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AREAS 6A AND 7 INVESTIGATION REPORT LTS NIKE MISSILE MAGAZINES VOLUME 1
SECTIONS 1 THROUGH 6 AND APPENDIX A NS GREAT LAKES IL
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ENSAFE, INC.

**AREAS 6A AND 7 INVESTIGATION REPORT
LTS NIKE MISSILE MAGAZINES**

**VOLUME I — SECTIONS 1 THROUGH 6 AND
APPENDIX A**

**LIBERTYVILLE TRAINING SITE
VERNON HILLS, ILLINOIS**

**SOUTHNAVFACENGCOM
CONTRACT NUMBER:
N62467-89-D-0318**

CTO-161

Prepared for:



**Department of the Navy
Southern Division
Naval Facilities Engineering Command
North Charleston, South Carolina**

Prepared by:



**EnSafe Inc.
5724 Summer Trees Drive
Memphis, Tennessee 38134
(901) 372-7962**

September 6, 2002

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Acronyms Used Frequently in this Report

ACM	asbestos-containing materials
BCT	BRAC Cleanup Team
BRAC	Base Realignment and Closure
bgs	below ground surface
CLP	Contract Laboratory Procedure
CQAPP	Comprehensive Quality Assurance Project Plan
FAA	Federal Aviation Administration
IDW	investigation-derived waste
LSL	Libertyville Screening Level
LTS	Libertyville Training Site
$\mu\text{g}/\text{kg}$	microgram per kilogram
$\mu\text{g}/\text{L}$	microgram per liter
mg/kg	milligram per kilogram
NAS	Naval Air Station
PAHs	polynuclear aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PID	photoionization detector
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
SPLP	Synthetic Precipitation Leaching Procedure
SVOCs	semivolatile organic compounds
TACO	Tiered Approach to Corrective Action Objectives
TAL	target analyte list
TCL	target compound list
TOC	top of casing
VOCs	volatile organic compounds

1.0 INTRODUCTION

This investigation report for Areas 6A and 7 at the Libertyville Training Site (LTS) in Vernon Hills, Illinois has been prepared for submittal to the Base Realignment and Closure (BRAC) Cleanup Team (BCT). It first summarizes the findings of the July 2001 investigation, and then discusses the activities and analytical results for the 2002 further investigation at Magazines Alpha, Bravo, and Charlie in Area 6A and the combined groundwater investigation of Areas 6A and 7.

1.1 Objectives

The objectives of the 2002 investigation were to address potential petroleum product and chlorinated organic solvent (trichloroethylene [TCE], trichloroethane [TCA], and carbon tetrachloride) contamination in Areas 6A and 7 at the LTS. Specific objectives were to:

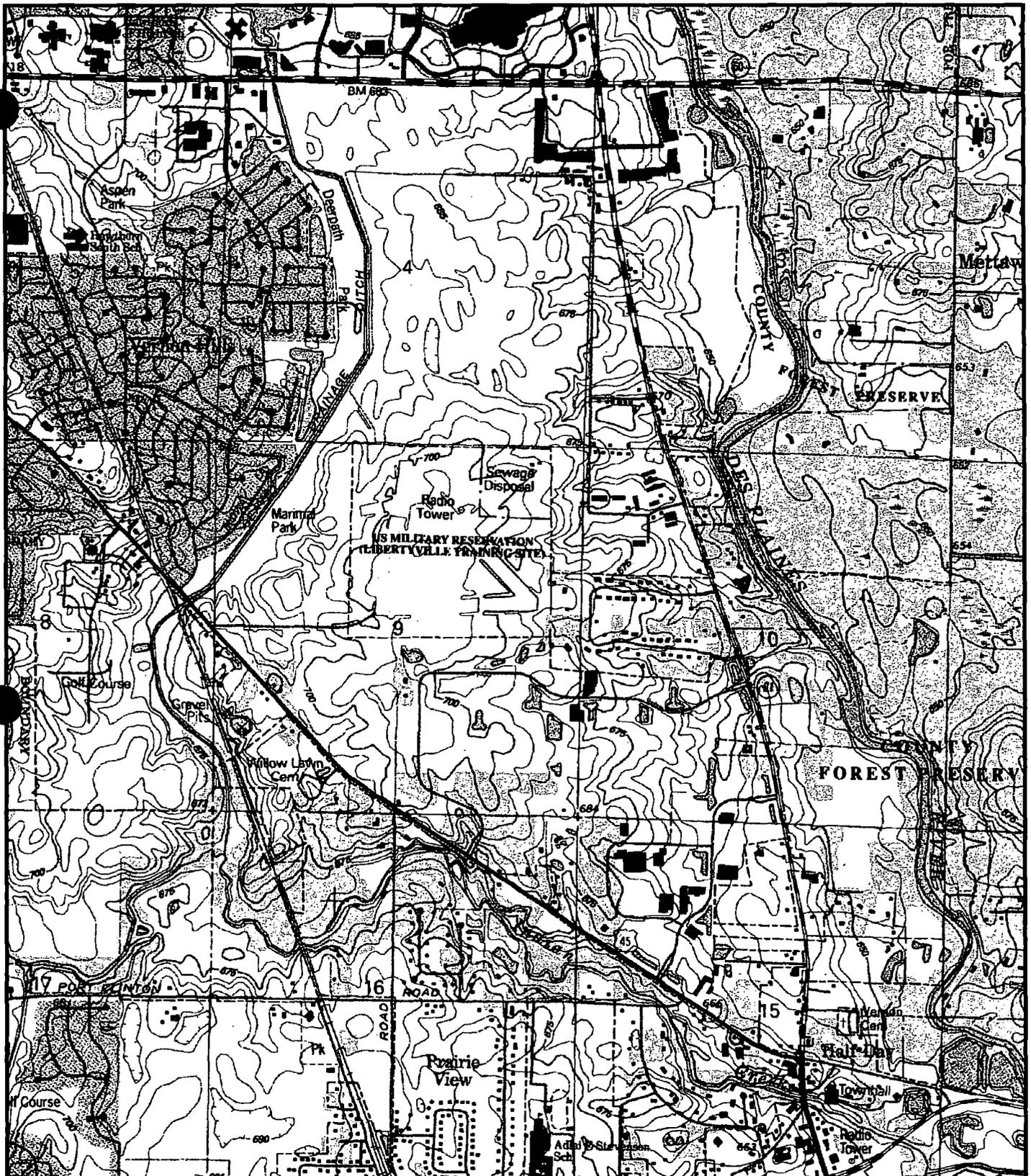
- In Area 6A: Determine whether the constituents detected in the subsurface soil and shallow groundwater surrounding the missile magazines during the July 2001 investigation were from waterproofing material on the magazine walls or other sources. Soil and groundwater samples collected from backfill material adjacent to Magazines Bravo and Charlie in 2001 indicated semivolatile organic compounds (SVOCs) exceeding Libertyville Screening Levels (LSLs). Based on these results, further investigative activities were required to determine whether the LSL exceedances around the exteriors of Magazines Bravo and Charlie were due to sources other than waterproofing and, if so, delineate extent and determine the potential impact to the soil and groundwater adjacent to Magazine Alpha.
- In Areas 6A and 7: Determine the potential impact to groundwater from chlorinated solvents and petroleum products associated with the missile assembly building, the acid neutralization area, and the missile magazines. These were areas where solvent and

petroleum products were most likely to have been used and possibly disposed at the NIKE facility.

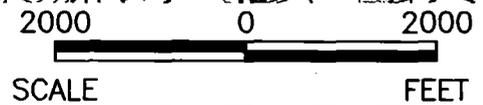
1.2 Background

Areas 6A and 7 are in the northwest corner of the 164.32-acre LTS, which lies approximately 30 miles north of downtown Chicago (Figure 1-1). With elevations varying from approximately 690 to 705 feet above mean sea level, the LTS property is higher than the surrounding area. The Navy purchased the LTS in 1945 for use as an auxiliary airfield and training site for Naval Air Station (NAS) Glenview. In 1954, the LTS was transferred to the Army and was used as a NIKE missile base until 1963. In 1972, the Navy resumed control of the LTS, intending to use the site for additional housing to serve NAS Glenview, which was never built. The LTS was later used for local military and civilian firearms training. From 1971 until the fall of 2000, the Federal Aviation Administration (FAA) used 6 acres for an aircraft navigational aid facility. In 1999, the Navy transferred 3.67 acres of the LTS to the FAA for construction of a new navigational aid facility, which became operational in the fall of 2000. Figure 1-2, a site map of the LTS, shows the locations of Areas 6A and 7. Figure 1-3 shows the July 2001 sample locations and Area 6A site features.

Area 6A consisted of the C-94 Launch Area, which included NIKE missile storage magazines. The three abandoned underground magazines are identified as Magazines Alpha, Bravo, and Charlie. During the site's use by the Army, NIKE missiles were stored in the magazines but were never deployed. The surface of Area 6A was paved, with a storm water drainage ditch around the perimeter of the magazines. Before redevelopment by the Village of Vernon Hills, most of the storm water from the LTS flowed to Area 6A via a 48-inch storm drain, from which it was discharged to Seavey Ditch immediately north of Area 6A. For many years, the Navy has blocked access to all three magazines to prevent trespassers from entering them. Recently, a



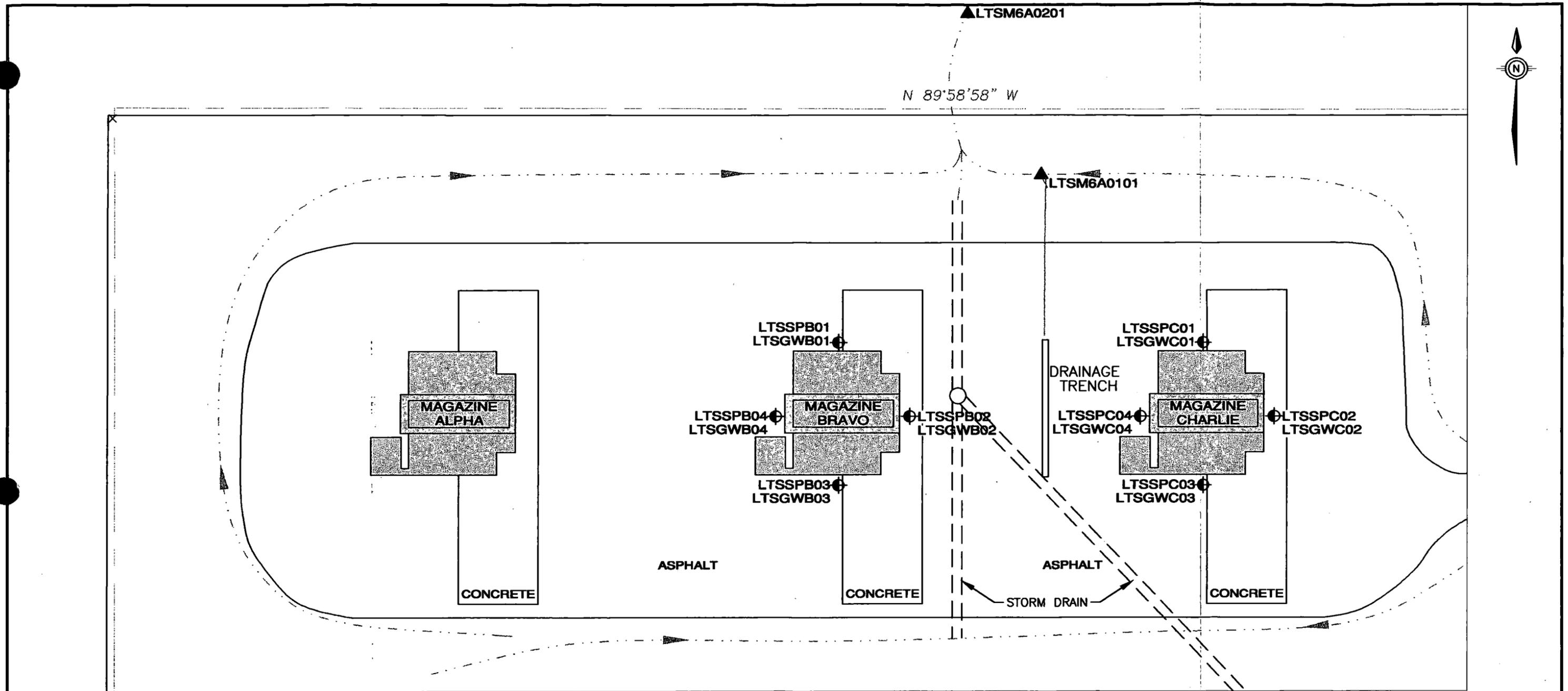
SOURCE: USGS 7.5 MINUTE QUADRANGLE
WHEELING, IL



AREAS 6A & 7
INVESTIGATION REPORT
LIBERTYVILLE
TRAINING SITE
VERNON HILLS, ILLINOIS

FIGURE 1-1
SITE LOCATION MAP

DWG DATE: 08/08/02 NAME: 0161001G007

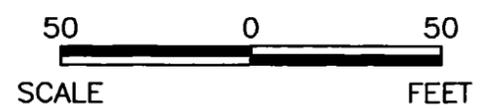


LEGEND

- 6A BOUNDARY
- ▲- DITCH; ARROW DENOTES FLOW DIRECTION
- ⊕ EXISTING SOIL BORING/PIEZOMETER
- ▲ DITCH SEDIMENT SAMPLE

NOTE

SHADED AREA DENOTES SUBSURFACE MAGAZINE LOCATION



	AREAS 6A & 7 INVESTIGATION REPORT LIBERTYVILLE TRAINING SITE VERNON HILLS, ILLINOIS	FIGURE 1-3 MAGAZINE EXTERIOR 2001 SAMPLE LOCATIONS
	DWG DATE: 08/08/02 NAME: 0161001G009	

chain-link fence was erected around Area 6A to further prevent unauthorized access to the site. Demolition of the magazines began in April 2002.

Prior to this investigation, Area 6A was evaluated during the original Gray Sites Investigation and the Gray Sites Addendum Investigation. During all previous phases of investigation, Magazine Alpha was empty of water and accessible for entry, inspection, and sampling. Until June 2001, Magazines Bravo and Charlie were filled with water and inaccessible. In June 2001, under a license from the Navy, the Village of Vernon Hills pumped most of the water out. During pumping, evidence of petroleum product was identified in the last 2 to 3 feet of water in each magazine. The Village ceased the pumping operations and the Navy returned to the site to address the newly identified environmental issues.

Until recently Area 7 was open space with scattered brush and trees bordered on the north by the fence and property line and on the south, east, and west by other portions of the LTS. Several sites in Area 7 were assessed during the original Gray Sites Investigation. Detected constituents at most of the sites were below the LSLs and no further action was required. Two sites in Area 7, the Missile Assembly building site and the Gray Denuded Area, required further investigation. These two sites were separated from the rest of Area 7 and designated as Area 7A. Further investigation of Area 7A resulted in non-time-critical removal actions, during which contaminated soil was removed and disposed of offsite.

As a result of investigations at other former NIKE sites in Illinois and Ohio, the Illinois Environmental Protection Agency (IEPA) was concerned about possible chlorinated solvent contamination in groundwater at the LTS. Areas where solvents were most likely to have been used at NIKE missile facilities were the missile assembly building, the acid neutralization area, and the missile magazines. The missile assembly building and acid neutralization area are within the original boundaries of Area 7. To address the chlorinated solvent concerns, the Navy investigated groundwater in both Areas 6A and 7.

1.3 Previous Investigations at LTS

Interior and exterior investigative activities were conducted at Magazines Bravo and Charlie in July 2001 (Magazine Alpha was excluded) to address issues that arose when the Village of Vernon Hills began pumping accumulated water out of the magazines. The interior investigation consisted of an inspection of the physical condition of the magazines and sampling of interior water, sediment, and potential asbestos-containing materials (ACM). The exterior investigation consisted of collecting subsurface soil samples from the fill material around the magazines, installation of temporary piezometric monitoring wells to sample groundwater in the fill material, and collection of sediment samples from the ditch where magazine water was discharged by the Village of Vernon Hills.

Because the July 2001 sample locations were so close to the magazine walls, it was suspected that LSL exceedances were caused by fragments of waterproofing material in the samples that was scraped off the exterior walls during sampling. All parameters exceeding LSLs were SVOCs that are constituents of petroleum-based waterproofing material. Other environmental evaluations, investigations, and removals conducted at the LTS are summarized in Section 1 of the *Area 6A NIKE Missile Magazines Investigation Report* (EnSafe 2001).

2.0 INVESTIGATION METHODOLOGY

The specific methods used for the investigation of the NIKE missile magazines are discussed in the following subsections. The sampling procedures and analytical methods used are detailed in the *Comprehensive Quality Assurance Project Plan (CQAPP)* (E&E, 1994), *Technical Memorandum No. 20, the Supplemental Quality Assurance Project Plan (SQAPP)* (EnSafe, 2001), and the *Areas 6A and 7 Further Investigation Work Plan* (EnSafe, 2002). The Area 6A investigation was performed to determine whether the polynuclear aromatic hydrocarbons (PAHs) detected in native soil and fill material along the exterior portions of Magazines Bravo and Charlie was due to waterproofing material on the magazine walls. The combined Areas 6A and 7 groundwater investigation was performed to determine the potential impact to groundwater from chlorinated solvents and petroleum products associated with the missile assembly building, the acid neutralization area, and the missile magazines.

During the July 2001 investigation, a number of PAHs detected in soil exceeded their LSLs on each side of Magazine Bravo and on the east and west sides of Magazine Charlie. The sample locations from the 2001 investigation are shown on Figure 1-3. The first sampling phase of this soil investigation focused on the areas at Magazines Bravo and Charlie where LSL exceedances occurred in July 2001. Subsequent phases targeted soil south of Magazine Bravo and soil and groundwater around Magazine Alpha.

Soil borings were advanced using hollow-stem augers, and samples were collected using 2- and 3-inch outer-diameter 24-inch split-spoon samplers. During the investigation of Magazine Bravo and Charlie, soil borings were placed in backfill soil and samples were collected from depths that corresponded with depths where LSL exceedances occurred in prior investigations or phases. A photoionization detector (PID) was used to screen samples for indications of volatile organic compounds.

During the investigation at Magazine Alpha, samples were continuously collected from the ground surface, through backfill material, until the native material was encountered. A PID was used to continuously screen the soil column for impacted intervals to target for analysis. If no elevated PID readings were observed, samples were generally collected from the vadose zone, the approximate water table interface, and the native soil beneath the fill.

2.1 Magazines Bravo and Charlie Further Investigation Approach

Soil samples were collected around Magazines Bravo and Charlie to determine whether waterproofing from the exterior magazine walls was the source of LSL exceedances in the July 2001 investigation. Fourteen soil borings were installed and sampled around Magazine Bravo during three phases of sampling. Two soil borings were installed and sampled on the east and west sides of Magazine Charlie. In addition, one permanent monitoring well was installed and sampled east of Magazine Bravo.

2.1.1 Soil Investigation

Magazine Bravo Delineation — April 2002

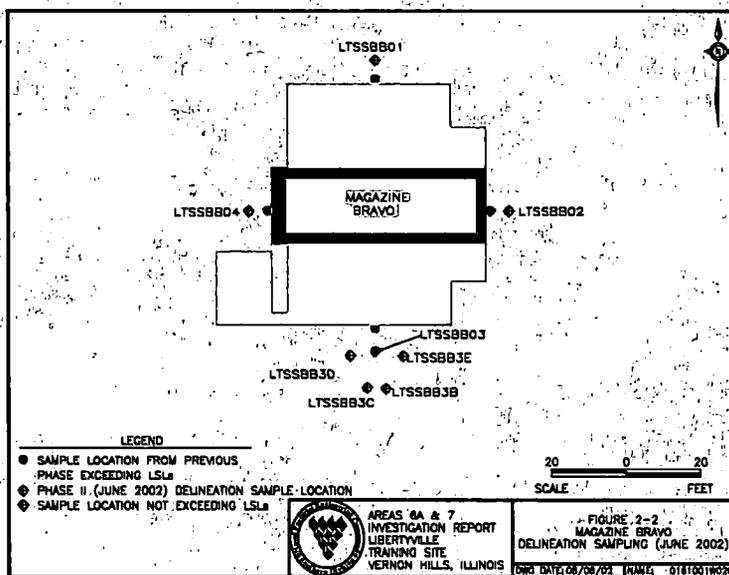
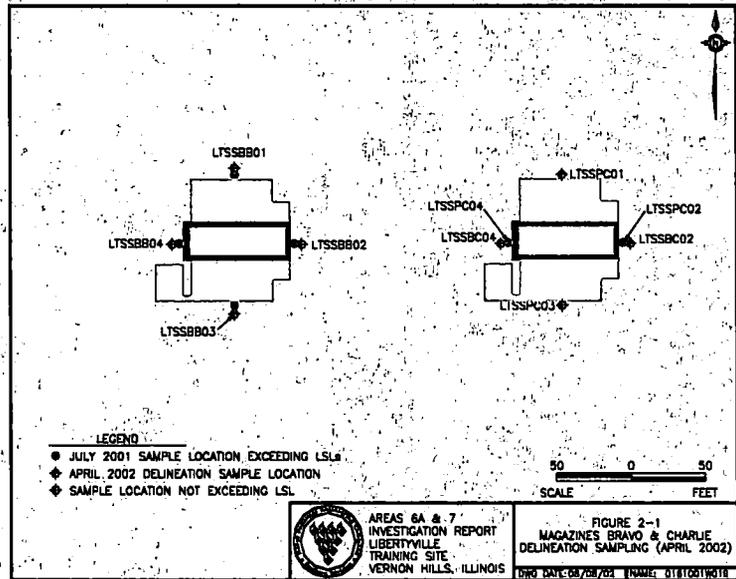
In accordance with the *Areas 6A and 7 Further Investigation Work Plan*, four soil borings were installed around Magazine Bravo to determine whether the July 2001 LSL exceedances were due to waterproofing scraped off magazine walls or other sources. As described in the work plan, stratigraphic borings were drilled in an attempt to identify the extent of backfill soil and the boundary between backfill and native soil. Based on the information obtained from the stratigraphic borings, Phase I samples were collected five feet away from the July 2001 locations. The April 2002 delineation sample locations are shown on Figure 2-1, along with the sample locations where LSLs were exceeded in July 2001. Samples LTSSBB0118 and LTSCBB0118 (duplicate) were collected on the magazine's north side at depths of 16 to 18 feet bgs. Samples LTSSBB0218 and LTSSBB0225 were collected on the magazine's east side at depths of 16 to 18 feet and 23 to 25 feet bgs, respectively. Samples LTSSBB0305 and LTSSBB0314 were collected on the magazine's south side at depths of 3 to 5 feet and 12 to 14 feet bgs, respectively. Samples LTSSBB0417 and LTSSBB0425

were collected on the magazine's west side at depths of 15 to 17 feet and 23 to 25 feet bgs, respectively.

Magazine Bravo Delineation — June 2002

The results of the April 2002 sampling event indicated PAH exceedances in sample LTSSB0314 (12 to 14 feet bgs) south of Magazine Bravo. Therefore, four additional borings were placed

south of Magazine Bravo in June 2002 to delineate the extent of contamination. These sample locations were placed approximately 5 to 10 feet away from the previous sample location (LTSSBB03). The four additional locations used to further delineate these constituents are shown on Figure 2-2.



Samples LTSSBB3B12, LTSSBB3B14, and LTSSBB3B16 were collected to the southeast of soil boring LTSSBB03. Samples LTSSBB3C12, LTSSBB3C14, and LTSSBB3C16 were collected to the southwest of soil boring LTSSBB03. Samples LTSSBB3D12, LTSSBB3D14, and LTSSBB3D16 were collected to the west of soil boring LTSSBB03. Samples LTSSBB3E12, LTSSBB3E14, and

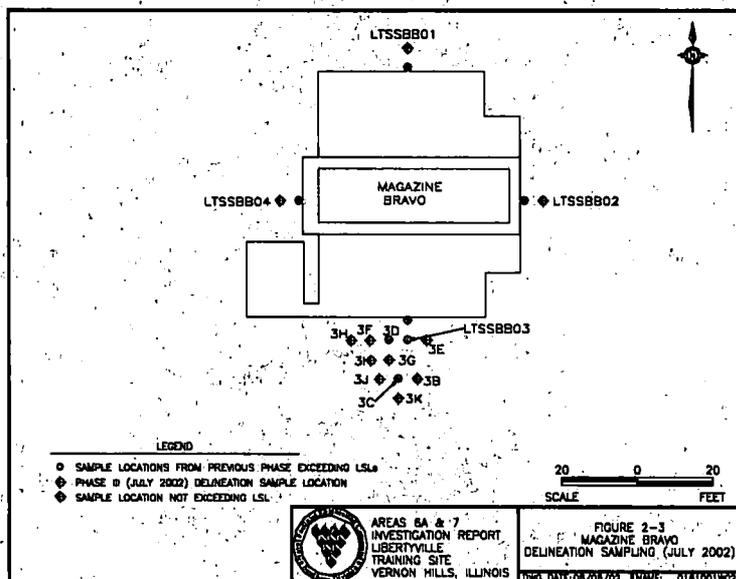
LTSSBB3E16 were collected to the east of soil boring LTSSBB03.

Because LSL exceedances were detected in the 12-to-14-foot interval during the April 2002 sampling, the June samples were collected from 10 to 12 feet, 12 to 14 feet, and 14 to 16 feet bgs.

Magazine Bravo Delineation — July 2002

The June 2002 sampling results indicated PAH and arsenic exceedances in samples LTSSB3D16 (14 to 16 feet) and LTSSB3C12 (10 to 12 feet). Therefore, six additional borings were placed around the

southwestern edge of Magazine Bravo in July 2002 to delineate the extent of contamination. Because LSLs had been exceeded in samples LTSSBB3D16 (the bottom sample), an additional sample was collected from the 16-to-18-foot interval at LTSSBB3D to further delineate the vertical extent at that location. The six additional locations sampled to further delineate these constituents are shown on Figure 2-3.



Locations LTSSBB3F, LTSSBB3H, and LTSSBB3I were each sampled at three subsurface intervals, 12 to 14 feet, 14 to 16 feet, and 16 to 18 feet bgs. Locations LTSSBB3G, LTSSBB3J, and LTSSBB3K were sampled from 8 to 10 feet, 10 to 12 feet, and 12 to 14 feet. Samples were also collected from the 14- to 16-foot and 16- to 18-foot intervals at location LTSSBB3G to delineate the southern extent of contamination detected at LTSSBB3D.

Magazine Charlie Delineation

In accordance with the *Areas 6A and 7 Further Investigation Work Plan*, two additional soil borings were installed around Magazine Charlie to determine whether waterproofing was the source of LSL exceedances at the 2001 sample locations. One location each was sampled on the east and west sides

of Magazine Charlie, approximately 5 feet away from the previous sample locations where LSLs had been exceeded, as shown on Figure 2-1.

Sample LTSSBC0212 was collected on the magazine's east side at depth of 10 to 12 feet bgs. Sample LTSSBC0422 was collected on the magazine's west side at a depth of 20 to 22 feet bgs. Sample LTSCBC0422 was a duplicate sample.

The samples collected at Magazines Bravo and Charlie are summarized in Table 2-1. The soil stratigraphy was described, classified, and logged by a professional geologist licensed in the State of Illinois. The site stratigraphic sequence is discussed in Section 3.2. Copies of the boring logs are contained in Appendix A.

Boring	Sample ID	Date Collected	Depth Collected (feet bgs)	Description
LTSSBB01	LTSSBB0118	4/26/02	16-18	Olive brown silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSCBB0118*	4/26/02	16-18	Olive brown silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
LTSSBB02	LTSSBB0218	4/26/02	16-18	Black, gray, and olive brown silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSSBB0225	4/26/02	23-25	Black, gray, and olive brown silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
LTSSBB03	LTSSBB0305	4/26/02	3-5	Black, gray, and brown silty clay, little coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSSBB0314	4/26/02	12-14	Dark grayish brown mottled silty clay, trace fine to coarse sand and fine gravel, medium plasticity, moist. Fill.
LTSSBB04	LTSSBB0417	4/26/02	15-17	Gray, black, and brown mixed silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSSBB0425	4/26/02	23-25	Gray silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Unweathered Native.
LTSSBB3B	LTSSBB3B12	6/7/02	10-12	Brown and gray silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSSBB3B14	6/7/02	12-14	Gray brown silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Weathered Native.
	LTSSBB3B16	6/7/02	14-16	Gray brown silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Weathered Native.
LTSSBB3C	LTSSBB3C12	6/7/02	10-12	Brown and gray silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSSBB3C14	6/7/02	12-14	Brown and gray silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSSBB3C16	6/7/02	14-16	Gray silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Weathered Native.

Table 2-1
Soil Boring Soil Sample Summary
Magazine Bravo and Charlie Exterior Investigation
Area 6A

Boring	Sample ID	Date Collected	Depth Collected (feet bgs)	Description
LTSSBB3D	LTSSBB3D12	6/7/02	10-12	Olive brown and gray silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSSBB3D14	6/7/02	12-14	Gray and brown silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSSBB3D16	6/7/02	14-16	Gray and brown silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSCBB3D16*	6/7/02	14-16	Gray, brown, and black silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSSBB3D18	7/11/02	16-18	Dark gray silty clay, trace coarse to fine sand, and coarse to fine gravel, medium plasticity. Unweathered Native.
LTSSBB3E	LTSSBB3E12	6/7/02	10-12	Gray and brown silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSSBB3E14	6/7/02	12-14	Gray and brown silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSSBB3E16	6/7/02	14-16	Gray and brown silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
LTSSBB3F	LTSSBB3F14	7/11/02	12-14	Olive brown and gray silty clay, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist. Fill.
	LTSSBB3F16	7/11/02	14-16	Olive brown and gray silty clay, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist. Fill.
	LTSSBB3F18	7/11/02	16-18	Dark gray silty clay, trace coarse to fine sand and coarse to fine gravel, medium plasticity, moist. Unweathered Native.
LTSSBB3G	LTSSBB3G10	7/11/02	8-10	Olive brown and gray silty clay, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist. Fill.
	LTSSBB3G12	7/11/02	10-12	Olive brown and gray silty clay, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist. Fill.
	LTSSBB3G14	7/11/02	12-14	Grayish brown silty clay, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist. Weathered Native.
	LTSSBB3G16	7/11/02	14-16	Grayish brown silty clay, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist. Weathered Native.
	LTSSBB3G18	7/11/02	16-18	Dark gray silty clay, trace coarse to fine sand, and coarse to fine gravel, medium plasticity. Unweathered Native.
LTSSBB3H	LTSSBB3H14	7/11/02	12-14	Olive brown and gray silty clay, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist. Fill.
	LTSSBB3H16	7/11/02	14-16	Olive brown and gray silty clay, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist. Fill.
	LTSSBB3H18	7/11/02	16-18	Olive brown and gray silty clay, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist. Fill.
LTSSBB3I	LTSSBB3I14	7/11/02	12-14	Olive brown and gray silty clay, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist. Fill.
	LTSSBB3I16	7/11/02	14-16	Grayish brown silty clay, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist. Weathered Native.
	LTSSBB3I18	7/11/02	16-18	Dark gray silty clay, trace coarse to fine sand, and coarse to fine gravel, medium plasticity. Unweathered Native.

Table 2-1 Soil Boring Soil Sample Summary Magazine Bravo and Charlie Exterior Investigation Area 6A				
Boring	Sample ID	Date Collected	Depth Collected (feet bgs)	Description
LTSSBB3J	LTSSBB3J10	7/11/02	8-10	Olive brown and gray silty clay, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist. Fill.
	LTSSBB3J12	7/11/02	10-12	Grayish brown silty clay, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist. Weathered Native.
	LTSSBB3J14	7/11/02	12-14	Grayish brown silty clay, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist. Weathered Native.
LTSSBB3K	LTSSBB3K10	7/11/02	8-10	Grayish brown silty clay, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist. Weathered Native.
	LTSSBB3K12	7/11/02	10-12	Grayish brown silty clay, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist. Weathered Native.
	LTSSBB3K14	7/11/02	12-14	Grayish brown silty clay, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist. Weathered Native.
LTSSBC02	LTSSBC0112	4/26/02	10-12	Olive brown silty clay, trace coarse to fine sand, and fine gravel, medium plasticity, moist. Fill.
LTSSBC04	LTSSBC0422	4/26/02	20-22	Gray fine to coarse sand, little fine to coarse gravel, very silty, saturated. Fill.
	LTSSBC0422*	4/26/02	20-22	Gray fine to coarse sand, little fine to coarse gravel, very silty, saturated. Fill.

Note:

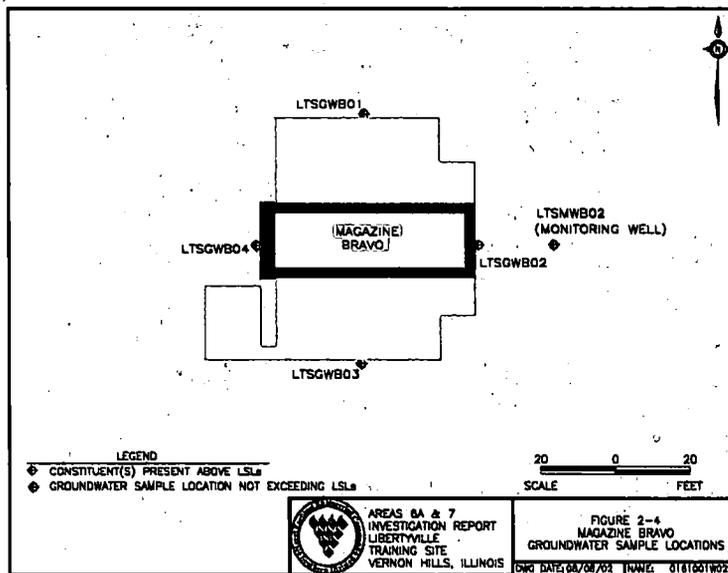
* = Duplicate Sample

Soil Sample Analysis

Soil samples were analyzed for target compound list (TCL) volatile organic compounds (VOCs); TCL (SVOCs), which included polynuclear aromatic hydrocarbons compounds (PAHs) at low detection levels; TCL polychlorinated biphenyls (PCBs); and target analyte list (TAL) metals. The Synthetic Precipitation Leaching Procedure (SPLP) was conducted for six metals. Soil samples were also analyzed for pH to determine the TACO1 screening criteria for each particular set of samples.

2.1.2 Magazine Bravo Groundwater Investigation

As described in Section 3 of the *Areas 6A and 7 Further Investigation Work Plan*, a single shallow monitoring well (LTSMWB02) was installed to the east of temporary well LTSGWB02. This is the location of the July 2001 temporary well sample that exhibited naphthalene in backfill groundwater at a concentration exceeding the LSL. The well was installed to a depth of approximately



28 feet bgs to allow sampling of groundwater in the undisturbed soil at the approximate depth of the near by temporary well. This well produces limited groundwater from the native glacial clay, presumably through fractures. The shallow monitoring well installed on the east side of Magazine Bravo, along with the temporary wells installed in July 2001, are shown on Figure 2-4.

The monitoring well was constructed of 2-inch ID, flush-jointed, polyvinyl chloride (PVC) riser, with a 10-foot-long 0.01-inch factory-slotted screen. Filter pack sand was placed from the bottom of the screen to at least 2 feet above the top of the screen. The remainder of the annulus was sealed with a high clay solids bentonite grout to ensure a positive seal. Protective bump posts and an aboveground steel well protector were installed and the monitoring well was secured with an expanding locked cap and keyed-alike brass locks. The monitoring well was developed using a Teflon bailer and sampled after waiting at least 24 hours from completion of development.

The monitoring well was first purged and the parameters of pH, conductivity, temperature, and turbidity were monitored and recorded to determine when purging was complete. After purging was completed, samples were collected from well LTSMB02 using low-flow methods with dedicated Teflon tubing and a peristaltic pump. Temporary well LTSQWB02 was also resampled using a peristaltic pump and dedicated Teflon tubing.

Groundwater Sample Analysis

Groundwater samples were analyzed for TCL VOCs; TCL SVOCs, which included PAHs at low detection levels; TCL PCBs; and TAL metals.

2.2 Magazine Alpha Investigation Approach

In accordance with the *Areas 6A and 7 Further Investigation Work Plan*, and based on the results of the additional samples collected around Magazine Bravo, investigative activities were conducted in the area surrounding Magazine Alpha. In all, eight soil borings and four temporary monitoring wells were installed and sampled around Magazine Alpha.

2.2.1 Magazine Alpha Soil Investigation

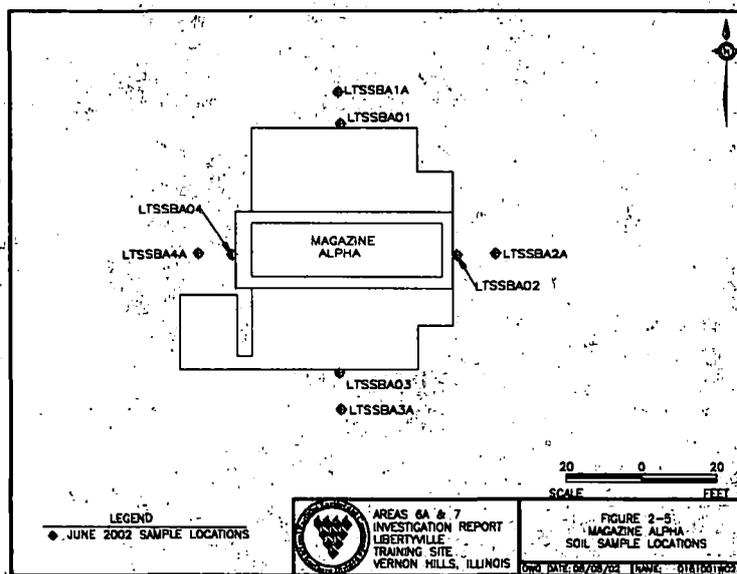
To accelerate completion of the project, all sampling for Magazine Alpha was conducted during one event. All three magazines were constructed identically, and the locations of the exterior walls had been determined during the investigation of Magazine Bravo and Magazine Charlie; therefore, four boring locations were marked at the center point of each magazine wall using the Magazine Bravo piezometer locations as a guide. Locations were positioned several feet from the walls to avoid scraping walls during sampling.

As described in the work plan, four soil borings (LTSSBA01, LTSSBA02, LTSSBA03, and LTSSBA04) were installed to depths ranging from 25 to 27 feet bgs. Samples were collected continuously from ground surface, through backfill material, and into undisturbed native soil. The previous investigations of Magazines Bravo and Charlie had shown that unsaturated clay fill material would be encountered first, then a saturated sand fill material in the lower part, on top of the unweathered gray glacial diamicton. Lithology encountered at Magazine Alpha was similar to that encountered at Magazines Bravo and Charlie.

Three subsurface soil samples were collected from each boring for laboratory analysis; one from the vadose zone (unsaturated clay fill), one at the approximate water table interface (sand fill), and one from the underlying unweathered gray diamicton. Samples from the clay fill were collected at varying depths (ranging from 3 to 5 feet to 11 to 13 feet bgs) so analytical data would be available from a range of depth intervals. Samples from the sand fill were collected from either 17 to 19 or 19 to 21 feet bgs because this unit is relatively thin, about 5 feet thick. Samples from the underlying unweathered gray diamicton were collected from 23 to 25 feet, just beneath the sand fill, to determine

if any impact from overlying fill material had occurred. Upon completion of soil sampling, these soil borings were converted to temporary monitoring wells.

Once monitoring wells were in place, four more soil borings (LTSSBA01A, LTSSBA02A, LTSSBA03A, and LTSSBA04A) were installed. Each was placed 5 to 8 feet from its corresponding monitoring well in a line perpendicular to the magazine wall. These borings were installed and sampled in the same manner as the monitoring well borings. Soil samples were collected from the same intervals to allow for same-depth data comparison. Again, a PID was used to continuously screen the soil column for impacted intervals. No visual, olfactory, or PID readings indicated impacted soil.



The soil sample locations for Magazine Alpha are shown on Figure 2-5. Soil samples collected at Magazine Alpha are summarized in Table 2-2, which also presents a stratigraphic summary. Soil stratigraphy was described, classified and logged by a professional geologist licensed in the State of Illinois. Copies of the boring logs are provided in Appendix A.

Soil Sample Analysis

Soil samples were analyzed for TCL VOCs; TCL SVOCs, which included PAHs at low detection levels; TCL PCBs; and TAL metals. SPLP analysis was performed on six metals. Soil samples were also analyzed for pH to determine the appropriate TACO screening criteria for each particular set of samples.

Table 2-2
Monitoring Well Boring Soil Sample Summary
Magazine Alpha Exterior Investigation
Area 6A

Boring	Sample ID	Date Collected	Depth Collected (feet bgs)	Description
LTSSBA01	LTSSBA0105	6/7/02	3-5	Brown and gray mottled silty clay, with trace fine to coarse sand and fine gravel, medium plasticity, moist. Fill.
	LTSSBA0121*	6/7/02	19-21	Loose multicolored fine to coarse sand and fine to medium gravel, very silty, moist. Fill.
	LTSCBA0121	6/7/02	19-21	Loose multicolored fine to coarse sand and fine to medium gravel, very silty, moist. Fill.
	LTSSBA0125	6/7/02	23-25	Gray silty clay, trace fine to coarse sand and fine gravel, medium plasticity, moist. Unweathered Native.
LTSSBA02	LTSSBA0207	6/7/02	5-7	Greenish gray and black mottled silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSSBA0221	6/7/02	19-21	Loose multicolored fine to coarse sand and fine to medium gravel, very silty, moist. Fill.
	LTSSBA0225	6/7/02	23-25	Gray silty clay, trace fine to coarse sand and fine gravel, medium plasticity, moist. Unweathered Native.
LTSSBA03	LTSSBA0313	6/8/02	11-13	Dark grayish brown and gray silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSCBA0313*	6/8/02	11-13	Dark grayish brown and gray silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSSBA0319	6/8/02	17-19	Loose multicolored fine to coarse sand and fine to medium gravel, very silty, moist. Fill.
	LTSSBA0325	6/8/02	23-25	Gray silty clay, trace fine to coarse sand and fine gravel, medium plasticity, moist. Unweathered Native.
LTSSBA04	LTSSBA0411	6/8/02	9-11	Greenish gray and gray mottled silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSSBA0421	6/8/02	19-21	Loose multicolored fine to coarse sand and fine to medium gravel, very silty, moist. Fill.
	LTSSBA0425	6/8/02	23-25	Gray silty clay, trace fine to coarse sand and fine gravel, medium plasticity, moist. Unweathered Native.
LTSSBA01A	LTSSBA1A05	6/11/02	3-5	Gray, black, and brown mixed silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSCBA1A05*	6/11/02	3-5	Gray, black, and brown mixed silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSSBA1A21	6/11/02	19-21	Gray silty clay, trace fine to coarse sand and fine gravel, medium plasticity, moist. Unweathered Native.
	LTSSBA1A25	6/11/02	23-25	Gray silty clay, trace fine to coarse sand and fine gravel, medium plasticity, moist. Unweathered Native.
LTSSBA02A	LTSSBA2A07	6/12/02	5-7	Black, gray, and orange brown silty clay, little coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSSBA2A21	6/12/02	19-21	Gray silty clay, trace fine to coarse sand and fine gravel, medium plasticity, moist. Unweathered Native.
	LTSSBA2A25	6/12/02	23-25	Gray silty clay, trace fine to coarse sand and fine gravel, medium plasticity, moist. Unweathered Native.

Table 2-2
Monitoring Well Boring Soil Sample Summary
Magazine Alpha Exterior Investigation
Area 6A

Boring	Sample ID	Date Collected	Depth Collected (feet bgs)	Description
LTSSBA03A	LTSSBA3A13	6/11/02	11-13	Dark grayish brown and gray silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSSBA3A19	6/11/02	17-19	Brown and gray mottled silty clay, trace fine to coarse sand and fine gravel, medium plasticity, moist. Weathered Native.
	LTSSBA3A25	6/11/02	23-25	Gray silty clay, trace fine to coarse sand and fine gravel, medium plasticity, moist. Unweathered Native.
LTSSBA04A	LTSSBA4A11	6/11/02	9-11	Gray, black, and brown mixed silty clay, trace coarse to fine sand and fine gravel, medium plasticity, moist. Fill.
	LTSSBA4A21	6/11/02	19-21	Loose multicolored fine to coarse sand and fine to medium gravel, very silty, moist. Fill.
	LTSSBA4A25	6/11/02	23-25	Gray silty clay, trace fine to coarse sand and fine gravel, medium plasticity, moist. Unweathered Native.

Note:

* = Duplicate Sample

2.2.2 Magazine Alpha Groundwater Investigation

As described in the work plan, four piezometric monitoring wells (LTSGWA01, LTSGWA02, LTSGWA03, and LTSGWA04) were installed to depths of approximately 25 feet bgs. Monitoring wells were constructed of 2-inch ID, flush-jointed, PVC riser and screen. A 10-foot length of 0.01-inch factory slotted screen was used at each location. Filter pack sand was placed from the bottom of the screen to at least 2 feet above the top of the screen. The remainder of the annulus was sealed with high-clay solids bentonite grout hydrated in 2-foot lifts to ensure a positive seal. No protective cover or bump posts were installed, as these were intended as temporary features. Each monitoring well was secured with an expanding locked cap and keyed-alike brass locks. The elevations of the tops of the well risers were not determined.

Monitoring wells were developed using a Teflon bailer. Monitoring wells at Magazine Alpha generally had little groundwater accumulation relative to the other magazines and therefore, wells were bailed dry repeatedly during the development process. The well locations at Magazine Alpha are shown on Figure 2-6. Monitoring well construction details are summarized in Table 2-3.

