	L
Lead	8	J

BM41-SSC2		
Arsenic	6.3	J
Cadmium	0.15	J
Copper	56	L
Lead	24	J

BM41-SSC6		
Arsenic	4.5	J
Cadmium	0.42	J
Copper	77	L
Lead	19	J

BM41-SSC1			Duplicate	
Arsenic	1.7	J	2.8	J
Cadmium	0.2	UL	0.1	J
Copper	24	L	29	L
Lead	8	J	16	J

BM41-SSC7		
Arsenic	1.8	J
Cadmium	0.19	UL
Copper	7.9	L
Lead	7.7	J

BM41-W3	(mg/wipe)	Qual
Arsenic	0.001	U
Cadmium	0.00092	B
Copper	0.021	
Lead	0.1	B

BM41-SS/SB21						
Depth (ft bgs)	0.0		0.5		1.0	
Arsenic (mg/kg)	0.82	J	1.2	L	0.96	J
Lead (mg/kg)	13		11		7.2	J
Cadmium (mg/kg)	0.2		0.12	J	0.23	U
Copper (mg/kg)	37		8.6		2.5	

BM41-SS/SB18A						
Depth (ft bgs)	0.0		1.0			
Arsenic (mg/kg)	0.64	J	2.5			
Lead (mg/kg)	12		10			
Cadmium (mg/kg)	0.23	U	0.2	U		
Copper (mg/kg)	17		32			

BM41-SS/SB11				
Depth (ft bgs)	0.0		0.5	
Arsenic (mg/kg)	1.2	L	2.4	
Lead (mg/kg)	37		8.4	
Cadmium (mg/kg)	0.71		0.093	J
Copper (mg/kg)	100		0.8	

BM41-SSC8		
Arsenic	3	J
Cadmium	037	UL
Copper	29	L
Lead	12	J

BM41-SS/SB20						
Depth (ft bgs)	0.0		0.5		1.0	
Arsenic (mg/kg)	0.68	J	0.73	J	2.7	
Lead (mg/kg)	20		9.3		9.2	J
Cadmium (mg/kg)	0.19	J	0.12	J	0.23	U
Copper (mg/kg)	19		7.3		5	

BM41-SS/SB12				
Depth (ft bgs)	0.0		0.5	
Arsenic (mg/kg)	0.74	J	0.78	J
Lead (mg/kg)	23		9.1	
Cadmium (mg/kg)	0.27		0.21	U
Copper (mg/kg)	42		9.2	

BM41-SS/SB10				
Depth (ft bgs)	0.0		0.5	
Arsenic (mg/kg)	1.5	L	2.1	L
Lead (mg/kg)	36		13	
Cadmium (mg/kg)	0.61		0.097	J
Copper (mg/kg)	100		7.7	

BM41-SS/SB14				
Depth (ft bgs)	0.0		0.5	
Arsenic (mg/kg)	0.88	J	1.5	L
Lead (mg/kg)	10		6.1	
Cadmium (mg/kg)	0.097	J	0.035	J
Copper (mg/kg)	11		3.2	

BM41-W1			Duplicate	
	(mg/wipe)	Qual	(mg/wipe)	Qual
Arsenic	0.001	U	0.001	U
Cadmium	0.00058	B	0.00095	B
Copper	0.0025	J	0.0058	J
Lead	0.0077	B	0.0091	B

BM41-W2	(mg/wipe)	Qual
Arsenic	0.001	U
Cadmium	0.00068	B
Copper	0.0068	
Lead	0.0097	B

BM41-SS/SB13				
Depth (ft bgs)	0.0		0.5	
Arsenic (mg/kg)	0.39	J	1.6	L
Lead (mg/kg)	15		12	
Cadmium (mg/kg)	0.2		0.15	J
Copper (mg/kg)	14		12	

BM41-SS/SB15						
Depth (ft bgs)	0.0		0.5		0.5 (duplicate)	
Arsenic (mg/kg)	0.91	J	0.51	J	0.43	J
Lead (mg/kg)	86		7.9		8.1	
Cadmium (mg/kg)	0.29		0.068	J	0.1	J
Copper (mg/kg)	12		7.9		6	

Legend

- November 2008 Sample Location
- Swipe Confirmation Sample Location
- February and March 2009 Step-Out Sample Location
- Discrete Confirmation Sample Location
- Monitoring Well
- January 2009 Step-Out Sample Location
- Sump Discharge Point
- Approximate Location of Pipe
- Remediation Area
- Unpaved Road
- Building
- Trench
- Sump
- Septic Tank

Notes:
Samples analyzed by TestAmerica in Chicago, IL
J=The associated value is an estimated quantity.
UL=The analyte was not detected, and the reported quantitation limit is probably higher than reported.
L=The analyte is present. The reported value may be biased low. The actual value is expected to be higher than reported.
mg/kg=milligram per kilogram
* = data not validated

Y:\Ft_Belvoir\AE10\TO_01\2009-06_SWMU-M41_Decision_Doc
July_09_conf_samples_results.mxd
02/18/10 TH
Source: HGL GIS Database,
Phase II Environmental Investigation Summary Report, SWMU M-41, TetraTech, 2008

HGL HydroGeoLogic, Inc