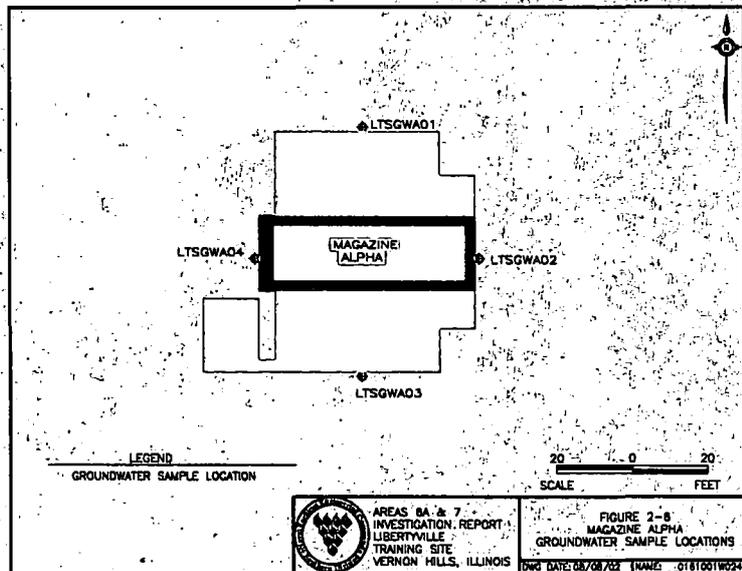


Table 2-3
Monitoring Well Construction
Magazine Alpha Exterior Investigation
Area 6A

Well ID	Date Installed	Construction Depth (ft bgs)			Depth to Water from TOC* (ft)	Total depth from TOC (ft)	Water Column Thickness (ft)
		Total Depth	Bottom of Screen	Top of Screen			
LTSGWA01	6/7/02	25	23	13	22.22	25.42	3.2
LTSGWA02	6/7/02	25	23	13	24.57	25.44	0.87
LTSGWA03	6/8/02	25	23	13	19.40	25.43	6.03
LTSGWA04	6/8/02	27	25	15	24.21	27.41	3.2

Notes:

- TOC = Top of casing.
- * = Measured on July 8, 2002.

Monitoring wells were sampled after waiting at least 24 hours from completion of development. Each well was first purged using dedicated Teflon tubing and a peristaltic pump in the same manner as those sampled at Magazines Bravo and Charlie. Conductivity, temperature, pH, and turbidity were monitored and recorded to determine when development was complete. After

purging was completed, samples were collected in the same manner as those collected at Magazines Bravo.

Groundwater Sample Analysis

Groundwater samples were analyzed for TCL VOCs; TCL SVOCs, which included PAHs at low detection levels; TCL PCBs; and TAL metals.

2.3 Area 6A Shallow Subsurface Investigation

As part of the Area 6A investigation, numerous soil borings were advanced to determine the horizontal and vertical extent of fill material in this area and to ascertain the shape of the original magazine construction excavation. The borings were oriented from east to west across all three magazines and also north to south across each magazine. They were generally spaced 15 to 20 feet apart and extended to the edges of the asphalt surrounding Area 6A. The locations are presented on Figure 2-7. Each boring was advanced using either a 3/4- or 4/4-inch inside diameter hollow stem auger (HSA). While setting the rig at each location, care was taken to ensure the boring was vertical. Samples were collected with a standard 2-inch-diameter split-spoon sampler until the unweathered glacial diamicton was encountered. At completion, the borings were checked for groundwater. Each boring was then sealed with bentonite chips, which were subsequently hydrated with potable water. The boring logs are contained in Appendix A.

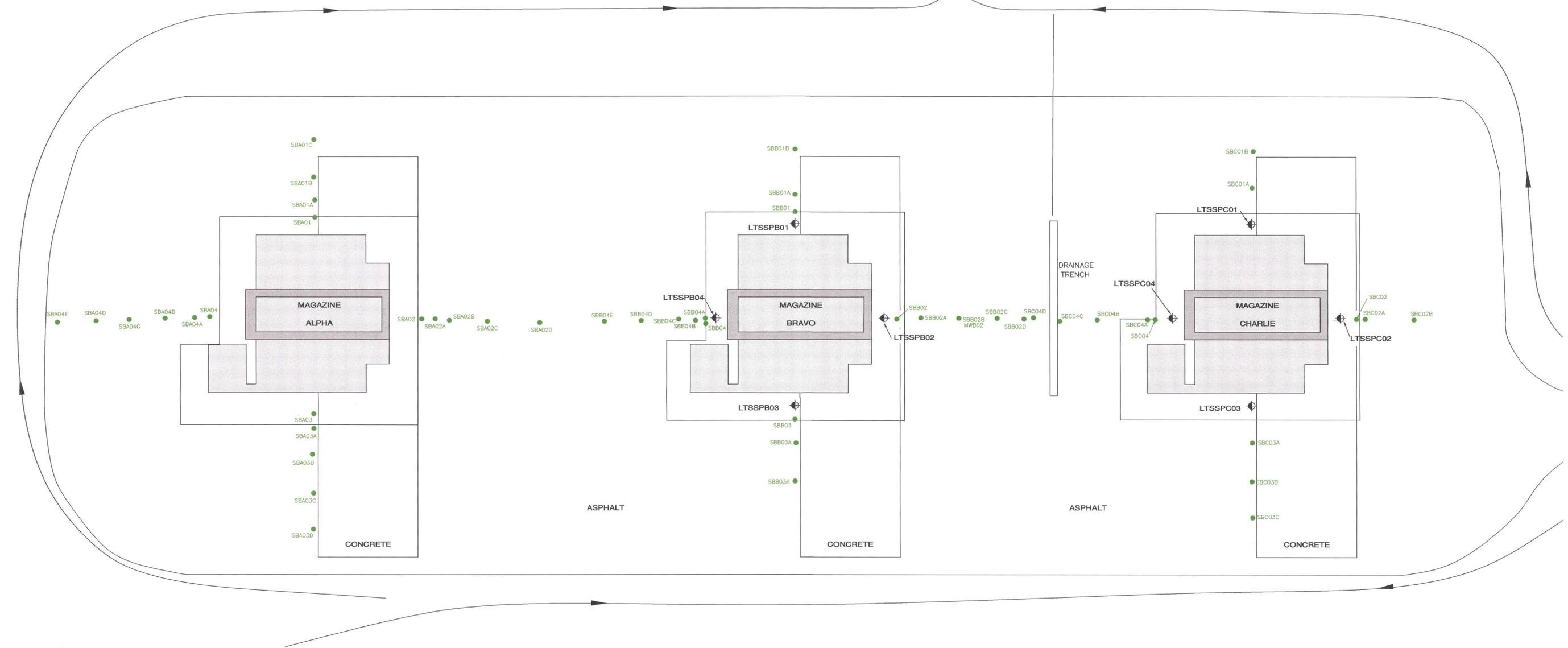
The borings were used to construct conceptual cross sections of Area 6A that would be used to guide additional delineation soil and groundwater sampling locations and to provide guidance for the magazine demolition and associated excavation.

2.4 Combined Areas 6A and 7 Groundwater Investigation Approach

The objective of the combined groundwater investigation was to determine if chlorinated solvents or possibly other materials released from Areas 6A and 7 had impacted groundwater. Because of



N 88°58'58" W



LEGEND

- GA BOUNDARY
- DITCH; ARROW DENOTES FLOW DIRECTION
- SOIL BORING LOCATION
- ⊕ EXISTING SOIL BORING/MONITORING WELL

NOTE
SHADED AREA DENOTES SUBSURFACE MAGAZINE LOCATION

REVISION		
Rev Number: 000	Rev Date: 00/00/00	Rev By: NAME
Rev Number: 000	Rev Date: 00/00/00	Rev By: NAME
Rev Number: 000	Rev Date: 00/00/00	Rev By: NAME
Rev Number: 000	Rev Date: 00/00/00	Rev By: NAME
Rev Number: 000	Rev Date: 00/00/00	Rev By: NAME

20 0 20
SCALE FEET



AREAS 6A & 7
FURTHER INVESTIGATION
WORK PLAN
LIBERTYVILLE
TRAINING SITE
VERNON HILLS, ILLINOIS

FIGURE 2-7
MAGAZINE EXTERIOR
SOIL BORING LOCATIONS

Dr by: NAME	Tr by: NAME
Ck by: NAME	App by: NAME
Date: 08/28/02	DWG Name: 0161001G003

Sheet 1
Of 1

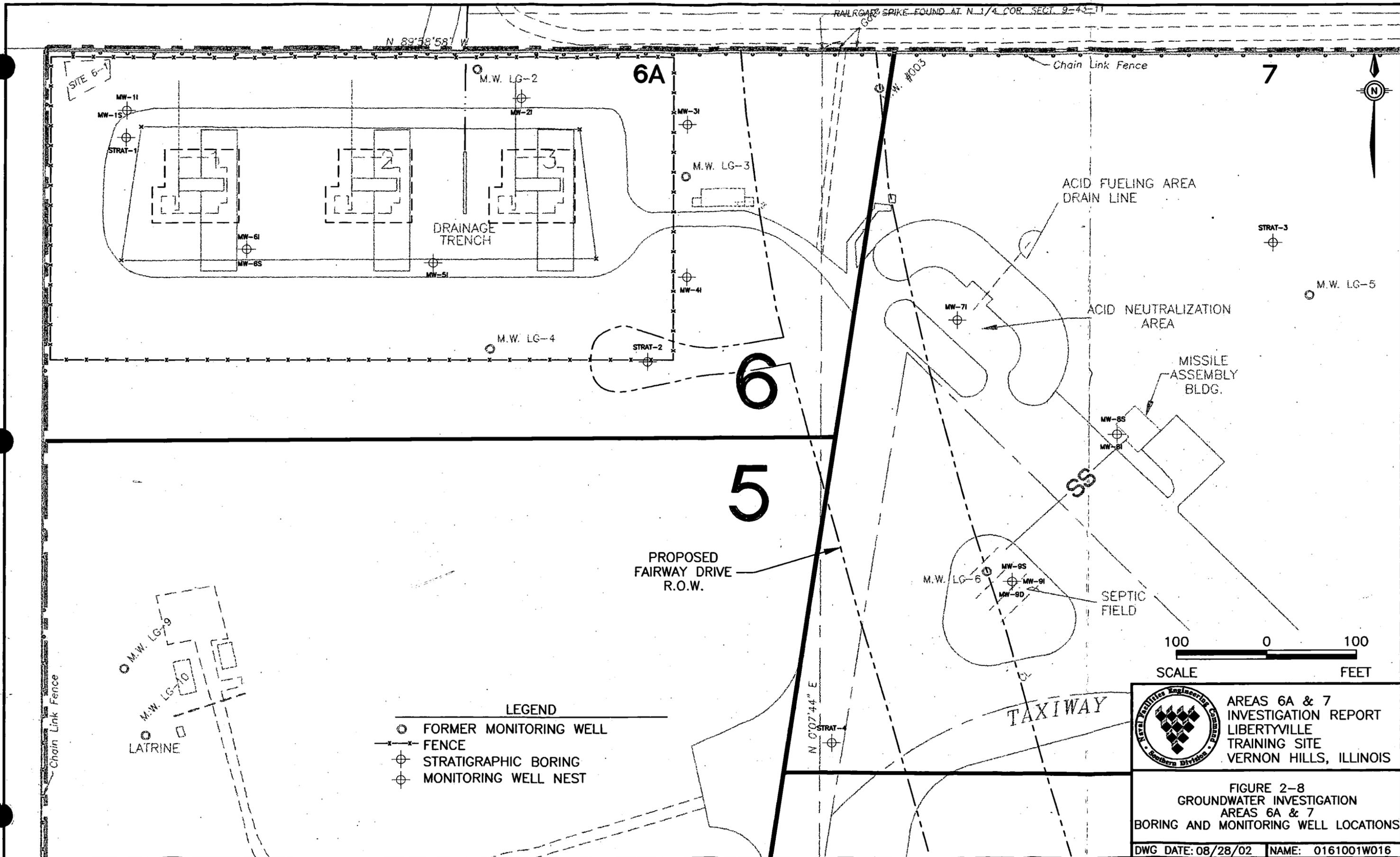
the complex nature of glacial sediments in this part of Illinois, it was important to phase the investigation approach to allow information gathered from each phase to be used to refine and focus future investigative efforts.

2.4.1 Phase I Stratigraphic Borings

The initial phase of the investigation involved the advancement and logging of four stratigraphic borings. The locations of the borings were selected to augment the existing subsurface information and target the area of interest. The locations are presented in Figure 2-8. The purpose of these borings was to define and characterize the stratigraphic sequence and depositional facies of the units encountered for design of the monitoring well network. The borings were logged with particular attention given to changes in depositional facies and weathering. Weathered or oxidized sediments encountered at depth are a key identifier of laterally continuous units capable of transmitting groundwater. Identification of these horizons is essential in an effective groundwater monitoring system.

Rotasonic drilling methods were used to advance the stratigraphic borings. The rotasonic drilling method provides a continuous, relatively undisturbed sample of the sediments encountered. The borings were advanced to 140 feet bgs, which was expected to be approximately 20 feet into the Silurian dolomite bedrock based on previous investigative activities. Each of the borings was advanced to the proposed depth but none encountered bedrock. Bowser-Morner of Dayton, Ohio was the drilling contractor for all stratigraphic borings.

Representative samples of clastic sediments were collected from the stratigraphic borings for grain-size analysis. Nine samples were submitted to Patrick Engineering for analysis. Sample depth intervals ranged from 30 feet bgs to 119 feet bgs with most being from the outwash facies. The results of these analyses were used to determine the filter-pack grain size and monitoring well screen slot size.



- LEGEND**
- FORMER MONITORING WELL
 - ⊗ FENCE
 - ⊕ STRATIGRAPHIC BORING
 - ⊕ MONITORING WELL NEST

SCALE 100 0 100 FEET



**AREAS 6A & 7
INVESTIGATION REPORT
LIBERTYVILLE
TRAINING SITE
VERNON HILLS, ILLINOIS**

**FIGURE 2-8
GROUNDWATER INVESTIGATION
AREAS 6A & 7
BORING AND MONITORING WELL LOCATIONS**

DWG DATE: 08/28/02 NAME: 0161001W016

At completion of borings Strat-1, Strat-3 and Strat-4, a representative of the Illinois State Geological Survey (ISGS) logged the subsurface materials using a natural gamma-ray borehole geophysical tool through the steel casing. The tooling and wire line were decontaminated before and after entering the borehole to avoid cross contamination issues. The natural gamma-ray is a clay content log; the tool measures the amount of natural radiation emitted by Potassium 40 (K40), Thorium and Uranium elements in their decay series. The logs highlight textural (grain-size) variations in sediments. Clay rich minerals log high readings and conversely sand and gravel log low readings. The logs are contained in Appendix A and are also incorporated into the cross sections.

After the wells were gamma logged, the boreholes were tremie grouted from the bottom of the hole to the ground surface. As the steel casing was withdrawn, the grout level was maintained to ensure a continuous positive seal.

2.4.2 Phase II Monitoring Well Installation

The subsurface information generated from the stratigraphic borings was used to determine the locations and depths for the proposed well nests. Initially, the plan was to install a maximum of 22 monitoring wells at nine nested locations. The proposed screened intervals and targeted stratigraphic units are presented in Table 2-4. The outwash facies was the primary target zone of the network. In addition, any potentially water bearing units greater than one foot thick that were encountered above the outwash would also be monitored. The goal was to identify and monitor any and all potentially impacted horizons in the outwash and above. If contamination was found in these units, deeper water bearing units would then be investigated.

At each of the monitoring well nest locations, a boring was advanced to a total depth agreed upon by the BCT. This depth ranged from 65 to 101 feet bgs. This initial boring was continuously sampled with a standard split-spoon sampler. The purpose of this boring was to identify any potentially water bearing units that may not have been encountered during Phase I due to the variable and complex geology of the glacial sediments. The onsite geologist continually correlated the boring information with the rotasonic boring logs to develop a dynamic conceptual model of the subsurface.

Table 2-4 Combined Areas Phase II Proposed Monitoring Wells			
Well Number	Proposed Intervals (feet bgs)	Screen Length (feet)	Target Zone
MW-1	27 - 34 37.5 - 49.5 52 - 66	7.5 10 15	upgradient top of outwash sand upgradient middle of outwash sand upgradient lower of outwash sand
MW-2	33 - 36 43 - 57 63 - 78	2.5 15 15	downgradient upper outwash gravel downgradient middle outwash sand down gradient lower outwash sand
MW-3	33 - 35 45 - 60 70 - 75 82 - 87	2.5 15 5 5	downgradient upper outwash gravel downgradient middle outwash sand downgradient middle outwash sand downgradient lower outwash sand
MW-4	48 - 58 68 - 73 83 - 88	10 5 5	downgradient upper outwash sand downgradient middle outwash sand downgradient lower outwash sand
MW-5	46 - 54	10	downgradient upper outwash sand
MW-6	40 - 48 51 - 61 70 - 75	7.5 10 5	upper outwash middle outwash lower outwash
MW-7	55 - 57.5 80 - 82.5	2.5 2.5	Acid Neutralization Area upper outwash Acid Neutralization Area lower outwash
MW-8	60 - 64 84 - 86	5 2.5	Missile Assembly Area upper outwash Missile Assembly Area lower outwash
MW-9	56 - 70	15	Septic Field upper outwash

All samples from each boring were screened for the presence of volatile organic compounds using a PID and were visually inspected. If any samples exhibited elevated readings or looked suspicious, a sample would be sent to the laboratory for analysis. No elevated readings were encountered in any samples and consequently no samples were analyzed.

The log of the initial boring at each nest location was then used to determine the specific intervals to be monitored at that location. Each initial boring was tremie grouted to the surface with a high clay-solids bentonite grout upon completion. The rig was then moved several feet and a new boring was advanced for the purpose of well installation.

While advancing these initial borings, several Shelby tube samples were collected for geotechnical analysis. The sample depths and locations were selected to characterize the materials across the combined area. The Shelby tube samples were analyzed for: (1) Standard test method for measurement of hydraulic conductivity of saturated porous materials using a flexible wall permeameter in accordance with American Society of Testing Materials (ASTM) D 5084; (2) standard test method for moisture, ash, and organic matter of peat and other organic soils using ASTM D 2974; (3) standard test method for laboratory determination of water (moisture) content of soil and rock mass using ASTM D 2216; and (4) standard practice for description and identification of soils using ASTM D 2488.

Based on the stratigraphy encountered at each of these nine well nest locations, 14 monitoring wells were installed. Figure 2-8 presents the locations of the monitoring wells. With the exception of MW-8S and MW-9S, all wells were completed in the outwash unit. Monitoring wells MW-8S and MW-9S were installed at the request of the IEPA to investigate potential near surface releases in these specific locations. The well construction details are presented in Table 2-5.

The boring for the monitoring well installation was generally advanced to within several feet of the targeted screen interval without sampling. The boring was then continuously sampled to and through the zone of interest. Care was taken to ensure the boring did not exceed the targeted zone by more than a few feet. In all cases, the screen length was tailored to the thickness of the aquifer.

All wells were constructed using 2-inch inside diameter PVC screen and riser materials. The results of the grain size analysis suggested that a 0.010-foot factory slot screen and a 20/40 sand would provide the proper sediment retention and pass-through for the zones monitored.

Monitoring well construction was accomplished through the annulus of the HSA. Once the total boring depth had been reached and the center plug was removed, the depth was verified and the screen and riser assembly was placed in the augers. The filter pack was then carefully added and the

Table 2-5
 Monitoring Well Construction and Water Level Elevations
 Libertyville Training Site

Location	Total Boring Depth (ft bgs)	Well Identifier	Date Installed	TOC Elevation (ft msl)	Ground Elevation (ft msl)	Construction Details (ft bgs)		Depth to Groundwater (ft below TOC) 6/19/02	Groundwater Elevation (ft msl) 6/19/02	Depth to Groundwater (ft below TOC) 7/8/02	Groundwater Elevation (ft msl) 7/8/02
						TOS	BOS				
MW-1	65	MW-1S	5/21/02	696.56	694.31	25	40	23.13	673.43	23.93	672.63
		MW-1I	5/14/02	696.46	694.41	46	56	23.01	673.45	23.81	672.65
MW-2	101	MW-2I	6/3/02	693.71	691.06	47	57	29.14	664.57	29.88	663.83
MW-3	101	MW-3I	6/6/02	699.32	696.93	54	64	36.14	663.18	37.05	662.27
MW-4	101	MW-4I	6/06/02	701.41	698.98	52.5	55	39.71	661.70	40.58	660.83
MW-5	81	MW-5I	5/22/02	692.85	690.50	41.5	46.5	30.18	662.67	31.30	661.55
MW-6	85	MW-6S	5/17/02	697.75	695.52	30	37.5	24.31	673.45	25.09	672.66
		MW-6I	5/20/02	697.89	695.53	61	62	30.04	667.85	30.98	666.91
MW-7	91	MW-7I	6/10/02	701.28	698.75	61.5	69	40.20	661.08	41.10	660.18
MW-8	95	MW-8S	6/9/02	707.23	704.58	10	20	14.67	692.56	12.09	695.14
		MW-8I	6/9/02	707.09	704.68	65	70	46.11	660.98	47.02	660.07
MW-9	91	MW-9S	6/11/02	701.93	699.16	10	20	22.12	679.81	15.31	686.62
		MW-9I	5/24/02	701.63	699.21	50.5	53	40.13	661.50	41.18	660.45
		MW-9D	5/23/02	701.89	699.50	58	68	40.91	660.98	41.89	660.00

Notes:
 TOC = Top of Well Casing
 TOS = Top of Screened Interval
 BOS = Bottom of Screened Interval
 GW = Groundwater
 ft bgs = Feet Below Ground Surface
 ft msl = Feet Mean Sea Level

depth continually monitored to ensure no bridging was occurring. The filter pack was placed from the bottom of the boring, generally half a foot below the screen slots to two feet above the top of the screened interval. A high clay-solids bentonite grout was then placed by side discharge tremie pipe to within a few feet of the ground surface to displace water in the hole and provide a positive annular seal. After the grout had been allowed to cure for a minimum of 24 hours, the remaining annular space was filled with concrete (Portland cement and fine gravel aggregate) and a 3-by-3-foot pad was built around each well. A locking steel well protector was secured into the concrete and allowed to cure. Steel bump posts, also filled with concrete, were then installed around each well to provide protection from the construction and demolition activities.

After the surface completion was installed and concrete cured, development of the wells was begun. The wells were developed by a combination of surging and purging actions. Initially, each well was surged by lowering a surge block into the screened interval and moving the block up and down through that interval for a minimum of 5 minutes. Many wells were surged for longer periods. A plastic submersible pump was then used to purge the standing water and entrained sediments from the well. Purging continued until the parameters of pH, conductivity, temperature and turbidity had stabilized. Two of the wells completed in non-water bearing zones bailed dry and only had 2 gallons removed during development. Most wells had between 28 and 105 gallons purged during development. The development records are contained in Appendix B.

The monitoring wells were sampled between June 6 and 18, 2002. The sampling was performed after the wells were allowed to rest a minimum of 24 hours following development. A Grunfos Redi-Flo II stainless-steel submersible pump with dedicated Teflon tubing was used to sample the wells using the low-flow method. The parameters of pH, conductivity, temperature, and turbidity were monitored and recorded to determine when representative formation water was being collected and purging was complete. The well sampling forms are contained in Appendix B.

Groundwater Sample Analysis

The groundwater samples were analyzed for the full TCL VOCs; TCL SVOCs, which included PAHs at low detection levels; TCL PCBs; and TAL metals. A courier for STL Labs of Chicago picked up the samples daily and transported them to the facility in University Park, Illinois. The SVOC and low level PAH sample aliquots were shipped by STL to their Savannah, Georgia facility for analysis. All sampling, sample management, and associated decontamination methods were performed in accordance with the CQAPP and the SQAPP.

Monitoring Well Survey

Each of the monitoring wells was surveyed after installation was completed. Patrick Engineering, an Illinois licensed surveyor, was contracted to perform this task. Table 2-5 also contains the elevations of the wells. The elevation and location of the well riser and concrete pad was determined for each well. The vertical datum was based on benchmark information provided by Civiltech Engineering. The elevation was determined relative to North American Vertical Datum 88 U.S. Survey Feet. The horizontal data is in the form of State Plane Coordinates, Illinois East Zone, North American Datum 1983 U.S. Survey Feet, as well as latitude and longitude.

Water Level Measurements

Synoptic water levels were measured and recorded on two different dates, June 19 and July 8, 2002. Table 2-5 presents the depth to water and groundwater elevations for these events.

The methods used were the same during both events. Several hours prior to measurement, the expanding well caps were removed to allow the water level to equilibrate. An electronic water meter was used to measure the depths to water.

Aquifer Testing

Based on the groundwater sample analytical results, the BCT determined that no aquifer testing was necessary to further characterize or classify the aquifer.

2.5 Quality Assurance/Quality Control

All field and sampling methods were completed in accordance with the CQAPP and Section 5 of the *Areas 6A and 7 Further Investigation Work Plan*, which is the site-specific quality assurance project plan. Samples were preserved and packed as required in the CQAPP and as recommended by the laboratory, contained in protective wrapping, placed in resealable plastic bags, and then packed in a cooler on ice. Samples were picked up by a STL Chicago courier and delivered to the laboratory. The laboratory supplied clean sample containers and preservatives. Field quality assurance/quality control (QA/QC) samples included field duplicates, equipment rinsate blanks, field blanks, and trip blanks. Field chain-of-custody forms, field documentation, sample labeling, packaging and shipping, and preservation were handled as specified in Section 5 of the work plan.

2.6 Investigation-Derived Waste

All soil, purge water, and decontamination water were contained and treated as investigation-derived waste (IDW). Excess soil from each hollow-stem auger boring was containerized in open-top 55-gallon steel drums. The drums were sealed, properly labeled, and staged in a designated area to prevent vehicular damage. The development and sampling purge water was collected and contained in bung-type 55-gallon steel drums, which were also sealed, labeled, and staged in the designated area. Water from the decontamination procedures was also containerized, labeled, and staged onsite.

All IDW was transported and disposed of by Clean Harbors Environmental Services of Chicago, Illinois.

2.7 Data Validation

All data were reviewed by an EnSafe chemist and validated by Heartland Environmental Services of St. Charles, Missouri. The data validation report is provided in Appendix C and the analytical data are provided in Appendix D.

2.8 Health and Safety

All sampling was performed in accordance with the site-specific health and safety plan, included in Section 4 of the *Areas 6A and 7 Further Investigation Work Plan*.

3.0 INVESTIGATION RESULTS

Results presented in this section summarize the geologic findings conducted during the investigation, in addition to the analytical results for samples collected in April, June, and July 2002. Previous magazine investigation results are discussed in the *Areas 6A NIKE Missile Magazines Investigation Report* (EnSafe, March 2002). Analytical results were compared with the LSLs for organic parameters and LSLs and background values for inorganic parameters. These values were provided in Section 2.7 of the *Areas 6A and 7 Further Investigation Work Plan* (EnSafe, 2002). The LSLs were developed in the *Final Gray Sites Investigation Work Plan* (EnSafe, 1997) and approved by the BCT. The LSLs are based on the TACO Tier 1 ingestion, inhalation, and soil-to-groundwater migration values for residential use and the U.S. EPA Region 9 preliminary remedial goals for residential use. They have been used throughout the Libertyville project to determine whether further action is required. However, during preparation of the *Areas 6A and 7 Further Investigation Work Plan*, the LSLs were updated to reflect revised TACO values.

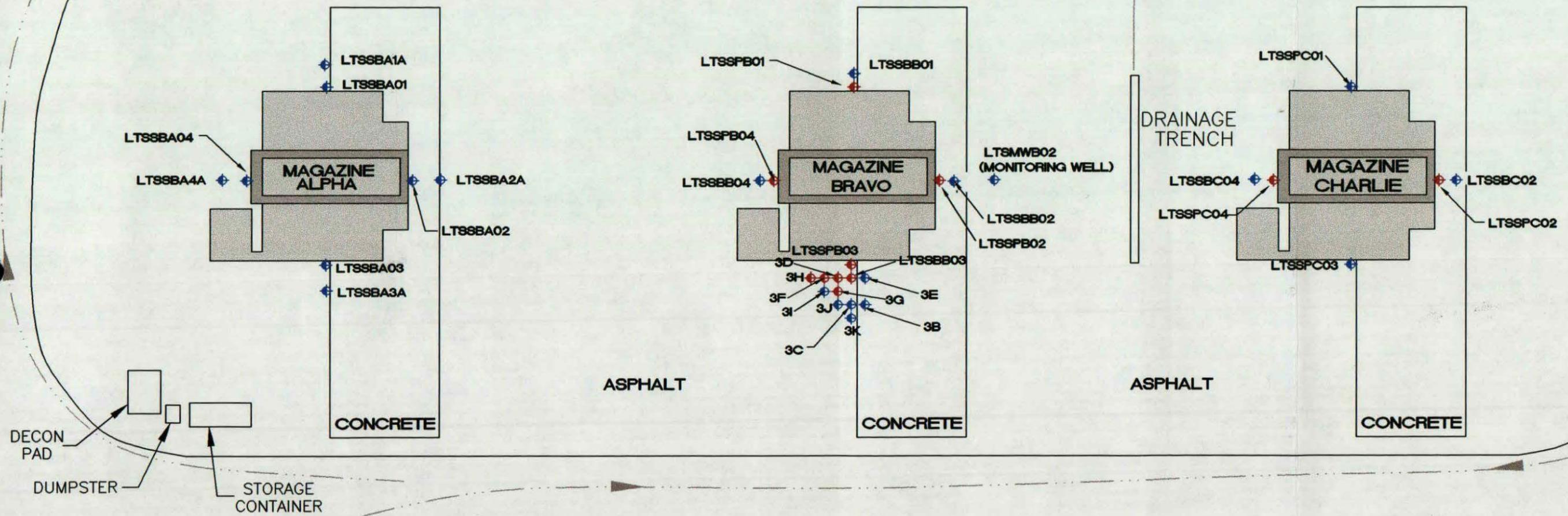
3.1 Area 6A Investigation Results

Results from the soil and groundwater investigations around the exterior portions of the missile magazines are summarized in this section.

3.1.1 Exterior Magazine Soil Investigation Results

Soil samples collected from outside the Area 6A missile magazines were analyzed for TCL VOCs, SVOCs including low-level PAHs, PCBs, and TAL metals in accordance with CLP. The following metals were also analyzed using SPLP to satisfy TACO cleanup objectives: chromium, cobalt, lead, manganese, silver, and vanadium. To achieve the necessary detection limits for PAH LSLs, the Low Method 8270 was used for PAH analysis. The laboratory's standard operating procedure for Low Method 8270 is included as Appendix A of the *Areas 6A and 7 Further Investigation Work Plan* (EnSafe, 2002). Soil sample locations and results from Area 6A are summarized on Figure 3-1. Locations where at least one result exceeded applicable standards are shown in red.

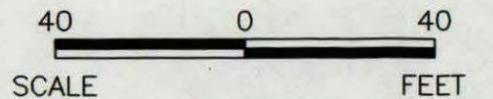
N 89°58'58" W



LEGEND

- 6A BOUNDARY
- - - - DITCH; ARROW DENOTES FLOW DIRECTION
- ◆ CONSTITUENT(S) PRESENT ABOVE LSLs
- ◆ DELINEATION SAMPLE LOCATION NOT EXCEEDING LSLs

NOTE: LSL @ LTSSBB03 EXCEEDED AT 12-14' INTERVAL (PAHs)
 LSL @ LTSSBB3D EXCEEDED AT 14-16' INTERVAL (PAHs)
 LSL @ LTSSBB3F EXCEEDED AT 14-16' INTERVAL (PAHs)
 LSL @ LTSSBB3G EXCEEDED AT 14-16' INTERVAL (SVOCs)
 LSL @ LTSSBB3H EXCEEDED AT 14-16' INTERVAL (PAHs)
 SHADED AREA DENOTES SUBSURFACE MAGAZINE LOCATION



AREAS 6A & 7
 INVESTIGATION REPORT
 LIBERTYVILLE
 TRAINING SITE
 VERNON HILLS, ILLINOIS

FIGURE 3-1
 MAGAZINE EXTERIOR
 SOIL SAMPLE LOCATIONS

DWG DATE: 08/09/02 NAME: 0161001W025

Soil samples were also analyzed for pH to determine the appropriate TACO screening criteria for inorganics, which are pH-specific. pH results from samples collected at Magazine Bravo (April, June, and July) and Magazine Charlie (April) have been averaged together because of the limited number of samples collected at Magazine Charlie. pH results are presented in Table 3-1.

3.1.1.1 Magazine Alpha — June 2002

Twenty-four subsurface soil samples and three duplicate samples were collected from Magazine Alpha as described in Section 2.2. Organic analytical results are provided in Table 3-2. Metals analytical results are provided in Table 3-3.

Semivolatile Organic Compounds

Nineteen SVOCs were detected in Magazine Alpha soil samples; 17 were low-level PAHs. No constituents exceeded LSLs and almost all were at least one order of magnitude below the LSLs.

Volatile Organic Compounds

One VOC (acetone) was detected in Magazine Alpha soil samples. The results are orders of magnitude below acetone's LSL.

PCBs

Aroclor-1260 was detected in six soil samples from Magazine Alpha. No result exceeded its LSL.

Metals

Twenty-one metals were detected in soil samples from Magazine Alpha. One inorganic (arsenic) was detected at 12.7 milligrams per kilogram (mg/kg), which exceeded both the LSL (0.39 mg/kg) and background concentration (11.8 mg/kg). This sample was collected in the underlying natural till material at a depth of 23 to 25 feet bgs. This sample result only slightly exceeds its background value and no overlying fill result exceeded its LSL or background concentrations.

Table 3-1
Area 6A Magazine Exterior Investigation
Average Soil pH Values

Sample ID	Sample Depth (feet bgs)	Sample Date	pH Result
LTSSBB0118	16-18	4/26/02	7.60
LTSCBB0118	16-18	4/26/02	7.62
LTSSBB0218	16-18	4/26/02	6.11
LTSSBB0225	23-25	4/26/02	6.99
LTSSBB0305	3-5	4/26/02	7.62
LTSSBB0314	12-14	4/26/02	7.37
LTSSBB0417	15-17	4/26/02	6.18
LTSSBB0425	23-25	4/26/02	7.73
LTSSBB3B12	10-12	6/7/02	8.15
LTSSBB3B14	12-14	6/7/02	7.91
LTSSBB3B16	14-16	6/7/02	7.82
LTSSBB3C12	10-12	6/7/02	7.67
LTSSBB3C14	12-14	6/7/02	8.09
LTSSBB3C16	14-16	6/7/02	8.19
LTSSBB3D12	10-12	6/7/02	6.60
LTSSBB3D14	12-14	6/7/02	6.70
LTSCBB3D16	14-16	6/7/02	6.60
LTSSBB3D16	14-16	6/7/02	6.70
LTSSBB3E12	10-12	6/7/02	4.60
LTSSBB3E14	12-14	6/7/02	4.90
LTSSBB3E16	14-16	6/7/02	5.00
LTSSBC0212	10-12	4/26/02	8.02
LTSSBC0422	20-22	4/26/02	7.63
LTSCBC0422	20-22	4/26/02	7.84
LTSSBB3G16	14-16	7/11/02	4.60
LTSSBB3G18	16-18	7/11/02	4.70
LTSSBB3H14	12-14	7/11/02	4.70
LTSSBB3H16	14-16	7/11/02	4.80
LTSSBB3H18	16-18	7/11/02	4.80
LTSSBB3F14	12-14	7/11/02	4.80
LTSSBB3F16	14-16	7/11/02	4.80
LTSSBB3F18	16-18	7/11/02	4.90
LTSSBB3D18	16-18	7/11/02	4.80
LTSSBB3K10	8-10	7/11/02	4.80
LTSSBB3K12	10-12	7/11/02	4.90
LTSSBB3K14	12-14	7/11/02	4.80
LTSSBB3J10	8-10	7/11/02	4.90
LTSCBB3J10	8-10	7/11/02	4.90
LTSSBB3J12	10-12	7/11/02	4.90
LTSSBB3J14	12-14	7/11/02	4.80
LTSSBB3I14	12-14	7/11/02	4.90
LTSSBB3I16	14-16	7/11/02	5.00
LTSSBB3I18	16-18	7/11/02	5.00
LTSSBB3G10	8-10	7/11/02	4.80
LTSSBB3G12	10-12	7/11/02	4.90
LTSSBB3G14	12-14	7/11/02	4.90
LTSSCB3G14	12-14	7/11/02	5.00
Magazines Bravo and Charlie Average pH =			5.98

Table 3-1
Area 6A Magazine Exterior Investigation
Average Soil pH Values

Sample ID	Sample Depth (feet bgs)	Sample Date	pH Result
LTSSBA0105	3-5	6/7/02	6.50
LTSCBA0121	19-21	6/7/02	6.60
LTSSBA0121	19-12	6/7/02	6.60
LTSSBA0125	23-25	6/7/02	6.50
LTSSBA0207	5-7	6/7/02	6.70
LTSSBA0221	19-21	6/7/02	6.70
LTSSBA0225	23-25	6/7/02	6.40
LTSSBA0313	11-13	6/8/02	6.60
LTSCBA0313	11-13	6/8/02	6.60
LTSSBA0319	17-19	6/8/02	6.60
LTSSBA0325	23-25	6/8/02	6.60
LTSSBA0411	9-11	6/8/02	6.60
LTSSBA0421	19-21	6/8/02	6.50
LTSSBA0425	23-25	6/8/02	6.50
LTSCBA1A05	3-5	6/11/02	5.10
LTSSBA1A05	3-5	6/11/02	5.10
LTSSBA1A21	19-21	6/11/02	5.20
LTSSBA1A25	23-25	6/11/02	5.20
LTSSBA2A07	5-7	6/12/02	4.90
LTSSBA2A21	19-21	6/12/02	4.90
LTSSBA2A25	23-25	6/12/02	5.00
LTSSBA3A13	11-13	6/11/02	4.90
LTSSBA3A19	17-19	6/11/02	5.00
LTSSBA3A25	23-25	6/11/02	5.10
LTSSBA4A11	9-11	6/11/02	5.00
LTSSBA4A21	19-21	6/11/02	5.00
LTSSBA4A25	23-25	6/11/02	5.10
Magazine Alpha Average pH =			5.83

Table 3-2
Area 6A Magazine Exterior Investigation
June 2002
Magazine Alpha Soil Samples - Organic Results

Constituent	LSL	LTSSB	LTSSB	LTSCB	LTSSB	LTSSB	LTSCB	LTSSB							
		A0105	A0121	A0121	A0125	A1A05	A1A05	A1A21	A1A25	A0207	A0221	A0225	A2A07	A2A21	A2A25
Low Level PAHs															
Naphthalene	18,000	3.3J	5.8J	40J	9.1	1.3J	ND	ND	4.3J	2J	1.5J	3J	3.5J	ND	2.7J
2-Methylnaphthalene	290,000	10	18	110J	27	1.5J	1.4J	2.5J	13	1.5J	2.2J	11	38	2.1J	12
Acenaphthene	2,900,000	ND	ND	ND	ND	3J	2.3J	ND	ND	3.4J	ND	ND	4.4J	ND	ND
Fluorene	2,600,000	1.4J	ND	ND	ND	2.5J	2.5J	ND	ND	4.5J	ND	ND	4.7J	ND	ND
Phenanthrene	1,100,000	15	8.5J	17J	24	11	10	6.3J	10	25	6.1J	13	34	8.5	9.3
Anthracene	22,000,000	2.1J	ND	ND	ND	2.5J	ND	ND	ND	7.7J	1.5J	ND	6.4J	ND	ND
Fluoranthene	2,300,000	11	1.8J	1.8J	ND	9.6	8.4	ND	ND	19	3.9J	ND	30	ND	ND
Pyrene	2,300,000	12	3.1J	4J	4.4J	16	9.7	2.1J	2.4J	16	4.4J	2.4J	52	3J	2.8J
Benzo(a)anthracene	620	6.1J	ND	ND	ND	6.3J	3.1J	ND	3.3J	7J	2.1J	ND	24	ND	ND
Chrysene	62,000	9.4	4.5J	5.7J	8.3	6.5J	4.1J	2.7J	ND	9.3	4J	5.2J	23	2.7J	3.9J
Benzo(b)fluoranthene	620	7.2J	ND	ND	ND	9.3J	ND	ND	ND	4.9J	2.5J	ND	38J	ND	ND
Benzo(k)fluoranthene	6,200	ND	2J	1.8J	ND	ND	6.2J	ND	ND	5.3J	ND	ND	ND	ND	ND
Benzo(a)pyrene	62	5J	ND	ND	ND	5.1J	3.5J	ND	ND	5.4J	1.5J	ND	22J	ND	ND
Indeno(1,2,3-cd)pyrene	620	2.9J	ND	ND	ND	1.3J	ND	ND	ND	2.8J	ND	ND	5.7J	ND	ND
Dibenz(a,h)anthracene	62	ND													
Benzo(g,h,i)perylene	2,300,000	4.6J	2.2J	3.1J	4.5J	2.5J	1.9J	ND	2.2J	3.8J	1.8J	3.4J	13J	2.1J	2.4J
1-Methylnaphthalene	NA	7.7J	9.1J	54J	19	ND	ND	ND	7.7J	ND	ND	7.5J	22	1.5J	6.4J
Semivolatile Organic Compounds															
Carbazole	2,800	ND													
Dibenzofuran	76,000	ND													
Volatile Organic Compounds															
Acetone	16,000	8 J	9	8 J	7 J	18	23	ND	ND	9	7 J	6 J	ND	ND	ND
Polychlorinated Biphenyls															
Aroclor-1260	220	ND	76	80J	ND	ND	ND	ND	ND	ND	46	ND	ND	ND	ND

Notes:

Only detected constituents are presented.

LSL = Libertyville screening levels.

Units = $\mu\text{g}/\text{kg}$

ND = Not detected.

J = Estimated value.

Bold = Concentration exceeds LSL.

NA = Not Available

Table 3-2
Area 6A Magazine Exterior Investigation
June 2002
Magazine Alpha Soil Samples - Organic Results

Constituent	LSL	LTSSB	LTSCB	LTSSB										
		A0313	A0313	A0319	A0325	A3A13	A3A19	A3A25	A0411	A0421	A0425	A4A11	A4A21	A4A25
Low Level PAHs														
Naphthalene	18,000	3.3J	1.8J	ND	ND	4J	ND	ND	1.7J	2.2J	ND	ND	1.9J	ND
2-Methylnaphthalene	290,000	1.8J	2.1J	6.7J	24J	2.5J	ND	ND	1.5J	4.6J	ND	1.5J	7.6J	ND
Acenaphthene	2,900,000	3.6J	ND	ND	ND	5.4J	ND	ND	1.9J	ND	ND	3.7J	ND	ND
Fluorene	2,600,000	3.2J	2.6J	ND	ND	6.3J	ND	ND	2J	ND	ND	3J	ND	ND
Phenanthrene	1,100,000	18	7.2J	9.3	25J	24	4.7J	3.2J	16	5.8J	6.2J	12	11	2.7J
Anthracene	22,000,000	3.7J	ND	ND	2.6J	4.1J	ND	ND	4.3J	ND	ND	2.4J	ND	ND
Fluoranthene	2,300,000	13	4.3J	3.2J	ND	10	ND	ND	16	ND	8J	4.7J	2.2J	ND
Pyrene	2,300,000	11	3.6J	4.1J	7.3J	14	2.7J	3.4J	15	2.3J	12J	7.4J	7J	3.9J
Benzo(a)anthracene	620	4.6J	ND	1.9J	ND	3.3J	ND	ND	7.5J	ND	6.7J	2J	2J	6.4J
Chrysene	62,000	6.2J	3J	4.2J	10J	3.9J	ND	ND	7.6J	4.2J	14J	2.8J	4.2J	ND
Benzo(b)fluoranthene	620	ND	8.7	ND	6.9J	ND	3J	ND						
Benzo(k)fluoranthene	6,200	7.2J	ND	2.4J	ND	3.2J	ND	ND	ND	1.7J	6.1J	ND	ND	ND
Benzo(a)pyrene	62	3.9J	ND	1.5J	ND	2.2J	ND	ND	6J	1.5J	6J	ND	ND	ND
Indeno(1,2,3-cd)pyrene	620	2.7J	ND	1.4J	ND	ND	ND	ND	3.5J	ND	6.6J	ND	ND	ND
Dibenz(a,h)anthracene	62	ND	1.7J	ND	4.4J	ND	ND	ND						
Benzo(g,h,i)perylene	2,300,000	3.1J	ND	3J	8.4J	1.9J	1.9J	2J	4.3J	2.6J	9.2J	1.7J	2.2J	1.9J
1-Methylnaphthalene		ND	1.7J	2.8J	17J	1.4J	ND	ND	ND	2.4J	ND	ND	3J	ND
Semivolatile Organic Compounds														
Carbazole	2,800	ND	72J	ND	ND									
Dibenzofuran	76,000	ND	43J	ND	ND									
Volatile Organic Compounds														
Acetone	16,000	11J	20J	ND	ND	10	ND	ND	10	6J	5J	12	ND	ND
Polychlorinated Biphenyls														
Aroclor-1260	220	ND	ND	37	ND	ND	ND	ND	ND	37	ND	ND	32J	ND

Notes:
Only detected constituents are presented.
LSL = Libertyville screening levels.
Units = $\mu\text{g}/\text{kg}$
ND = Not detected.
J = Estimated value.
Bold = Concentration exceeds LSL.

Page 3-3
 Area 6A Magazine Exterior Investigation
 June 2002

Magazine Alpha Soil Samples - Metals Results

Constituent	LSL	Bkgd 6"-10'	Bkgd 10'-60'	LTSSB	LTSSB	LTSCB	LTSSB	LTSSB	LTSCB	LTSSB							
				A0105	A0121	A0121	A0125	A1A05	A1A05	A1A21	A1A25	A0207	A0221	A0225	A2A07	A2A21	A2A25
Metals																	
Aluminum	76,000	17,985	8,392	11,300	3,760	3,020	7,940	12,200	10,800	7,920	8,130	8,770	5,120	10,300	8,910	8,240	8,780
Antimony	20	1.5	0.94	ND	ND	0.62J	0.63J	0.8J	ND	ND	ND	ND	0.66J	ND	ND	ND	ND
Arsenic	0.39	29.9	11.8	6.2	6.7	6.9	5.6	11.1	6.5J	6.4J	6.1J	7.4	11.2	5.7	6.9J	7.8J	5.6J
Barium	1,200	147.6	86.38	48.5	15J	11.7J	34.4J	97.6	66.6	64.5	33.5J	41.2J	24.4J	44.1	43.5J	32J	36.6J
Beryllium	150	1.26	0.7	0.6J	0.21J	0.17J	0.46J	0.68J	0.57J	0.46J	0.47J	0.48J	0.29J	0.57J	0.49J	0.48J	0.51J
Calcium	EN	104,000	110,922	70,000	104,000	129,000	80,000	18,000	58,100	79,000	84,600	83,100	92,600	77,700	73,700	79,700	76,500
Chromium	210	31.3	23.8	18.7	7.9	7	15.1	20.2	18.3	15.2	15.4	14.6	11.7	19	15.8	16	17
Cobalt	4,700	25.4	13.1	9.7J	7.1J	5.1J	9.2J	13	9.8J	9.7	9.4J	10J	10.3J	10.3J	11	9.8J	10.1J
Copper	2,900	55.7	44.7	23.9	22.2	13.6	19.8	27.1	22.2	21.3	21.4	21.7	28.6	21.1	22.6	33.3	21.7
Iron	EN	53,577	20,936	20,800	20,100	14,200	17,800	28,500	19,900	19,200	18,400	20,300	33,500	19,800	20,300	19,400	19,500
Lead	400	27.9	14.9	12.1J	10J	7.6J	10J	17.3J	13.5J	10J	10.1J	11.6J	22.5J	9.8J	11.8J	10.5J	10J
Magnesium	EN	36,100	63,513	37,700	54,100	61,400	41,700	11,900	31,800	40,600	41,400	45,100	48,700	40,800	39,900	41,300	38,400
Manganese	1,800	2,191	928	616	650	711	568	994	698	642	641	914	747	575	833	630	605
Nickel	1,500	66.6	34.9	24.3	17.9	12.9	22.6	33.4	23.8	23.1	22.4	23.7	30.9	25.2	24.3	23.6	24.4
Potassium	EN	17,905	3,180	3,050J	1,050J	1,020J	2,480J	2,200J	2,450J	2,520J	2,690J	2,060J	1,470J	3,360J	2,270J	2,590J	2,790J
Selenium	8.8	2.11	NA	ND	0.33J	0.45J	0.45J	0.59J	ND	ND	ND	0.57J	0.68J	ND	0.38J	0.4J	0.37J
Silver	390	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	EN	NA	270	184J	289J	274J	262J	98.2J	152J	197J	209J	165J	244J	214J	169J	198J	205J
Thallium	5.2	NA	NA	0.76J	0.91J	ND	ND	0.68J	0.53J	0.78J	ND	1.9J	1.5J	1.2J	ND	ND	ND
Vanadium	550	49.4	20.6	26.1J	15.7J	13.9J	19.2J	29.4	25.4	19.1	19.9	20.9J	17.9J	23.4J	21.6	20.2	21.1
Zinc	7,200	100.46	399	55.4J	68.9J	29.5J	65.6J	63.7	50.3	38.6	39.8	47.8J	134J	40.6J	46.3	48.6	45.2
SPLP Metal	Class II Soil to GW Migration																
Chromium	1.0	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	0.011J	ND	ND	ND	0.017J	ND
Cobalt	1.0	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.005J	ND
Lead	0.1	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	0.0076	ND	ND	ND	ND	ND
Manganese	10.0	NA	NA	0.021J	ND	ND	0.02J	0.16	0.11	0.027J	0.038J	0.13	ND	0.028J	0.11	0.14	0.031J
Vanadium	0.1	NA	NA	0.009J	ND	ND	ND	ND	0.009J	ND	ND	0.017J	ND	0.006J	ND	0.022J	ND

Notes:

Only detected constituents are presented.

LSL = Libertyville screening levels.

Bkgd = Background.

Metals units = mg/kg; SPLP metals units = mg/L.

ND = Not detected.

J = Estimated value.

EN = Essential Nutrient.

NA = Not available / not applicable.

Bold = Concentration exceeds LSL (and background, when background is available).

Italics = Concentration exceeds background.

e 3-3
Area 6A Magazine Exterior Investigation
June 2002

Magazine Alpha Soil Samples - Metals Results

Constituent	LSL	Bkgd 6"-10'	Bkgd 10'-60'	LTSSB	LTSCB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB
				A0313	A0313	A0319	A0325	A3A13	A3A19	A3A25	A0411	A0421	A0425	A4A11	A4A21	A4A25
Metals																
Aluminum	76,000	17,985	8,392	10,000	ND	3,260	9,380	8,890	8,550	10,800	9,190	4,360	4,590	9,000	3,220	7,410
Antimony	20	1.5	0.94	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.63J	ND	ND	1J
Arsenic	0.39	29.9	11.8	8.2	7.9	5.4	6.5	5.4J	4.5J	5.9J	6	9	12.7	7.8J	9.1J	4.6J
Barium	1,200	147.6	86.38	42.4	44.2	13.7J	41.2J	35J	28.6J	44.3	32.3J	11.6J	17.4J	40.9	12.3J	29.8J
Beryllium	150	1.26	0.7	0.54J	0.54J	0.21J	0.55J	0.5J	0.46J	0.61J	0.52J	0.27J	0.3J	0.5J	0.25J	0.45J
Calcium	EN	104,000	110,922	56,300	69,200	<i>118,000</i>	73,500	74,600	76,500	73,100	81,400	64,900	103,000	65,100	<i>115,000</i>	76,500
Chromium	210	31.3	23.8	16.8	17.4	7.2	17.8	16.7	16.1	19.5	16.8	6.6	9.2	16	7.8	14.8
Cobalt	4,700	25.4	13.1	10.1J	11.4J	5.6J	10.7J	8.5J	5.2J	11	12.9J	7.4J	9.7J	10.6J	7J	8.9J
Copper	2,900	55.7	44.7	24.3	24.8	16.4	24.6	23.6	22	23.4	22.6	24.9	24.6	23.6	25.2	20
Iron	EN	53,577	20,936	<i>23,100</i>	<i>22,800</i>	15,400	20,800	18,600	18,300	<i>21,700</i>	19,400	<i>22,500</i>	18,300	<i>21,100</i>	<i>27,200</i>	15,600
Lead	400	27.9	14.9	13.6J	12.9J	9.9J	11.7J	11.1J	11.3J	11.1J	11.8J	9.4J	10.4J	13.2J	11J	9J
Magnesium	EN	36,100	63,513	31,800	37,400	61,200	38,300	40,300	41,100	37,500	42,800	36,000	55,700	35,500	60,900	33,900
Manganese	1,800	2,191	928	673	802	761	613	766	542	584	759	543	1070	638	758	477
Nickel	1,500	66.6	34.9	24.9	26.7	15.6	26.6	23.4	18.6	27.3	27	17.7	21.1	25	18.2	22.1
Potassium	EN	17,905	3,180	2,280J	2,660J	1,060J	2,780J	2,360J	2,460J	3,470J	2,980J	872J	1,930J	2,190J	931J	2,220J
Selenium	8.8	2.11	NA	ND	ND	0.67J	0.67J	0.76J	0.46J	ND	0.58J	0.43J	0.51J	0.33J	0.33J	0.39J
Silver	390	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	0.22J	ND	ND	ND	ND
Sodium	EN	NA	270	139J	175J	264J	206J	163J	179J	211J	209J	192J	191J	153J	255J	174J
Thallium	5.2	NA	NA	0.73J	1.5J	0.89J	0.83J	ND	ND	ND	1.6J	1.1J	1.3J	ND	ND	ND
Vanadium	550	49.4	20.6	22.8J	23J	14.3J	22J	22.2	20.5	24.2	22J	27.7J	14.3J	21.2	15.4	18.1
Zinc	7,200	100.46	399	57J	48.4J	58.3J	39.5J	46.6	40.4	57.3	43.1J	51.3J	39.7J	51.2	102	30
SPLP Metal	Class II Soil to GW Migration															
Chromium	1.0	NA	NA	ND	ND	ND	ND	0.014J	ND	ND	ND	ND	ND	ND	ND	ND
Cobalt	1.0	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lead	0.1	NA	NA	ND	ND	ND	ND	0.0063J	ND	ND	ND	ND	ND	ND	ND	ND
Manganese	10.0	NA	NA	0.064	0.066	ND	0.03J	0.18	ND	0.037J	0.07	ND	0.025J	0.18	ND	0.033J
Vanadium	0.1	NA	NA	ND	0.005J	ND	ND	0.02J	ND	ND	ND	ND	ND	0.009J	ND	ND

Notes:

Only detected constituents are presented.

LSL = Libertyville screening levels.

Bkgd = Background.

Metals units = mg/kg; SPLP metals units = mg/L.

ND = Not detected.

J = Estimated value.

EN = Essential Nutrient.

NA = Not available / not applicable.

Bold = Concentration exceeds LSL (and background, when background is available).

Italics = Concentration exceeds background.

Three calcium, seven iron, and two sodium results exceeded background levels. All three metals are considered essential nutrients. No other metals results exceeded either background or LSL values.

SPLP Metals

All metals (except silver) submitted for SPLP analysis were detected in at least one sample. However, no result exceeded the TACO Class II soil to groundwater migration route and all results were at least one order of magnitude below it.

3.1.1.2 Magazines Bravo and Charlie April 2002 Soil Results

To determine whether SVOC soil exceedances identified in July 2001 were due to waterproofing material on the magazines' exterior walls or other sources, seven subsurface soil samples and one duplicate sample were collected from Magazine Bravo. Two subsurface and one duplicate sample were collected from Magazine Charlie. All samples were collected as described in Section 2.1. Organic analytical results are provided in Table 3-4. Metals analytical results are provided in Table 3-5.

Semivolatile Organic Compounds

Eighteen SVOCs were detected in Magazine Bravo soil samples; 17 were low-level PAHs. Four constituents detected at sample location LTSSB03 exceeded LSLs. All four exceedances are from the sample collected from 12- to 14-foot bgs (LTSSBB0314). Benzo(a)anthracene was detected at a concentration of 2,000 micrograms per kilogram ($\mu\text{g}/\text{kg}$), exceeding its LSL of 620 $\mu\text{g}/\text{kg}$; Benzo(b)fluoranthene was detected at a concentration of 1,700 $\mu\text{g}/\text{kg}$, exceeding its LSL of 620 $\mu\text{g}/\text{kg}$; Benzo(a)pyrene was detected at a concentration of 370 $\mu\text{g}/\text{kg}$, exceeding its LSL of 62 $\mu\text{g}/\text{kg}$; and Dibenz(a,h)anthracene was detected at a concentration of 1,700 $\mu\text{g}/\text{kg}$, exceeding its LSL of 62 $\mu\text{g}/\text{kg}$.

No other constituents exceeded LSLs and most other SVOC results were at least one order of magnitude below them.

Table 3-4
 Area 6A Magazine Exterior Investigation
 April 2002
 Magazine Bravo and Charlie Soil Samples - Organic Results

Constituent	LSL	Magazine Bravo Results								Mag. Charlie Results		
		LTSSB	LTSCB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSCB
		B0118	B0118	B0218	B0225	B0305	B0314	B0417	B0425	C0212	C0422	C0422
Low Level PAHs												
Naphthalene	18,000	1.3 J	1.5 J	6.2 J	2.7 J	2.3 J	11	2.5 J	5.5 J	2.5 J	3.5 J	4.6 J
Acenaphthene	2,900,000	ND	ND	11	2.4 J	2.0 J	330	2.1 J	ND	ND	3.0 J	4.1 J
Fluorene	2,600,000	ND	ND	13	3.2 J	2.8 J	450	3.1 J	ND	1.6 J	3.8 J	4.6 J
Phenanthrene	1,100,000	4.0 J	7.1 J	88	8.0 J	14	3800 D	13	14	9.6	24	32
Anthracene	22,000,000	ND	1.4 J	25	2.8 J	ND	1600 D	3.4 J	ND	1.6 J	7.0 J	9.7
Fluoranthene	2,300,000	3.0 J	2.9 J	92	7.2 J	15	4900 D	7.0 J	ND	5.4 J	21	31
Pyrene	2,300,000	4.8 J	4.8 J	87	8.1 J	13	4600 D	8.3	3.0 J	5.7 J	23	33
Chrysene	62,000	3.9 J	3.9 J	41	4.1 J	7.1 J	1900 D	5.1 J	5.4 J	4.2 J	12	17
Benzo(a)anthracene	620	ND	ND	38	2.6 J	2.4 J	2000 D	2.4 J	ND	1.9 J	10	14
Benzo(b)fluoranthene	620	ND	ND	27	2.7 J	5.3 J	1700 D	2.1 J	ND	2.0 J	7.2 J	12
Benzo(k)fluoranthene	6,200	ND	ND	28	2.3 J	2.7 J	1500 D	ND	ND	1.8 J	8.2	11
Benzo(a)pyrene	62	ND	ND	33	2.5 J	1.7 J	1900 D	2.0 J	ND	ND	9.2	13
Indeno(1,2,3-cd)pyrene	620	ND	ND	22	8.0 J	7.3 J	530	7.5 J	ND	ND	11	11
Dibenz(a,h)anthracene	62	ND	ND	19	ND	ND	370	ND	ND	ND	12 J	ND
Benzo(g,h,i)perylene	2,300,000	2.5 J	2.3 J	20	2.8 J	2.4 J	650	3.1 J	3.0 J	ND	7.4 J	7.8 J
2-Methylnaphthalene	290,000	ND	ND	8.2 J	1.6 J	2.0 J	21	9.6	16	3.5 J	3.7 J	4.3 J
1-Methylnaphthalene	NA	ND	ND	5.6 J	ND	1.4 J	14	7.6 J	12	2.9 J	2.1 J	2.9 J
Semivolatile Organic Compounds												
Carbazole	2,800	ND	ND	ND	ND	ND	ND	ND	ND	ND	76 J	ND
Volatile Organic Compounds												
Acetone	16,000	10	11	10	14	26	23	14	11	13	ND	ND
Polychlorinated Biphenyls		None detected in any sample										

Notes:

Only detected constituents are presented.

LSL = Libertyville screening levels.

Units = $\mu\text{g}/\text{kg}$

ND = Not detected.

J = Estimated value.

Bold = Concentration exceeds LSL.

NA = Not Available

Area 6A Magazine Exterior Investigation

April 2002

Magazine Bravo and Charlie Soil Samples - Metals Results

Constituent	LSL	Bkgd 6"-10'	Bkgr 10' - 60'	Magazine Bravo Results								Mag. Charlie Results		
				LTSSB B0118	LTSCB B0118	LTSSB B0218	LTSSB B0225	LTSSB B0305	LTSSB B0314	LTSSB B0417	LTSSB B0425	LTSSB C0212	LTSSB C0422	LTSCB C0422
Metals														
Aluminum	76,000	17,985	8,392	7,300	4,800	8,360	8,740	11,600	10,500	8,640	9,610	9,490	3,100	4,220
Arsenic	0.39	29.9	11.8	6.5	7	7.8	7.9	7.8	8.2	8.1	6.7	7.4	5.9	9.1
Barium	1,200	147.6	86.38	34.7 J	27.4 J	36.9 J	39.2 J	65.3 J	65.2 J	44.7 J	42.1 J	51.1 J	12.8 J	15.8 J
Beryllium	150	1.26	0.7	0.38 J	0.32 J	0.52 J	0.49 J	0.6 J	0.57 J	0.47 J	0.53 J	0.5 J	0.16 J	0.19 J
Cadmium	37	0.34	2.1	0.25 J	ND	0.1 J	ND	0.26 J	0.13 J	0.092 J	ND	0.12 J	1.1	ND
Calcium	EN	104,000	110,922	77,500	85,900	74,900	72,100	48,600	45,800	69,300	69,300	82,700	100,000	90,600
Chromium	210	31.3	23.8	14.7	10.1	16.8	17	19.3	18.3	16.3	18.5	16.4	7.5	8.9
Cobalt	4,700	25.4	13.1	9.5 J	5.1 J	9.5	10.4	11	10.8	9.6 J	9.7	9.5 J	6.3 J	7.3 J
Copper	2,900	55.7	44.7	22.6	22.1	21	21.8	22.9	21.5	22.9	22.3	20.6	19.3	29.2
Iron	EN	53,577	20,936	18,100	18,700	23,500	19,700	21,700	24,500	20,100	19,600	19,400	20,800	20,300
Lead	400	27.9	14.9	13 J	18 J	13.7 J	13.2 J	15.5 J	12.5 J	14.5 J	13.8 J	12.1 J	8.4 J	8.4 J
Magnesium	EN	36,100	63,513	39,600	47,000	39,700	37,100	26,700	25,700	36,400	35,100	29,300	54,000	47,200
Manganese	1,800	2,191	928	637	832	641	619	640	802	646	557	611	656	610
Nickel	1,500	66.6	34.9	22.7 J	16.1 J	24.8 J	25.1 J	25.9 J	25.9 J	23.5 J	23.9 J	23.2 J	14.1 J	19.4 J
Potassium	EN	17,905	3,180	2,160 J	1,660 J	2,530 J	2,700 J	2,530 J	2,110 J	2,310 J	3,110 J	1,970 J	836 J	1,020 J
Selenium	8.8	2.11	NA	ND	0.28 J	0.26 J	ND	0.27 J	ND	0.23 J	ND	0.31 J	ND	ND
Sodium	EN	NA	270	313 J	295 J	378 J	345 J	308 J	333 J	297 J	345 J	249 J	318 J	466 J
Thallium	5.2	NA	NA	2.8	1.6 J	2	2.1	2.2	1.7 J	1.5 J	1.8 J	2.0 J	1.9	2.1 J
Vanadium	550	49.4	20.6	20.1	16	25.3	23.3	29.3	28.5	23.4	24.2	24.2	17.9	19.5
Zinc	7,200	100.46	399	42.6 J	39.5 J	51.4 J	51.7 J	74.3 J	53.3 J	47.9 J	44.4 J	52.4 J	282 J	51.8 J
SPLP Metal	Class II Soil to GW Migration													
Chromium	1	NA	NA	0.033 J	ND	ND	0.02 J	ND	ND	ND	ND	ND	ND	ND
Cobalt	1	NA	NA	0.01 J	ND	ND	0.008 J	ND	ND	ND	ND	ND	ND	ND
Lead	0.1	NA	NA	0.017 J	ND	0.005 J	0.01 J	ND	ND	ND	ND	ND	ND	ND
Manganese	10	NA	NA	0.21	0.03 J	0.065	0.26	0.085	0.19	0.052	0.033 J	0.19	ND	ND
Vanadium	0.1	NA	NA	0.043 J	0.009 J	0.015 J	0.028 J	ND	0.008 J	ND	0.006 J	0.007 J	ND	ND

Notes:

Only detected constituents are presented.

LSL = Libertyville screening levels.

Bkgd = Background.

Metals units = mg/kg; SPLP metals units = mg/L.

ND = Not detected.

B = Estimated value.

EN = Essential Nutrient.

NA = Not available / not applicable.

Bold = Concentration exceeds LSL (and background, when background is available).*Italics* = Concentration exceeds background.

Eighteen SVOCs were detected in Magazine Charlie soil samples; 17 of were low-level PAHs. No constituents exceeded LSLs and almost all were at least one order of magnitude below them.

Volatile Organic Compounds

One VOC (acetone) was detected in Magazine Bravo and Magazine Charlie soil samples. The results are orders of magnitude below acetone's LSL.

PCBs

No PCBs were detected in soil samples from Magazine Bravo or Magazine Charlie.

Metals

Twenty metals were detected in soil samples from Magazine Bravo and Magazine Charlie. None exceeded background levels or LSLs.

SPLP Metals

All metals (except silver) submitted for SPLP analysis were detected in at least one Magazine Bravo soil sample. Two were detected in Magazine Charlie soil samples. However, no result exceeded the TACO Class II soil component of the groundwater ingestion exposure route. All results were at least one order of magnitude below it.

Based on the results above, soil contamination concerns had been delineated at Magazine Charlie in the April 2002 sampling event and no further investigation was required. The SVOC soil contamination concerns at Magazine Bravo were not fully delineated and required further investigation.

3.1.1.3 Magazine Bravo June 2002 Delineation Soil Results

Based on the results of the April 2002 investigation activities, a second phase of delineation sampling was required south of Magazine Bravo. To further delineate SVOC soil exceedances identified at sample location LTSSB03, 12 subsurface soil samples and one duplicate sample were collected from Magazine Bravo as described in Section 2.1. Organic analytical results are provided in Table 3-6. Metals analytical results are provided in Table 3-7.

Semivolatile Organic Compounds

During this phase of delineation sampling, 20 SVOCs were detected in Magazine Bravo soil samples; 17 were low-level PAHs. One constituent (benzo[a]pyrene), and its duplicate sample result from sample location LTSSB3D exceeded its LSL. The exceedance was from the sample collected from 14 to 16 feet bgs (LTSSBB3D16 and duplicate sample LTSCBB3D16). Benzo(a)pyrene was detected at a concentration of 97 µg/kg in the primary sample and 230 µg/kg in the duplicate sample, exceeding its LSL of 62 µg/kg.

No other constituents exceeded LSLs; most other SVOC results were at least one order of magnitude below them.

Volatile Organic Compounds

One VOC (acetone) was detected in soil samples collected during the second phase of delineation sampling at Magazine Bravo. The results are orders of magnitude below acetone's LSL.

PCBs

No PCBs were detected in soil samples collected during the second phase of delineation sampling at Magazine Bravo.

Table 3-6
Area 6A Magazine Exterior Investigation
June 2002
Magazine Bravo Soil Samples - Organic Results

Constituent	LSL	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB
		B3B12	B3B14	B3B16	B3C12	B3C14	B3C16	B3D12	B3D14	B3D16	B3D16	B3E12	B3E14	B3E16
Low Level PAHs														
Naphthalene	18,000	1.6 J	ND	ND	2.4 J	ND	ND	20	4.3 J	26J	56J	7.8	26	9.1
Acenaphthene	2,900,000	ND	ND	ND	17	ND	ND	18	12	74J	220J	15	29	22
Fluorene	2,600,000	ND	ND	ND	16	ND	ND	15	12	75J	240J	21	29	18
Phenanthrene	1,100,000	4.6 J	3.2 J	4.1 J	66	1.8 J	6.2 J	71	60	220J	400J	96	110	72
Anthracene	22,000,000	ND	ND	ND	26	ND	ND	30	19	120J	360J	23	27	21
Fluoranthene	2,300,000	3.6 J	ND	2.4 J	87	ND	ND	85	62	300J	700J	98	52	78
Pyrene	2,300,000	4.7 J	7.2 J	7.4 J	71	6.5 J	3.4 J	75	55	240J	550J	62	41	63
Chrysene	62,000	3.5 J	8.7	9.8	31	7.8	5.0 J	34	27	110J	260J	9.1	20	33
Benzo(a)anthracene	620	ND	ND	ND	32	ND	ND	35	27	120J	300J	6.3 J	17	32
Benzo(b)fluoranthene	620	ND	2.3 J	3.2 J	22	2.7 J	ND	24	21	74J	170J	5.2 J	19	33
Benzo(k)fluoranthene	6,200	1.7 J	ND	ND	22	ND	ND	23	16	92J	230J	ND	ND	ND
Benzo(a)pyrene	62	ND	ND	2.5 J	26	ND	ND	28	22	97J	230J	3.4 J	14	24
Indeno(1,2,3-cd)pyrene	620	ND	ND	1.6 J	12	ND	ND	13	10	44J	120J	1.7 J	8.3	13
Dibenz(a,h)anthracene	62	ND	ND	ND	4.8 J	ND	ND	4.8 J	4.1 J	14J	50J	ND	3.0 J	3.2 J
Benzo(g,h,i)perylene	2,300,000	2.6 J	5.0 J	5.1 J	13	5.9 J	3.8 J	15	11	41J	100J	4.4 J	10	12
2-Methylnaphthalene	290,000	0.93 J	1.1 J	ND	3.8 J	0.87 J	1.8 J	8.7	3.6 J	7.9J	14J	6.3 J	10	4.7 J
1-Methylnaphthalene	NA	ND	ND	ND	2.9 J	ND	1.5 J	6.5 J	2.9 J	5.0 J	8.9	4.4 J	6.2 J	3.3 J
Semivolatile Organic Compounds														
Dibenzofuran	76,000	ND	ND	ND	ND	ND	ND	ND	ND	83 J	55 J	ND	ND	40 J
Carbazole	2,800	ND	ND	ND	ND	ND	ND	ND	ND	130 J	87 J	ND	ND	56 J
bis(2-Ethylhexyl)phthalate	35,000	ND	ND	ND	ND	ND	ND	ND	60 J	ND	ND	ND	ND	ND
Volatile Organic Compounds														
Acetone	16,000	13J	ND	ND	10J	ND	ND	8J	11	12	9 J	11J	12J	ND
Polychlorinated Biphenyls		None detected in any sample												

Notes:

Only detected constituents are presented.

LSL = Libertyville screening levels.

Units = $\mu\text{g}/\text{kg}$

ND = Not detected.

J = Estimated value.

Bold = Concentration exceeds LSL

NA = Not Available

Table 3-7
Area 6A Magazine Exterior Investigation
June 2002
Magazine Bravo Soil Samples - Metals Results

Constituent	LSL	Bkgd 6"-10'	Bkgd 10'-60'	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB
				B3B12	B3B14	B3B16	B3C12	B3C14	B3C16	B3D12	B3D14	B3D16	B3D16	B3E12	B3E14	B3E16
Metals																
Aluminum	76,000	17,985	8,392	10,400	9,310	7,980	9,830	8,400	10,100	10,900	9,290	10,300	9,740	11,100	9,530	9,750
Antimony	20	1.5	0.94	ND	ND	ND	ND	ND	1.1J	ND	ND	ND	ND	ND	ND	
Arsenic	0.39	29.9	11.8	9.3J	5.7J	8.5J	22.3J	6.9J	8.9J	9.6	7.8	6.9	7.7	6.1J	7.2J	6.9J
Barium	1,200	147.6	86.38	61.6	40.7J	39.1J	65.8	33.8J	54.6	83.4	60.6	61.9	56.6	67	51.4	55.3
Beryllium	150	1.26	0.7	0.51J	0.43J	0.37J	0.48J	0.38J	0.48J	0.61J	0.53J	0.54J	0.53J	0.53J	0.44J	0.46J
Cadmium	37	0.34	2.1	0.18J	0.13J	ND	0.18J	0.11J	0.12J	ND	ND	ND	0.18J	0.16J	0.12J	0.14J
Calcium	EN	104,000	110,922	52,900	66,400	70,500	55,200	66,800	55,100	53,600	63,500	56,000	64,700	36,400	45,500	59,400
Chromium	210	31.3	23.8	17.2	16.4	15	17	15.7	17.1	18.1	16.6	17.3	16.7	18	15.9	16.6
Cobalt	4,700	25.4	13.1	10.7	9.8J	9.4J	17	8.5J	10.4J	14.2J	11J	11.2J	9.9J	9J	9.6J	10.1J
Copper	2,900	55.7	44.7	29.9	23.8	25	23.9	23.2	28.7	24.1	23.3	22.8	26.3	24.3	22.3	24
Iron	EN	53,577	20,936	<i>23,600</i>	18,300	19,400	<i>33,400</i>	18,600	<i>22,100</i>	<i>24,800</i>	<i>22,400</i>	<i>21,500</i>	<i>23,200</i>	19,100	20,100	20,200
Lead	400	27.9	14.9	16.6J	12.2J	14.3J	13.8J	10.8J	13.6J	16.6J	12.2J	13.5J	15.3J	12.7J	12.3J	13.2J
Magnesium	EN	36,100	63,513	31,100	40,000	40,200	35,300	39,400	32,900	27,900	34,100	30,800	35,200	20,200	27,300	34,800
Manganese	1,800	2191	928	643	626	593	808	540	633	1000	789	647	784	516	557	686
Nickel	1,500	66.6	34.9	26.4	22.6	23.1	32.8	24.1	25.6	26.6	25.2	25.2	23.7	22.2	23.1	24.2
Potassium	EN	17,905	3,180	2,150J	2,990J	2,520J	2,780J	2,720J	2,390J	2,110J	2,300J	2,260J	2,100J	1,700J	1,960J	2,350J
Selenium	8.8	2.11	NA	ND	0.28J	ND	0.31J	ND	0.16J	0.36J	0.4J	0.33J	0.41J	ND	ND	ND
Sodium	EN	NA	270	<i>274J</i>	245J	240J	<i>295J</i>	216J	210J	142J	168J	154J	171J	252J	ND	237J
Thallium	5.2	NA	NA	ND	ND	ND	ND	0.25J	0.23J	1.8J	1.8J	1.3J	1.2J	ND	ND	ND
Vanadium	550	49.4	20.6	24.1	18.6	17.2	21.3	17.8	21.9	27.8J	23.7	23.7J	24J	23.2	20.8	21.4
Zinc	7,200	100.46	399	60.9	45	46.9	58	45.5	52.5	62.2J	48.6	55.6J	96.5J	58.8	49.9	53.9
SPLP Metals	Class II Soil to GW Migration															
Chromium	1.0	NA	NA	0.14J	ND	0.017J	ND	ND	0.016J	0.013J	0.01J	0.038J	0.014J	ND	0.019J	0.026J
Cobalt	1.0	NA	NA	0.005J	ND	0.006J	ND	ND	0.007J	ND	ND	0.018J	0.005J	ND	0.008J	0.013J
Lead	0.1	NA	NA	0.0057J	ND	0.0069J	ND	ND	ND	0.0067J	0.0057J	0.026	0.0097	ND	0.01	0.02
Manganese	10.0	NA	NA	0.23	0.018J	0.097	0.1	ND	0.14	0.25	0.17	0.51	0.24	0.15	0.28	0.35
Vanadium	0.1	NA	NA	0.019J	ND	0.02J	0.006J	ND	0.021J	0.021J	0.016J	0.056	0.023J	0.007J	0.027J	0.038J

Notes:

Only detected constituents are presented.

LSL = Libertyville screening levels.

Bkgd = Background.

Metals units = mg/kg; SPLP metals units = mg/L.

ND = Not detected.

J = Estimated value.

EN = Essential Nutrient.

NA = Not available / not applicable.

Bold = Concentration exceeds LSL (and background, when background is available).

Italics = Concentration exceeds background.

Metals

During this phase of delineation sampling, 21 metals were detected in soil samples from Magazine Bravo. Arsenic in sample LTSSBB3C12 from location LTSSB3C was detected at 22.3 mg/kg, exceeding both the LSL (0.39 mg/kg) and deep subsurface (10 to 60 feet bgs) background (11.8 mg/kg) concentrations. However, this result does not exceed the shallow subsurface (6 inches to 10 feet bgs) background concentration of 29.9 mg/kg and is the only arsenic exceedance found at Magazine Bravo. This result is not thought to represent contamination.

Six iron and two sodium results exceeded background levels. Both metals are considered essential nutrients and no result exceeded LSLs. No other metals results exceeded either background or LSL values. Based on these and previous sampling results, metals are not a concern at Magazine Bravo.

SPLP Metals

All metals (except silver) analyzed for SPLP were detected in at least one sample. However, no result exceeded the TACO Class II soil component of the groundwater ingestion exposure route and all results were at least one order of magnitude below it.

Based on the above results, SVOC soil contamination concerns at Magazine Bravo were not fully delineated and required further investigation.

3.1.1.4 Magazine Bravo July 2002 Delineation Soil Results

Based on the results of the June 2002 investigation activities, a third phase of delineation sampling was required. To further delineate SVOC soil exceedances identified at sample location LTSSB3D, 21 subsurface soil samples and 2 duplicate samples were collected from Magazine Bravo as described in Section 2.1. Organic analytical results are provided in Table 3-8. Metals analytical results are provided in Table 3-9.

Table 3-8
Area 6A Magazine Exterior Investigation
July 2002
Magazine Bravo Soil Samples - Organic Results

Constituent	LSL	LTSSB	LTSCB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB						
		B3D18	B3F14	B3F16	B3F18	B3G10	B3G12	B3G14	B3G14	B3G16	B3G18	B3H14	B3H16	B3H18
Low Level PAHs														
Naphthalene	18,000	26	ND	13	7.4J	12	9.5	6.3J	4.8J	8.1	5.2J	5.7J	81	15
Acenaphthene	2,900,000	4.0J	5.0J	39	ND	7.7J	13	24J	9J	10	ND	9.4	120	3.1J
Fluorene	2,600,000	5.7J	7.8	40	ND	11	14	34J	8.6J	11	ND	9.5	140	3.1J
Phenanthrene	1,100,000	31	50	170	20	68	55	44J	19J	60	17	42	650	25
Anthracene	22,000,000	3.4J	14	67	ND	14	14	24J	7.1J	16	ND	9.7	260	ND
Fluoranthene	2,300,000	11	42	230	ND	79	38	44J	17J	46	1.8J	37	760	3.1J
Pyrene	2,300,000	10	36	140	3.5J	59	29	35J	14J	33	3.5J	25	650	4.6J
Chrysene	62,000	11	23	76	6.8J	33	14	16J	6.7J	20	8.4	18	270	7.5J
Benzo(a)anthracene	620	4.4J	19	80	ND	29	12	15J	5.5J	15	ND	13	300	ND
Benzo(b)fluoranthene	620	6.9J	25	57	ND	28	10	14J	5.6J	9	3.0J	10	230	5.1J
Benzo(k)fluoranthene	6,200	ND	ND	49	ND	22	8.8	9.2J	3.3J	9.9	ND	9.8	180	3.3J
Benzo(a)pyrene	62	ND	ND	67	ND	28	11	13J	5.2J	ND	ND	ND	260	4.9J
Indeno(1,2,3-cd)pyrene	620	ND	17	28	ND	20	13	15J	10J	15	ND	14	95	ND
Dibenz(a,h)anthracene	62	ND	ND	ND	ND	14	ND	12J	ND	ND	ND	11	57	ND
Benzo(g,h,i)perylene	2,300,000	4.1J	11	21	3.3J	12	5.5J	6.3J	2.6J	9.9	4.3J	7.1J	96	4.3J
2-Methylnaphthalene	290,000	22	1.0J	8	28	4.6J	5.3J	4.2J	5.6J	4.7J	11	4.3J	20	26
1-Methylnaphthalene	NA	15	ND	5.4J	21	3.4J	3.4J	2.7J	4.1J	3.6J	7.6J	3.4J	12	20
Semivolatile Organic Compounds														
3-Methylphenol/4-Methylphenol	240	ND	630J	ND	ND	ND	ND	ND						
Carbazole	2,800	32J	ND	35J	ND	ND	ND	ND	15,000	ND	ND	ND	62J	ND
2-Methylnaphthalene	290,000	ND	5,100	ND	ND	ND	ND	ND						
Dibenzofuran	76,000	ND	10,000	ND	ND	ND	ND	ND						
Di-n-Butylphthalate	2,300,000	ND	ND	ND	ND	ND	35J							
Volatile Organic Compounds														
Acetone	16,000	14	14	14	12	23	10	16	19	12J	10	ND	13	ND
Polychlorinated Biphenyls														
None detected in any sample														

Notes:

Only detected constituents are presented. This data has not been validated.

LSL = Libertyville screening levels.

Units = µg/kg

ND = Not detected.

J = Estimated value.

Bold = Concentration exceeds LSL

NA = Not Available

Table 3-8
Area 6A Magazine Exterior Investigation
July 2002
Magazine Bravo Soil Samples - Organic Results

Constituent	LSL	LTSSB	LTSSB	LTSSB	LTSSB	LTSCB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB
		B3I14	B3I16	B3I18	B3J10	B3J10	B3J12	B3J14	B3K10	B3K12	B3K14
Low Level PAHs											
Naphthalene	18,000	2.7J	ND	5.8J	2.0J	8.0J	ND	ND	3.2J	11	ND
Acenaphthene	2,900,000	ND	ND	ND	ND	13J	ND	ND	ND	10	ND
Fluorene	2,600,000	1.4J	ND	2.3J	2.1J	19J	ND	ND	2.3J	14	ND
Phenanthrene	1,100,000	11	7.4J	17	12J	69J	4.8J	1.5J	12	99	5.4J
Anthracene	22,000,000	ND	1.8J	3.2J	2.6J	23J	ND	ND	2.7J	24	ND
Fluoranthene	2,300,000	2.6J	6.9J	12	15J	120J	3.0J	ND	16	150	ND
Pyrene	2,300,000	3.6J	6.7J	9.8	12J	94J	3.4J	3.6J	10	120	2.2J
Chrysene	62,000	3.7J	4.3J	7.4J	7.6J	42J	3.5J	4.6J	7.6J	69	4.4J
Benzo(a)anthracene	620	ND	2.9J	5.7J	6.7J	39J	ND	ND	6.7J	70	ND
Benzo(b)fluoranthene	620	2.9J	3.4J	5.2J	8.1J	29J	ND	3.1J	7.5J	60	ND
Benzo(k)fluoranthene	6,200	ND	2.1J	4.0J	5.1J	28J	ND	ND	5.0J	53	ND
Benzo(a)pyrene	62	ND	3.4J	ND	6.9J	34J	ND	ND	5.9J	62	ND
Indeno(1,2,3-cd)pyrene	620	ND	ND	11	11J	24J	ND	ND	ND	25	ND
Dibenz(a,h)anthracene	62	ND	ND	ND	ND	15J	ND	ND	ND	19	ND
Benzo(g,h,i)perylene	2,300,000	2.2J	3.1J	4.1J	2.9J	18J	ND	2.9J	2.4J	18	2.0J
2-Methylnaphthalene	290,000	4.6J	ND	12	2.5J	4.8J	ND	ND	1.2J	3.5J	ND
1-Methylnaphthalene	NA	6.4J	ND	8.7	1.7J	3.2J	ND	ND	ND	2.4J	ND
Semivolatile Organic Compounds											
Dibenzofuran	76,000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbazole	2,800	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	290,000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	76,000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-Butylphthalate	2,300,000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Volatile Organic Compounds											
Acetone	16,000	8	ND	10	11	10	18	ND	12	12J	10
Polychlorinated Biphenyls		None detected in any sample									

Notes:

Only detected constituents are presented. This data has not been validated.

LSL = Libertyville screening levels.

Units = µg/kg

ND = Not detected.

J = Estimated value.

Bold = Concentration exceeds LSL

NA = Not Available

Table 3-9
Area 6A Magazine Exterior Investigation
July 2002
Magazine Bravo Soil Samples - Metals Results

Constituent	LSL	Bkgd 6"-10'	Bkgd 10'-60'	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB	LTSCB	LTSSB	LTSSB	LTSSB	LTSSB	LTSSB
				B3D18	B3F14	B3F16	B3F18	B3G10	B3G12	B3G14	B3G14	B3G16	B3G18	B3H14	B3H16	B3H18
Metals																
Aluminum	76,000	17,985	8,392	6,190J	7,590J	8,750J	6,430J	10,700J	10,600J	9,270J	10,600J	9,260J	7,650J	11,000J	8,900J	7,470J
Arsenic	0.39	29.9	11.8	8.4J	11.7J	7.2J	6.7J	7.3J	7.9J	7.8J	6.9J	8J	7.9J	8.7J	7.1J	7.0J
Barium	1,200	147.6	86.38	27.7J	73.8	50.1	31.1J	57.5	47.3	40.7J	61.4	45.5	33.4J	64.6	53	35.6J
Beryllium	150	1.26	0.7	0.32J	0.45J	0.46J	0.33J	0.53J	0.54J	0.48J	0.56J	0.48J	0.40J	0.55J	0.45J	0.40J
Cadmium	37	0.34	2.1	ND	ND	ND	ND	0.12J	0.15J	ND	ND	0.086J	ND	0.090J	0.096J	ND
Calcium	EN	104,000	110,922	75,200	69,600	57,300	73,900	51,800	57,600	62,400	43,100	62,100	74,900	50,400	57,400	78,200
Chromium	210	31.3	23.8	11.9	15	15.7	12.8	17.6	17.8	16.2	17	16.3	14.4	18	15.4	13.9
Cobalt	4,700	25.4	13.1	8.0J	10.4J	9.9J	9.2J	9.5J	9.9J	9.9J	9.1J	9.8J	10.7J	14.1	9.8J	9.1J
Copper	2,900	55.7	44.7	19.7	23.8	23.7	21.5	23.9	25	24	25.3	25.4	22.1	24.7	23.3	22.6
Iron	EN	53,577	20,936	19,200	21,100	19,400	16,900	20,900	21,900	19,500	20,700	20,800	18,100	21,400	20,100	17,200
Lead	400	27.9	14.9	11.8J	14.3J	12.7J	10.8J	15.0J	13.3J	12.5J	12.6J	12.6J	11.2J	13.5J	14.9J	11.4J
Magnesium	EN	36,100	63,513	39,900	38,100	32,300	38,800	29,500	33,600	35,800	24,700	36,100	41,000	29,500	33,100	35,500
Manganese	1,800	2191	928	599	703	669	595	636	673	693	487	635	648	602	653	600
Nickel	1,500	66.6	34.9	19.7J	23.9J	24.5J	22.1J	24.2J	25.6J	24.2J	23J	24.5J	25J	28.9J	24J	21.5J
Potassium	EN	17,905	3,180	1,810J	2,220J	2,000J	1,820J	2,400J	2,760J	2,430J	1,690J	2,480J	2,460J	2,440J	1,720J	2,270J
Sodium	EN	NA	270	341J	346J	358J	296J	289J	292J	323J	319J	330J	334J	292J	336J	326J
Thallium	5.2	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	550	49.4	20.6	17.6	22.4	22.7	18.4	26.6	25.7	23	24.1	24.1	20.3	27.1	22.6	19.7
Zinc	7,200	100.46	399	36.4J	48.7J	46.2J	37.7J	54.8J	52J	46.6J	50.2J	53.1J	43.8J	54.1J	50.8J	37.2J
SPLP Metals																
	Class II Soil to GW Migration															
Chromium	1.0	NA	NA	0.016J	0.012J	0.016J	0.018J	ND	0.013J	ND	0.017J	ND	ND	0.010J	0.032J	ND
Cobalt	1.0	NA	NA	0.005J	ND	0.005J	0.006J	ND	ND	ND	0.005J	ND	ND	ND	0.013J	ND
Lead	0.1	NA	NA	ND	ND	0.013	0.0066J	ND	ND	ND	0.0061J	ND	ND	ND	0.02	ND
Manganese	10.0	NA	NA	0.086	0.16	0.18	0.12	0.11	0.17	0.058	0.17	0.063	0.027J	0.19	0.36	0.057
Vanadium	0.1	NA	NA	0.023J	0.018J	0.025J	0.024J	0.007J	0.018J	0.009J	0.025J	0.011J	ND	0.017J	0.048J	0.011J

Notes:

Only detected constituents are presented. Data has not been validated.

LSL = Libertyville screening levels.

Bkgd = Background.

Metals units = mg/kg; SPLP metals units = mg/L.

ND = Not detected.

B = Estimated value.

EN = Essential Nutrient.

NA = Not available / not applicable.

Bold = Concentration exceeds LSL (and background, when background is available).

Italics = Concentration exceeds background.

Table 3-9
Area 6A Magazine Exterior Investigation
July 2002
Magazine Bravo Soil Samples - Metals Results

Constituent	LSL	Bkgd 6'-10'	Bkgd 10'-60'	LTSSB B3I14	LTSSB B3I16	LTSSB B3I18	LTSSB B3J10	LTSCB B3J10	LTSSB B3J12	LTSSB B3J14	LTSSB B3K10	LTSSB B3K12	LTSSB B3K14
Metals													
Aluminum	76,000	17,985	8,392	6,450J	7,090J	7,410J	7,410J	10,600J	10,500J	8,440J	9,030J	8,840J	6,570J
Arsenic	0.39	29.9	11.8	6.3J	7.0J	6.9J	7.4J	7.8J	8.6J	7.1J	2.9J	11.6J	6.3J
Barium	1,200	147.6	86.38	50.9	30.3J	33.1J	42.8	55	46.1	31.1J	31.0J	30.0J	27.1J
Beryllium	150	1.26	0.7	0.35J	0.37J	0.39J	0.40J	0.52J	0.54J	0.44J	0.45J	0.49J	0.34J
Cadmium	37	0.34	2.1	0.21J	ND	0.088J	ND	0.13J	0.13J	ND	0.16J	0.11J	ND
Calcium	EN	104,000	110,922	79,100	71,400	72,200	63,800	50,800	61,200	66,200	65,600	57,900	70,100
Chromium	210	31.3	23.8	13	13.3	14	14	17.6	18	15.5	16.1	16.2	13.1
Cobalt	4,700	25.4	13.1	8.6J	8.8J	9.4J	9.0J	9.4J	8.9J	9.0J	9.2J	11.4	9.3
Copper	2,900	55.7	44.7	21.2	22.8	24.8	21.9	24.6	24.7	22.2	22.6	27.2	21.5
Iron	EN	53,577	20,936	16,900	17,400	17,500	19,100	22,000	21,300	17,900	11,600	24,300	15,700
Lead	400	27.9	14.9	10.6J	10.6J	11.3J	11.6J	13.5J	12.1J	10.1J	13.4J	17.4J	11.0J
Magnesium	EN	36,100	63,513	44,500	38,900	39,200	34,800	30,100	35,500	38,100	37,900	36,300	38,000
Manganese	1,800	2191	928	821	604	608	710	553	604	578	523	490	599
Nickel	1,500	66.6	34.9	21.5J	22.8J	23.2J	22.1J	24.7J	24.3J	24.3J	24.2J	27.5J	21.6J
Potassium	EN	17,905	3,180	1,870J	2,160J	2,350J	1,890J	2,710J	2,910J	2,620J	2,790J	2,290J	1,900J
Sodium	EN	NA	270	309J	344J	367J	303J	316J	316J	327J	255J	294J	281J
Thallium	5.2	NA	NA	ND	1.7J	ND							
Vanadium	550	49.4	20.6	18.8	19.5	20.7	20.1	25.6	25.1	21.2	21.3	23.9	19
Zinc	7,200	100.46	399	59J	38.6J	40.2J	40.1J	56.2J	49J	63.3J	70J	56.5J	38.7J
SPLP Metals	Class II Soil to GW Migration												
Chromium	1.0	NA	NA	0.022J	ND	ND	0.020J	0.024J	ND	ND	ND	ND	0.53
Cobalt	1.0	NA	NA	0.008J	ND	ND	0.007J	0.009J	ND	ND	ND	ND	0.021J
Lead	0.1	NA	NA	0.012	ND	ND	0.012	0.012	ND	ND	ND	ND	0.017
Manganese	10.0	NA	NA	0.29	0.034J	0.030J	0.22	0.12	0.030J	ND	ND	ND	0.33
Vanadium	0.1	NA	NA	0.031J	0.007J	0.007J	0.032J	0.036J	0.008J	0.008J	ND	ND	0.074

Notes:

Only detected constituents are presented. Data has not been validated.

LSL = Libertyville screening levels.

Bkgd = Background.

Metals units = mg/kg; SPLP metals units = mg/L.

ND = Not detected.

B = Estimated value.

EN = Essential Nutrient.

NA = Not available / not applicable.

Bold = Concentration exceeds LSL (and background, when background is available).

Italics = Concentration exceeds background.

Semivolatile Organic Compounds

During this phase of delineation sampling, 20 SVOCs were detected in Magazine Bravo soil samples; 17 were low-level PAHs. One constituent from sample location LTSSB3F exceeded its LSL in a sample from 14 to 16 feet bgs (LTSSBB3F16). Benzo(a)pyrene was detected at a concentration of 67 µg/kg, exceeding its LSL of 62 µg/kg.

Two constituents from sample location LTSSB3G exceeded LSLs. Both were from the duplicate sample collected from 12 to 14 feet bgs (LTSCBB3G14). There were no exceedances in the primary sample. 3-methylphenol/4-methylphenol was detected at a concentration of 630 µg/kg. This result is a total value for 3-methylphenol and 4-methylphenol. Because no total value LSL is available, this result was compared with the more conservative LSL value of 240 µg/kg for 4-methylphenol. Carbazole was detected at a concentration of 15,000 µg/kg, which exceeds its LSL of 2,800 µg/kg.

One constituent from sample location LTSSB3H exceeded its LSL in a sample collected from 14 to 16 feet bgs (LTSSBB3H16). Benzo(a)pyrene was detected at a concentration of 260 µg/kg, exceeding its LSL of 62 µg/kg.

No other constituents exceeded LSLs and most other SVOC results were at least one order of magnitude below them.

Volatile Organic Compounds

One VOC (acetone) was detected in Magazine Bravo soil samples. The results are orders of magnitude below acetone's LSL. Based on these and previous sampling results, VOCs are not a concern at Magazine Bravo.

PCBs

No PCBs were detected in soil samples from Magazine Bravo. Based on these and previous sampling results, PCBs are not a concern at Magazine Bravo.

Metals

Twenty-one metals were detected in soil samples from Magazine Bravo. Five iron and 22 sodium results exceeded background levels. Both metals are considered essential nutrients and no result exceeded LSLs. No other metals results exceeded either background or LSL values. Based on these and previous sampling results, metals are not a concern at Magazine Bravo.

SPLP Metals

All metals (except silver) submitted for SPLP analysis were detected in at least one sample. However, no result exceeded the TACO Class II soil component of the groundwater ingestion exposure route. All results were at least one order of magnitude lower than the TACO Class II soil component of the groundwater ingestion exposure route.

3.1.2 Magazines Alpha and Bravo Groundwater Results

In June 2002, four temporary monitoring wells (LTSGWA01 - LTSGWA04) were installed around the exterior of Magazine Alpha. A monitoring well (LTSMWB02) was installed between Magazines Bravo and Charlie in April 2002. These wells, along with a previously installed temporary well (LTSGWB02) east of Magazine Bravo, were sampled and analytical results were compared with the TACO Class II Groundwater Remediation Objectives (GROs).

Seven groundwater samples were collected; five primary and two duplicate samples. Monitoring well LTSGWA02 did not produce water and no sample was collected.

Magazine exterior groundwater sample locations are shown on Figure 3-2. Locations with one or more result exceeding applicable standards are shown in red. Analytical results are summarized in Table 3-10.

Semivolatile Organic Compounds

Eighteen SVOCs were detected in groundwater samples; 17 were low-level PAHs. All 18 were from temporary well LTSGWB02, which was re-sampled in April 2002 due to a single detection of naphthalene (63 µg/L) that exceeded its July 2001 LSL of 39 µg/L. Naphthalene was detected in both the primary and duplicate sample (4.5 µg/L and 5.8 µg/L), but was well below its current LSL (220 µg/L).

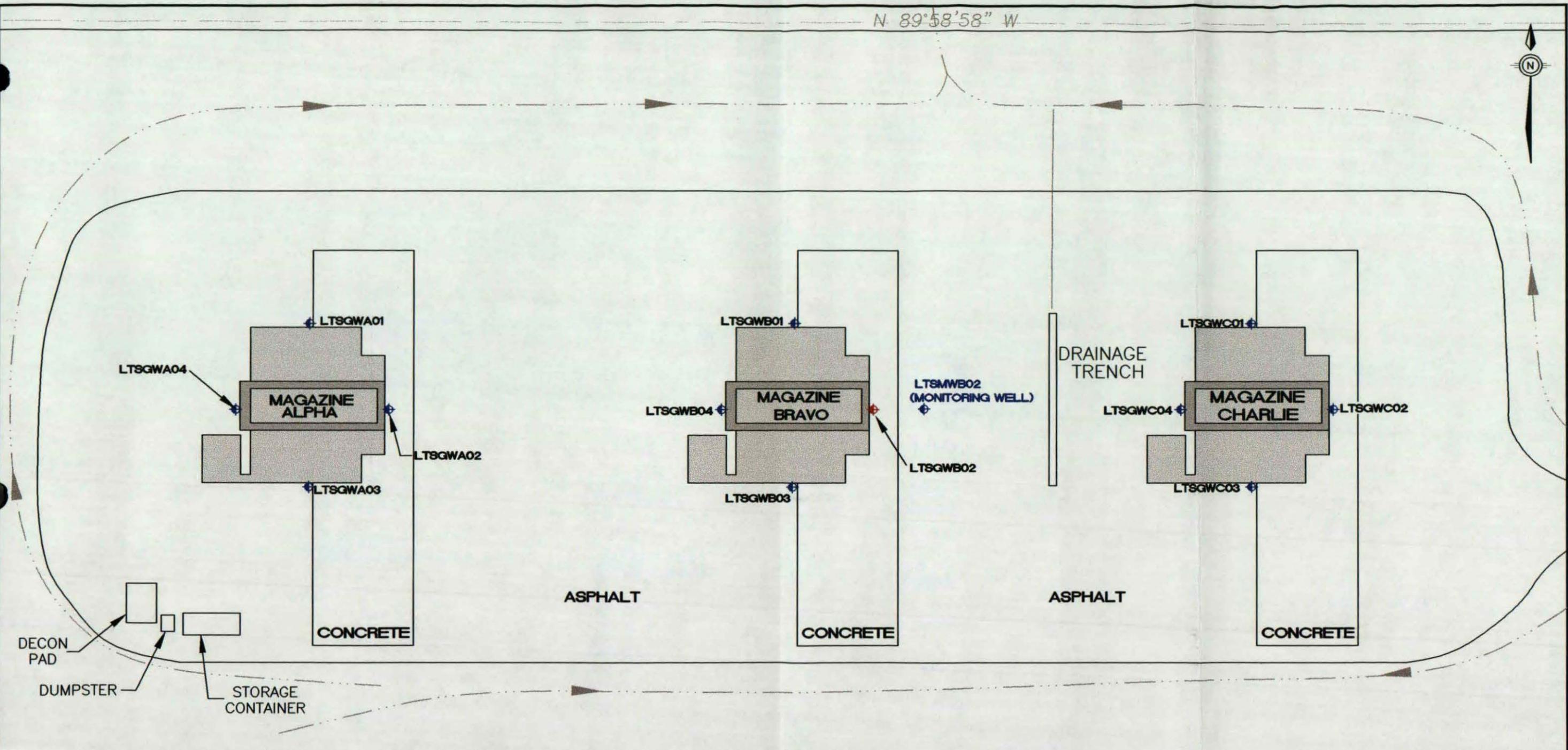
Benzo(a)anthracene was detected in this second sampling event at a concentration of 0.66 µg/L in the primary sample from LTSGWB02. This result exceeds its LSL of 0.65 µg/L. Additionally, benzo(a)anthracene was detected at 0.32 µg/L in the duplicate sample, well below the LSL, and it was not detected in the initial sampling event.

All other SVOC detections were well below applicable LSLs. Based on these and previous sampling results, SVOCs are not a concern at Magazines Alpha and Bravo.

Metals

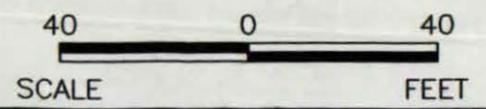
Sixteen metals were detected in groundwater samples collected from the fill material surrounding the magazines. One constituent from temporary well LTSGWB02 exceeded its LSL. Iron was detected at concentrations of 6,400 µg/L in the primary sample and 6,360 µg/L in the duplicate sample. These two iron results only slightly exceed its LSL (5,000 µg/L) and iron is considered an essential nutrient. No background value is available for iron. Additionally, iron was only detected at a concentration of 2,560 µg/L from well LTSGWB02 in the first sampling event.

N 89°58'58" W



LEGEND

- 6A BOUNDARY
- - - DITCH; ARROW DENOTES FLOW DIRECTION
- ◆ CONSTITUENT(S) PRESENT ABOVE LSLs
- ◆ GROUNDWATER SAMPLE LOCATION NOT EXCEEDING LSLs



NOTE: LSL @ LTSGWB02 EXCEEDED (BENZO(A)PYRENE)
 SHADED AREA DENOTES SUBSURFACE MAGAZINE LOCATION



AREAS 6A & 7
 INVESTIGATION REPORT
 LIBERTYVILLE
 TRAINING SITE
 VERNON HILLS, ILLINOIS

FIGURE 3-2
 MAGAZINE EXTERIOR
 GROUNDWATER SAMPLE LOCATIONS

DWG DATE: 08/09/02 NAME: 0161001W026

Table 3-10
Area 6A Magazine Exterior Investigation
Groundwater Results

Constituent	LSL	BKGR	LTSGM WA101	LTSHM WA101	LTSGM WA301	LTSGM WA401	LTSGM WB201	LTSGW B0202	LTSHW B0202
Low Level PAHs									
1-Methyl naphthalene	-	NA	ND	ND	ND	ND	ND	0.74	0.8
2-Methylnaphthalene	1,050	NA	ND	ND	ND	ND	ND	0.1J	0.11J
Acenaphthene	2,100	NA	ND	ND	ND	ND	ND	6.8	7.1
Anthracene	10,500	NA	ND	ND	ND	ND	ND	2.3	2.4
Benzo(a)anthracene	0.65	NA	ND	ND	ND	ND	ND	0.66J	0.32J
Benzo(a)pyrene	2	NA	ND	ND	ND	ND	ND	0.4J	0.15J
Benzo(b)fluoranthene	0.9	NA	ND	ND	ND	ND	ND	0.32J	0.13J
Benzo(g,h,i)perylene	1,050	NA	ND	ND	ND	ND	ND	0.22J	0.099J
Benzo(k)fluoranthene	0.85	NA	ND	ND	ND	ND	ND	0.4J	0.14J
Chrysene	7.5	NA	ND	ND	ND	ND	ND	0.62J	0.32J
Dibenz(a,h)anthracene	1.5	NA	ND	ND	ND	ND	ND	0.34	0.29
Fluoranthene	1,400	NA	ND	ND	ND	ND	ND	4.6	3.9
Fluorene	1,400	NA	ND	ND	ND	ND	ND	3.9	4.4
Indeno(1,2,3-cd)pyrene	2.15	NA	ND	ND	ND	ND	ND	0.37J	0.25J
Naphthalene	220	NA	ND	ND	ND	ND	ND	4.5	5.8
Phenanthrene	1,050	NA	ND	ND	ND	ND	ND	8.2	10
Pyrene	1,050	NA	ND	ND	ND	ND	ND	3.2	2.7
Semivolatile Organic Compounds									
Dibenzofuran	140	NA	ND	ND	ND	ND	ND	2.5J	ND
Volatile Organic Compounds									
None detected in any sample.									
Polychlorinated Biphenyls									
None detected in any sample.									
Metals									
Aluminum	-	79,300	ND	ND	1,920J	ND	122J	ND	ND
Barium	2,000	1,680	51.6J	58.7J	80.1J	52.4J	59.3J	77.3J	79.2J
Beryllium	500	-	ND	0.14J	0.32B	ND	ND	ND	ND
Calcium	-	-	166,000	168,000	121,000	215,000	52,900	69,000	69,000
Chromium	1,000	210	ND	ND	1.5J	ND	ND	ND	ND
Cobalt	1,000	64	3.1J	6.9J	3.7J	11.6J	ND	ND	ND
Copper	650	265	ND	5J	10.6J	ND	ND	ND	ND
Iron	5,000	-	1,940	1,910	2,170	1,200	37.1J	6,400	6,360
Magnesium	-	-	63,600	64,000	60,200	85,700	32,200	19,600	19,300
Manganese	10,000	4,340	510	529	323	1020	25.8	135	126
Nickel	2,000	230	5.6J	9J	17.4J	17.2J	ND	ND	ND
Potassium	-	-	1,810J	1,830J	3,550J	4,140J	5,590	2,500J	2,510J
Selenium	50	-	ND	ND	ND	ND	1.7J	ND	ND
Sodium	-	-	3,980J	5,790	8,430	6,210	181,000	4,470J	4,410J
Vanadium	100	149	4.7J	ND	7.6J	12J	ND	ND	ND
Zinc	10,000	573	ND	ND	ND	ND	14.1J	ND	ND

Notes:

Only detected constituents are presented.

LSL = Libertyville screening levels.

Units = µg/L.

ND = Not detected.

J = Estimated value.

B = Concentration exceeds LSL

No other metal result exceeded its background or LSL value. Based on these and previous sample results, metals are not a concern at Magazines Alpha and Bravo.

VOCs

No VOCs were detected in any sample.

PCBs

No PCBs were detected in any sample.

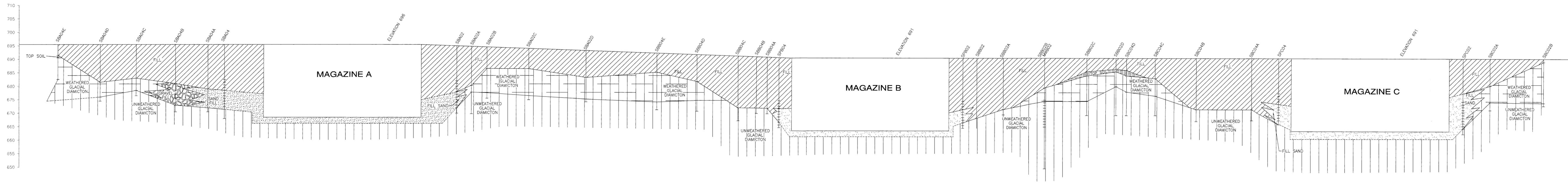
3.2 Area 6A Shallow Subsurface Investigation Results

The shallow stratigraphic borings advanced across Area 6A show that the area was significantly modified during construction of the magazines. Figures 3-3, 3-4, 3-5, and 3-6 present the shallow stratigraphy across Area 6A. The surficial reworked silty clay fill ranges in thickness from approximately 18 feet directly adjacent to the magazines to a few feet near the edges of the asphalt. Immediately surrounding the magazines at a distance that ranges from 5 to 20 feet from the wall, is a granular fill that was presumably placed to facilitate drainage around the magazines. The clay fill materials were apparently sourced from the site because they match the native topsoil and weathered and unweathered glacial diamicton. The fill directly overlies the weathered and unweathered native glacial diamicton. The weathered material is light olive brown silty clay with varying amounts of gray and brown mottling. The unweathered diamicton is generally unoxidized and unleached dark gray silty clay with minor amounts of sand and gravel.

The areas under and directly adjacent to the magazines have been excavated to approximately 26 feet bgs. The slope of the excavation appears to be approximately 2:1. This indicated that the site was excavated, the magazines were constructed and then backfilled with primarily native materials.

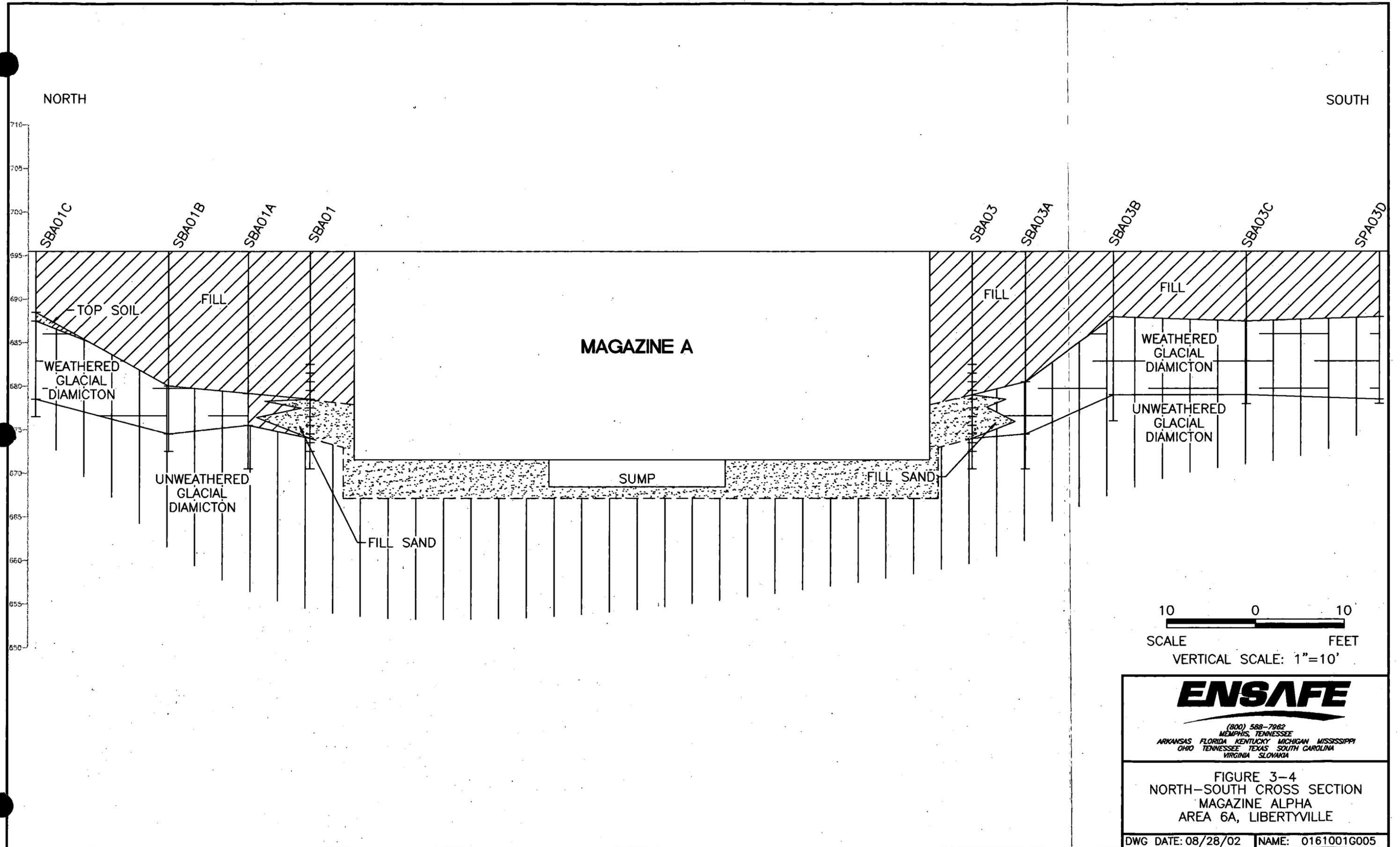
WEST

EAST



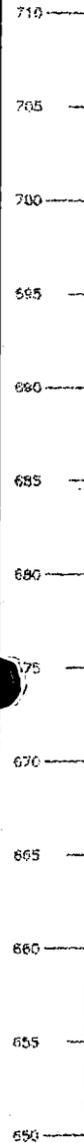
ENSAFE
 (800) 588-7868
 ALABAMA ARIZONA CALIFORNIA FLORIDA GEORGIA ILLINOIS INDIANA KENTUCKY LOUISIANA MISSISSIPPI MISSOURI NORTH CAROLINA SOUTH CAROLINA TEXAS VIRGINIA WISCONSIN

FIGURE 3-3
 EAST-WEST CROSS SECTION
 AREA 6A, LIBERTYVILLE
 DWG DATE: 08/27/02 NAME: 01610010006



NORTH

SOUTH



SBB01B

SBB01A

SBB01

SPB01

SPB03

SBB03

SBB03A

SBB03K

FILL

FILL

TOPSOIL

MAGAZINE B

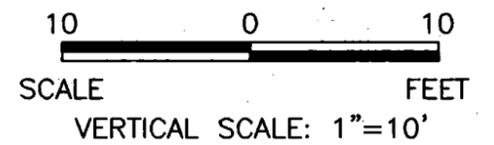
WEATHERED
GLACIAL
DIAMICTON

WEATHERED GLACIAL
DIAMICTON

UNWEATHERED
GLACIAL
DIAMICTON

UNWEATHERED
GLACIAL
DIAMICTON

SUMP

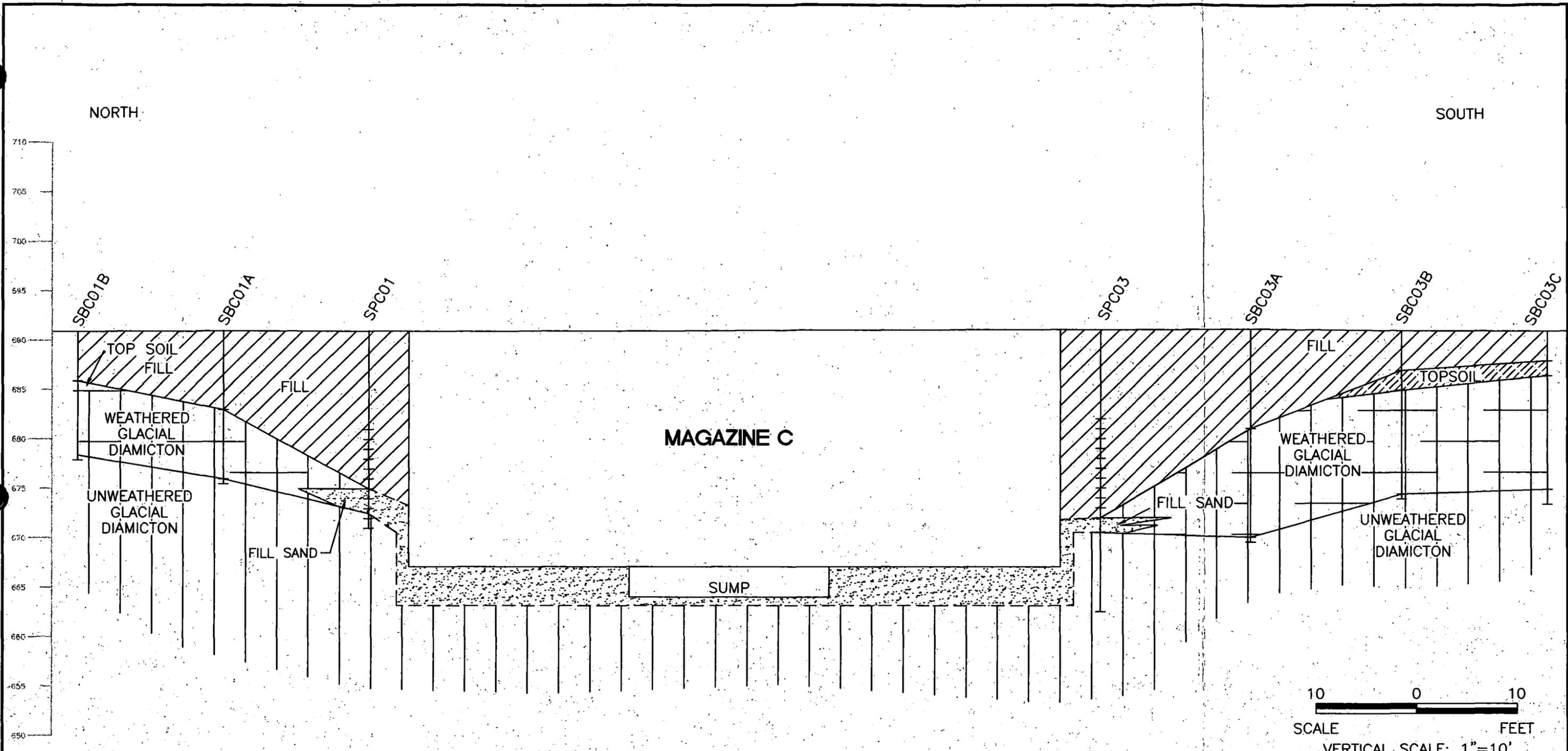


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MEMPHIS, TENNESSEE
ARKANSAS FLORIDA KENTUCKY MICHIGAN MISSISSIPPI
OHIO TENNESSEE TEXAS SOUTH CAROLINA
VIRGINIA SLOVAKIA

FIGURE 3-5
NORTH-SOUTH CROSS SECTION
MAGAZINE BRAVO
AREA 6A, LIBERTYVILLE

DWG DATE: 08/28/02 NAME: 0161001G002



10 0 10
 SCALE FEET
 VERTICAL SCALE: 1"=10'

ENSAFE

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 MEMPHIS, TENNESSEE
 ARKANSAS FLORIDA KENTUCKY MICHIGAN MISSISSIPPI
 OHIO TENNESSEE TEXAS SOUTH CAROLINA
 VIRGINIA SLOVAKIA

FIGURE 3-6
 NORTH-SOUTH CROSS SECTION
 MAGAZINE CHARLIE
 AREA 6A, LIBERTYVILLE

DWG DATE: 08/28/02 NAME: 0161001G004

Groundwater was encountered in the granular fill material surrounding the magazines. This water is confined by the overlying silty clay backfill. This water is also laterally constrained by the silty clay sidewalls of the excavation. At Magazines Bravo and Charlie, no naturally occurring water-bearing units were encountered in the glacial sediments that would allow migration away from the magazine. At Magazine Alpha, the glacial outwash aquifer may have been encountered during removal of the sump. The removal action contractor reported that while removing the concrete bottom of the sump, the excavation began to fill with water and numerous boulders were found beneath the sump. It is presumed that during construction of Magazine Alpha, the excavation breached the top of the outwash aquifer, which consists of boulders, cobbles, gravel, and sand. This unit was encountered at a depth of 27 feet bgs at Strat-1 and 26.5 feet bgs at MW-1. To facilitate construction above the water level of this aquifer, large-diameter granular fill was placed on top of the aquifer to raise the floor above the static water level. The difference in elevation between Magazine Alpha and Magazines Bravo and Charlie is approximately 6 feet. This could also explain why Magazines Bravo and Charlie filled with water to the approximate elevation of the head observed in the surrounding piezometers when the sump pumps were deactivated. Magazine Alpha was primarily dry, which could be due to water in the granular fill surrounding the magazine draining into the aquifer.

3.3 Geologic Investigation Results

3.3.1 Geologic and Hydrologic Setting

This section describes the regional and local physiography and geology of the LTS area as it relates to the investigation of soil at Area 6A. The LTS is a 164.32-acre facility located at T43N, R11E and is generally contained in the north half of Section 9.

Physiography

The LTS lies in the central portion of the Central Lowland Province, a glacial lowland bordering the Appalachian Plateau on the east, the Great Plains on the west, the Superior Upland on the

north, and the interior Low Plateau and Ozark Plateau on the south. The property is situated in Wheaton Morainal Country, a subsection of the Great Lakes Section, a subdivision of the Central Lowland Province. Area topography consists of features associated with continental glaciers. The surficial features of the area are mainly the result of Wisconsinan glaciation, which masks the underlying bedrock surface (Leighton, Ekblaw, and Hornberg, 1948).

3.3.2 Regional Geology/Hydrogeology

Regional Geology

The geologic setting of the LTS region in northeastern Illinois is typically characterized by Silurian Niagarian dolomite overlain by Quaternary Pleistocene glacial drift sediments of the Wisconsinan Stage. The glacial sediments overlie the sub-Pleistocene unconformity of the dolomitic bedrock (Willman, 1971). In the LTS area, the depth of this unconformable surface varies from approximately 107 to 180 feet bgs (Illinois State Water Survey, 1997; Brown & Root, 1998). Because this report is concerned with surficial glacial sediments and fill material only, bedrock stratigraphy will not be discussed further.

The Wisconsinan glacial sediments of northern Illinois are divided into five substages. The sediments underlying the LTS make up the late Wisconsinan Woodfordian Substage. Based on studies of the Woodfordian sediments, the till underlying LTS represents the Wadsworth Till moraine complex, which consists of (from oldest to youngest) the Valparaiso Moraine System, the Tinley Moraine, and the Lake Border Moraine System. Till sequences with some limited lacustrine and fluvial sediments from proglacial and interglacial environments dominate the regional stratigraphic sequence in this area (Hänsel, 1983).

Regional Hydrogeology

Groundwater in northeastern Illinois is derived from four aquifer systems (in descending order): sand and gravel associated with the glacial deposition; shallow Silurian dolomite; the Cambrian-Ordovician aquifer, which includes the Ironton-Galesville and Galena-St. Peter sandstones; and the Mt. Simon basal aquifer. Regionally, the glacial sand and gravel and Silurian aquifers are generally considered hydraulically connected. The relatively low-permeability Maquoketa shale separates the Cambrian-Ordovician aquifer from these overlying aquifers. Similarly, low-permeability units of the Eau Claire Formation function as aquitards between the deeper aquifers (Suter et al., 1959 and Willman, 1971).

3.3.3 Area 6A and 7 Geology

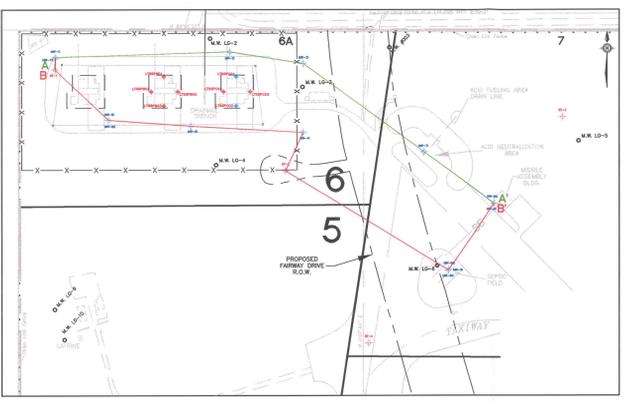
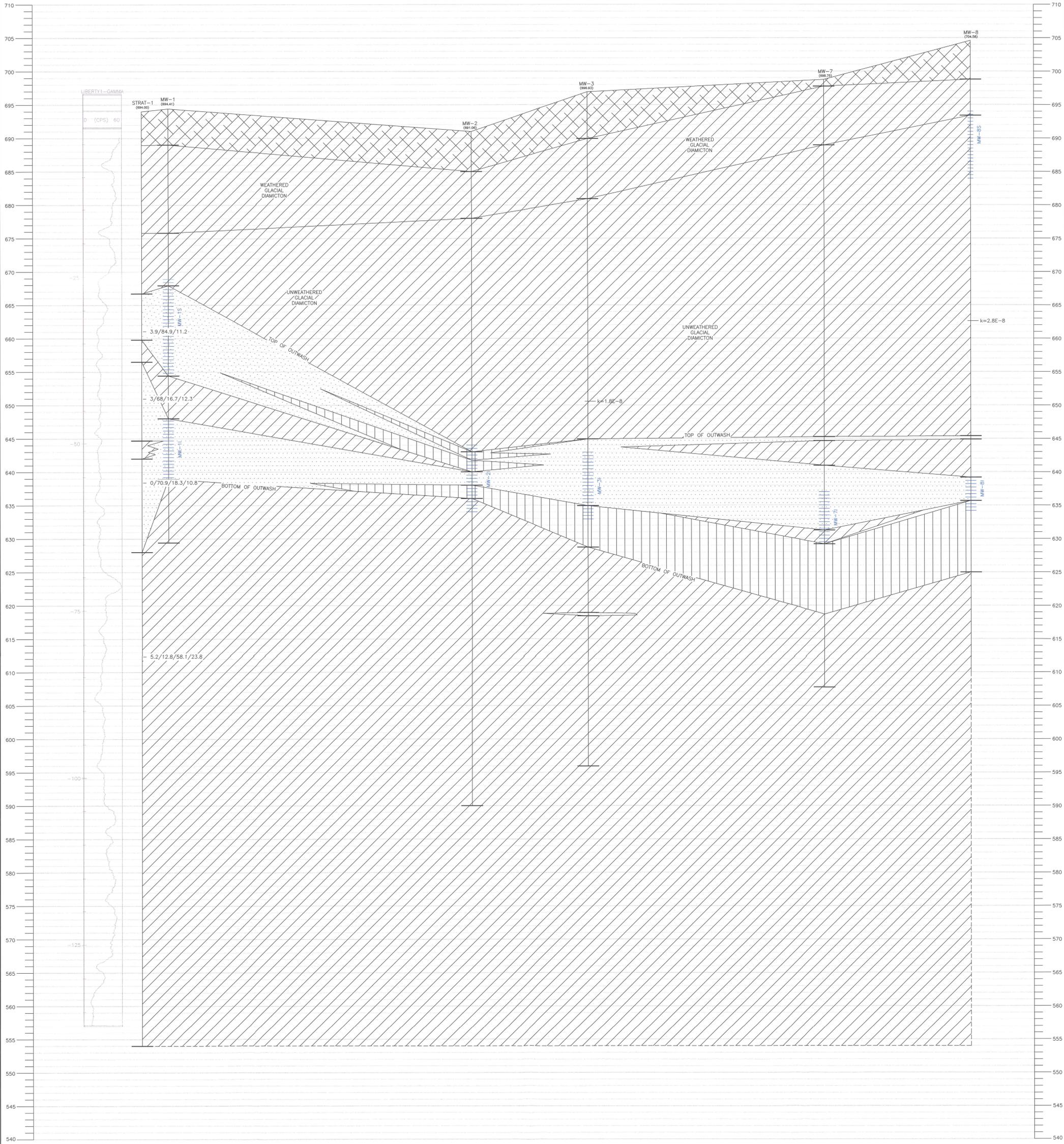
Areas 6A and 7 Geology

The geology of the combined area is consistent with the regional stratigraphy and sediment types. The surficial Wadsworth Till overlies fluvial and lacustrine outwash sediments, which overlie the unnamed till which rests unconformably upon the Silurian dolomite bedrock. This stratigraphic relationship of the glacial units is presented in Figure 3-7 (cross section A-A') and Figure 3-8 (cross section B-B'). Although no borings from this investigation encountered the bedrock, a recently installed irrigation well, located near the southeast corner of Area 6A encountered the dolomite at 178 feet bgs.

The Wadsworth is the surficial glacial unit at the LTS. In this area of Illinois, it is comprised of the surficial Tinley and underlying Valparaiso. The younger Lake Border Moraine System is not present. For the purpose of this investigation, the individual moraine systems are undifferentiated.

A
(WEST)

A'
(EAST)



SAND
 CLAY
 FILL
 SILT

GRAIN SIZE DISTRIBUTION
 (GRAVEL/SAND/SILT/CLAY) 5.2/12.8/58.1/23.8
 (GRAVEL/SAND/SILT AND CLAY) 3.9/84.9/11.2
 k = HYDRAULIC CONDUCTIVITY CM/SEC

- WELL SCREEN INTERVAL
 MW-3

REVISION		
Rev Number: 001	Rev Date: 07/25/02	Rev By: K. WOODSLEY
Rev Number: 000	Rev Date: 00/00/00	Rev By: NAME
Rev Number: 000	Rev Date: 00/00/00	Rev By: NAME
Rev Number: 000	Rev Date: 00/00/00	Rev By: NAME
Rev Number: 000	Rev Date: 00/00/00	Rev By: NAME

HORIZ. SCALE 0' 50' 100'
 VERT. SCALE 0' 5' 10'

ENSAFE

FIGURE 3-7
 GEOLOGIC CROSS SECTION A-A'

Dr by: NAME Tr by: NAME
 Ck by: NAME App by: NAME
 Date: 08/28/02 DWG Name: 0161001W013

Sheet 1
 of 1

The Wadsworth thickness varies from approximately 27 feet in the northwest corner of Area 6A to 63 feet in the eastern part of Area 7. The upper 10 to 18 feet is weathered, but the diamitic texture is very similar to the unweathered below. The weathered zone was extensively leached and oxidized and is generally described as a light olive brown silty clay with minor amounts (less than 15%) of sand and gravel. Most were of medium plasticity. This weathered zone also had numerous high angle fractures, many of which were lined with secondary mineralization of hematite. At most locations there was a gradational contact to dark gray unweathered silty clay with a similar clastic content. Fractures in the unweathered diamicton were rare. Five Shelby tubes were collected of this unweathered Wadsworth diamicton. The hydraulic conductivities were very consistent ranging from 1.3E-08 and 2.8E-08 cm/sec. Table 3-11 presents the results of the geotechnical laboratory testing. No sand or gravel lens greater than one foot thick was encountered in the Wadsworth. Also, where potential aquifers less than one foot were found, the material underlying the thin sand was unweathered, supporting its existence as an isolated lens.

Directly underlying the Wadsworth is a laterally continuous outwash facies unit. Although the unit was encountered in all borings that went to this depth, the thickness and texture of the outwash was highly variable across the combined areas. This unit generally consists of complexly interbedded sand, silt, silty clay. Many of the sand deposits exhibited a fining upward sequence, suggesting that these were stream deposits. Most of the borings found outwash to be between approximately 20 and 26 feet thick. The thicker sections were found along the western portion of Area 6A, where it was 36 feet. This was also where the larger diameter clastics were encountered. Three samples for grain size analysis were collected from the outwash at Strat 1. Table 3-12 presents the results of the grain size analysis. Although the percentages of gravel appears low in these samples (0-3.9 %), this is due to the fact the boulder, cobbles, and coarse gravel fractions would not fit into the sample container.

Table 3-11
Summary of Geotechnical Laboratory Testing

Well Location	Stratigraphic Unit	Depth (Feet)	Soil Description	Hydraulic Conductivity (cm/sec)	Total Organic Content (%)	Dry Density (Pcf)	Moisture Content (%)
MW-3	Wadsworth	45 - 47	Dark gray silty clay, CL	1.8×10^{-8}	1.14	115.5	17.3
MW-4	Wadsworth	39 - 41	Dark gray silty clay, CL	1.9×10^{-8}		122.2	15.0
MW-5	Unnamed Till	67 - 69	Dark gray silty clay, CL	2.8×10^{-8}		109.5	20.0
MW-6	Wadsworth	21 - 23	Dark gray silty clay, CL	1.3×10^{-8}	1.16	119.8	15.3
MW-8	Wadsworth	41 - 43	Dark gray silty clay, CL	2.8×10^{-8}		124.6	13.4
MW-9	Wadsworth	17 - 19	Dark gray silty clay, CL	2.7×10^{-8}	1.23	112.0	19.3

Table 3-12							
Summary of Grain Size Analysis							
Well Location	Sample ID	Stratigraphic Unit	Depth (feet bgs)	Distribution (%)			
				Gravel	Sand	Silt	Clay
Strat 1	GS - 1	Outwash	30 - 33	3.9	84.9	11.2	
Strat 1	GS - 2	Outwash	43 - 44	3.0	68.0	16.7	12.3
Strat 1	GS - 3	Outwash	55 - 56	0.0	70.9	18.3	10.8
Strat 1	GS - 4	Unnamed Till	81 - 82	5.2	12.8	58.1	23.8
Strat 2	GS - 1	Outwash	50.4 - 51	0.7	82.4	16.9	
Strat 2	GS - 2	Unnamed Till	115 - 116	0.0	92.9	7.1	
Strat 3	GS - 1	Unnamed Till	86 - 86.6	27.3	63.8	9.0	
Strat 4	GS - 1	Outwash	57 - 58	0.0	95.3	3.6	1.1
Strat 4	GS - 2	Unnamed Till	118 - 119	0.0	78.8	18.0	3.2

While drilling at MW-1 and MW-6, the HSA drill rig encountered refusal several times near the top of the outwash, presumably on boulders. While drilling Strat 1, the rotasonic rig penetrated several boulders as evidenced by the rock cores that were in the sample. The thinner outwash deposits were found near the center and east side of the areas at MW-2 and Strat 3, where the thickness was reduced to 7 and 9.5 feet, respectively. These were also the areas where the finer grained deposits, mainly silt and fine sand, were observed. Although not measured, the finer deposits would be expected to yield significantly lower hydraulic conductivities.

Directly underlying the outwash is the unnamed till unit. The contact between these units was sharp with no weathering, suggesting the top of the till was an erosional surface developed by the advancing glacier. The texture of the unnamed till was generally a silty clay diamicton, which is interbedded with clayey silt at most of the boring locations. A few potentially significant saturated sand zones were encountered in the till. These were primarily well graded sand with some silt and clay size particles. An exception to this was a thin (0.6 feet thick) gravely sand found in Strat 3.

A single Shelby tube was collected from the unnamed till. Several other attempts were made to collect tubes to assess the material in this zone; however, the density of the material prohibited collection. The hydraulic conductivity of this single sample was similar to that of the Wadsworth at $1.3E-08$ cm/sec. The irrigation, well drilled by others, provides the only location to determine the thickness of the unit, where it was approximately 124 feet thick.

3.3.4 Area 6A and 7 Hydrogeology

The hydrogeology of the glacial sedimentary sequence in the combined areas of investigation involves the glacial diamicton of the Wadsworth and unnamed till and the variable clastic textures of the outwash deposits. The Wadsworth is primarily diamicton, an unstratified random mixture of sand, gravel, and cobbles set into a silty clay matrix. Few thin silty sand lenses are present in the unit; however, they appear to be laterally discontinuous. The investigation included two wells completed in the shallow Wadsworth, MW-8S and MW-9S. Although no discrete water bearing horizons were observed in either of these well borings, both produced enough water to yield a sample for analysis. This water was from the mainly vertical fractures common in the upper weathered portions of the unit. These would most likely be considered Class II aquifers based on the anticipated hydraulic conductivities.

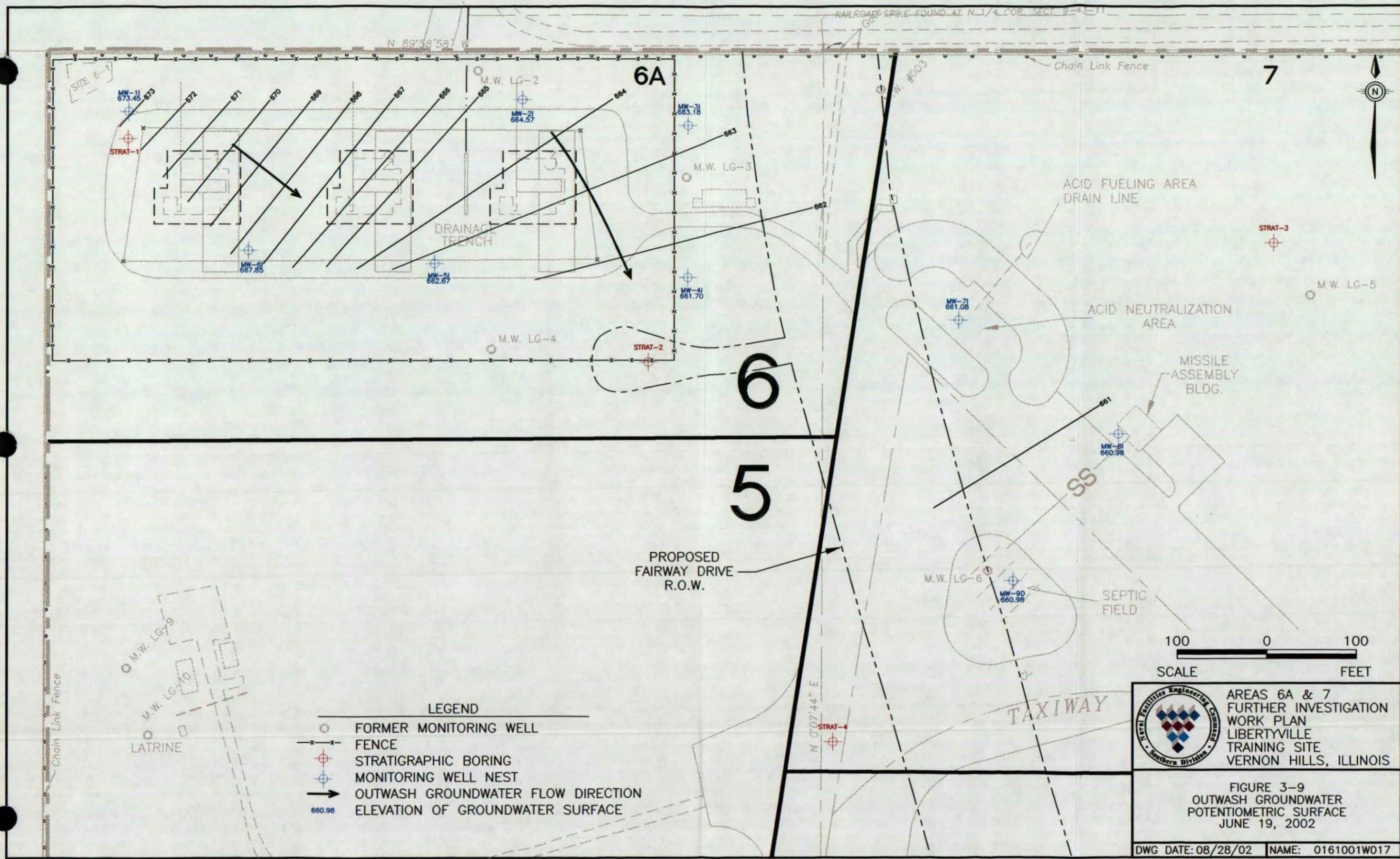
The outwash facies are the most prolific water producing deposit of this glacial sequence. Although the sedimentary texture of the unit is highly variable, all well locations encountered sufficient water to provide a sample. With the exception of MW-8S and MW-9S, all wells installed for this investigation were completed in this unit. Groundwater in the outwash aquifer is contained by the overlying Wadsworth. Based on the thickness of the aquifer and expected hydraulic conductivities, most of these locations would qualify as a Class I aquifer. Two of the locations are questionable and may be Class II; however, for the purpose of this investigation, all outwash samples will be compared to Class I groundwater quality standards.

Groundwater flow was determined from two sets of synoptic water level measurements, recorded on June 19 and July 8, 2002. The resulting horizontal groundwater flow patterns are shown on Figures 3-9 and 3-10. Flow was very consistent between the two events. The direction is primarily to the southeast. The gradient is significantly greater in the western portion of the site and gradually lessens in the wells located on the eastern half of the area. This is probably due to the finer sediments and thinner sequence observed at wells MW-2I and MW-5I. The eastern well borings encountered thicker and more consistent clastic aquifer materials, which would allow the water to flow more freely by contrast and consequently decrease the gradient.

Based on this flow pattern, the monitoring wells are properly positioned to intercept potential contamination migrating away from the magazines in Area 6A and the features of concern in Area 7. Well MW-1S and MW-1I provide an upgradient location to the combined areas. Wells MW-6S, MW-6I, MW-5I, and MW-4I provide samples from directly downgradient of the magazines. Well MW-7I is positioned to monitor the acid neutralization area. The missile assembly area is monitored by MW-8I and MW-8S. The assembly building septic field is monitored by wells MW-9S, MW-9I, and MW-9D. Based on this coverage, no additional wells are needed to evaluate potential releases from these features.

The underlying unnamed till unit contains aquifer materials that appear to be capable of producing significant groundwater and may be locally continuous. Water contained in these aquifers exists under confined conditions. In accordance with the provisions of the work plan, no wells were installed in this unnamed till unit.

The potentiometric levels were also used to evaluate the vertical flow potential between the Wadsworth and the outwash and between individual units within the outwash. This evaluation was performed at locations where well nests of each unit were installed. At locations MW-8 and

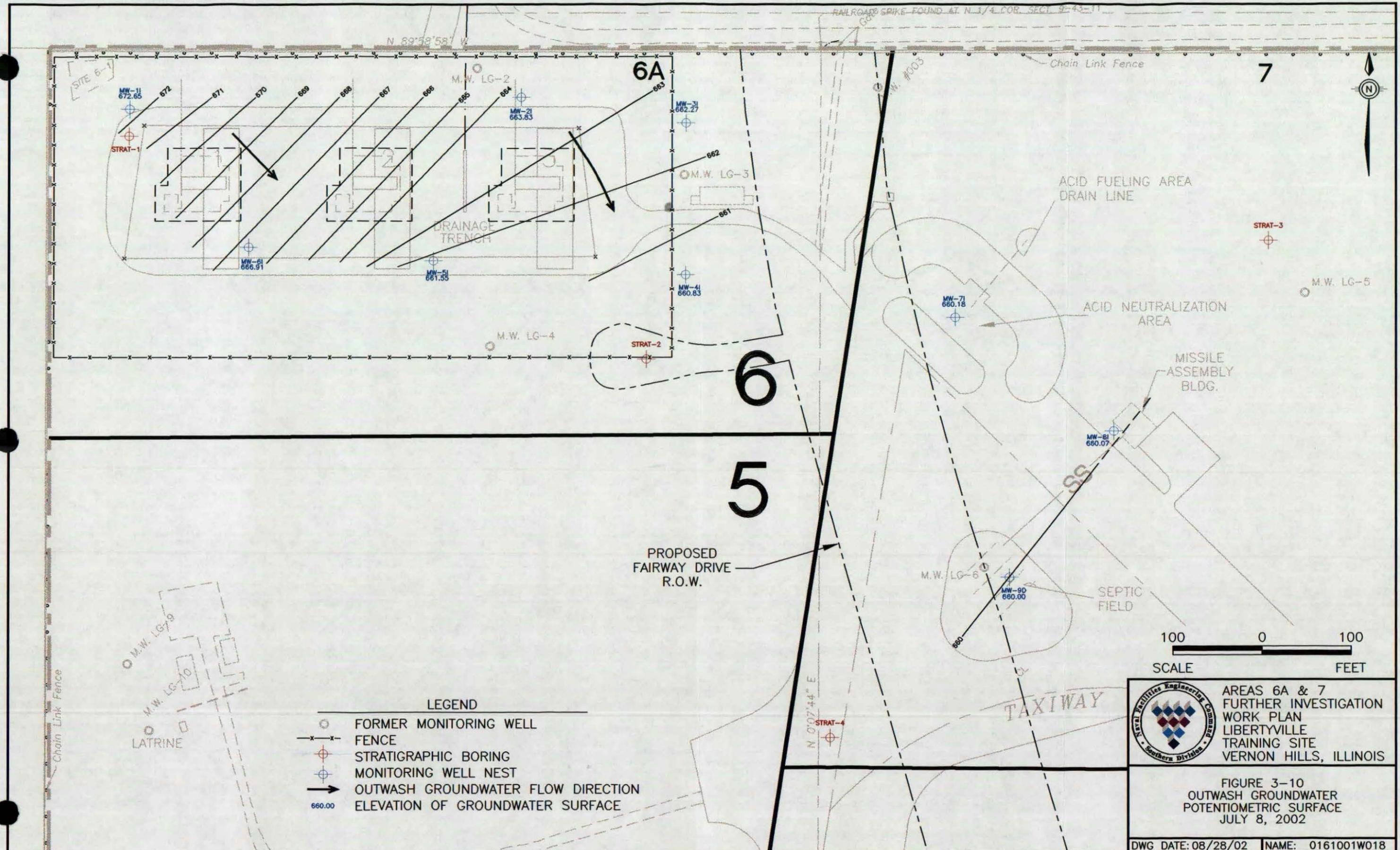


- LEGEND**
- FORMER MONITORING WELL
 - x-x- FENCE
 - ⊕ STRATIGRAPHIC BORING
 - ⊕ MONITORING WELL NEST
 - OUTWASH GROUNDWATER FLOW DIRECTION
 - 660.98 ELEVATION OF GROUNDWATER SURFACE


AREAS 6A & 7
 FURTHER INVESTIGATION
 WORK PLAN
 LIBERTYVILLE
 TRAINING SITE
 VERNON HILLS, ILLINOIS

FIGURE 3-9
 OUTWASH GROUNDWATER
 POTENTIOMETRIC SURFACE
 JUNE 19, 2002

DWG DATE: 08/28/02 NAME: 0161001W017



MW-9, the relationship between the Wadsworth and outwash were evaluated. At both locations, a comparable potential for downward migration was observed. At MW-8, the vertical flow gradient was 0.67 and at MW-9 the gradient was 0.71. The potential for vertical flow within the outwash sediments was evaluated at MW-1, MW-6, and MW-9. At MW-1, a very slight upward migration potential of 0.0011 was observed. At MW-6 and MW-9, a downward potential of 0.21 and 0.04 were measured, respectively. The most significant factor of these results is the relatively strong downward migration potential between the Wadsworth and the outwash aquifer. This would indicate a possibility for contaminants released near the surface to be transported downward to the aquifer if the hydraulic conductivities of the overlying unweathered Wadsworth were not so low. All samples of the Wadsworth exhibited consistent hydraulic conductivities of between 1.3E-08 and 2.8E-08 cm/sec. These values support the role of the Wadsworth as an effective aquitard between the surface and the outwash aquifers.

3.4 Areas 6A and 7 Groundwater Investigation Results

In May and June 2002, fourteen monitoring wells were installed around the perimeter of Area 6A and at specific locations within Area 7. These were areas where organic solvents and petroleum were most likely to have been used at the NIKE facility. Monitoring wells were sampled and analytical results were compared with the TACO Class I and II GROs.

Fifteen groundwater samples were collected; fourteen primary and one duplicate sample. Areas 6A and 7 monitoring well locations are shown on Figure 2-8. The analytical results are summarized in Table 3-13.

Semivolatile Organic Compounds

Two SVOCs were detected in groundwater samples. Di-n-butylphthalate was detected in four outwash monitoring wells; however, these detections were well below the applicable LSL. Bis(2-Ethylhexyl)phthalate was detected in one well and was well below its applicable LSL. No

Table 3-13
 Areas 6A and 7 Combined Groundwater Investigation
 Groundwater Results

Constituent	LSL	BKGR	Shallow Wells - Class II				Outwash Wells - Class I												
			MW-8S	MW-9S	LSL	BKGR	MW-1S	MW-1I	MW-2I	MW-3I	MW-4I	MW-5I	MW-5I (Duplicate)	MW-6S	MW-6I	MW-7I	MW-8I	MW-9I	MW-9D
Metals																			
Aluminum	-	7930	ND	758	-	1610	102J	182J	283	495	500J	2460	2890	76.4J	166J	802	ND	615	ND
Arsenic	200	77	ND	ND	50	182	ND	6J	ND	ND	ND	ND	3.8J	ND	ND	ND	ND	ND	ND
Barium	2000	1680	122J	64.3J	2000	1730	46.4J	96.1J	86.6J	50.9J	93.1J	109J	115J	114J	122J	52.8J	66.1J	60.2J	67.5J
Beryllium	500	-	ND	ND	4	13	ND	0.1J	ND	ND	ND	ND	0.17J	ND	ND	ND	ND	ND	ND
Cadmium	50	-	ND	ND	5	-	ND	0.53J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	-	-	93000	106000	-	-	122000	129000	58600	69500	53500	56600	58700	83000	107000	34800	29800	28600	36900
Chromium	1000	210	ND	4.9J	100	863	ND	ND	ND	3.6J	3.8J	8.7J	18.9	2.3J	3.6J	1.8J	ND	33.4	ND
Cobalt	1000	64	ND	1.3J	1000	187	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Copper	650	265	ND	ND	650	526	ND	4.6J	2.5J	ND	ND	8.7J	8.3J	ND	4.3J	ND	ND	ND	ND
Iron	5000	-	ND	1500	5000	-	300	2120	755	1000	789	1970	3650	724	585	820	590	655	431
Lead	100	124	ND	2.4J	7.5	251	ND	ND	1.5J	ND	ND	1.9J	4.3	ND	1.6J	2.1J	ND	ND	ND
Magnesium	-	-	49400	64700	-	-	64300	57700	40200	46900	41200	45600	47100	44800	54900	28100	22200	24800	31600
Manganese	10000	4340	66.5	66.3	150	2450	291	84.1	61	88.7	30.2	44.7	79.7	87.3	70.6	26	12.7J	28.2	10.4J
Nickel	2000	230	5.5J	6.7J	100	698	ND	2.9J	4.8J	ND	4J	7.3J	13.7J	ND	3.5J	0.92J	ND	24.5J	ND
Potassium	-	-	6810	8070	-	-	1080J	2430J	2760J	1760J	2400J	5360	6420	2380J	2130J	1900J	1350J	2540J	1750J
Selenium	50	-	1.5J	5.4	50	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	-	-	ND	ND	50	-	ND	ND	1.8J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	-	-	11300	34200	-	-	4050J	9820J	32500	38200	21400	31600	31800	13700	19900	37700	32600	34900	33900
Vanadium	100	149	5.2J	4.4J	49	372	ND	ND	ND	ND	ND	ND	5.1J	ND	ND	3J	1.3J	3.1J	1.4J
Zinc	10000	573	ND	ND	5000	1140	1.2J	6.1J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Semivolatile Organic Compounds																			
Di-n-butylphthalate	3500	NA	ND	ND	700	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	3J	3J	2J	3J
bis(2-Ethylhexyl)phthalate (BEHP)	-	NA	ND	ND	-	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.5J	ND
Low Level PAHs																			
No PAHs were detected.																			
Volatile Organic Compounds																			
No VOAs were detected.																			
Polychlorinated Biphenyls																			
No PCBs were detected.																			

Notes:

Only detected constituents are presented.

LSL = Libertyville screening levels.

Units = µg/kg

ND = Not detected.

J = Estimated value.

Bold = Concentration exceeds LSL

low-level PAHs were detected in the groundwater samples. Based on these results, SVOCs are not a concern in groundwater in the combined Areas 6A and 7.

Metals

Twenty metals were detected in groundwater samples. One constituent (manganese — 291 µg/L) exceeded its LSL in monitoring well MW-1S; however, it was well below its background value of 2,450 µg/L. Aluminum was present in the sample collected from MW-5 and its duplicate at concentrations that exceed the background. No LSL was established for aluminum. No other metal result exceeded its background or LSL value. Based on these results, metals are not a concern in groundwater at the LTS.

VOCs

No VOCs were detected in any monitoring well samples.

PCBs

No PCBs were detected in any monitoring well samples.

4.0 CONCLUSIONS

The further investigation of the missile magazines at LTS was conducted to determine whether constituents in soil and groundwater that had exceeded LSLs during the July 2001 investigation were due to waterproofing material on the magazines' exterior walls or to other sources. Groundwater was also investigated to address potential petroleum product and chlorinated organic solvent (TCE, TCA, and carbon tetrachloride) contamination in Areas 6A and 7 at the LTS. Investigative activities were conducted at Areas 6A and 7 from April to July 2002. The conclusions of these activities are presented below.

4.1 Area 6A Soil Investigation Conclusions

Analytical results indicated the presence of a number of PAHs and one metal (arsenic) exceeding cleanup objectives for subsurface soil.

Magazine Alpha

Magazine Alpha was investigated based on results of the investigation at Magazines Bravo and Charlie. Nineteen SVOCs were detected in Magazine Alpha soil samples; 17 were low-level PAHs; however, no constituents exceeded LSLs and most were at least one order of magnitude below them. One VOC (acetone) was detected in soil samples; however, these results were orders of magnitude below acetone's LSL. One PCB (Aroclor-1260) was detected in six soil samples from Magazine Alpha; however, these results were well below the LSL.

One inorganic (arsenic) result (LTSSBA0425) from sample location LTSSA04 was detected at 12.7 mg/kg, above both arsenic's LSL (0.39 mg/kg) and background (11.8 mg/kg). This sample was collected in the underlying native till material at a depth of 23 to 25 feet bgs. This sample result only slightly exceeds its background value and no overlying fill analytical result exceeded its LSL or background concentrations. Additionally, because the background value is the 95% upper confidence limit, 5% of sample results can be expected to naturally exceed background.

Therefore, this result is thought to represent a variation in natural concentrations and not contamination.

One or more calcium, iron, and sodium result exceeded background levels. All three metals are considered essential nutrients. No other metals results exceeded either background or LSL values.

Based on these results, soil contamination around Magazine Alpha is not a concern.

Magazines Bravo and Charlie

To investigate the SVOC soil exceedances identified at Magazines Bravo and Charlie in July 2001, several phases of delineation sampling were required. During the initial phase, PAHs at sample location LTSSB03 exceeded LSLs at Magazine Bravo. All four exceedances were from the sample collected from 12 to 14 feet bgs (LTSSBB0314). No other sample result exceeded LSLs and most other SVOC results were at least one order of magnitude below LSLs.

At Magazine Charlie, no constituents exceeded LSLs and most detections were at least one order of magnitude below them. One VOC (acetone) was detected in Magazine Bravo and Magazine Charlie soil samples; these results were orders of magnitude below its LSL. No PCBs were detected in soil samples from Magazine Bravo or Magazine Charlie. Twenty metals were detected in soil samples from Magazine Bravo and Magazine Charlie; however, no metals results exceeded background levels or LSLs.

Based on the results of the initial phase of delineation sampling, SVOC soil contamination concerns were delineated at Magazine Charlie and no further investigation was required. The SVOC soil contamination concerns at Magazine Bravo were not fully delineated and required further investigation to the south.

During the second phase of delineation sampling at Magazine Bravo, one constituent (benzo[a]pyrene) exceeded its LSL at sample location LTSSB3D from 14 to 16 feet bgs (LTSSBB3D16 and duplicate sample LTSCBB3D16). No other sample result exceeded LSLs and most other SVOC results were at least one order of magnitude below them. One VOC (acetone) was detected in Magazine Bravo soil samples; however, these results were orders of magnitude below its LSL. No PCBs were detected in additional soil samples.

One inorganic constituent (arsenic) from sample location LTSSB3C was detected at 22.3 mg/kg, above both the LSL (0.39 mg/kg) and background (11.8 mg/kg) concentrations. This exceedance was from the sample collected from 10 to 12 feet bgs. Because the backfill around the magazines is reworked native soil that could have originally come from any interval between surface and approximately 25 feet bgs, comparison to the shallow subsurface (6 inches to 10 feet bgs) value of 29.9 mg/kg is appropriate. The detected arsenic concentration is below this level. Furthermore, this was the only arsenic exceedance at Magazine Bravo and it is not thought to represent contamination. No other metals results exceeded either background or LSL values.

Based on these results, soil contamination concerns at Magazine Bravo, specifically benzo(a)pyrene, were not fully delineated and required further investigation to the south.

During the third phase of delineation sampling at Magazine Bravo, one constituent (benzo[a]pyrene) exceeded its LSL at two sample locations, LTSSB3F and LTSSBB3H. These exceedances were from samples collected from 14 to 16 feet bgs (LTSSBB3F16 and LTSSBB3H16). Two constituents, 3-methylphenol and carbazole, also exceeded their respective LSLs at location LTSSBB3G. These exceedances were from the sample collected from 12 to 14 feet bgs (LTSSBB3G14). One VOC (acetone) was detected in Magazine Bravo soil samples; however, these results are orders of magnitude below its LSL. No PCBs were detected in additional soil samples.

The results of the three phases of soil sampling south of Magazine Bravo were discussed with the BCT. Because the extent of contamination has been delineated east and south of Magazine Bravo and the Navy is committed to removal of the contaminated soil, the BCT agreed investigation sampling could be terminated and the western boundary of contaminated soil can be delineated by confirmation sampling during the removal action.

To accommodate the Village of Vernon Hills' redevelopment schedule and the Navy's desire to transfer the property as quickly as possible, in July 2002, the BCT agreed the contaminated soil could be removed under a time-critical removal action.

4.2 Groundwater Investigation Conclusions

Area 6A — Magazine Exterior Groundwater

In June 2002, four temporary monitoring wells were installed around the exterior of Magazine Alpha, and in April 2002, one permanent monitoring well was installed between Magazines Bravo and Charlie. These wells, along with a previously installed temporary well on the east side of Magazine Bravo, were sampled and analytical results were compared with TACO Class II GROs. Metals and SVOCs were detected in the groundwater samples collected from the monitoring wells surrounding the magazines. One metal (iron) exceeded its LSL in one groundwater sample; however, iron is considered an essential nutrient. Only one SVOC, benzo(a)anthracene (0.66 µg/L), slightly exceeded the LSL (0.65 µg/L) in a single water sample location. No VOCs, pesticides, or PCBs were detected in groundwater samples.

The sampling results indicated there are no contamination issues. Based on this investigation's sampling results, groundwater in the backfill around the magazines is uncontaminated and no further action is required.

Combined Areas 6A and 7 Groundwater

In May and June 2002, 14 monitoring wells were installed around the perimeter of Area 6A and at specific locations within Area 7. These wells were sampled and analytical results were compared with TACO Class I and II GROs.

Metals and VOCs were detected in the groundwater samples collected for the combined Area 6A and 7 investigation. The concentrations of metals were generally within the range of naturally occurring elements. Manganese was present in the sample collected from monitoring well MW-1S at a concentration of 291 $\mu\text{g/L}$ which exceeds the LSL of 150 $\mu\text{g/L}$ but is far below the background concentration of 2,450 $\mu\text{g/L}$ for outwash sediments. Aluminum was present in the sample collected from MW-5 and its duplicate at concentrations that exceed the background. No LSL was established for aluminum. Only trace concentrations of two SVOCs were detected in groundwater samples. Concentrations of Di-n-butylphthalate were approximately three orders of magnitude below the LSL. The other SVOC, bis(2-Ethylhexyl)phthalate, was detected at a single location at 0.5 $\mu\text{g/L}$. No LSL was established for this compound. No VOCs, low level PAHs or PCBs were detected in any groundwater samples. Based on these results of this investigation, it appears that no unresolved groundwater issues remain with regard to the missile magazines and supporting features.

ILLINOIS PROFESSIONAL GEOLOGIST SEAL

I have read and approve of the Areas 6A and 7 Investigation Report Libertyville Training Site NIKE Missile Magazines September, 2002, and seal it in accordance with the State of Illinois Professional Geologist Licensing Act, 225 ILCS 745. In sealing this document, I certify the geological information contained in it is true to the best of my knowledge and the geological method and procedures included herein are consistent with currently accepted geological practices.

Name: Craig R. Smith
License Number: 196-000258
State: Illinois
Expiration Date: 3/31/03



Craig R. Smith, PG

9/6/02

Date

6.0 REFERENCES

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**Appendix A
Gamma Logs
Boring Logs**



LOG OF BORING Strat. 1

(Page 1 of 7)

Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 694.00
Date Completed : 4/9/02
Hole Diameter : 6-inch
Drilling Method : Rotasonic
Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 42.22600555
Westing Coord. : 87.95823669

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev. 694.00
0					Asphalt.		694
1		Run #1 1 - 10' 8.7' R	SW		Gravelly SAND fill.		693
2			CL		Dark grayish brown and black (2.5y 4/2) silty CLAY fill. Some coarse to fine sand, little coarse to fine gravel, hard, low plasticity. Moist.	qu = 4.5+*	692
3	0				Sharp contact.		691
4			OL		Black (2.5y 2.5/1) organic CLAY topsoil, little coarse to fine sand, medium, medium plasticity, moist.	qu = 0.5*	690
5	0				Gradational contact.		689
6			CL		Light olive brown (2.5y 5/3) silty CLAY, little coarse to fine sand, trace coarse to fine gravel (calc), very stiff, medium plasticity, massive, mottled, oxidized, leached, moist	qu = 2.5*	688
7	0					Weathered Diamiction	687
8							686
9							685
10		Run #2 10 - 20' 10' R					684
11							683
12			CL		Increase in clastics below 12 feet bgs. Little coarse to fine gravel, carbonate (80%) and shale (20%), stiff.	qu = 1.25*	682
13	0						681
14						qu = 1.75*	680
15							679
16							678
17	0						677
18							676
19			CL		Gradational contact.		675
20						Unweathered Diamiction	

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LOG OF BORING Strat. 1

(Page 2 of 7)

Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 694.00
Date Completed : 4/9/02
Hole Diameter : 6-inch
Drilling Method : Rotasonic
Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 42.22600555
Westing Coord. : 87.95823669

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev. 694.00
20		Run #3 20 - 40' 14.5' R			Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, little coarse to fine gravel, stiff, medium plasticity, massive, unweathered, unoxidized, moist.		674
21							673
22						qu = 3.25*	672
23	0						671
24			CL		Interbedded massive silt encountered from 21.7 - 22.3' bgs.		670
25							669
26							668
27					Sharp contact.	Top of Outwash	667
28					Dark gray (2.5y 4/1) coarse to fine SAND, little coarse to fine gravel, occasional cobbles, saturated, limestone cobbles at 28.2' bgs. Clastics are limestone and shale - angular.		666
29							665
30	0					Collected GS - 1 30 - 33' 4/85/11	664
31			SW				663
32							662
33							661
34	0				Gradational contact. Gray (2.5y 5/1) coarse to fine GRAVEL with coarse to fine sand, fining upward. Loose, saturated.	qu = 3.7*	660
35					Sharp contact.	No Recovery = 35 - 40' Carbonate cobble lodged in shoe @ 35'.	659
36			CL		Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, some coarse to fine gravel, occasional cobbles, very stiff, medium plasticity, massive, unoxidized, unleached, moist.		658
37	0						657
38					Dark gray (2.5y 4/1) coarse to fine silty SAND, trace coarse to fine gravel, thickly bedded, saturated.		656
39			SM				655
40							

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LOG OF BORING Strat. 1

(Page 3 of 7)

Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 694.00
Date Completed : 4/9/02
Hole Diameter : 6-inch
Drilling Method : Rotasonic
Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 42.22600555
Westing Coord. : 87.95823669

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev. 694.00
40		Run #4 40 - 60' 18.7' R					654
41							653
42							652
43						Collected GS - 2 43 - 44' 3/68/17/12	651
44	0		SM				650
45							649
46							648
47							647
48							646
49					Sharp contact.		645
50			CL		Dark gray (2.5y 4/1) silty CLAY, some coarse to fine gravel, some coarse to fine sand, low plasticity, very stiff, massive, unoxidized, moist.	qu = 2.7*	644
51							643
52	0						642
53					Dark gray (2.5y 4/1) silty coarse to fine SAND, trace coarse to fine gravel, trace cobbles, interbedded clay clasts .3 - 1.7' T, saturated.	Collected GS - 3 55 - 56' 0/71/18/11	641
54	0						640
55							639
56			SM				638
57							637
58							636
59							635
60	0						

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LOG OF BORING Strat. 1

(Page 4 of 7)

Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Surface Elevation : 694.00
Date Completed : 4/9/02
Hole Diameter : 6-inch
Drilling Method : Rotasonic
Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 42.22600555
Westing Coord. : 87.95823669

Project Number: 0161-001

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev. 694.00
60		Run #5 60 - 80' 20' R					634
61							633
62							632
63			SM				631
64	0						630
65							629
66	0				Sharp contact. Gray (2.5y 5/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, trace cobbles, medium plasticity, very stiff, massive, unoxidized, unweathered, moist.	Bottom of Outwash qu = 3.25*	628
67							627
68							626
69							625
70			CL				624
71							623
72							622
73							621
74					Gradational contact.		620
75					Dark gray (2.5y 4/1) clayey SILT, trace coarse to fine sand, trace coarse to fine gravel, trace cobbles, hard, moist.		619
76	0						618
77			ML				617
78							616
79							615
80	0						

09-04-2002 G:\AMCCAFFERY\VILLE LOGS\STRAT 1.BOR



LOG OF BORING Strat. 1

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 694.00
Date Completed : 4/9/02
Hole Diameter : 6-inch
Drilling Method : Rotasonic
Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 42.22600555
Westing Coord. : 87.95823669

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev. 694.00
80		Run #6 80 - 100' 19.2' R					614
81			ML			Collected GS - 4 81 - 82' 5/13/58/24	613
82	0				Gradational contact.		612
83					Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, trace cobbles, medium plasticity, hard, massive, unleached, moist.	qu = 4.2*	611
84	0						610
85							609
86							608
87							607
88							606
89							605
90					Very stiff.	qu = 2.1*	604
91			CL				603
92							602
93							601
94							600
95							599
96							598
97							597
98							596
99							595
100							

Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 694.00
Date Completed : 4/9/02
Hole Diameter : 6-inch
Drilling Method : Rotasonic
Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 42.22600555
Westing Coord. : 87.95823669

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev. 694.00
100		Run #7 100 - 110' 0' R					594
101						Large cobble in shoe - No Recovery,	593
102							592
103							591
104							590
105							589
106	0						588
107			CL				587
108							586
109							585
110		Run #8 110 - 130' 20' R					584
111							583
112							582
113							581
114					Gradational contact.		580
115	0				Gray (2.5y 5/1) CLAY, trace coarse to fine sand, high plasticity, massive, unweathered, unleached, moist.		579
116						qu = 1.72"	578
117			CH				577
118							576
119							575
120							

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LOG OF BORING Strat. 1

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 694.00
Date Completed : 4/9/02
Hole Diameter : 6-inch
Drilling Method : Rotasonic
Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 42.22600555
Westing Coord. : 87.95823669

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev. 694.00
120							574
121							573
122						qu = .75*	572
123							571
124	0						570
125							569
126			CH				568
127							567
128							566
129							565
130		Run #9 130 - 140' 10' R					564
131							563
132	0				Gray (2.5y 4/1) silty CLAY, some coarse to fine sand, little coarse to fine gravel, occasional cobbles, medium plasticity, hard, massive, unleached, moist.		562
133						qu = 2.3*	561
134							560
135							559
136			CL				558
137							557
138							556
139					Low plasticity.		555
140	0				Total depth of boring 140'.	qu = 4.5+*	

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LOG OF BORING Strat. 2

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Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois
 Project Number: 0161-001

Surface Elevation : 698.67
 Date Completed : 4/10/02
 Hole Diameter : 6-inch
 Drilling Method : Rotasonic
 Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
 Northing Coord. : 42.22526932
 Westing Coord. : 87.95581818

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev.
0					Soil/bare ground.		698.67
1		Run #1 1 - 10' 3.9' R	OL		Black (2.5y 2.5/1) organic top soil, FILL		698
2	0		CL		Light olive brown (2.5y 6/5) silty CLAY FILL, little coarse to fine sand, little coarse to fine gravel, medium plasticity, moist, massive, oxidized, leached.		697
3					Sharp contact.		696
4	0				Black (2.5y 2.5/1) organic CLAY, trace fine sand, trace coarse to fine gravel, medium plasticity, very stiff, massive.		695
5			OL			qu = 3.1*	694
6							693
7							692
8					Light olive brown (2.5y 5/3) silty CLAY, little coarse to fine sand, little coarse to fine gravel, medium plasticity, stiff, massive, oxidized, leached, moist.	Weathered Diamicton	691
9							690
10		Run #2 10 - 20' 8.6' R					689
11	0		CL				688
12						qu = 1.7*	687
13							686
14					Transition zone begins		685
15	0						684
16					Gradational contact.		683
17	0				Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, massive, unoxidized, unleached, moist.	Unweathered Diamicton	682
18			CL			qu = 2.7*	681
19							680
20	0		CH				679



LOG OF BORING Strat. 2

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois
Project Number: 0161-001

Surface Elevation : 698.67
Date Completed : 4/10/02
Hole Diameter : 6-inch
Drilling Method : Rotasonic
Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 42.22526932
Westing Coord. : 87.95581818

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev. 698.67
20		Run #3 20 - 40' 19.2" R			Gray (2.5y 5/1) CLAY, little coarse to fine sand, trace coarse to fine gravel, occasional cobbles, high plasticity, stiff, massive, moist, unleached.		678
21	0						677
22						qu = 1.25*	676
23							675
24	0					Clastics limestone/ dolostone/ shale	674
25							673
26							672
27							671
28						qu = 1.0*	670
29							669
30			CH				668
31	0						667
32						qu = 1.2*	666
33							665
34							664
35							663
36							662
37							661
38						qu = 1.3*	660
39					Little coarse to fine gravel below 39'.		659
40	0						

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LOG OF BORING Strat. 2

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Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois
 Project Number: 0161-001

Surface Elevation : 698.67
 Date Completed : 4/10/02
 Hole Diameter : 6-inch
 Drilling Method : Rotasonic
 Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
 Northing Coord. : 42.22526932
 Westing Coord. : 87.95581818

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev.
40		Run #4 40 - 50' 2.7' R			Cobbles below 41'	qu = 1.2*	698.67
41	0					40 - 50' very hard drilling. Drilled on a cobble at 42.6' bgs.	658
42							657
43							656
44							655
45			CH				654
46							653
47	0						652
48							651
49					Cobble.	Another cobble at 49'.	650
50	0	Run #5 50 - 70' 15.3' R				Very Hard Drilling at 50' Large metamorphic cobble cut in top of core. Bit RPM increased Collected GS-1 50.4 - 51.0' bgs. 1/82/17	649
51			SP		Gray (2.5y 5/1) fine SAND with clay clasts, dense, saturated.		648
52			SW		Gray (2.5y 5/1) medium to fine SAND, trace coarse sand with interbedded silt and clay clasts. Loose, saturated.		647
53	0				Gray (2.5y 5/1) SILT, some interbedded clayey silt, horizons (<3" T), thickly bedded, unoxidized, saturated.		646
54							645
55							644
56			ML				643
57							642
58							641
59	0						640
60							639

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois
Project Number: 0161-001

Surface Elevation : 698.67
Date Completed : 4/10/02
Hole Diameter : 6-inch
Drilling Method : Rotasonic
Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 42.22526932
Westing Coord. : 87.95581818

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev.
60							698.67
61	0						638
62							637
63							636
64							635
65							634
66							633
67	0		ML				632
68							631
69							630
70	0	Run #6 70 - 90' 20' R			Trace coarse to fine sand, trace fine gravel.		629
71							628
72							627
73							626
74					1" thick very fine sand layer at 74.3. Sharp contact.		625
75					Gray (2.5y 5/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, very hard, medium plasticity, massive, unweathered, unoxidized, moist.		624
76						qu = 4.5+*	623
77	0		CL				622
78							621
79							620
80	0						619

Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois
 Project Number: 0161-001

Surface Elevation : 698.67
 Date Completed : 4/10/02
 Hole Diameter : 6-inch
 Drilling Method : Rotasonic
 Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
 Northing Coord. : 42.22526932
 Westing Coord. : 87.95581818

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev.
80		Run #6 70 - 90' 20' R					698.67
81	0				2" T silt - saturated.		618
82					3" T silt - saturated.		617
83			CL				616
84							615
85							614
86					Sharp contact.		613
87	0		ML		Gray (2.5y 5/1) SILT, some coarse gravel (at 86.3 - 86.4') moist, dense.		612
88					Gray (2.5y 5/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, low plasticity, massive, very hard, moist.		611
89						qu = 4.5+*	610
90		Run #7 90 - 110' 20' R					609
91							608
92	0						607
93							606
94			CL				605
95							604
96							603
97							602
98							601
99	0						600
100							599



LOG OF BORING Strat. 2

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 698.67
Date Completed : 4/10/02
Hole Diameter : 6-inch
Drilling Method : Rotasonic
Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 42.22526932
Westing Coord. : 87.95581818

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev.
100							698.67
101							598
102							597
103							596
104	0						595
105							594
106							593
107							592
108			CL				591
109							590
110	0	Run #8 110 - 130' 20' R					589
111							588
112							587
113							586
114							585
115					Gradational contact, unoxidized, unleached.		584
116	0				Gray (2.5y 5/1) fine SAND, dense, unoxidized, unleached, thickly bedded, saturated.		583
117			SP			Collect GS - 2 115 - 116' 0/93/7	582
118					Gradational contact.		581
119	0				Gray (2.5y 5/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very hard, massive, unweathered, moist.	qu = 4.1*	580
120			CL				579

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LOG OF BORING Strat. 2

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois
Project Number: 0161-001

Surface Elevation : 698.67
Date Completed : 4/10/02
Hole Diameter : 6-inch
Drilling Method : Rotasonic
Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 42.22526932
Westing Coord. : 87.95581818

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev. 698.67
120	0						578
121	0						577
122	0						576
123	0						575
124	0						574
125	0					qu = 4.2*	573
126	0						572
127	0						571
128	0						570
129	0						569
130	0	Run #9 130 - 140' 10' R	CL				568
131	0						567
132	0						566
133	0					qu = 4.3*	565
134	0						564
135	0						563
136	0						562
137	0						561
138	0						560
139	0						559
140	0						559

Total Depth of boring 140.0'

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LOG OF BORING Strat. 3

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 701.73
Date Completed : 4/11/02
Hole Diameter : 6-inch
Drilling Method : Rotasonic
Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 42.22563171
Westing Coord. : 87.95323181

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev.
0					Reworked brown CLAY fill.		701.73
1		Run #1 0 - 10' 8.2' R			Reworked brown and black silty CLAY fill, very hard, moist.		701
2	0		CL			qu = 4.5+* Mechanically compacted soil at edge of roadway.	700
3							699
4					Sharp contact.		698
5	0				Light olive brown (2.5y 5/3) silty CLAY, with little gray (2.5y 5/1) mottling some coarse to fine sand, little coarse to fine gravel, occasional cobbles, very hard, massive, oxidized, jointed, leached, low plasticity, moist.	qu = 4.5+*	697
6							696
7			CL				695
8							694
9	0						693
10					Olive brown (2.5y 4/3) silty CLAY, little coarse to fine sand, little coarse to fine gravel, occasional cobbles, very hard, low plasticity, massive, oxidized, jointed, leached, moist.		692
11	0	Run #2 10 - 20' 6.7' R					691
12			CL				690
13						Gradational contact.	
14	0				Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, little coarse to fine gravel, occasional cobbles, massive unoxidized, unleached, very stiff, medium plasticity, moist.	qu = 4.5+*	688
15							687
16						qu = 2.5*	686
17			CL				685
18							684
19							683
20							682



LOG OF BORING Strat. 3

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois
Project Number: 0161-001

Surface Elevation : 701.73
Date Completed : 4/11/02
Hole Diameter : 6-inch
Drilling Method : Rotasonic
Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 42.22563171
Westing Coord. : 87.95323181

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev.
20		Run #3 20' - 40' 20' R.					701.73
21	0						681
22							680
23						qu = 2.7*	679
24							678
25							677
26	0				Very consistent.		676
27							675
28							674
29							673
30							672
31	0		CL				671
32							670
33							669
34							668
35							667
36	0					qu = 2.4*	666
37							665
38							664
39							663
40							662



LOG OF BORING Strat. 3

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois
Project Number: 0161-001

Surface Elevation : 701.73
Date Completed : 4/11/02
Hole Diameter : 6-inch
Drilling Method : Rotasonic
Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 42.22563171
Westing Coord. : 87.95323181

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev.
40		Run #4 40 - 60' 20' R					701.73
41	0						661
42							660
43							659
44							658
45	0						657
46						qu = 2.9*	656
47							655
48			CL				654
49							653
50	0						652
51							651
52							650
53							649
54							648
55	0						647
56					Gradational contact. Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, occasional cobbles, massive, high plasticity, very stiff, moist, unoxidized, unleached, moist.		646
57	0					qu = 2.7*	645
58			CH				644
59							643
60							642

Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 701.73
 Date Completed : 4/11/02
 Hole Diameter : 6-inch
 Drilling Method : Rotasonic
 Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
 Northing Coord. : 42.22563171
 Westing Coord. : 87.95323181

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev.
60		Run #5 60' - 80' 20' R					701.73
61	0		CH				641
62					Gradational contact.		640
63	0		ML		Gray (2.5y 5/1) clayey SILT, saturated, loose. Sharp contact.		639
64			CL		Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, massive, moist.		638
65	0					qu = 3.5*	637
66					Gray (2.5y 5/1) clayey SILT, trace coarse to fine sand, trace coarse to fine gravel, occasional cobbles, dense, saturated.		636
67	0						635
68			ML				634
69							633
70							632
71	0						631
72					Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, occasional cobbles, very hard, medium plasticity, massive, moist, unoxidized, unleached.		630
73						qu = 4.5*	629
74	0						628
75							627
76			CL				626
77							625
78							624
79	0						623
80							622



LOG OF BORING Strat. 3

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 701.73
Date Completed : 4/11/02
Hole Diameter : 6-inch
Drilling Method : Rotasonic
Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 42.22563171
Westing Coord. : 87.95323181

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev.
80		Run #6 80 - 100' 20' R					701.73
81							621
82						qu = 3.5*	620
83	0		CL				619
84							618
85							617
86	0		SW		Sharp contact. Gray coarse to fine SAND, with coarse to fine gravel, saturated.	GS - 1 86 - 86.6' 27/64/9	616
87					Sharp contact.		615
88	0				Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity.	qu = 4.5+*	614
89							613
90							612
91							611
92							610
93			CL				609
94							608
95							607
96	0						606
97							605
98							604
99							603
100							602



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Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois
 Project Number: 0161-001

Surface Elevation : 701.73
 Date Completed : 4/11/02
 Hole Diameter : 6-inch
 Drilling Method : Rotasonic
 Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
 Northing Coord. : 42.22563171
 Westing Coord. : 87.95323181

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev.
100							701.73
101	0	Run #7 100 - 120' 20' R	CL				601
102					Gradational contact.		600
103						Gray (2.5y 4/1) clayey SILT, with silty clay clasts, thinly bedded, trace coarse to fine sand in clay clasts, wet, unoxidized, unleached.	599
104							598
105							597
106							596
107	0		ML				595
108							594
109							593
110							592
111							591
112					Sharp contact.		590
113					Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, little coarse to fine gravel, occasional cobbles, low plasticity, very hard, moist, unoxidized, unleached.	qu = 4.5+*	589
114	0						588
115							587
116			CL				586
117							585
118							584
119	0						583
120							582

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LOG OF BORING Strat. 3

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois
Project Number: 0161-001

Surface Elevation : 701.73
Date Completed : 4/11/02
Hole Diameter : 6-inch
Drilling Method : Rotasonic
Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 42.22563171
Westing Coord. : 87.95323181

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev. 701.73
120		Run #8 120 - 140' 20' R					
121	0					qu = 4.5+	581
122							580
123							579
124							578
125			CL				577
126							576
127							575
128	0						574
129					Gradational contact. Gray (2.5y 4/1) SILT with fine sand, occasional limestone cobbles.		573
130	0		ML				572
131					Sharp contact		571
132					Dark gray (2.5y 4/1) silty CLAY, some coarse to fine sand, little coarse to fine gravel, little limestone cobbles, low plasticity, very hard, massive.	qu = 4.5+	570
133							569
134							568
135	0						567
136			CL				566
137							565
138							564
139	0						563
140					Total Depth of boring 140.0'		562

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LOG OF BORING Strat. 4

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Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois
 Project Number: 0161-001

Surface Elevation : 700.91
 Date Completed : 4/10/02
 Hole Diameter : 6-inch
 Drilling Method : Rotasonic
 Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
 Northing Coord. : 42.22443008
 Westing Coord. : 87.95549011

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev.
0					Bare soil/mulch.		700.91
1	0	Run #1 0 - 10' 8.7" R	OL		Black (2.5y 2.5/1) organic silty CLAY. Top soil.		700
2	0				Light olive brown (2.5y 5/4) silty CLAY, little coarse to fine sand, little coarse to fine gravel, massive, medium plasticity, very stiff, oxidized, weathered.	qu = 3.7*	699
3							698
4							697
5			CL				696
6							695
7							694
8							693
9					Gradational contact.		692
10	0	Run #2 10 - 20' 10" R			Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, massive, stiff, mottled (light brown) oxidized, leached, moist.	qu = 1.7*	691
11	0		CL				690
12							689
13							688
14	0				Gradational contact.		687
15					Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, little coarse to fine gravel, very stiff, high plasticity, moist, massive, unoxidized, unleached.		686
16	0						685
17			CH				684
18							683
19							682
20	0						681



LOG OF BORING Strat. 4

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Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois
 Project Number: 0161-001

Surface Elevation : 700.91
 Date Completed : 4/10/02
 Hole Diameter : 6-inch
 Drilling Method : Rotasonic
 Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
 Northing Coord. : 42.22443008
 Westing Coord. : 87.95549011

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev. 700.91
20	0	Run #3 20' - 40' 20' R			Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, little coarse to fine gravel, very stiff, high plasticity, moist, massive, unoxidized, unleached.		680
21						qu = 1.7*	679
22							678
23							677
24							676
25					Very consistent		675
26							674
27	0						673
28							672
29						qu = 1.5*	671
30			CH				670
31							669
32							668
33							667
34	0						666
35							665
36							664
37							663
38						qu = 1.3*	662
39	0						661
40							



LOG OF BORING Strat. 4

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Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois
 Project Number: 0161-001

Surface Elevation : 700.91
 Date Completed : 4/10/02
 Hole Diameter : 6-inch
 Drilling Method : Rotasonic
 Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
 Northing Coord. : 42.22443008
 Westing Coord. : 87.95549011

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev. 700.91
40	0	Run #4 40 - 60' 20' R			Same as above.		660
41							659
42						qu = 2.1*	658
43							657
44							656
45							655
46	0						654
47			CH				653
48							652
49							651
50							650
51							649
52							648
53	0						647
54					Sharp contact.		646
55	0				Gray (2.5y 6/1) fine SAND, trace silt, loose, thickly bedded with clay clasts, saturated.		645
56						Collect GS - 1 57 - 58' 0/95/5	644
57			SP				643
58							642
59							641
60	0						641



LOG OF BORING Strat. 4

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois
Project Number: 0161-001

Surface Elevation : 700.91
Date Completed : 4/10/02
Hole Diameter : 6-inch
Drilling Method : Rotasonic
Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 42.22443008
Westing Coord. : 87.95549011

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev.
60	0	Run #5 60' - 80' 20' R					700.91
61	0						640
62	0						639
63	0				Below 63', little coarse to fine gravel, (limestone) in distinct bedding planes.		638
64	0						637
65	0						636
66	0		SP				635
67	0						634
68	0						633
69	0						632
70	0						631
71	0						630
72	0				Gradational contact.		629
73	0		ML		Gray (2.5y 5/1) clayey SILT, dense, saturated, with coarse to fine gravel and cobbles.		628
74	0				Gradational contact.		627
75	0				Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, occasional cobbles, medium plasticity, massive, moist, unoxidized, unleached, very hard.	qu = 4.5+*	626
76	0						625
77	0		CL				624
78	0						623
79	0						622
80	0						621

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Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois
 Project Number: 0161-001

Surface Elevation : 700.91
 Date Completed : 4/10/02
 Hole Diameter : 6-inch
 Drilling Method : Rotasonic
 Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
 Northing Coord. : 42.22443008
 Westing Coord. : 87.95549011

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev. 700.91
80	0	Run #6 80 - 90' 9.5' R					
81							620
82					Same as above with low plasticity.		619
83							618
84			CL			qu = 4.5+*	617
85							616
86	0						615
87							614
88							613
89					Sharp contact.		612
90	0	Run #7 90 - 110' 20' R			Gray (2.5y 5/1) clayey SILT, little coarse to fine sand, little coarse to fine gravel, low plasticity, massive, moist, unoxidized, unleached.		611
91	0		ML				610
92							609
93	0				Silt grades to a 2" thick, very fine sand, wet. Sharp contact.		608
94					Dark gray (2.5y 4/1) silty CLAY, some coarse to fine sand, some coarse to fine gravel, little cobbles, massive, low plasticity, very hard, unoxidized, unleached.		607
95	0					qu = 4.5+* Clastics = 80% LS/DS 20% SH	606
96			CL				605
97							604
98							603
99							602
100	0						601

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LOG OF BORING Strat. 4

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Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois
 Project Number: 0161-001

Surface Elevation : 700.91
 Date Completed : 4/10/02
 Hole Diameter : 6-inch
 Drilling Method : Rotasonic
 Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
 Northing Coord. : 42.22443008
 Westing Coord. : 87.95549011

Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev.
100	0						700.91
101	0						600
102							599
103							598
104							597
105							596
106	0						595
107							594
108			CL				593
109							592
110	0	Run #8 110 - 130' 20' R					591
111	0						590
112							589
113							588
114							587
115							586
116	0		ML		Sharp contact. Light Gray (2.5y 7/1) sandy SILT, dense, massive, wet.		585
117	0				Gradational contact. Gray (2.5y 6/1) fine SAND with silt, massive, dense, wet.	GS - 2 118 - 119' 07/9/21	584
118	0		SM				583
119							582
120							581

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LOG OF BORING Strat. 4

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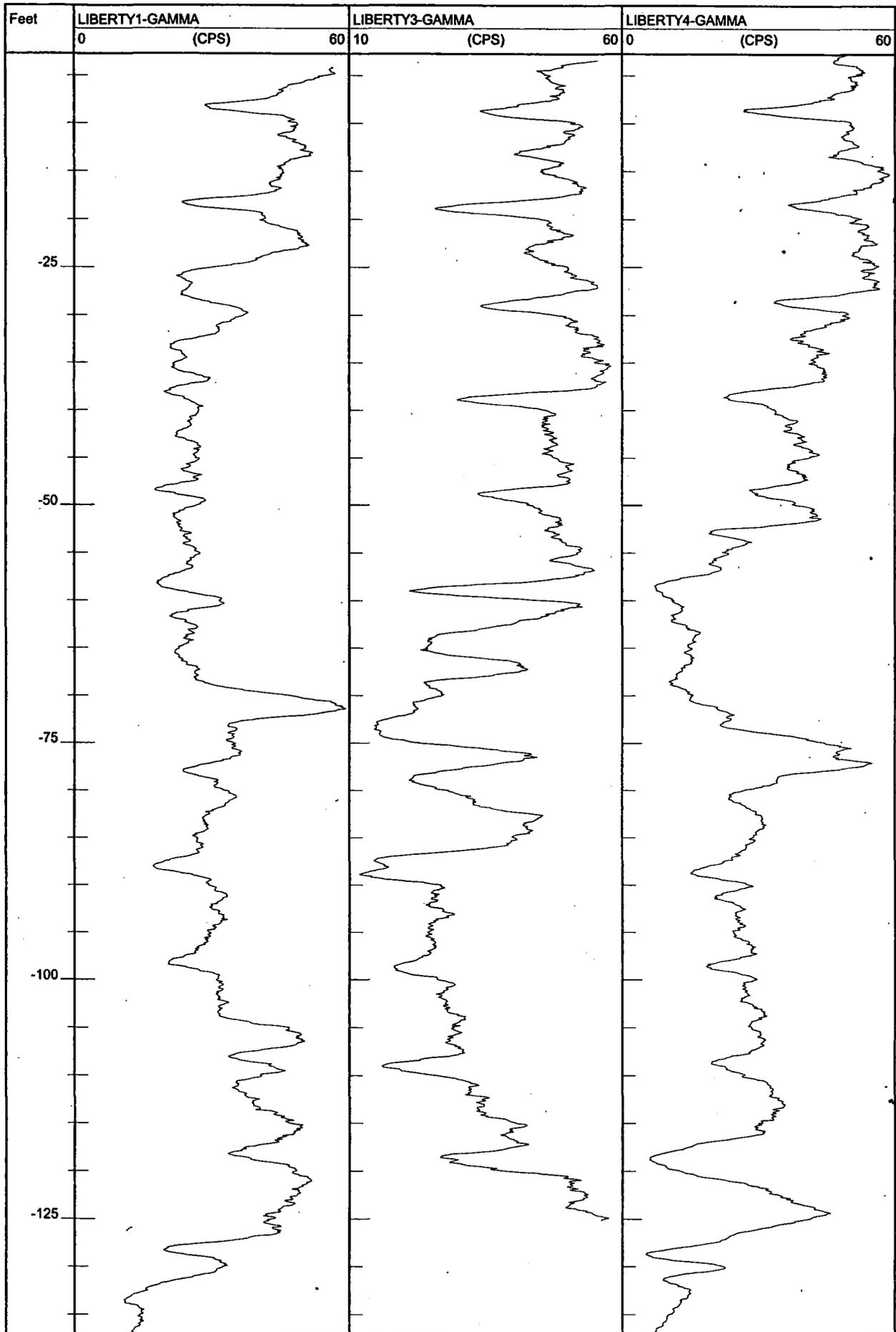
Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois
 Project Number: 0161-001

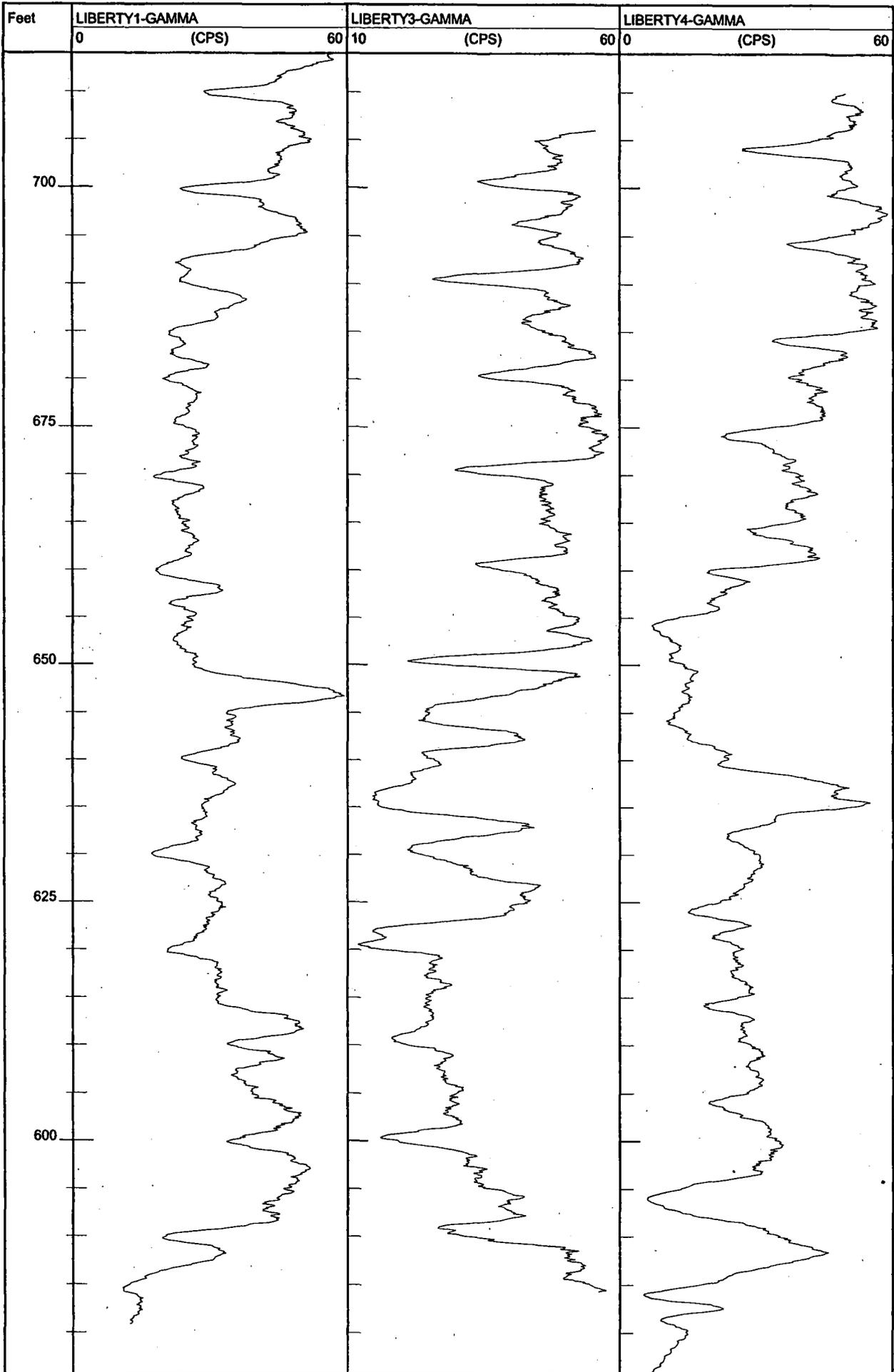
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 Date Completed : 4/10/02
 Hole Diameter : 6-inch
 Drilling Method : Rotasonic
 Sampling Method : Continuous 4" Core

Ensafe Rep. : C. Smith/G. Temple
 Northing Coord. : 42.22443008
 Westing Coord. : 87.95549011

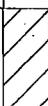
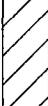
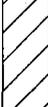
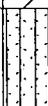
Depth in Feet	PID (ppm)	Core Data	USCS	GRAPHIC	DESCRIPTION	REMARKS	Surf. Elev. 700.91
120							
121			SM				580
122	0		ML		Sharp. Gray (2.5y 6/1) SILT, dense, massive, wet. Gradational.		579
123	0				Gray (2.5y 5/1) silty CLAY, some coarse to fine sand, little coarse to fine gravel, occasional cobbles, massive, very hard, unoxidized, unleached, moist.		578
124							577
125						qu = 4.5+*	576
126							575
127							574
128							573
129							572
130	0	Run #9 130 - 140' 10' R				Drilled Boulder 130 - 131.2' bgs LS/DS	571
131	0		CL				570
132							569
133							568
134							567
135	0					qu = 4.5+*	566
136							565
137							564
138							563
139					Light gray limestone/dolostone boulder.		562
140	0				Total Depth of boring 140.0'.		561

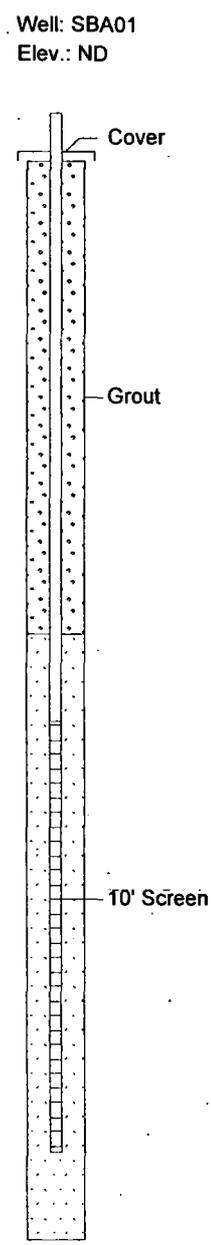
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Libertyville Training Site Sites 6A and 7 Vernon Hills, Illinois	Surface Elevation : ND	EnSafe Rep. : D. Felter
	Date : 6/7/02	Northing Coord. : ND
Project Number 0161-001	Drilling Method : 4 1/4" HSA	Westing Coord. : ND
	Sampling Method : Continuous Split Spoon	TOC Elevation : ND
	Drilling Company : Patrick Drilling	Total Depth : 23 feet

Depth in feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt					
1	Brown and gray mottled (2.5y 4/3), silty clay FILL with trace fine to coarse sand, trace fine gravel, medium plasticity, medium stiff, moist.	CL		SS-1	0	
2				1-3' 18" R		
3	Thin (<2") wet zone at 5'.	CL		SS-2	0	
4				3-5' 6" R		
5	Gray with brown mottling (2.5y 4/1), silty clay FILL with trace fine to coarse sand, trace fine gravelmoist, medium plasticity, stiff, moist.	CL		SS-3	0	
6				5-7' 18" R		
7				SS-4		
8		CL		7-9' 19" R	0	
9				SS-5	0	
10				9-11' 21" R	0	
11	Brown with gray and black mottling (2.5y 4/3), silty clay FILL with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-6	0	
12				11-13' 20" R		
13				SS-7	0	
14		CL		13-15' 17" R	0	
15				SS-8	0	
16				15-17' 18" R	0	
17	Multicolored fine to coarse sand and fine to medium gravel FILL, very silty, moist.	SM		SS-9	0	
18				17-19' 20" R		
19				SS-10	0	
20				19-21' 20" R	0	
21				SS-11	0	
22	Dark gray (2.5y 4/1) silty CLAY with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		21-23' 6" R	0	
23				SS-12		
24				23-25' 24" R	0	
25						
26						
27	Total Boring Depth - 25' bgs.					
28	Well Depth - 23' bgs. Saturated last few feet.					
29						
30						



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LOG OF BORING LTSSBA01A

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number 0161-001

Surface Elevation : ND
Date : 6/11/02
Drilling Method : 4 1/4" HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

EnSafe Rep. : D. Felter
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 25'

Depth in feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt					
1	Gray, black and brown (2.5y 4/3), silty clay FILL with trace fine to coarse sand, trace fine gravel, medium plasticity, medium stiff, moist.	CL		SS-1 3-5' 20" R	0	
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17	Dark gray (2.5y 4/1) silty CLAY with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-2 19-21' 19" R	0	
18						
19						
20						
21		CL		SS-3 23-25' 24" R	0	
22						
23						
24						
25						
26						
27	Total Boring Depth - 25' bgs. Dry					
28						
29						
30						

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LOG OF BORING LTSSBA01B

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Libertyville Training Site Sites 6A and 7 Vernon Hills, Illinois	Surface Elevation : ND	Ensafe Rep. : C. Smith
	Date Completed : 6/11/02	Northing Coord. : ND
Project Number: 0161-001	Drilling Method : HSA 3 1/4"	Westing Coord. : ND
	Sampling Method : Continuous SS	Total Depth : 23
	Drilling Company : Patrick Drilling	

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt.					
1	Brown silty coarse to fine gravel and sand FILL, moist.			SS - 1		
2	Olive brown, gray and black mottled silty clay FILL, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, medium stiff, moist.			1 - 3' 19" R	0	qu = 2.3*
3				SS - 2		
4				3 - 5' 21" R	0	qu = 2.7*
5				SS - 3		
6				5 - 7' 22" R	0	qu = 3.9*
7				SS - 4		
8		CL		7 - 9' 18" R	0	qu = 3.4*
9				SS - 5		
10				9 - 11' 13" R	0	qu = 3.4*
11				SS - 6		
12				11 - 13' 22" R	0	qu = 3.1*
13				SS - 7		
14				13 - 15' 9" R	0	qu = 2.7* SS-7 Driven in coarse gravel at 13.8'
15	Sharp contact.			SS - 8		
16	Light olive brown (2.5 y 5/4) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, leached, fractured, oxidized, hard, moist.			15 - 17' 24" R	0	qu = 4.5*
17				SS - 9		
18		CL		17 - 19' 22" R	0	qu = 4.3*
19				SS - 10		
20	Gradational contact.			19 - 21' 6" R	0	qu = 3.8*
21	Dark gray (2.5 y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, very stiff, moist, unoxidized, unleached.			SS - 11		
22		CL		21 - 23' 24" R	0	qu = 3.4*
23	Total Depth at 23' bgs. Dry.					
24						

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LOG OF BORING LTSSBA01C

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Libertyville Training Site Sites 6A and 7 Vernon Hills, Illinois	Surface Elevation : ND Date Completed : 6/11/02 Drilling Method : HSA 3 1/4"	Ensafe Rep. : C. Smith Northing Coord. : ND Westing Coord. : ND
Project Number: 0161-001	Sampling Method : Continuous SS 24" Drilling Company : Patrick Drilling	Total Depth : 19

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt.					
1	Brown silty coarse to fine gravel and sand FILL, moist.			SS - 1		
2	Black, gray and olive brown mottled silty clay FILL, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.	CL		1 - 3' 14" R	0	qu = 1.7*
3				SS - 2		
4		CL		3 - 5' 18" R	0	qu = 3.4*
5				SS - 3		
6				5 - 7' 17" R	0	qu = 3.1*
7	Sharp contact.			SS - 4		
8	Black (2.5 y 2.5/1) organic CLAY topsoil, trace coarse to fine sand, moist. Gradational contact.	OL		7 - 9' 21" R	0	qu = 3.2*
9	Light olive brown (2.5 y 5/4) silty CLAY with mottling little coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist, oxidized/leached along fractures.	CL		SS - 5		
10				9 - 11' 22" R	0	qu = 2.7*
11				SS - 6		
12		CL		11 - 13' 18" R	0	qu = 2.1*
13				SS - 7		
14				13 - 15' 21" R	0	qu = 2.5*
15				SS - 8		
16				15 - 17' 21" R	0	qu = 3.1*
17	Gradational contact.			SS - 9		
18	Dark gray (2.5 y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, unoxidized, unleached, moist.	CL		17 - 19' 22" R	0	qu = 3.4*
19	Total Depth at 19' bgs. Dry.					
20						

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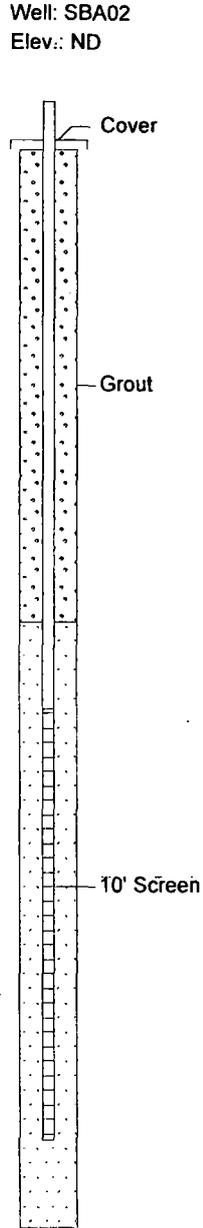


LOG OF BORING LTSSBA02

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Libertyville Training Site Sites 6A and 7 Vernon Hills, Illinois	Surface Elevation : ND	EnSafe Rep. : D. Feller
	Date : 6/7/02	Northing Coord. : ND
Project Number 0161-001	Drilling Method : 4 1/4" HSA	Westing Coord. : ND
	Sampling Method : Continuous Split Spoon	TOC Elevation : ND
	Drilling Company : Patrick Drilling	Total Depth : 23 feet

Depth in feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Concrete					
1	Greenish gray and black (2.5y 3/2), silty clay FILL with trace fine to coarse sand, trace fine gravel, medium plasticity, medium stiff, moist.	CL		SS-1	0	
2				1-3'		
3				10" R		
4	Light brown and gray mottled (2.5y 4/3), silty clay FILL with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-2	0	
5				3-5'		
6				13" R		
7	Greenish gray and black (2.5y 3/2), silty clay FILL with trace fine to coarse sand, trace fine gravel, medium plasticity, medium stiff, moist.	CL		SS-3	0	
8				5-7'		
9				8" R		
10	Brown and gray mottled (2.5y 4/3), silty clay FILL with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-4	0	
11				7-9'		
12				20" R		
13	Brown (2.5y 4/3), silty clay FILL with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-5	0	
14				9-11'		
15				20" R		
16	Multicolored fine to coarse sand and fine to medium gravel FILL, very silty, moist.	SM		SS-6	0	
17				11-13'		
18				22" R		
19	Dark gray (2.5y 4/1) silty CLAY with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-7	0	
20				13-15'		
21				18" R		
22	Dark gray (2.5y 4/1) silty CLAY with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-8	0	
23				15-17'		
24				18" R		
25	Dark gray (2.5y 4/1) silty CLAY with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-9	0	
26				17-19'		
27				18" R		
28	Dark gray (2.5y 4/1) silty CLAY with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-10	0	
29				19-21'		
30				17" R		
31	Dark gray (2.5y 4/1) silty CLAY with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-11	0	
32				21-23'		
33				3" R		
34	Dark gray (2.5y 4/1) silty CLAY with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-12	0	
35				23-25'		
36				15" R		
37	Total Boring Depth - 25' bgs.					
38	Well Depth - 23' bgs. Dry, well does not make water.					



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LOG OF BORING LTSSBA02A

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Libertyville Training Site Sites 6A and 7 Vernon Hills, Illinois	Surface Elevation : ND	Ensafe Rep. : C. Smith
	Date Completed : 6/11/02	Northing Coord. : ND
Project Number: 0161-001	Drilling Method : HSA 3 1/4"	Westing Coord. : ND
	Sampling Method : Continuous Split Spoon	Total Depth : 25'
	Drilling Company : Patrick Drilling	

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt.					
1	Brown silty coarse to fine gravel and sand FILL, moist.			SS - 1		
2	Black, gray and olive brown silty clay FILL, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.	CL		1 - 3'	0	qu = 3.4*
				19" R		
3		CL		SS - 2	0	qu = 3.7*
4				3 - 5'		
5		CL		SS - 3	0	qu = 3.4*
6				5 - 7'		LTSSBA2A07 (5-7')
7		CL		SS - 4	0	qu = 3.7*
8				7 - 9'		
9		CL		SS - 5	0	qu = 3.8*
10				9 - 11'		
11		CL		SS - 6	0	qu = 3.9*
12				11 - 13'		
13	Sharp contact.	CL		SS - 7	0	qu = 4.1*
14				13 - 15'		
15	Light Olive brown (2.5 y 5/4) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist.	CL		SS - 8	0	qu = 4.2*
16	Gradational contact.			15 - 17'		
17	Dark gray (2.5 y 4/1) silty CLAY with brown (FEO2) mottling, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, hard, moist, some vertical fractures coated with FEO2.	CL		SS - 9	0	qu = 4.4*
18				17 - 19'		
19		CL		SS - 10	0	qu = 4.3*
20				19 - 21'		LTSSBA2A21 (19 - 21')
21		CL		SS - 11	0	qu = 3.7*
22				21 - 23'		
23		CL		SS - 12	0	qu = 3.9*
24				23 - 25'		LTSSBA2A25 (23-25')
25	Total Depth at 25' bgs. Dry.					
26						

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LOG OF BORING LTSSBA02B

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Libertyville Training Site Sites 6A and 7 Vernon Hills, Illinois Project Number 0161-001	Surface Elevation : ND	EnSafe Rep. : D. Felter
	Date : 6/11/02	Northing Coord. : ND
	Drilling Method : 4 1/4" HSA	Westing Coord. : ND
	Sampling Method : Continuous Split Spoon	Total Depth : 19'
	Drilling Company : Patrick Drilling	

Depth in feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt					
1	Greenish gray, brown, and black mottled (2.5y 3/2), silty clay FILL with trace fine to coarse sand, trace fine gravel, medium plasticity, medium stiff, moist.	CL		SS-1		
2				1-3'		
3				15" R		
4				SS-2		
5				3-5'		
6				16" R		
7				SS-3		
8				5-7'		
9	Brown and gray (2.5y 4/3), silty CLAY with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-4		
10				7-9'		
11				18" R		
12				SS-5		
13	9-11'					
14	14" R					
15	SS-6					
16	11-13'					
17	23" R					
18	Dark gray (2.5y 4/1) silty CLAY with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-7		
19				13-15'		
20	20" R					
21	SS-8					
22	15-17'					
23	18" R					
24	SS-9					
25	17-19'					
26	24" R					
27	Total Boring Depth - 19' bgs. Dry					
28						
29						
30						

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LOG OF BORING LTSSBA02C

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Libertyville Training Site Sites 6A and 7 Vernon Hills, Illinois	Surface Elevation : ND	EnSafe Rep. : D. Felter
	Date : 6/12/02	Northing Coord. : ND
Project Number 0161-001	Drilling Method : 4 1/4" HSA	Westing Coord. : ND
	Sampling Method : Continuous Split Spoon	Total Depth : 19'
	Drilling Company : Patrick Drilling	

Depth in feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt					
1	Brown, gray, and black mottled (2.5y 3/2), silty clay FILL with trace fine to coarse sand, trace fine gravel, medium plasticity, medium stiff, moist.	CL		SS-1		
2				1-3'		
3				13" R		
4				SS-2		
5				3-5'		
6				9" R		
7				SS-3		
8	Brown and gray (2.5y 4/3), silty CLAY with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-4		
9				7-9'		
10				18" R		
11				SS-5		
12				9-11'		
13				15" R		
14	Dark gray (2.5y 4/1) silty CLAY with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-6		
15				11-13'		
16				16" R		
17				SS-7		
18				13-15'		
19	18" R					
20				SS-8		
21				15-17'		
22				18" R		
23				SS-9		
24				17-19'		
25				21" R		
26						
27	Total Boring Depth - 19' bgs. Dry					
28						
29						
30						

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LOG OF BORING LTSSBA02D

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
Date Completed : 6/11/02
Drilling Method : HSA 3 1/4"
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 19

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt.					
1	Brown silty coarse to fine gravel and sand FILL, moist.	FL		SS - 1		
2	Gray, black and olive brown silty clay FILL, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.	CL		1 - 3'	0	qu = 4.2*
16" R						
3				SS - 2		
3 - 5'				0	qu = 3.7*	
21" R						
4	Light Olive brown (2.5 y 5/4) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, very stiff, moist, leached, oxidized, along fractures.	CL		SS - 3		
5 - 7'				0	qu = 3.5*	
22" R						
7				SS - 4		
8	Dark gray (2.5 y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist, unoxidized/unleached.	CL		7 - 9'	0	qu = 4.2*
21" R						
9				SS - 5		SS-5 Driven on coarse gravel
10		CL		9 - 11'		
2" R						
11		CL		SS - 6		
11 - 13'				0	qu = 3.2*	
12		CL		24" R		
13				SS - 7		
14		CL		13 - 15'	0	qu = 3.1*
21" R						
15		CL		SS - 8		
15 - 17'				0	qu = 3.4	
16		CL		18" R		
17				SS - 9		
18		CL		17 - 19'	0	qu = 4.0*
24" R						
19	Total Depth at 19' bgs. Dry.					
20						

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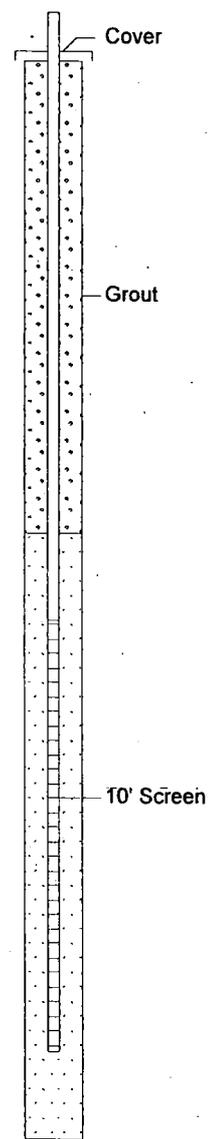
LOG OF BORING LTSSBA03

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Libertyville Training Site Sites 6A and 7 Vernon Hills, Illinois	Surface Elevation : ND	EnSafe Rep. : D. Felter
	Date : 6/8/02	Northing Coord. : ND
Project Number 0161-001	Drilling Method : 4 1/4" HSA	Westing Coord. : ND
	Sampling Method : Continuous Split Spoon	TOC Elevation : ND
	Drilling Company : Patrick Drilling	Total Depth : 23 feet

Depth in feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt					
1	Greenish brown, gray, and black (2.5y 3/2), silty clay FILL with trace fine to coarse sand, trace fine gravel, medium plasticity, medium stiff, moist.	CL		SS-1	0	
2				5-7'		
3				14" R		
4						
5						
6						
7	Dark grayish brown (2.5y 4/2) and gray (2.5y 5/1), silty clay FILL with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-2	0	
8				7-9'		
9				15" R		
10						
11						
12						
13	Multicolored fine to coarse sand and fine to medium gravel FILL, very silty. Saturated and muddy at 19'.	SM		SS-3	0	
14				9-11'		
15				18" R		
16						
17						
18						
19	Dark gray (2.5y 4/1) silty CLAY with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-4	0	
20				11-13'		
21				20" R		
22						
23				SS-5	0	
24				13-15'		
25				16" R		
26				SS-6	0	
27				15-17'		
28				18" R		
29				SS-7	0	
30				17-19'		
				16" R		
				SS-8	0	
				19-21'		
				14" R		
				SS-9	0	
				21-23'		
				11" R		
				SS-10	0	
				23-25'		
				20" R		
27	Total Boring Depth - 25' bgs.					
28	Well Depth - 23' bgs. Wet at 17', saturated at 19'.					

Well: SBA03
Elev.: ND



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LOG OF BORING LTSSBA03A

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Libertyville Training Site Sites 6A and 7 Vernon Hills, Illinois	Surface Elevation : ND	EnSafe Rep. : D. Felter
Project Number 0161-001	Date : 6/11/02	Northing Coord. : ND
	Drilling Method : 4 1/4" HSA	Westing Coord. : ND
	Sampling Method : Continuous Split Spoon	Total Depth : 25'
	Drilling Company : Patrick Drilling	

Depth in feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt					
1	Green, brown, gray, and black (2.5y 4/3), silty clay FILL with trace fine to coarse sand, trace fine gravel, medium plasticity, medium stiff, moist.	CL		SS-1 3-5' 17" R	0	
2						
3						
4						
5						
5	Dark grayish brown and gray (2.5y 4/3), silty clay FILL with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-2 5-7' 18" R	0	
6						
7						
8						
9						
10	Brown and gray (2.5y 4/3), silty CLAY with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-3 7-9' 20" R	0	
11						
12						
13						
14						
15	Dark gray (2.5y 4/1) silty CLAY with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-4 9-11' 20" R	0	
16						
17						
18						
19						
20	Dark gray (2.5y 4/1) silty CLAY with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-5 11-13' 18" R	0	
21						
22						
23						
24						
25	Total Boring Depth - 25' bgs. Dry			SS-6 17-19' 20" R	0	
26						
27						
28						
29						
30				SS-7 23-25' 24" R	0	
23						

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LOG OF BORING LTSSBA03B

(Page 1 of 1)

Libertyville Training Site Sites 6A and 7 Vernon Hills, Illinois	Surface Elevation : ND	Ensafe Rep. : C. Smith
Project Number: 0161-001	Date Completed : 6/12/02	Northing Coord. : ND
	Drilling Method : HSA 3 1/4"	Westing Coord. : ND
	Sampling Method : Continuous Split Spoon	Total Depth : 19'
	Drilling Company : Patrick Drilling	

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt.					
1	Brown silty coarse to fine gravel and sand FILL, moist.	GM		SS - 1		
2	Gray, black and olive brown silty clay FILL, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.			1 - 3' 19" R	0	qu = 1.7*
3				SS - 2		
4		CL		3 - 5' 21" R	0	qu = 3.4*
5				SS - 3		
6				5 - 7' 17" R	0	qu = 3.2*
7	Sharp contact.			SS - 4		
8	Light olive brown (2.5 y 5/4) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist.			7 - 9' 20" R	0	qu = 3.1*
9				SS - 5		
10				9 - 11' 24" R	0	qu = 2.8*
11				SS - 6		
12		CL		11 - 13' 24" R	0	qu = 3.8*
13				SS - 7		
14				13 - 15' 24" R	0	qu = 4.2*
15	Fractured, leached and oxidized, Fe O2 on fractures.			SS - 8		
16	Gradational contact.			15 - 17' 24" R	0	qu = 3.9*
17	Dark gray (2.5 y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist.			SS - 9		
18		CL		17 - 19' 24" R	0	qu = 4.1*
19	Total Depth at 19' bgs. Dry.					
20						

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LOG OF BORING LTSSBA03C

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
Date Completed : 6/12/02
Drilling Method : HSA 3 1/4"
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 17'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt.					
1	Brown silty coarse to fine gravel and sand FILL, moist.			SS - 1		
2	Black, gray and olive brown silty clay FILL, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.			1 - 3' 19" R	0	qu = 3.1*
3				SS - 2		
4				3 - 5' 0 R		
5		CL		SS - 3		
6				5 - 7' 8" R	0	qu = 4.2*
7	Sharp contact.			SS - 4		
8	Light Olive brown (2.5 y 5/4) with gray mottling, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist, leached, oxidized, Fe O2 lining fractures.			7 - 9' 24" R	0	qu = 3.8*
9				SS - 5		
10				9 - 11' 24" R	0	qu = 3.4*
11				SS - 6		
12		CL		11 - 13' 24" R	0	qu = 2.7*
13				SS - 7		
14				13 - 15' 24" R	0	qu = 2.9*
15				SS - 8		
16				15 - 17' 24" R	0	qu = 3.8*
17	Dark gray (2.5 y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, unleached, unoxidized, moist.	CL				
18	Total Depth at 17' bgs. Dry.					

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LOG OF BORING LTSSBA03D

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Libertyville Training Site Sites 6A and 7 Vernon Hills, Illinois	Surface Elevation : ND	Ensafe Rep. : C. Smith
	Date Completed : 6/12/02	Northing Coord. : ND
Project Number: 0161-001	Drilling Method : HSA 3 1/4"	Westing Coord. : ND
	Sampling Method : Continuous Split Spoon	Total Depth : 17'
	Drilling Company : Patrick Drilling	

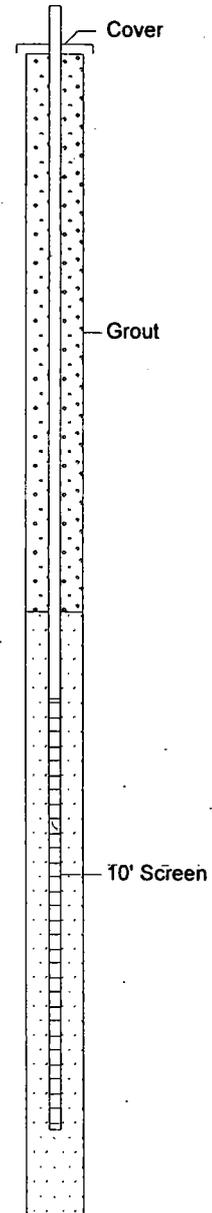
Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt.					
1	Brown silty coarse to fine gravel and sand FILL, moist.			SS - 1		
2	Gray, black and olive brown silty clay FILL, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.			1 - 3' 8" R	0	qu = 3.2*
3				SS - 2		
4				3 - 5' 2" R	0	
5				SS - 3		
6				5 - 7' 14" R	0	qu = 3.7*
7	Sharp contact.			SS - 4		
8	Light Olive brown (2.5 y 5/4) with gray mottling silty CLAY, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist, leached, oxidized, Fe O2 coating vertical fractures.			7 - 9' 24" R	0	qu = 3.2*
9				SS - 5		
10				9 - 11' 24" R	0	qu = 3.7*
11				SS - 6		
12				11 - 13' 19" R	0	qu = 2.4*
13	Fractures more numerous below 13' bgs.			SS - 7		
14				13 - 15' 24" R	0	qu = 2.9*
15				SS - 8		
16			15 - 17' 24" R	0	qu = 3.9*	
17	Total Depth at 17' bgs. Dry.					
18						

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Libertyville Training Site Sites 6A and 7 Vernon Hills, Illinois	Surface Elevation : ND	EnSafe Rep. : D. Felter
	Date : 6/8/02	Northing Coord. : ND
Project Number 0161-001	Drilling Method : 4 1/4" HSA	Westing Coord. : ND
	Sampling Method : Continuous Split Spoon	TOC Elevation : ND
	Drilling Company : Patrick Drilling	Total Depth : 25 feet

Depth in feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Tan sand and gravel FILL.	SM				
1				SS-1		
2	Dark gray, brown, and black mottled (2.5y 3/2), silty clay FILL with trace fine to coarse sand, trace fine gravel, medium plasticity, medium stiff, moist.	CL		1-3' 14" R	0	
3				SS-2		
4				3-5' 16" R	0	
5				SS-3		
6	Fibrous organics at 6'			5-7' 15" R	0	
7				SS-4		
8				7-9' 15" R	0	
9	Greenish gray and gray (2.5y 4/3), silty clay FILL with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		9-11' 18" R	0	
10				SS-5		
11				11-13' 17" R	0	
12				SS-6		
13				13-15' 17" R	0	
14				SS-7		
15				15-17' 17" R	0	
16				SS-8		
17				17-19' 18" R	0	
18	Multicolored fine to coarse sand and fine to medium gravel FILL, very silty. Wet at 20.5'.	SM		19-21' 18" R	0	
19				SS-9		
20				21-23' 22" R	0	
21				SS-10		
22				23-25' 18" R	0	
23				SS-11		
24				25-27' 10"	0	
25	Dark gray (2.5y 4/1) silty CLAY with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL				
26						
27						
28	Total Boring Depth - 27' bgs. Well Depth - 25' bgs. Wet at 20.5'.					
29						
30						

Well: SBA04
Elev.: ND





LOG OF BORING LTSSBA04A

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Libertyville Training Site Sites 6A and 7 Vernon Hills, Illinois	Surface Elevation : ND	EnSafe Rep. : D. Felter
	Date : 6/11/02	Northing Coord. : ND
Project Number 0161-001	Drilling Method : 4 1/4" HSA	Westing Coord. : ND
	Sampling Method : Continuous Split Spoon	Total Depth : 27'
	Drilling Company : Patrick Drilling	

Depth in feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt					
1	Gray, black and brown (2.5y 4/3), silty clay FILL with trace fine to coarse sand, trace fine gravel, medium plasticity, medium stiff, moist.	CL				
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17	Multicolored fine to coarse sand and fine to medium gravel FILL, very silty.	SM		SS-2 19-21' 22" R	0	
18						
19	Dark gray (2.5y 4/1) silty CLAY with trace fine to coarse sand, trace fine gravel, medium plasticity, stiff, moist.	CL		SS-3 23-25' 21" R	0	
20						
21						
22						
23	Total Boring Depth - 27' bgs. Wet in sand zone.					
24						
25						
26						
27						
28						
29						
30						

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LOG OF BORING LTSSBA04B

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Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
 Date Completed : 6/11/02
 Drilling Method : HSA 3 1/4"
 Sampling Method : Continuous Split Spoon
 Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
 Northing Coord. : ND
 Westing Coord. : ND
 Total Depth : 25'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Broken Asphalt.					
1	Brown silty coarse to fine gravel and sand FILL, moist.			SS - 1		
2	Gray, black and olive brown mottled silty clay FILL, some coarse to fine sand, little coarse to fine gravel, hard, medium plasticity, moist.	CL		1 - 3'	0	qu = 4.5+*
				17" R		
3				SS - 2		
4				3 - 5'	0	qu = 3.7*
				19" R		
5				SS - 3		
6				5 - 7'	0	qu = 3.4*
				9" R		
7				SS - 4		
8				7 - 9'	0	qu = 3.7*
				14" R		
9				SS - 5		
10				9 - 11'	0	qu = 3.4*
				17" R		
11				SS - 6		
12				11 - 13'	0	qu = 3.1*
				17" R		
13				SS - 7		
14				13 - 15'	0	qu = 3.1* SS-7
				9" R		Driven on coarse gravel/cobble at 13.9' refusal of split spoon
15	Coarse gravel and cobbles, some coarse to fine sand with clay, FILL, moist.			SS - 8		
16				15 - 17'	0	qu = 3.4*
				9" R		
17		GW		SS - 9		Very hard
18				17 - 19'	0	
				4" R		
19				SS - 10		
20	Dark gray (2.5 y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, hard, medium plasticity, moist.			19 - 21'	0	Very hard
				11" R		
21				SS - 11		
22		CL		21 - 23'	0	Very hard
				7" R		
23				SS - 13		
24				23 - 25'	0	qu = 4.3*
				21" R		
25	Total Depth at 25' bgs. Dry.					
26						

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LOG OF BORING LTSSBA04C

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Libertyville Training Site Sites 6A and 7 Vernon Hills, Illinois	Surface Elevation : ND	Ensafe Rep. : C. Smith
Project Number: 0161-001	Date Completed : 6/11/02	Northing Coord. : ND
	Drilling Method : HSA 5 1/4"	Westing Coord. : ND
	Sampling Method : Continuous Split Spoon	Total Depth : 19'
	Drilling Company : Patrick Drilling	

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Broken Asphalt.					
1	Brown silty coarse to fine gravel FILL, very dense.	GM		SS - 1 1 - 3'		
2	Gray, black and olive brown mottled silty clay FILL, some coarse to fine sand, little coarse to fine gravel, very stiff, medium plasticity, moist.			17" R	0	
3				SS - 2 3 - 5'		
4				19" R	0	qu = 3.7*
5				SS - 3 5 - 7'		
6				22" R	0	qu = 3.4*
7		CL		SS - 4 7 - 9'		
8				18" R	0	qu = 2.7*
9				SS - 5 9 - 11'		
10				17" R	0	qu = 3.9*
11				SS - 6 11 - 13'		
12				14" R	0	qu = 3.8*
13	Light olive brown (2.5 y 5/4) silty CLAY, gray and reddish brown mottling and oxidation, trace coarse to fine sand, trace coarse to fine gravel, very stiff, moist, oxidized, leached, fractures, vertical with Fe O2 lining. -17.0 Gradational contact			SS - 7 13 - 15'		
14				21" R	0	qu = 3.7*
15		CL		SS - 8 15 - 17'		
16				24" R	0	qu = 2.4*
17				SS - 9 17 - 19'		
18	Dark gray (2.5 y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist.	CL		24" R	0	qu = 2.5*
19	Total Depth at 19' bgs. Dry.					
20						

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LOG OF BORING LTSSBA04D

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Libertyville Training Site Sites 6A and 7 Vernon Hills, Illinois	Surface Elevation : ND	Ensafe Rep. : C. Smith
	Date Completed : 6/11/02	Northing Coord. : ND
Project Number: 0161-001	Drilling Method : HSA 3 1/4"	Westing Coord. : ND
	Sampling Method : Continuous Split Spoon	Total Depth : 21'
	Drilling Company : Patrick Drilling	

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt.					
1	Brown silty coarse to fine gravel FILL, moist.			SS - 1		
2	Gray, black and olive brown mottled silty clay FILL, little coarse to fine sand, little coarse to fine gravel, very stiff, medium plasticity, moist.	CL		1 - 3'	0	qu = 3.4*
				14" R		
3		CL		SS - 2		
				3 - 5'	0	qu = 3.2*
4		CL		11" R		
				SS - 3		
5		CL		5 - 7'	0	qu = 3.4*
				24" R		
6		CL		SS - 4		
				7 - 9'	0	qu = 4.1*
7		CL		18" R		
				SS - 5		
8		CL		9 - 11'	0	qu = 3.1*
				21" R		
9		CL		SS - 6		
				11 - 13'	0	qu = 3.4*
10		CL		24" R		
				SS - 7		
11	Sharp contact.	CL		13 - 15'	0	qu = 2.6*
				24" R		
12	Light olive brown (2.5 y 5/4) silty CLAY with gray mottling, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.	CL		SS - 8		
				15 - 17'	0	qu = 2.9*
13		CL		24" R		
				SS - 9		
14		CL		17 - 19'	0	qu = 3.4*
				16" R		
15	Gradational contact	CL		SS - 10		
				19 - 21'	0	qu = 3.2*
16	Dark gray (2.5 y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist.	CL		24" R		
17	Total Depth at 21' bgs. Dry.					
18						
19						
20						
21						
22						

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LOG OF BORING LTSSBA04E

(Page 1 of 1)

Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
Date Completed : 6/11/02
Drilling Method : HSA 3 1/4"
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 13'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt.					
1	Brown silty coarse to fine gravel FILL, moist.			SS - 1		
2	Gray, black and olive brown mottled silty clay FILL, little coarse to fine sand, little coarse to fine gravel, very stiff, medium plasticity, moist.	CL		1 - 3' 19" R	0	qu = 3.1*
3				SS - 2		
4	Sharp contact. Black (2.5 y 2.5/1) organic top soil, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.	OL		3 - 5' 17" R	0	qu = 3.4*
5	Light olive brown (2.5 y 5/4) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, very stiff, moist, leached with some gray mottling, oxidized.	CL		SS - 3		
6				5 - 7' 22" R	0	qu = 3.4*
7				SS - 4		
8				7 - 9' 24" R	0	qu = 3.4*
9				SS - 5		
10				9 - 11' 19" R	0	qu = 3.1*
11				SS - 6		
12				11 - 13' 22" R	0	qu = 2.7*
13	Total Depth at 13' bgs. Dry.					Auger Refusal at 13'.
14						



LOG OF BORING LTSSBB01

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
Date Completed : 4/26/02
Drilling Method : 4 1/4" HSA
Sampling Method : Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord : ND
Easting Coord : ND
Total Depth : 18'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14	Olive brown (2.5y 4/3) silty CLAY, stiff, medium plasticity, moist.			SS - 1 14' - 16' 22" R	0	
15						
16				SS - 2 16' - 18' 24" R	0	LTSSBB0118 and duplicate (16 - 18')
17						
18	Total Depth at 18' bgs. Dry.					
19						

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LOG OF BORING LTSSBB01A

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Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois
 Project Number: 0161-001

Surface Elevation : ND
 Date Completed : 4/25/02
 Drilling Method : 4 1/4" HSA
 Sampling Method : Continuous Split Spoon
 Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
 Northing Coord. : ND
 Westing Coord. : ND
 Total Depth : 19'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt					
1	Brown sandy gravel FILL, moist.			SS - 1		
2	Olive brown, black and gray silty clay FILL, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.			1 - 3' 0 R		
3				SS - 2		
4				3 - 5' 19" R	0	
5				SS - 3		
6				5 - 7' 20" R	0	
7				SS - 4		
8				7 - 9' 11" R	0	
9				SS - 5		
10				9 - 11' 7" R	0	
11				SS - 6		
12				11 - 13' 11" R	0	
13	Olive brown (2.5y 4/3) silty CLAY with brown mottling, stiff, medium plasticity, moist.			SS - 6		
14				13 - 15' 14" R	0	
15		CL		SS - 7		
16				15 - 17' 19" R	0	
17				SS - 8		
18	Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.	CL		17 - 19' 24" R	0	
19	Total Depth at 19' bgs. Dry					
20						

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LOG OF BORING LTSSBB01B

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
Date Completed : 4/25/02
Drilling Method : 4 1/4" HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : ND
Westing Coord. : ND

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt Brown sandy gravel FILL.					
1	Black organic CLAY topsoil, trace coarse to fine sand, medium plasticity, stiff, moist.	OL		SS - 1 1 - 3' 8" R	0	
2						
3	Olive brown (2.5y 4/3) gray mottled silty CLAY, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist.	CL		SS - 2 3 - 5' 9" R	0	
4						
5				SS - 3 5 - 7' 16" R	0	
6						
7				SS - 4 7 - 9' 18" R	0	
8						
9				SS - 5 9 - 11' 24" R	0	
10	Graditional contact.					
11	Dark grayish brown (2.5y 4/4) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist.	CL		SS - 6 11 - 13' 24" R	0	
12						
13				SS - 7 13 - 15' 18" R	0	
14						
15				SS - 8 15 - 17' 18" R	0	
16						
17	Graditional contact.			SS - 9 17 - 19' 24" R	0	
18	Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist.	CL				
19	Total Depth at 19' bgs. Dry					
20						

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LOG OF BORING LTSSBB02

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
Date Completed : 4/26/02
Drilling Method : 4 1/4" HSA
Sampling Method : Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 25'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Concrete					
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13		FL				
14	Gray, black and olive brown silty clay FILL.			SS - 1 14 - 16' 14" R	0	
15						
16				SS - 2 16 - 18' 18" R	0	LTSSBB0218 (16 - 18')
17						
18						
19						
20						
21				SS - 3 21 - 23' 8" R	0	
22						
23				SS - 4 23 - 25' 19" R	0	LTSSBB0225 (23 - 25')
24						
25	Total Depth at 25' bgs. Dry.					

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LOG OF BORING LTSSBB02A

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
Date Completed : 4/25/02
Drilling Method : 3 1/4 HSA
Sampling Method : Split Spoon Continuous
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 21

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt					
0	Brown sandy coarse to fine gravel FILL, wet	FL				
1	Dark gray, black and brown silty clay FILL			SS - 1		
1-3'				1 - 3'	0	
8"				8" R		
3				SS - 2		
3-5'				3 - 5'	0	
12"				12" R		
5				SS - 3		
5-7'				5 - 7'	0	
21"				21" R		
7				SS - 4		
7-9'				7 - 9'	0	
16"				16" R		
9				SS - 5		
9-11'				9 - 11'	0	
19"		CL		19" R		
11				SS - 6		
11-13'				11 - 13'	0	
17"				17" R		
13				SS - 7		
13-15'				13 - 15'	0	
9"				9" R		
15				SS - 8		
15-17'				15 - 17'	0	
13"				13" R		
17				SS - 9		
17-19'				17 - 19'	0	
9"				9" R		
19				SS - 10		
19-21'				19 - 21'	0	qu = 2.2"
11"		CL		11" R		
20	Gray (2.5y 5/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.					
21	Total Depth at 21' bgs. Dry.					
22						

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LOG OF BORING LTSSBB02B

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation :
Date Completed : 4/24/02
Drilling Method : HSA 4 1/4"
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 41'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt					
	Brown sandy coarse to fine gravel, FILL, wet.	GP				
1	Black, brown and gray silty clay FILL, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.	CL		SS - 1		Coarse gravel in shoe
				1 - 3'	0	
2				1" R		
3				SS - 2		
				3 - 5'	0	
4				7" R		
5				SS - 3		
				5 - 7'	0	
6				9" R		
7				SS - 4		
	7 - 9'	0				
8	11" R					
9	SS - 5					
	9 - 11'	0				
10	16" R					
	Sharp contact					
11	Olive brown (2.5y 4/3) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.	CL		SS - 6		qu = 2.7*
				11 - 13'	0	
12	14" R					
13	SS - 7					
	13 - 15'	0				
14	24" R					
15	SS - 8					
	15 - 17'	0				
16	Gray (2.5y 5/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.	CL		10" R		qu = 2.7*
				SS - 9		
17				17 - 19'	0	
18	19" R					
19	SS - 10					
	19 - 21'	0				
20	16" R					



LOG OF BORING LTSSBB02B

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation :
Date Completed : 4/24/02
Drilling Method : HSA 4 1/4"
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 41'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
20						
21				SS - 11	0	qu = 2.6*
22				21 - 23'		
23				24" R		
24				SS-12	0	qu = 2.5*
25				23-25'		
26				24" R		
27				SS-13	0	qu = 2.1*
28				25-27'		
29				24" R		
30		CL		SS-14	0	qu = 2.6*
31				27-29'		
32				24" R		
33				SS-15	0	qu = 2.4*
34	Stiff			29-31'		
35				24" R		
36				SS-16	0	qu = 2.4*
37				31-33'		
38				24" R		
39				SS-17	0	qu = 2.1*
40				33-35'		
				24" R		
				SS-18	0	qu = 1.9*
				35-37'		
				24" R		
				SS-19		qu = 1.4*
				37-39'		
				24" R		
				SS-20	0	qu = 1.7*
				39-41'		
				24" R		

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LOG OF BORING LTSSBB02B

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation :
Date Completed : 4/24/02
Drilling Method : HSA 4 1/4"
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 41'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
40	Total depth 41'. Dry	CL				
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
51						
52						
53						
54						
55						
56						
57						
58						
59						
60						

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LOG OF BORING LTSSBB02C

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
Date Completed : 4/25/02
Drilling Method : 4 1/4" HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 21

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt					
0 - 1	Brown sandy gravel FILL, wet.	FL		SS - 1		
1 - 2	Black, gray and brown silty clay FILL.			1 - 3' 8" R	0	
2 - 3		CL		SS - 2		
3 - 4				3 - 5' 14"	0	
4 - 5				SS - 3		
5 - 6	Black (2.5y 5/1) organic CLAY (topsoil), trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist.	OL		5 - 7' 13"	0	
6 - 7	Brown and gray mottled silty CLAY, medium plasticity, stiff, moist, leached, oxidized.			SS - 4		
7 - 8		CL		7 - 9' 17"	0	
8 - 9				SS - 5		
9 - 10				9 - 11' 24"	0	
10 - 11	Olive brown (2.5y 4/3) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist.			SS - 6		
11 - 12				11 - 13' 24"	0	
12 - 13		CL		SS - 7		Driven in coarse gravel at 13.3' bgs.
13 - 14				13 - 15' 7"	0	
14 - 15				SS - 8		Coarse gravel at 15'.
15 - 16				15 - 17' 0	-	
16 - 17	Gray (2.5y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, high plasticity, stiff, moist.			SS - 9		
17 - 18				17 - 19' 12" R	0	
18 - 19		CL		SS - 10		
19 - 20				19 - 21' 24" R	0	
20 - 21	Total Depth at 21' bgs. Dry.					

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LOG OF BORING LTSSBB02D

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Surface Elevation : ND
Date Completed : 4/25/02
Drilling Method : 4 1/4" HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 21

Project Number: 0161-001

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt					
1	Brown sandy gravel FILL, wet.	GP		SS - 1		
2	Brown, black and gray mottled silty clay FILL, little coarse to fine sand, trace coarse to fine gravel, medium stiff, medium plasticity, moist.	CL		1 - 3' 7" R	0	
3				SS - 2		
4	Black (2.5y 5/1) organic CLAY (topsoil), little coarse to fine sand, trace coarse to fine gravel, high plasticity, medium dense, moist.	OL		3 - 5' 14" R	0	
5	Olive brown and gray mottled silty CLAY, little coarse to fine sand, little coarse to fine gravel, medium plasticity, stiff, oxidized, leached.			SS - 3		
6				5 - 7' 18" R	0	
7				SS - 4		
8		CL		7 - 9' 22" R	0	
9				SS - 5		
10				9 - 11' 24" R	0	
11	Gray (2.5y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.			SS - 6		
12				11 - 13' 24" R	0	
13				SS - 7		
14				13 - 15' 24" R	0	
15				SS - 8		
16		CL		15 - 17' 24" R	0	
17				SS - 9		
18				17 - 19' 24" R	0	
19				SS - 10		
20				19 - 21' 24" R	0	
21	Total Depth at 21' bgs. Dry.					

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LOG OF BORING LTSSBB03

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Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
 Date Completed : 4/26/02
 Drilling Method : 4 1/4" HSA
 Sampling Method : Continuous Split Spoon
 Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
 Northing Coord. : ND
 Westing Coord. : ND
 Total Depth : 14'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0						
1				SS - 1		
2	Black, brown and gray silty clay FILL.			1 - 3' 14"	0	
3				SS - 2		LTSSBB0305 (3-5')
4				3 - 5' 16"	0	
5						
6						
7		CL				
8						
9						
10				SS - 3		
11	Dark grayish brown silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist			10 - 12" 24"	0	
12				SS - 4		LTSSBB0314 (12-14')
13				12 - 14"		
14	Total Depth at 14' bgs. Dry.					
15						

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LOG OF BORING LTSSBB03A

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Libertyville Training Site Sites 6A and 7 Vernon Hills, Illinois Project Number: 0161-001	Surface Elevation : ND Date Completed : 4/25/02 Drilling Method : 4 1/4" HSA Sampling Method : Continuous Split Spoon Drilling Company : Patrick Drilling	Ensafe Rep. : C. Smith Northing Coord. : ND Westing Coord. : ND Total Depth : 19'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt					
1	Brown sandy gravel FILL, moist.	FL		SS - 1		
2	Olive brown, black and gray silty clay FILL, little coarse to fine sand, little coarse to fine gravel, medium plasticity, very stiff, moist.	CL		1 - 3'	0	
3				9" R		
4				SS - 2		
5				3 - 5'		
6				16" R		
7				SS - 3		
8		5 - 7'				
9		9" R				
10		SS - 4				
11		7 - 9'				
12	Sharp contact					
13	Dark grayish brown (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.	CL		11 - 13'	0	
14				15" R		
15				SS - 7		
16	Gradational contact					
17	Dark gray (2.5y 4/1) silty CLAY, trace to coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.	CL		13 - 15'	0	
18				8" R		
19		SS - 8				
		15 - 17'				
		24" R				
		SS - 9				
		17 - 19'				
		20" R				
19	Total Depth at 19' bgs. Dry.					

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LOG OF BORING LTSSBB03K

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
Date Completed : 4/25/02
Drilling Method : 4 1/4" HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 17'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt					
0	Brown sandy gravel FILL.	GP				
1				SS - 1		
1	Black, dark greenish brown and gray silty clay FILL, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.			1 - 3'	0	
2				7" R		
3		CL		SS - 2		
3				3 - 5'	0	
4				12" R		
5				SS - 3		
5				5 - 7'	0	
6	Black organic CLAY topsoil, trace coarse to fine sand, medium plasticity, stiff, moist.	OL		18" R		
7				SS - 4		
7				7 - 9'	0	
8	Olive brown and gray mottled silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.			22" R		
9		CL		SS - 5		
9				9 - 11'	0	
10				21" R		
11	Gradational contact.			SS - 6		
11	Dark grayish Brown (2.5y 4/4) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.			11 - 13'	0	
12				24" R		
13		CL		SS - 7		
13				13 - 15'	0	
14	Gradational contact.			24" R		
14	Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.			SS - 8		
15		CL		15 - 17'	0	
15				24" R		
16						
17	Total Depth at 17' bgs. Dry.					
18						

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LOG OF BORING LTSSBB04

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
Date Completed : 4/26/02
Drilling Method : 4 1/4" HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 25'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14	Black, brown and gray silty clay FILL.			SS - 1 13 - 15' 4" R	0	
15						
16		CL		SS - 2 15 - 17' 18" R	0	LTSSBB0417 (15 - 17')
17						
18						
19						
20						
21	Gray (2.5y 5/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist			SS - 3 21 - 23' 24"	0	
22		CL				
23						
24						
25	Total Depth at 25' bgs. Dry.					

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LOG OF BORING LTSSBB04A

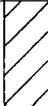
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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
Date Completed : 4/24/02
Drilling Method : 4 1/4" HSA
Sampling Method : Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 21'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						Blind drill to 15' bgs.
15	Black, brown and gray mottled silty clay FILL.			SS - 1 15 - 17' 11" R	0	
16						
17		CL		SS - 2 17 - 19' 16" R	0	
18						
19	Sharp contact Gray (2.5y 5/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist			SS - 3 19 - 21' 8" R	0	
20		CL				
21	Total Depth at 21' bgs. Dry.					
22						

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LOG OF BORING LTSSBB04B

(Page 1 of 1)

Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
Date Completed : 4/24/02
Drilling Method : 4 1/4" HSA
Sampling Method : Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 21'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt.					
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15	Brown, black and gray mottled silty clay FILL.					Blind drill to 17' bgs.
16						
17				SS - 1		
18				17 - 19' 11" R	0	
19				SS - 2		
20	Gray (2.5y 5/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.	CL		19 - 21' 24" R	0	qu = 1.7
21	Total Depth at 21' bgs. Dry.					
22						

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LOG OF BORING LTSSBB04C

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Libertyville Training Site Sites 6A and 7 Vernon Hills, Illinois	Surface Elevation : ND	Ensafe Rep. : D. Felter
	Date Completed : 4/23/02	Northing Coord. : ND
Project Number: 0161-001	Drilling Method : 4 1/4" HSA	Westing Coord. : ND
	Sampling Method : Continuous Split Spoon	Total Depth : 24'
	Drilling Company : Patrick Drilling	

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt					
1	Brown and gray mottled silty clay FILL.			SS - 1		
2	Black and brown mottled silty clay, FILL, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very dense, moist.			1 - 3' 2" R	0	
3				SS - 2		
4				3 - 5' 2" R	0	
5				SS - 3		
6				5 - 7' 12" R	0	
7				SS - 4		Asphaltic material in sample at 7.8'
8				7 - 9' 14" R	0	
9				SS - 5		
10		CL		9 - 11' 16" R	0	
11				SS - 6		
12				11 - 13' 17" R	0	
13				SS - 7		
14				13 - 15' 18" R	0	
15				SS - 8		
16				15 - 17' 21" R	0	
17				SS - 9		
18				17 - 19' 16" R	0	
19				SS - 10		
20	Gray (2.5y 5/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist.			19 - 21' 24" R	0	
21				SS - 11		
22		CL		21 - 23' 24" R	0	
23						
24	Total depth at 24'. Dry.					
25						

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LOG OF BORING LTSSBB04D

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
Date Completed : 4/27/02
Drilling Method : 3 1/4" HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 21'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt					
0 - 1	Brown sandy gravel FILL, moist.	GP		SS - 1		
1 - 2	Black, brown and gray silty clay FILL, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.	CL		1 - 3'	0	
2 - 3				7" R		
3 - 4		CL		SS - 2	0	
4 - 5				3 - 5'		
5 - 6		CL		SS - 3	0	
6 - 7				5 - 7'		
7 - 8		CL		SS - 4	0	
8 - 9				7 - 9'		
9 - 10	Sharp contact.	CL		SS - 5	0	
10 - 11				9 - 11'		
11 - 12	Olive brown (2.5y 4/3) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.	CL		SS - 6	0	
12 - 13				11 - 13'		
13 - 14		CL		SS - 7	0	
14 - 15				13 - 15'		
15 - 16	Olive brown (2.5y 4/3) with gray mottled silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.	CL		SS - 8	0	
16 - 17				15 - 17'		
17 - 18	Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.	CL		SS - 9	0	
18 - 19				17 - 19'		
19 - 20		CL		SS - 10	0	
20 - 21				19 - 21'		
21	Total Depth at 21' bgs. Dry.					

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LOG OF BORING LTSSBB04E

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
Date Completed : 4/27/02
Drilling Method : 3 1/4" HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 21'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt Brown sandy gravel FILL, moist.	GP		SS - 1		
1	Brown, gray and black silty clay FILL, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.	CL		1 - 3'	0	
2				4" R		
3	Black sand saturated, no odor, in shoe of sample.	CL		SS - 2	0	
4				3 - 5'		
5				12" R		
6	Olive brown silty CLAY, some coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff.	CL		SS - 3	0	
7				5 - 7'		
8	Brown gravely CLAY, some coarse to fine sand, hard, saturated.	CL		SS - 4	0	
9				7 - 9'		
10	Gray and olive brown mottled silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.	CL		SS - 5	0	
11				9 - 11'		
12	Gradational contact.	CL		SS - 6	0	Sampler driven on cobble/coarse gravel at 11.3'.
13				11 - 13'		
14	Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.	CL		SS - 7	0	
15				13 - 15'		
16	Total Depth at 21' bgs, water at 20.7'.	CL		SS - 8	0	
17				15 - 17'		
18				SS - 9	0	
19				17 - 19'		
20				24" R		
21				SS - 10	0	
				19 - 21'		
				21" R		

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LOG OF BORING LTSSBC01A

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
Date Completed : 6/12/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : D. Felter
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 15'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	REMARKS
0	Asphalt					
1	Brown sandy gravel FILL.	FL		0	SS-1 1-3' 17" R	
2	Olive brown, gray and black mixed silty clay FILL, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, medium stiff, moist.			0	SS-2 3-5' 17" R	
3				0	SS-3 5-7' 14" R	
4		CL		0	SS-4 7-9' 18" R	
5				0	SS-5 9-11' 20" R	
6				0	SS-6 11-13' 20" R	
7	Sharp contact			0	SS-7 13-15' 20" R	
8	Olive brown and gray silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.			0		
9				0		
10				0		
11		CL		0		
12				0		
13				0		
14				0		
15	Dark gray silty clay, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.	CL		0		
15	Total depth at 15'. Dry.					
16						
17						
18						
19						
20						

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LOG OF BORING LTSSBC01B

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
Date Completed : 6/12/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : D. Felter
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 13'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	REMARKS
0	Asphalt					
1	Brown sandy gravel FILL.	FL		0	SS-1 1-3' 16" R	
2	Green, brown, gray and black mixed silty clay FILL, trace coarse to fine sand, trace fine gravel, medium plasticity, stiff, moist.					
3		CL		0	SS-2 3-5' 15" R	
4						
5	Black topsoil.	OL		0	SS-3 5-7' 14" R	
6	Brown and gray mottled weathered till.					
7				0	SS-4 7-9' 20" R	
8						
9						
10		GT		0	SS-5 9-11' 23" R	
11						
12						
13	Gray silty clay till.			0	SS-6 11-13' 24" R	
14						
15						
16						
17						
18						
19						
20						

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LOG OF BORING LTSSBC02

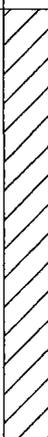
(Page 1 of 1)

Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
Date Completed : 4/26/02
Drilling Method : 4 1/4" HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 12'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0						
1						
2						
3						
4						
5						
6						
7						
8				SS - 1		
9	Olive brown (2.5y 4/3) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, medium plasticity, moist.			8 - 10' 12" R	0	
10		CL		SS - 2		LTSSBC0212 (10-12)
11				10 - 12' 19" R	0	
12	Total Depth at 12' bgs. Dry.					

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LOG OF BORING LTSSBC02A

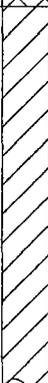
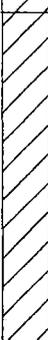
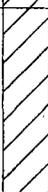
(Page 1 of 1)

Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
Date Completed : 4/25/02
Drilling Method : 4 1/4" HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 19'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt.					
1	Brown sandy gravel FILL, moist.	FL		SS - 1		
2	Black, olive brown and gray silty clay FILL, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.			1 - 3' 20" R	0	
3				SS - 2		
4		CL		3 - 5' 18" R	0	
5				SS - 3		
6				5 - 7' 17" R	0	
7	Olive brown (2.5y 4/3) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.			SS - 4		
8				7 - 9' 19" R	0	
9		CL		SS - 5		
10				9 - 11' 22" R	0	
11	Gradational contact.			SS - 6		
12	Light olive brown (2.5y 5/3) and dark medium brown (10y 4/4) mottled silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.			11 - 13' 24" R	0	
13				SS - 7		
14		CL		13 - 15' 24" R	0	
15				SS - 8		
16	Gradational contact.			15 - 17' 24" R	0	
17	Gray (2.5y 4/2) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.			SS - 9		
18		CL		17 - 19' 24" R	0	
19	Total Depth at 19' bgs. Dry.					

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LOG OF BORING LTSSBC02B

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
Date Completed : 4/25/02
Drilling Method : 4 1/4" HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 17'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt. Brown sandy gravel FILL, moist.	FL				
1				SS - 1		
2	Olive brown (2.5y 4/3) and gray (2.5y 5/1) mottled silty CLAY, medium plasticity, stiff, moist.			1 - 3' 4" R	0	
3				SS - 2		
4				3 - 5' 9" R	0	
5				SS - 3		
6		CL		5 - 7' 10" R	0	
7				SS - 4		
8				7 - 9' 24" R	0	
9				SS - 5		
10	Gradational contact.			9 - 11' 24" R	0	
11	Brown (7.5y 4/4) with little gray mottled silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.			SS - 6		
12				11 - 13' 24" R	0	
13		CL		SS - 7		
14				13 - 15' 24" R	0	
15	Gradational contact.			SS - 8		
16	Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.	CL		15 - 17' 24" R	0	
17	Total Depth at 17' bgs. Dry.					

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LOG OF BORING LTSSBC03A

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Libertyville Training Site Sites 6A and 7 Vernon Hills, Illinois	Surface Elevation : ND	Ensafe Rep. : D. Felter
Project Number: 0161-001	Date Completed : 6/12/02	Northing Coord. : ND
	Drilling Method : 4 1/4" HSA	Westing Coord. : ND
	Sampling Method : Continuous Split Spoon	Total Depth : 21'
	Drilling Company : Patrick Drilling	

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt/base					
1	Gray, black, green brown mixed silty clay FILL	CL		SS-1	0	
2				1-3'		
3				0" R		
4				SS-2		
5				3-5'		
6	SS-3					
7	Brown and gray mottled weathered silty CLAY.	CL		5-7'	0	
8				16" R		
9				SS-4		
10				7-9'		
11	Brown and gray mottled weathered silty CLAY.	CL		17" R	0	
12				SS-5		
13				9-11'		
14	Brown and gray mottled weathered silty CLAY.	CL		16" R	0	
15				SS-6		
16	Brown and gray mottled weathered silty CLAY.	CL		11-13'	0	
17				18" R		
18				SS-7		
19	Weak red (2.5y 5/2) silty CLAY, high plasticity, soft.	CL		13-15'	0	
20				20" R		
21	Weak red (2.5y 5/2) silty CLAY, high plasticity, soft.	CL		SS-8	0	
22				15-17'		
23	Weak red (2.5y 5/2) silty CLAY, high plasticity, soft.	CL		17-19'	0	
24				24" R		
25	Weak red (2.5y 5/2) silty CLAY, high plasticity, soft.	CL		SS-9	0	
26				19-21'		
27	Weak red (2.5y 5/2) silty CLAY, high plasticity, soft.	CL		24" R	0	
28				SS-10		
29	Weak red (2.5y 5/2) silty CLAY, high plasticity, soft.	CL		17-19'	0	
30				24" R		
31	Weak red (2.5y 5/2) silty CLAY, high plasticity, soft.	CL		SS-10	0	
32				19-21'		
33	Weak red (2.5y 5/2) silty CLAY, high plasticity, soft.	CL		24" R	0	
34				SS-10		
35	Weak red (2.5y 5/2) silty CLAY, high plasticity, soft.	CL		17-19'	0	
36				24" R		
37	Weak red (2.5y 5/2) silty CLAY, high plasticity, soft.	CL		SS-10	0	
38				19-21'		
39	Weak red (2.5y 5/2) silty CLAY, high plasticity, soft.	CL		24" R	0	
40				SS-10		

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LOG OF BORING LTSSBC03B

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois
Project Number: 0161-001

Surface Elevation : ND
Date Completed : 6/12/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split-Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : D. Felter
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 17'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	REMARKS
0	Asphalt/base					
1	Gray, green, brown, and black silty clay, FILL, trace coarse to fine sand, trace fine gravel.	CL			SS-1 1-3' 15" R	
2					SS-2 3-5' 14" R	
3	Black top soil	OL			SS-3 5-7' 14" R	
4					SS-4 7-9' 18" R	
5	Green brown and blue brown silty clay.	CL			SS-5 9-11' 19" R	
6					SS-6 11-13' 17" R	
7	Brown and gray mottled silty clay.	CL			SS-7 13-15' 20" R	
8					SS-8 15-17' 21" R	
9	Gray silty clay.	CL				
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

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LOG OF BORING LTSSBC03C

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois
Project Number: 0161-001

Surface Elevation : ND
Date Completed : 6/12/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : D. Felter
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 17'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	REMARKS
0	Asphalt/base					
1	Gray, brown and black mixed silty clay FILL.				SS-1 1-3' 14" R	
2		CL				
3	Black top soil.				SS-2 3-5' 12" R	
4		OL				
5	Blue and green brown silty clay.				SS-3 5-7' 8" R	
6		CL				
7	Brown and gray mottled silty clay.				SS-4 7-9' 16" R	
8						
9					SS-5 9-11' 21" R	
10		CL				
11					SS-6 11-13' 22" R	
12						
13					SS-7 13-15' 24" R	
14	Weak red (2.5y 5/2) silty clay, high plasticity, soft.					
15		CL			SS-8 15-17' 24" R	
16	Gray silty clay.					
17		CL				
18						
19						
20						

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LOG OF BORING LTSSBC04

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois
Project Number: 0161-001

Surface Elevation : ND
Date Completed : 4/26/02
Drilling Method : 4 1/4" HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : ND
Westing Coord. : ND
Total Depth : 22'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18	Gray coarse to fine sand, little coarse to fine gravel, loose, saturated, fill.	SW		SS - 1	0	
18 - 20' 9" R						
20	Total Depth at 22' bgs. Dry.	SW		SS - 2	0	LTSSBC0422 and Dup. (20-22')
20 - 22' 18" R						
21						
22						
23						

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LOG OF BORING LTSSBC04A

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Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : ND
 Date Completed : 4/25/02
 Drilling Method : 4 1/4" HSA
 Sampling Method : Continuous Split Spoon
 Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
 Northing Coord. : ND
 Westing Coord. : ND
 Total Depth : 23'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Weathered asphalt.					
1	Brown sandy gravel FILL, moist.	FL		SS - 1		
2	Black, brown and gray silty clay FILL, little coarse to fine sand, little coarse to fine gravel, medium plasticity, moist.			1 - 3' 14"	0	
3				SS - 2		
4				3 - 5' 7"	0	
5				SS - 3		
6				5 - 7' 14"	0	
7				SS - 4		
8				7 - 9' 17"	0	
9				SS - 5		
10				9 - 11' 22"	0	
11		CL		SS - 6		
12				11 - 13' 19"	0	
13				SS - 7		
14				13 - 15' 8"	0	
15				SS - 8		
16				15 - 17' 9"	0	
17				SS - 9		
18				17 - 19' 10"	0	
19				SS - 10		
20	Gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.			19 - 21' 10"	0	
21		CL		SS - 11		
22				21 - 23' 18"	0	
23	Total Depth at 23' bgs. Dry.					
24						

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LOG OF BORING LTSSBC04B

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Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois
 Project Number: 0161-001

Surface Elevation : ND
 Date Completed : 4/25/02
 Drilling Method : 4 1/4" HSA
 Sampling Method : Continuous Split Spoon
 Drilling Company : Patrick Drilling

Ensafte Rep. : C. Smith
 Northing Coord. : ND
 Westing Coord. : ND
 Total Depth : 23'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt.					
1	Brown sandy gravel FILL, moist.	FL		SS - 1		
2	Olive brown, black and gray silty clay FILL, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.			1 - 3' 9" R	0	
3				SS - 2		
4				3 - 5' 11" R	0	
5				SS - 3		
6				5 - 7' 14" R	0	
7				SS - 4		
8				7 - 9' 19" R	0	
9				SS - 5		
10				9 - 11' 21" R	0	
11		CL		SS - 6		
12				11 - 13' 22" R	0	
13				SS - 7		
14				13 - 15' 18" R	0	
15				SS - 8		
16				15 - 17' 18" R	0	
17				SS - 9		Driven on Limestone cobble at 17.2' bgs.
18				17 - 19' 2" R	0	
19				SS - 10		
20	Gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.			19 - 21' 24" R	0	
21				SS - 11		
22		CL		21 - 23' 20" R	0	
23	Total Depth at 23' bgs. Dry.					
24						

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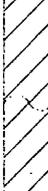
LOG OF BORING LTSSBC04C

(Page 1 of 1)

Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois
 Project Number: 0161-001

Surface Elevation : ND
 Date Completed : 4/27/02
 Drilling Method : 4 1/4" HSA
 Sampling Method : Continuous Split Spoon
 Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
 Northing Coord. : ND
 Westing Coord. : ND
 Total Depth : 21'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt.					
1	Brown sandy coarse to fine gravel FILL.	FL		SS - 1		
2	Olive brown, black and gray silty clay FILL, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.			1 - 3' 12" R	0	
3				SS - 2		
4				3 - 5' 14" R	0	
5		CL		SS - 3		
6				5 - 7' 21" R	0	
7				SS - 4		
8	Olive brown and gray mottled silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.			7 - 9' 24" R	0	
9				SS - 5		
10		CL		9 - 11' 24" R	0	
11	Gradational contact.			SS - 6		
12	Olive brown (2.5y 4/3) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.			11 - 13' 18" R	0	
13		CL		SS - 7		
14	Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.			13 - 15' 9" R	0	
15				SS - 8		
16				15 - 17' 21" R	0	
17				SS - 9		
18		CL		17 - 19' 14" R	0	
19				SS - 10		
20				19 - 21' 19" R	0	
21	Total Depth at 21' bgs. Dry.					

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LOG OF BORING LTSSBC04D

(Page 1 of 1)

Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois
 Project Number: 0161-001

Surface Elevation : ND
 Date Completed : 4/27/02
 Drilling Method : 4 1/4" HSA
 Sampling Method : Continuous Split Spoon
 Drilling Company : Patrick Driling

Ensafe Rep. : C. Smith
 Northing Coord. : ND
 Westing Coord. : ND
 Total Depth : 21'

Depth in Feet	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	Asphalt Brown sandy gravel FILL.					
1	Brown, black and gray silty clay FILL.	FL		SS - 1	0	
2				1 - 3'		
3		FL		SS - 2	0	
4				3 - 5'		
4	Black (2.5y 2.5/1) organic CLAY, topsoil, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.			12" R		
5	Sharp contact.	OL		SS - 3	0	
6	Olive brown (2.5y 4/3) and gray mottled silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.			5 - 7'		
7				SS - 4	0	
8				7 - 9'		
9				SS - 5	0	
10				9 - 11'		
11				SS - 6	0	
12				11 - 13'		
13				SS - 7	0	
14				13 - 15'		
15		CL		9" R	0	
16				SS - 8		
17				15 - 17'	0	
18				0 R		
19				SS - 9	0	
20				17 - 19'		
21				SS - 10	0	
20				19 - 21'		
21	Total Depth at 21' bgs. Dry.			21" R		



LOG OF BORING MW BO2

(Page 1 of 3)

Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

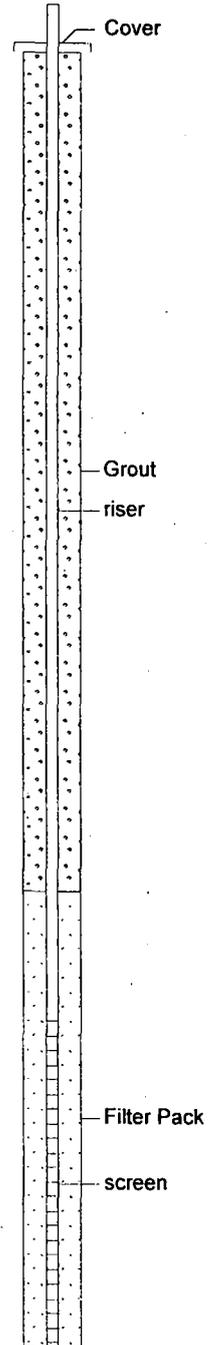
Project Number: 0161-001

Surface Elevation : 690.87
Date Completed : 4/24/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025131.0660
Westing Coord. : 1086242.1156
Total Depth : 41.0
Well Screen : 15-25'

Depth in Feet	Surf. Elev. 690.87	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0		Asphalt	FL				
1	690	Brown sandy coarse to fine gravel FILL, wet.	GP				
2	689	Black brown and gray silty clay FILL, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.			SS - 1 1 - 3' 1" R	0	Coarse gravel in shoe.
3	688				SS - 2 3 - 5' 7" R	0	
4	687				SS - 3 5 - 7' 9" R	0	
5	686				SS - 4 7 - 9' 11" R	0	
6	685		CL		SS - 5 9 - 11' 16" R	0	
7	684				SS - 6 11 - 13' 14" R	0	qu = 2.7*
8	683				SS - 7 13 - 15' 24" R	0	qu = 2.5*
9	682				SS - 8 15 - 17' 1" R	0	qu = 2.7*
10	681	Sharp contact			SS - 9 17 - 19' 19" R	0	qu = 2.9*
11	680	Olive brown (2.5y 4/3) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.			SS - 10 19 - 21' 16" R	0	qu = 2.8*
12	679						
13	678						
14	677						
15	676						
16	675	Gray (2.5y 5/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.					
17	674						
18	673						
19	672						
20	671						

Well: MW BO2
Elev.: 693.20



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LOG OF BORING MW BO2

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

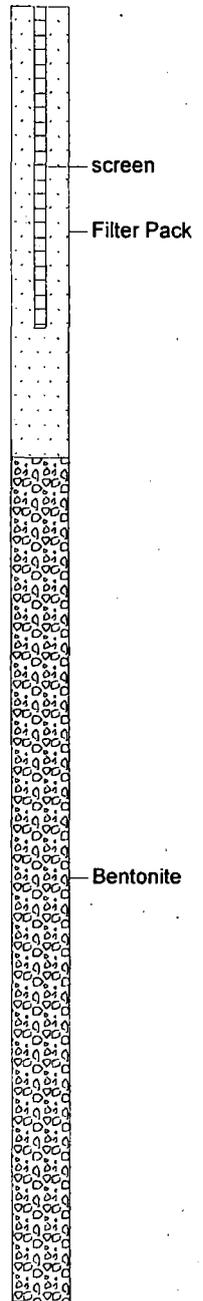
Project Number: 0161-001

Surface Elevation : 690.87
Date Completed : 4/24/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025131.0660
Westing Coord. : 1086242.1156
Total Depth : 41.0
Well Screen : 15-25'

Well: MW BO2
Elev.: 693.20

Depth in Feet	Surf. Elev. 690.87	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
20							
21	670		CL		SS - 11 21 - 23' 24" R		qu = 2.6"
22	669						
23	668				SS - 12 23 - 25' 24" R	0	qu = 2.5"
24	667						
25	666				SS - 13 25 - 27' 24" R	0	qu = 2.1"
26	665						
27	664				SS - 14 27 - 29' 24" R	0	qu = 2.6"
28	663						
29	662				SS - 15 29 - 31' 24" R	0	qu = 2.4"
30	661						
31	660		CL		SS - 16 31 - 33' 24" R	0	qu = 2.4"
32	659						
33	658				SS - 17 33 - 35' 24" R	0	qu = 2.1"
34	657	Stiff					
35	656				SS - 18 35 - 37' 24" R	0	qu = 1.9"
36	655						
37	654				SS - 19 37 - 39' 24" R	0	qu = 1.4"
38	653						
39	652				SS - 20 39 - 41' 24" R	0	qu = 1.7"
40	651						



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LOG OF BORING MW BO2

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 690.87
Date Completed : 4/24/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025131.0660
Westing Coord. : 1086242.1156
Total Depth : 41.0
Well Screen : 15-25'

Well: MW BO2
Elev.: 693.20

Depth in Feet	Surf. Elev. 690.87	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
40							
41	650	Total Depth at 41'. Dry.	CL				 Bentonite
42	649						
43	648						
44	647						
45	646						
46	645						
47	644						
48	643						
49	642						
50	641						
51	640						
52	639						
53	638						
54	637						
55	636						
56	635						
57	634						
58	633						
59	632						
60	631						

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LOG OF BORING MW-1

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Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois
 Project Number: 0161-001

Surface Elevation : 694.41
 Date Completed : 5/14/02
 Drilling Method : 4 1/4 - Inch HSA
 Sampling Method : Continuous Split Spoon
 Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
 Northing Coord. : 2025196.0439
 Westing Coord. : 1085921.2931
 Total Depth : 65.0

Depth in Feet	Surf. Elev. 694.41	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	694	Asphalt					
1	693	Brown sandy coarse to fine gravel FILL.	GW		SS - 1 1 - 3' 8" R	0	
2	692	Gray and black silty clay FILL, some coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist.	CL		SS - 2 3 - 5' 17" R	0	3.4* *= field measured unconfined strength ton/sq. ft.
3	691						
4	690	Sharp contact Light olive brown (2.5 y 5/3) silty CLAY, some brown mottling, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist.	CL		SS - 3 5 - 7' 8" R	0	
5	689						
6	688		CL		SS - 4 7 - 9' 17" R	0	3.0*
7	687						
8	686		CL		SS - 5 9 - 11' 21" R	0	
9	685						
10	684		CL		SS - 6 11 - 13' 16" R	0	3.4*
11	683						
12	682		CL		SS - 7 13 - 15' 21" R	0	
13	681						
14	680		CL		SS - 8 15 - 17' 7" R	0	3.2*
15	679						
16	678		CL		SS - 9 17 - 19' 18" R	0	
17	677						
18	676	Gradational contact					
19	675	Dark gray (2.5 y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, stiff, medium plasticity, moist.	CL		SS - 10 19 - 21' 21" R	0	1.75*
20							

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LOG OF BORING MW-1

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 694.41
Date Completed : 5/14/02
Drilling Method : 4 1/4 - Inch HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025196.0439
Westing Coord. : 1085921.2931
Total Depth : 65.0

Depth in Feet	Surf. Elev. 694.41	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
20	674						
21	673				SS - 11 21 - 23 24" R	0	
22	672						
23	671		CL		SS - 12 23 - 25' 18" R	0	
24	670						2.5"
25	669				SS - 13 25 - 27 4" R	0	SS - 13 Driven on cobble at 25.3' bgs
26	668	Sharp contact					
27	667	Gray (2.5 y 5/1) coarse to fine SAND, some coarse to fine gravel, trace silt and clay, cobbles and boulders, dense, saturated.			SS - 14 27 - 29 7" R	0	Top of Outwash
28	666						
29	665				SS - 15 29 - 31 12" R	0	
30	664						
31	663				SS - 16 31 - 33 2" R	0	
32	662						SS-16 Driven on cobble
33	661		SW		SS - 17 33 - 35 18" R	0	
34	660						
35	659				SS - 18 35 - 37 0	0	5' Blowin at 35 - 30' charge with fresh H2O
36	658						
37	657				SS - 19 37 - 39 4" R	0	
38	656						
39	655				SS - 20 39 - 41 16" R	0	
40							

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LOG OF BORING MW-1

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 694.41
Date Completed : 5/14/02
Drilling Method : 4 1/4 - Inch HSA
Sampling Method : Continuous Split-Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025196.0439
Westing Coord. : 1085921.2931
Total Depth : 65.0

Depth in Feet	Surf. Elev. 694.41	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
40	654						
41	653				SS - 21 41 - 43 14" R	0	
42	652						
43	651		CL		SS - 22 43 - 45 4" R	0	
44	650						
45	649				SS - 23 45 - 47 6" R	0	
46	648						
47	647	Dark gray (2.5 y 4/1) coarse to fine sand, little coarse to fine gravel, dense, saturated.			SS - 24 47 - 49 16" R	0	
48	646						
49	645				SS - 25 49 - 51 14" R	0	
50	644						
51	643		SW		SS - 26 51 - 53 8" R	0	
52	642						
53	641				SS - 27 53 - 55 4" R	0	
54	640						
55	639	Sharp contact			SS - 28 55 - 57 12" R		Bottom of outwash
56	638	Dark gray (2.5 y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist.					
57	637		CL		SS - 29 57 - 59 24" R	3.4*	
58	636						
59	635				SS - 30 59 - 61 16" R		
60							

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LOG OF BORING MW-1

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 694.41
Date Completed : 5/14/02
Drilling Method : 4 1/4 - Inch HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025196.0439
Westing Coord. : 1085921.2931
Total Depth : 65.0

Depth in Feet	Surf. Elev. 694.41	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
60	634						
61	633		CL		SS - 31 61 - 63 20" R		Abandon MW-1 move approx. 5' north redrill for well installation.
62	632	Dark gray clayey SILT (2.5 y 4/1) trace coarse to fine sand, trace coarse to fine gravel, hard, moist.					
63	631		ML		SS - 32 63 - 65 24" R		
64	630	Total Depth of boring 65'					
65	629						
66	628						
67	627						
68	626						
69	625						
70	624						
71	623						
72	622						
73	621						
74	620						
75	619						
76	618						
77	617						
78	616						
79	615						
80							

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LOG OF BORING MW-1I

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

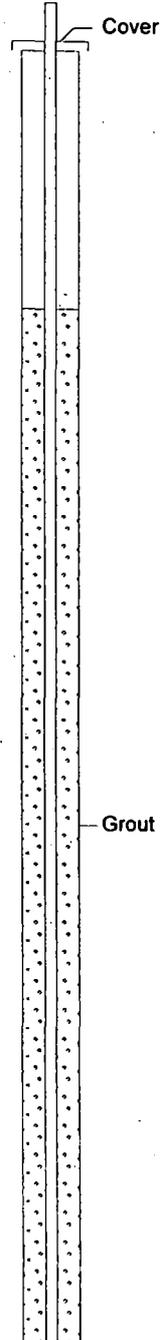
Project Number: 0161-001

Surface Elevation : 694.41
Date Completed : 5/20/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025196.0439
Westing Coord. : 1085921.2931
Total Depth : 57
Well Screen : 46 - 56

Depth in Feet	Surf. Elev. 694.41	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
0	694	MW-1I was advanced to 45 feet below ground surface without sampling. Please see log of Boring MW-1 for stratigraphic details of this interval.	GW				
1	693						
2	692						
3	691						
4	690						
5	689						
6	688						
7	687						
8	686						
9	685						
10	684						
11	683						
12	682		CL				
13	681						
14	680						
15	679						
16	678						
17	677						
18	676						
19	675		CL				
20							

Well: MW-1I
Elev.: 696.46



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LOG OF BORING MW-11

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 694.41
Date Completed : 5/20/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025196.0439
Westing Coord. : 1085921.2931
Total Depth : 57
Well Screen : 46 - 56

Depth in Feet	Surf. Elev. 694.41	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
20	674						
21	673						
22	672						
23	671		CL				
24	670						
25	669						
26	668						
27	667						
28	666						
29	665						
30	664						
31	663						
32	662						
33	661		SW				
34	660						
35	659						
36	658						
37	657						
38	656						
39	655						
40							

Well: MW-11
Elev.: 696.46

Grout



LOG OF BORING MW-11

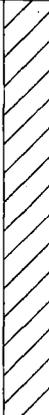
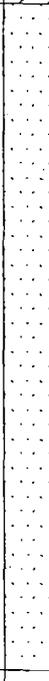
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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

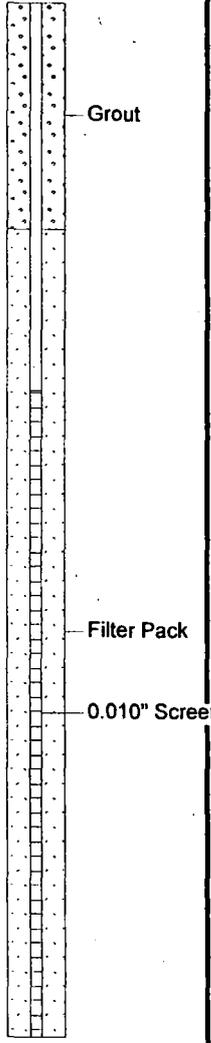
Project Number: 0161-001

Surface Elevation : 694.41
Date Completed : 5/20/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025196.0439
Westing Coord. : 1085921.2931
Total Depth : 57
Well Screen : 46 - 56

Depth in Feet	Surf. Elev. 694.41	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS	
40	654	Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium stiff, moist.	CL		SS - 1 45 - 47 22" R			
41	653							
42	652							
43	651							
44	650							
45	649							
46	648	Dark gray (2.5y 4/1) coarse to fine SAND, little coarse to fine gravel, dense, saturated.	SW		SS - 2 47 - 49 24" R			
47	647							
48	646							
49	645							
50	644							
51	643							
52	642	Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist.			SS - 3 49 - 51 18"			
53	641							
54	640							
55	639							
56	638							
57	637							
58	636	Total Depth of boring 57'.						
59	635							
60	635							

Well: MW-11
Elev.: 696.46



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LOG OF BORING MW-1S

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 694.31
Date Completed : 5/20/02
Drilling Method : 4 1/4" ID HSA
Drilling Company : Patrick Drilling
Sampling Method : Continuous Splitspoon

Ensafe Rep. : Jeff Albert
Northing Coord. : 2025189.4054
Westing Coord. : 1085915.1983
Total Depth : 40
Well Screen : 25 - 40

Depth in Feet
Surf. Elev. 694.31

DESCRIPTION

USCS

GRAPHIC

Sample No.

PID

REMARKS

Well: MW-1S
Elev.: 696.56

No sampling 0 - 22'.
See MW-1 for stratigraphy.

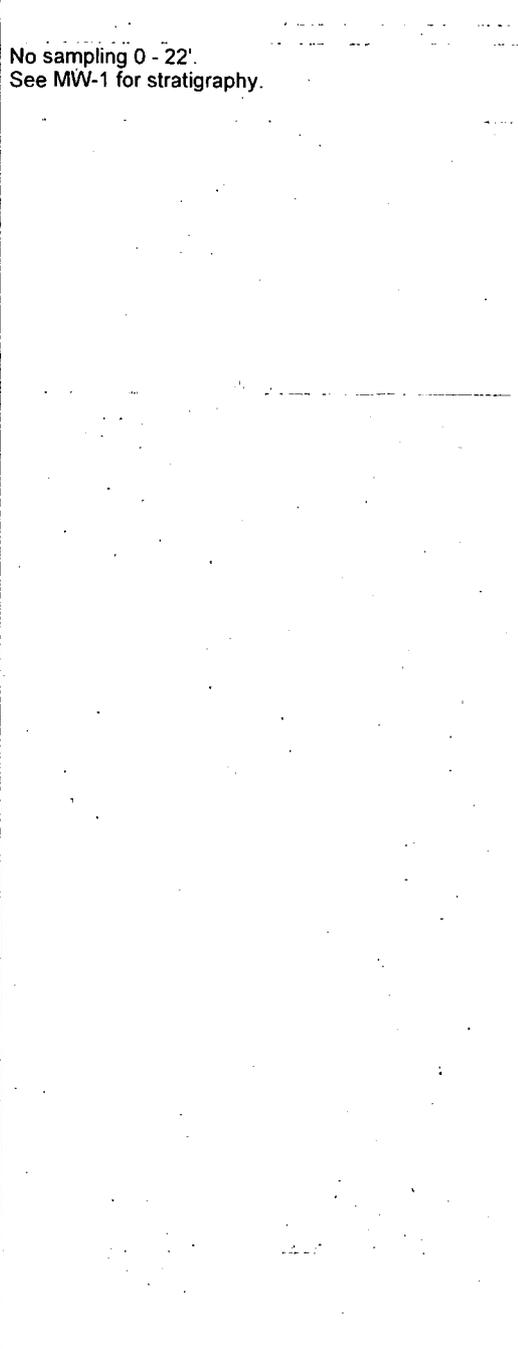
Cover

Grout

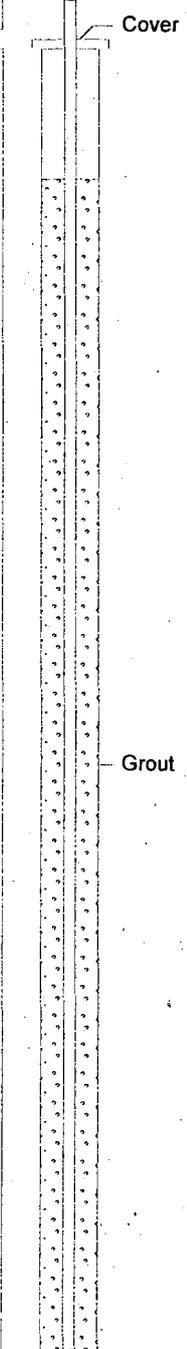
09-04-2002 G:\MCCAFFERYVILLE LOGS\MW-1S.BOR

0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

694
693
692
691
690
689
688
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676
675



USCS	GRAPHIC	Sample No.	PID	REMARKS
GW	[Dotted pattern]			
CL	[Diagonal hatching]			
CL	[Diagonal hatching]			
CL	[Diagonal hatching]			
CL	[Diagonal hatching]			
CL	[Diagonal hatching]			
CL	[Diagonal hatching]			





LOG OF BORING MW-1S

(Page 2 of 2)

Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois
 Project Number: 0161-001

Surface Elevation : 694.31
 Date Completed : 5/20/02
 Drilling Method : 4 1/4" ID HSA
 Drilling Company : Patrick Drilling
 Sampling Method : Continuous Splitspoon

Ensafe Rep. : Jeff Albert
 Northing Coord. : 2025189.4054
 Westing Coord. : 1085915.1983
 Total Depth : 40
 Well Screen : 25 - 40

Depth in Feet	Surf. Elev. 694.31	DESCRIPTION	USCS	GRAPHIC	Sample No.	PID	REMARKS
20	674						
21	673	Begin sampling at 22'.					
22	672	Dark gray (2.5y 4/1) silty, CLAY, trace coarse to fine sand, trace coarse to fine gravel, stiff, medium plasticity, moist.	CL		SS - 1 22 - 24'		
23	671						
24	670	Gray (2.5y 5/1) coarse to fine SAND, some coarse to fine gravel, trace silt and clay, little cobbles and boulders, dense, saturated.			SS - 2 24 - 26'		
25	669						
26	668				SS - 3 26 - 28'		
27	667						
28	666				SS - 4 28 - 30'		
29	665						
30	664				SS - 5 30 - 32'		
31	663		SW				
32	662				SS - 6 32 - 34'		
33	661						
34	660				SS - 7 34 - 36'		
35	659						
36	658				SS - 8 36 - 38'		
37	657						
38	656	Dark gray (2.5 y 4/1) silty CLAY, some coarse to fine SAND, stiff (with some gravel in bottom 0.2').	CL		SS - 9 38 - 40'		
39	655						
40		Total Depth at 40'.					

Well: MW-1S
 Elev.: 696.56

Grout
 Filter Pack
 Screen

0 ppm at TOC with PID 0 ppm in sample with PID.

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LOG OF BORING MW-2

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 691.06
Date Completed : 5/23/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : J. Albert
Northing Coord. : 2025205.5023
Westing Coord. : 1086359.4889
Total Depth : 101.0'

Depth in Feet	Surf. Elev. 691.06	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
0	691	Asphalt: Gravel	FL				
1	690	Olive brown (2.5y 4/3) silty CLAY, slight moist, very stiff with some limestone gravel.	CL		SS - 1		
2	689				1 - 3'		
3	688	Black (2.5y 4/3) organic top soil, slight moist, dense.	OL		SS - 2	0	
4	687				3 - 5'		
5	686	Olive brown (2.5 y 4/3) silty CLAY, moist, stiff.	CL		SS - 3	0	
6	685				5 - 7'		
7	684				7 - 9		
8	683	Dark gray (2.5y 4/1) silty CLAY, moist, stiff.	CL		SS - 4	0	
9	682				9 - 11		
10	681				11 - 13		
11	680	Dark gray (2.5y 4/1) silty clay, high plasticity, stiff, moist.	CH		SS - 5	0	
12	679				13 - 15		
13	678				15 - 17		
14	677	Dark gray (2.5y 4/1) silty clay, high plasticity, stiff, moist.	CH		SS - 6		
15	676				17 - 19		
16	675				19 - 21		
17	674						
18	673						
19	672						
20							

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LOG OF BORING MW-2

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 691.06
Date Completed : 5/23/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : J. Albert
Northing Coord. : 2025205.5023
Westing Coord. : 1086359.4889
Total Depth : 101.0'

Depth in Feet	Surf. Elev. 691.06	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS		
20	671		CH		SS - 11 21 - 23	0			
21	670								
22	669								
23	668								
24	667								
25	666								
26	665								
27	664								
28	663								
29	662								
30	661								
31	660								
32	659								
33	658								
34	657								
35	656								
36	655								
37	654	Dark gray (2.5y 4/1) silty clay, medium plasticity, very stiff, moist.			CL			SS - 19 37 - 39	0
38	653								
39	652				SS - 20 39 - 41	0			
40									

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LOG OF BORING MW-2

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Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 691.06
 Date Completed : 5/23/02
 Drilling Method : 4 1/4" ID HSA
 Sampling Method : Continuous Split Spoon
 Drilling Company : Patrick Drilling

Ensafe Rep. : J. Albert
 Northing Coord. : 2025205.5023
 Westing Coord. : 1086359.4889
 Total Depth : 101.0'

Depth in Feet	Surf. Elev. 691.06	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
40	651						
41	650		CL		SS - 21 41 - 43	0	
42	649						
43	648	Dark gray (2.5y 4/1) fine sandy SILT, wet.	ML		SS - 22 43 - 45		
44	647	Dark gray (2.5y 4/1) silty CLAY, moist, very stiff (with occasional very thin wet sandy silt lenses (<.05')).					
45	646		CL		SS - 23 45 - 47		
46	645						
47	644	Dark gray (2.5y 4/1) SILT, very moist to wet, dense. (.1 - .2') (silty sand and gravel lenses).			SS - 24 47 - 49		
48	643						
49	642		ML		SS - 25 49 - 51	0	
50	641						
51	640	Dark gray (2.5y 4/1) SILT, some fine gravel, dense, very moist - moist.			SS - 26 51 - 53		
52	639						
53	638		ML		SS - 27 53 - 55		
54	637						
55	636	Dark gray (2.5y 4/1) silty CLAY, moist, stiff.			SS - 28 55 - 57		
56	635						
57	634		CL		SS - 29 57 - 59		
58	633						
59	632				SS - 30 59 - 61		
60							

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LOG OF BORING MW-2

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 691.06
Date Completed : 5/23/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : J. Albert
Northing Coord. : 2025205.5023
Westing Coord. : 1086359.4889
Total Depth : 101.0'

Depth in Feet	Surf. Elev. 691.06	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
60	631		CL				
61	630	Dark gray CLAY, medium to high plasticity, very stiff, moist.			SS - 31 61 - 63	0	
62	629						
63	628				SS - 32 63 - 65		
64	627						
65	626				SS - 33 65 - 67		
66	625						
67	624				SS - 34 67 - 69		
68	623		CL				
69	622				SS - 35 69 - 71		
70	621						
71	620				SS - 36 71 - 73		
72	619						
73	618				SS - 37 73 - 75		
74	617						
75	616	Dark gray (2.5y 4/1) SILT, trace gravel, dense.			SS - 38 75 - 77		
76	615		ML				
77	614	Dark gray (2.5y 4/1) silty CLAY, very stiff.			SS - 39 77 - 79		
78	613						
79	612		CL		SS - 40 79 - 81		
80							

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LOG OF BORING MW-2

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 691.06
Date Completed : 5/23/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : J. Albert
Northing Coord. : 2025205.5023
Westing Coord. : 1086359.4889
Total Depth : 101.0'

Depth in Feet	Surf. Elev. 691.06	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
80	611						
81	610				SS - 41 81 - 83		
82	609						
83	608				SS - 42 83 - 85		
84	607						
85	606				SS - 43 85 - 87		
86	605		CL				
87	604				SS - 44 87 - 89		
88	603						
89	602				SS - 45 89 - 91		End of shift 1700 hrs 5/3/02. Resume drilling @ 91' 0815 5/24/02.
90	601						
91	600				SS - 46 91 - 93		
92	599	Dark gray silty CLAY, trace coarse sand to fine gravel pebbles, very stiff, (noted .1 - .2' silty sandy GRAVEL lense @ 92').					
93	598				SS - 47 93 - 95		
94	597						
95	596				SS - 48 95 - 97		
96	595		CL				
97	594				SS - 49 97 - 99		
98	593						
99	592				SS - 50 99 - 101		
100							

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LOG OF BORING MW-2

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 691.06
Date Completed : 5/23/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : J. Albert
Northing Coord. : 2025205.5023
Westing Coord. : 1086359.4889
Total Depth : 101.0'

Depth in Feet	Surf. Elev. 691.06	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
100	591						
101	590	Total Depth of boring at 101'	CL				
102	589						
103	588						
104	587						
105	586						
106	585						
107	584						
108	583						
109	582						
110	581						
111	580						
112	579						
113	578						
114	577						
115	576						
116	575						
117	574						
118	573						
119	572						
120							

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LOG OF BORING MW-21

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

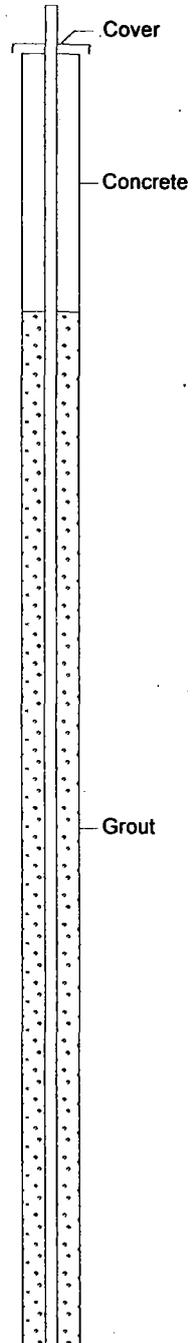
Project Number: 0161-001

Surface Elevation : 691.06
Date Completed : 6/03/02
Drilling Method : 4 1/4 - Inch HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 2025205.5023
Westing Coord. : 1086359.4889
Total Depth : 57.0
Well Screen : 47-57'

Depth in Feet	Surf. Elev. 691.06	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS	
0	691	MW-21 was drilled to 41 feet below ground surface without sampling. Please see log of Boring MW-2 for stratigraphic details of this interval.	FL					
1	690							
2	689			CL				
3	688							
4	687							
5	686			OL				
6	685							
7	684							
8	683							
9	682			CL				
10	681							
11	680							
12	679							
13	678							
14	677			CL				
15	676							
16	675			CL				
17	674							
18	673							
19	672			CH				
20								

Well: MW-21
Elev.: 693.71





LOG OF BORING MW-2I

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 691.06
Date Completed : 6/03/02
Drilling Method : 4 1/4 - Inch HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 2025205.5023
Westing Coord. : 1086359.4889
Total Depth : 57.0
Well Screen : 47-57'

Depth in Feet	Surf. Elev. 691.06	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
20	671						
21	670						
22	669						
23	668						
24	667						
25	666						
26	665						
27	664						
28	663		CH				
29	662						
30	661						
31	660						
32	659						
33	658						
34	657						
35	656						
36	655						
37	654						
38	653		CL				
39	652						
40							

Well: MW-2I
Elev.: 693.71

Grout

Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 691.06
Date Completed : 6/03/02
Drilling Method : 4 1/4 - Inch HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 2025205.5023
Westing Coord. : 1086359.4889
Total Depth : 57.0
Well Screen : 47-57'

Well: MW-2I
Elev.: 693.71

Depth in Feet	Surf. Elev. 691.06	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
40	651						
41	650	Dark Gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, low plasticity, very stiff, moist.	CL		SS - 1	0	3.2"
42	649				41 - 43'		
43	648				22" R		
44	647				SS - 2		
45	646	2" fine sandy SILT, saturated at 45'.			SS - 3	0	4.5+
46	645				45 - 47'		
47	644	Gradational contact.			24"	0	
48	643	Dark gray (2.5y 4/1) clayey SILT, grading to SILT at 48.3', saturated.	ML		SS - 4	0	SS-5 Driven on cobble/ gravel at 49'. Water in hole.
49	642				47 - 49'		
50	641				19"		
51	640	Dark gray (2.5y 4/1) gravelly CLAY, some coarse to fine sand, stiff, moist.	GC		SS - 5	0	Filter Pack
52	639				49 - 51'		
53	638				2"		
54	637	1.2" SILT, saturated at 54.3'.			SS - 6		
55	636				51 - 53'	0	0.010" Screen
56	635				11"		
57	634	Total Depth at 57'.			SS - 7		
58	633				53 - 55'		
59	632				18"		
60					SS - 8		
					55 - 57'		
					3"		



LOG OF BORING MW-3

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 696.93
Date Completed : 5/23/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : D. Felter
Northing Coord. : 2025176.1904
Westing Coord. : 1086545.0030
Total Depth : 101.0

Depth in Feet	Surf. Elev. 696.93	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS
0		Olive brown (2.5y 4/3), gray (2.5y 4/1) and black (2.5y 2.5/1) silty clay FILL, trace coarse to fine sand, trace coarse to fine gravel, stiff, medium plasticity, moist.						
1	696				0	SS-1 1-3'	14"	
2	695							
3	694		CL		0	SS-2 3-5'	12"	
4	693							
5	692					SS-3 5-7'	17"	
6	691	Sharp contact Black (2.5y 2.5/1) organic TOPSOIL, moist, stiff.	OL					
7	690					SS-4 7-9'	19"	
8	689	Light brownish gray (2.5y 6/2) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, stiff, medium plasticity, fractured, mottled, moist.						
9	688				0	SS-5 9-11'	18"	
10	687							
11	686		CL		0	SS-6 11-13'	21"	
12	685							
13	684				0	SS-7 13-15'	15"	
14	683							
15	682				0	SS-8 15-17'	23"	
16	681	Gradational contact Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, little coarse to fine gravel, medium stiff, medium plasticity, moist.						
17	680				0	SS-9 17-19'	20"	
18	679		CL					
19	678				0	SS-10 19-21'	12"	
20	677							

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LOG OF BORING MW-3

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 696.93
Date Completed : 5/23/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : D. Felter
Northing Coord. : 2025176.1904
Westing Coord. : 1086545.0030
Total Depth : 101.0

Depth in Feet	Surf. Elev. 696.93	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS
20								
21	676				0	SS-11 21-23'	21"	
22	675				0			
23	674				0	SS-12 23-25'	15"	
24	673				0			
25	672				0	SS-13 25-27'	20"	
26	671				0			
27	670				0	SS-14 27-29'	24"	
28	669				0			
29	668				0	SS-15 29-31'	24"	
30	667		CL		0			
31	666				0	SS-16 31-33'	0"	
32	665				0			
33	664				0	SS-17 33-35'	4"	
34	663				0			
35	662				0	SS-18 35-37'	20"	
36	661				0			
37	660				0	SS-19 37-39'	19"	
38	659				0			
39	658				0	SS-20 39-41'	22"	
40	657				0			

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 696.93
Date Completed : 5/23/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : D. Felter
Northing Coord. : 2025176.1904
Westing Coord. : 1086545.0030
Total Depth : 101.0

Depth in Feet	Surf. Elev. 696.93	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS
40								
41	656					SS-21 41-43'	21"	
42	655				0			
43	654					SS-22 43-45'	21"	
44	653				0			
45	652					SS-23 45-47'	10"	
46	651		CL		0			Collect shelly tube k = 1.8 x 10 ⁻⁸ cm/sec
47	650					SS-24 47-49'	24"	
48	649				0			
49	648					SS-25 49-51'	18"	
50	647				0			
51	646					SS-26 51-53'	17"	
52	645	Sharp contact Gray (2.5y 5/1) silty fine SAND, dense, saturated.			0			
53	644		SM			SS-27 53-55'	17"	
54	643	Gray (2.5y 5/1) silty CLAY with fine sand and coarse to fine gravel.			0			
55	642		CL			SS-28 55-57'	18"	
56	641				0			
57	640	Light gray (2.5y 7/1) fine silty SAND, dense, saturated.				SS-29 57-59'	14"	
58	639		SM		0			
59	638					SS-30 59-61'	10"	
60	637							



LOG OF BORING MW-3

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 696.93
Date Completed : 5/23/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : D. Felter
Northing Coord. : 2025176.1904
Westing Coord. : 1086545.0030
Total Depth : 101.0

Depth in Feet	Surf. Elev. 696.93	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS
60								
61	636	Gradational contact	SM		0			
		Gray fine GRAVEL and coarse to fine sand, saturated.	GP			SS-31 61-63'	12"	
62	635	Gray (2.5y 4/1), SILT with fine sand, wet.			0			
63	634					SS-32 63-65'	12"	
64	633				0			
65	632		ML			SS-33 65-67'	12"	
66	631				0			
67	630					SS-34 67-69'	12"	
68	629	Sharp contact			0			
69	628	Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, stiff, medium plasticity, moist.				SS-35 69-71'	17"	
70	627				0			
71	626					SS-36 71-73'	8"	
72	625				0			
73	624		CL			SS-37 73-75'	15"	
74	623				0			
75	622					SS-38 75-77'	12"	
76	621				0			
77	620					SS-39 77-79'	14"	
78	619	Sharp contact						
		Gray (2.5y 4/1) fine SAND, dense, saturated.	SP		0			
79	618	Gray SILT with fine sand, wet.						
			ML			SS-40 79-81'	10"	
80	617							

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LOG OF BORING MW-3

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 696.93
Date Completed : 5/23/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : D. Felter
Northing Coord. : 2025176.1904
Westing Coord. : 1086545.0030
Total Depth : 101.0

Depth in Feet	Surf. Elev. 696.93	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS
80			ML					
81	616	Dark gray (2.5y 4/1) clayey SILT, trace coarse to fine sand, trace coarse to fine gravel, dense, moist.			0	SS-41	12"	
82	615					81-83'		
83	614				0	SS-42	15"	
84	613					83-85'		
85	612				0	SS-43	11"	
86	611					85-87'		
87	610				0	SS-44	16"	
88	609					87-89'		
89	608		ML		0	SS-45	15"	
90	607					89-91'		
91	606				0	SS-46	16"	
92	605					91-93'		
93	604				0	SS-47	13"	
94	603					93-95'		
95	602				0	SS-48	13"	
96	601					95-97'		
97	600				0	SS-49	17"	
98	599	Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist.	CL		0	SS-49		
99	598					97-99'		
100	597				0	SS-50	12"	
						99-101'		

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LOG OF BORING MW-3

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 696.93
Date Completed : 5/23/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : D. Felter
Northing Coord. : 2025176.1904
Westing Coord. : 1086545.0030
Total Depth : 101.0

Depth in Feet	Surf. Elev. 696.93	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS
100			CL					
101	596	Total depth of Boring 101.0'						
102	595							
103	594							
104	593							
105	592							
106	591							
107	590							
108	589							
109	588							
110	587							
111	586							
112	585							
113	584							
114	583							
115	582							
116	581							
117	580							
118	579							
119	578							
120	577							

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LOG OF BORING MW-3I

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

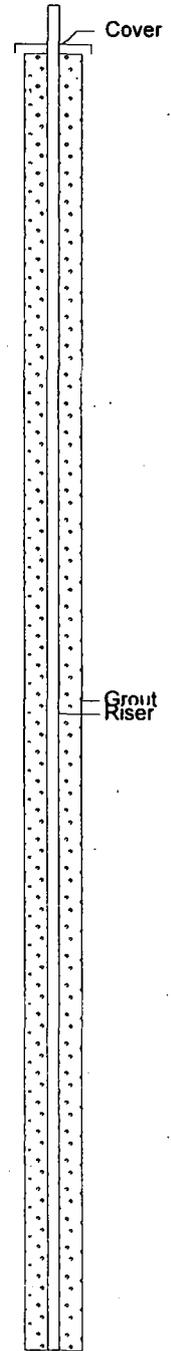
Project Number: 0161-001

Surface Elevation : 696.93
Date Completed : 6/03/02
Drilling Method : 4 1/4 - Inch HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 2025176.1904
Westing Coord. : 1086545.0030
Total Depth : 66.0
Well Screen : 54-64

Depth in Feet	Surf. Elev. 696.93	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
0		MW-3I was advanced to 48 feet without sampling. Please see MW-3 for stratigraphy.					
1	696						
2	695						
3	694		CL				
4	693						
5	692						
6	691						
7	690		OL				
8	689						
9	688						
10	687						
11	686						
12	685		CL				
13	684						
14	683						
15	682						
16	681						
17	680						
18	679		CL				
19	678						
20	677						

Well: MW-3I
Elev.: 699.32



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LOG OF BORING MW-3I

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 696.93
Date Completed : 6/03/02
Drilling Method : 4 1/4 - Inch HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 2025176.1904
Westing Coord. : 1086545.0030
Total Depth : 66.0
Well Screen : 54-64

Depth in Feet	Surf. Elev. 696.93	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
20							
21	676						
22	675						
23	674						
24	673						
25	672						
26	671						
27	670						
28	669						
29	668						
30	667		CL				
31	666						Grout Riser
32	665						
33	664						
34	663						
35	662						
36	661						
37	660						
38	659						
39	658						
40	657						

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LOG OF BORING MW-3I

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

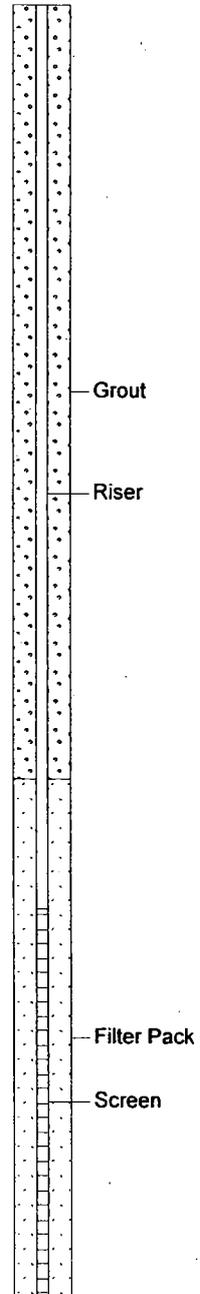
Project Number: 0161-001

Surface Elevation : 696.93
Date Completed : 6/03/02
Drilling Method : 4 1/4 - Inch HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 2025176.1904
Westing Coord. : 1086545.0030
Total Depth : 66.0
Well Screen : 54-64

Depth in Feet	Surf. Elev. 696.93	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
40							
41	656						
42	655						
43	654						
44	653		CL				
45	652						
46	651						
47	650						
48	649						
49	648	Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.	CL		SS-1 48-50' 17" R	0	
50	647		CL		SS-2 50-52' 17" R	0	
51	646						
52	645	Sharp contact					
53	644	Gray (2.5y 5/1) silty fine sand, dense, saturated.	SM		SS-3 52-54' 12" R	0	
54	643						
55	642	Gradational contact					
56	641	Dark gray (2.5y 4/1) fine sandy silt, saturated.	ML		SS-4 54-56' 24" R	0	
57	640	Gradational contact					
58	639	Dark gray (2.5y 4/1) silty fine sand saturated.	SM		SS-5 56-58' 18" R	0	
59	638						
60	637						

Well: MW-3I
Elev.: 699.32



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LOG OF BORING MW-31

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

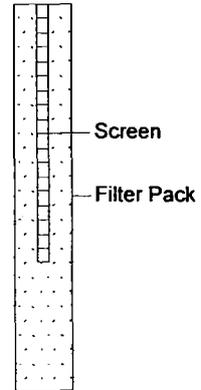
Project Number: 0161-001

Surface Elevation : 696.93
Date Completed : 6/03/02
Drilling Method : 4 1/4 - Inch HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 2025176.1904
Westing Coord. : 1086545.0030
Total Depth : 66.0
Well Screen : 54-64

Depth in Feet	Surf. Elev. 696.93	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
60							
61	636		SM		SS-7 60-62' 17" R	0	
62	635	Gray (2.5y 5/1) coarse sand with fine gravel, saturated.	SP		SS-7 62-64' 16" R	0	
63	634						
64	633	Dark gray (2.5y 4/1) silt, dense, moist.	ML		SS-8 64-66' 10" R	0	
65	632						
66	631	Total depth of Boring at 66.0					
67	630						
68	629						
69	628						
70	627						
71	626						
72	625						
73	624						
74	623						
75	622						
76	621						
77	620						
78	619						
79	618						
80	617						

Well: MW-31
Elev.: 699.32





LOG OF BORING MW-4

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 698.98
Date Completed : 6/5/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025003.3109
Westing Coord. : 1086544.6348
Total Depth : 101.0'

Depth in Feet	Surf. Elev. 698.98	DESCRIPTION	USCS	GRAPHIC	PID	Sample No.	Recovery	REMARKS
0		Soil bare - graded.						
1	698	Black (2.5y 2.5/1) organic CLAY, topsoil.	OL			SS - 1 1 - 3'	14"	
2	697	Light olive brown (2.5y 5/4) with black silty clay FILL, little coarse to fine sand, trace coarse to fine gravel, hard, medium plasticity.			0	SS - 2 3 - 5'	19"	qu = 4.5*
3	696					SS - 3 5 - 7'	21"	
4	695				0	SS - 4 7 - 9'	24"	qu = 3.5*
5	694		CL			SS - 5 9 - 11'	24"	qu = 3.2*
6	693					SS - 6 11 - 13'	24"	
7	692					SS - 7 13 - 15'	24"	qu = 2.7*
8	691	Sharp contact.				SS - 8 15 - 17'	24"	qu = 2.2*
9	690	Dark grayish brown (2.5y 4/2) with gray mottling silty CLAY, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, oxidized, leached, moist.				SS - 9 17 - 19'	24"	qu = 2.5*
10	689					SS - 10 19 - 21'	24"	
11	688							
12	687							
13	686							
14	685		CL					
15	684							
16	683							
17	682	Grading to (2.5 4/2) dark grayish brown without mottling - SAA.						
18	681	Gradational contact.						
19	680	Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, unoxidized, unleached, moist.	CL					
20	679							

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LOG OF BORING MW-4

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 698.98
Date Completed : 6/5/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025003.3109
Westing Coord. : 1086544.6348
Total Depth : 101.0'

Depth in Feet	Surf. Elev. 698.98	DESCRIPTION	USCS	GRAPHIC	PID	Sample No.	Recovery	REMARKS
20								qu = 3.4*
21	678					SS - 11 21 - 23	24"	
22	677				0			qu = 2.2*
23	676					SS - 12 23 - 25	24"	
24	675				0			qu = 2.7*
25	674					SS - 13 25 - 27	24"	
26	673				0			qu = 2.8*
27	672					SS - 14 27 - 29	24"	
28	671				0			qu = 3.1*
29	670					SS - 15 29 - 31	24"	
30	669		CL		0			qu = 2.1*
31	668					SS - 16 31 - 33	24"	
32	667				0			qu = 2.2*
33	666					SS - 17 33 - 35	24"	
34	665				0			qu = 1.7*
35	664					SS - 18 35 - 37	9"	
36	663				0			SS-18 Driven on coarse gravel at 35.8'.
37	662					SS - 19 37 - 39	24"	
38	661				0			qu = 1.5*
39	660					SS - 20 39 - 41	24"	3T-1 39 - 41' k = 1.9 x 10 ⁻⁸ cm/sec 24" R
40	659				0			

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 698.98
Date Completed : 6/5/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025003.3109
Westing Coord. : 1086544.6348
Total Depth : 101.0'

Depth in Feet	Surf. Elev. 698.98	DESCRIPTION	USCS	GRAPHIC	PID	Sample No.	Recovery	REMARKS
40								
41	658							
42	657				0	SS - 21 41 - 43	19"	qu = 2.3*
43	656							
44	655				0	SS - 22 43 - 45	24"	qu = 2.4*
45	654							
46	653	Little coarse to fine gravel.	CL		0	SS - 23 45 - 47	24"	qu = 3.7*
47	652							
48	651				0	SS - 24 47 - 49	24"	qu = 3.2*
49	650							
50	649				0	SS - 25 49 - 51	24"	qu = 3.4*
51	648	Gray (2.5y 5/1) coarse to fine silty SAND, trace coarse to fine gravel, dense, saturated.						
52	647	Interbedded with 2" clay, seams.	SW		0	SS - 26 51 - 53	24"	
53	646	Gray (2.5y 5/1) SILT, dense, saturated.	ML					
54	645	Gray (2.5y 5/1) fine SAND, with silt, very dense, saturated.	SM		0	SS - 27 53 - 55	24"	
55	644	Gray (2.5y 5/1) clayey SILT, interbedded with 2" fine sand and silt, very dense, saturated.						
56	643				0	SS - 28 55 - 57	24"	
57	642							
58	641		ML		0	SS - 29 57 - 59	24"	
59	640	Little coarse to fine SAND, little fine gravel.						
60	639				0	SS - 30 59 - 61	24"	

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LOG OF BORING MW-4

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 698.98
Date Completed : 6/5/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025003.3109
Westing Coord. : 1086544.6348
Total Depth : 101.0'

Depth in Feet	Surf. Elev. 698.98	DESCRIPTION	USCS	GRAPHIC	PID	Sample No.	Recovery	REMARKS
60		Little coarse to fine GRAVEL, trace coarse to fine sand.						
61	638		ML		0	SS - 31 61 - 63	8"	SS-31 Driven on coarse gravel at 61.6' (Lt. gray LS/DS).
62	637							
63	636							
64	635	Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.			0	SS - 32 63 - 65	18"	qu = 3.7*
65	634							
66	633				0	SS - 33 65 - 67	9"	qu = 4.5*
67	632							
68	631				0	SS-34 67-69	24"	qu = 3.9*
69	630							
70	629	Trace coarse to fine sand.			0	SS-35 69-71	24"	qu = 4.1*
71	628							
72	627		CL		0	SS-36 71-73	24"	qu = 3.4*
73	626							
74	625				0	SS-37 73-75	24"	qu = 3.2*
75	624	Little coarse to fine SAND, little coarse to fine gravel.						
76	623				0	SS-38 75-77	24"	qu = 3.4*
77	622							
78	621				0	SS-39 77-79	24"	qu = 2.7*
79	620							
80	619		SP		0	SS-40 79-81	24"	

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LOG OF BORING MW-4

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 698.98
Date Completed : 6/5/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025003.3109
Westing Coord. : 1086544.6348
Total Depth : 101.0'

Depth in Feet	Surf. Elev.	DESCRIPTION	USCS	GRAPHIC	PID	Sample No.	Recovery	REMARKS
80		Gray (2.5y 5/1) fine sand, very dense, saturated.						
81	618	Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium stiff, very stiff, moist. 2" T silt layer at 81.7 bgs.		SP				
82	617				0	SS-41 81-83	19"	qu = 3.8*
83	616				0	SS-42 83-85	24"	qu = 2.9*
84	615				0	SS-43 85-87	24"	qu = 3.1*
85	614				0	SS-44 87-89	22"	qu = 3.5*
86	613				0	SS-45 89-91	24"	qu = 4.5*
87	612				0	SS-46 91-93	11"	qu = 4.5+*
88	611				0	SS-47 93-95	19"	qu = 4.5+*
89	610				0	SS-48 95-97	24"	qu = 4.5+*
90	609				0	SS-49 97-99	24"	qu = 4.5+*
91	608			0	SS-50 99-101	24"		
92	607							
93	606							
94	605							
95	604							
96	603							
97	602	Trace coarse to fine sand below 97' bgs.						
98	601							
99	600							
100	599							

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LOG OF BORING MW-4

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 698.98
Date Completed : 6/5/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025003.3109
Westing Coord. : 1086544.6348
Total Depth : 101.0'

Depth in Feet	Surf. Elev.	DESCRIPTION	USCS	GRAPHIC	PID	Sample No.	Recovery	REMARKS
100	698.98	Total Depth of boring 101'	CL					qu = 4.5+*
101	598							
102	597							
103	596							
104	595							
105	594							
106	593							
107	592							
108	591							
109	590							
110	589							
111	588							
112	587							
113	586							
114	585							
115	584							
116	583							
117	582							
118	581							
119	580							
120	579							

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LOG OF BORING MW-4I

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

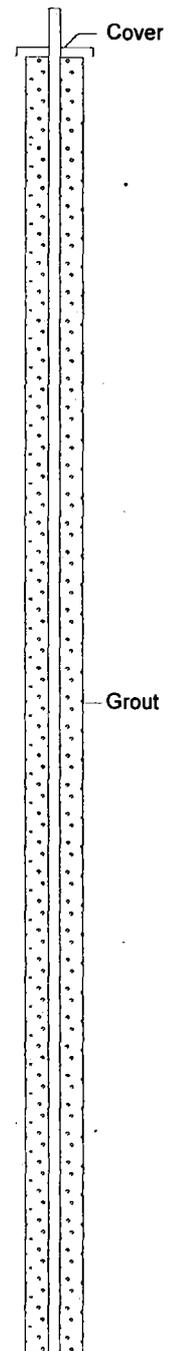
Project Number: 0161-001

Surface Elevation : 698.98
Date Completed : 6/6/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025003.3109
Westing Coord. : 1086544.6348
Total Depth : 57
Well Screen : 52.5-55

Depth in Feet	Surf. Elev. 698.98	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
0		No Sampling 0-47' Please see MW-4 for stratigraphy					
1	698		OL				
2	697						
3	696						
4	695						
5	694		CL				
6	693						
7	692						
8	691						
9	690						
10	689						
11	688						
12	687						
13	686		CL				
14	685						
15	684						
16	683						
17	682						
18	681						
19	680		CL				
20	679						

Well: MW-4I
Elev.: 701.41



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LOG OF BORING MW-4I

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 698.98
Date Completed : 6/6/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025003.3109
Westing Coord. : 1086544.6348
Total Depth : 57
Well Screen : 52.5-55

Depth in Feet	Surf. Elev. 698.98	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
20							
21	678						
22	677						
23	676						
24	675						
25	674						
26	673						
27	672						
28	671						
29	670						
30	669		CL				
31	668						
32	667						
33	666						
34	665						
35	664						
36	663						
37	662						
38	661						
39	660						
40	659						

Well: MW-4I
Elev.: 701.41

Grout

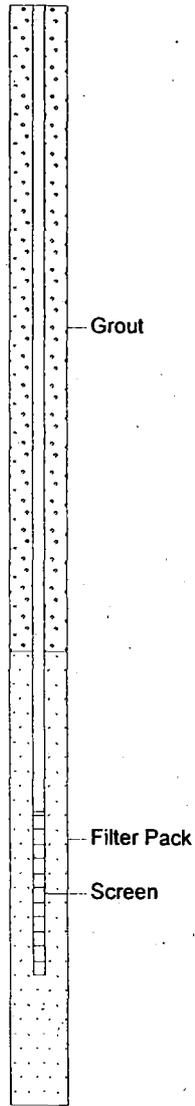
Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 698.98
Date Completed : 6/6/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025003.3109
Westing Coord. : 1086544.6348
Total Depth : 57
Well Screen : 52.5-55

Depth in Feet	Surf. Elev. 698.98	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS	Well: MW-4I Elev.: 701.41
40								
41	658							
42	657							
43	656							
44	655							
45	654							
46	653							
47	652	Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist.	CL		SS - 1			
48	651				47 - 49	0	3.7*	
					8" R			
49	650							
50	649							
51	648							
52	647							
53	646	Gray (2.5y 5/1) silty medium to fine SAND, dense, saturated.	SM		SS - 4			
54	645				53 - 55	0	3.1*	
55	644	Gray (2.5y 5/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.	CL		SS - 5			
56	643				55 - 57	0	3.4*	
					14" R			
57	642	Total Depth of Boring 57'.						
58	641							
59	640							
60	639							



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LOG OF BORING MW-5

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 690.50
Date Completed : 5/21/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : J. Albert
Northing Coord. : 2025019.1832
Westing Coord. : 1086261.0772
Total Depth : 81.0

Depth in Feet	Surf. Elev. 690.50	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
0	690	Asphalt: Gravel	FL				
1	689	Yellowish brown (10y 5/6) sand, FILL, medium, some gravel, moist, dense.	SW		SS - 1 1 - 3'	0	
2	688	Dark brown (2.5y 5/4) silty CLAY very stiff.					
3	687		CL		SS - 2 3 - 5'	0	
4	686						
5	685	Olive brown (2.5y 5/4) silty CLAY to clayey SILT, black organic (2.5y 2.5/1), dark grayish brown (2.5y 4/2), stratified, stiff.	CL		SS - 3 5 - 7'	0	
6	684						
7	683	Olive brown (2.5y 4/3) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, very stiff.					
8	682						
9	681		CL		SS - 5 9 - 11	0	
10	680						
11	679						
12	678	Gradational Contact Dark Gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.					
13	677						
14	676						
15	675						
16	674		CL		SS - 8 15 - 17	0	
17	673						
18	672						
19	671	No recovery 19 - 21, gravel blocked sampler.					
20					SS - 9 17 - 19	0	
					SS - 10 19 - 21	0	

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LOG OF BORING MW-5

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 690.50
Date Completed : 5/21/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : J. Albert
Northing Coord. : 2025019.1832
Westing Coord. : 1086261.0772
Total Depth : 81.0

Depth in Feet	Surf. Elev. 690.50	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
20	670						
21	669		CL		SS - 11 21 - 23	0	
22	668						
23	667	Dark Gray (2.5y 4/1) CLAY, trace coarse to fine sand, trace coarse to fine gravel, high plasticity, stiff, moist.			SS - 12 23 - 25'	0	
24	666						
25	665				SS - 13 25 - 27	0	
26	664						
27	663				SS - 14 27 - 29	0	
28	662						
29	661				SS - 15 29 - 31		
30	660						
31	659		CH		SS - 16 31 - 33		
32	658						
33	657				SS - 17 33 - 35		
34	656						
35	655				SS - 18 35 - 37		Encountered gravel at 35', poor recovery.
36	654						
37	653				SS - 19 37 - 39		
38	652						
39	651				SS - 20 39 - 41		
40							

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LOG OF BORING MW-5

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 690.50
Date Completed : 5/21/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : J. Albert
Northing Coord. : 2025019.1832
Westing Coord. : 1086261.0772
Total Depth : 81.0

Depth in Feet	Surf. Elev. 690.50	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
40	650		CH				
41	649	Dark gray (2.5y 4/1) coarse to fine SAND, trace fine gravel, wet, medium dense.	SW		SS - 21 41 - 43		
42	648						
43	647	Dark Gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist, stiff.	CL		SS - 22 43 - 45		
44	646						
45	645				SS - 23 45 - 47		
46	644	Dark gray (2.5y 4/1) medium to coarse SAND, saturated.	SP				
47	643	Light olive brown (2.5y 5/3) fine SAND, saturated. Dark gray (5y 4/1) SILT, medium dense, saturated.	SP		SS - 24 47 - 49		
48	642						
49	641				SS - 25 49 - 51		
50	640						
51	639				SS - 26 51 - 53		
52	638		ML				
53	637				SS - 27 53 - 55		
54	636						
55	635				SS - 28 55 - 57		
56	634						
57	633	Dark gray (5y 4/1) clayey SILT, dense, moist.			SS - 29 57 - 59		
58	632		ML				
59	631				SS - 30 59 - 61		
60							

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LOG OF BORING MW-5

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 690.50
Date Completed : 5/21/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : J. Albert
Northing Coord. : 2025019.1832
Westing Coord. : 1086261.0772
Total Depth : 81.0

Depth in Feet	Surf. Elev. 690.50	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
60	630		ML				
61	629	Dark grayish brown (2.5y 4/2) silty fine SAND, saturated.	SM		SS - 31 61 - 63		
62	628	Grayish brown (2.5y 5/2) SILT, grading to silty CLAY, wet.					
63	627				SS - 32 63 - 65		
64	626		ML				
65	625				SS - 33 65 - 67		
66	624						
67	623	Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace fine gravel, stiff, medium plasticity, moist.			3 ST 1 67 - 69		3 ST-1 shelly tube 67 - 69' k = 2.8 x 10 ⁻⁸ cm/sec
68	622						
69	621				SS - 35 69 - 71		
70	620						
71	619				SS - 36 71 - 73		
72	618		CL				
73	617				SS - 37 73 - 75		
74	616						
75	615				SS - 38 75 - 77		
76	614						
77	613				SS - 39 77 - 79		
78	612						
79	611	Dark gray (5y 4/1), clayey SILT, dense.	ML		SS - 40 79 - 81		
80							

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LOG OF BORING MW-5

(Page 5 of 5)

Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 690.50
Date Completed : 5/21/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : J. Albert
Northing Coord. : 2025019.1832
Westing Coord. : 1086261.0772
Total Depth : 81.0

Depth in Feet	Surf. Elev. 690.50	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
80	610	Total depth of Boring 81.0'	ML				
81	609						
82	608						
83	607						
84	606						
85	605						
86	604						
87	603						
88	602						
89	601						
90	600						
91	599						
92	598						
93	597						
94	596						
95	595						
96	594						
97	593						
98	592						
99	591						
100							

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LOG OF BORING MW-5I

(Page 1 of 3)

Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

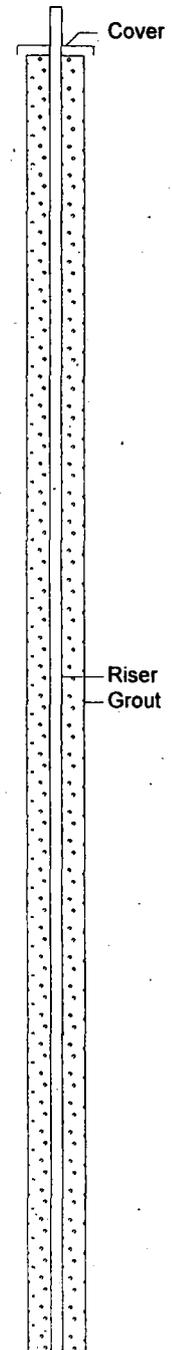
Project Number: 0161-001

Surface Elevation : 690.50
Date Completed : 5/21/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : J. Albert
Northing Coord. : 2025019.1832
Westing Coord. : 1086261.0772
Total Depth : 50.0
Well Screen : 41.5-46.5

Depth in Feet	Surf. Elev. 690.50	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
0	690	No sampling 0 - 42'. Please see MW-5 for stratigraphy.	FL				
1	689		SW				
2	688		CL				
3	687						
4	686		CL				
5	685						
6	684		CL				
7	683						
8	682		CL				
9	681						
10	680		CL				
11	679						
12	678	CL					
13	677						
14	676						
15	675						
16	674						
17	673						
18	672						
19	671						
20							

Well: MW-5S
Elev.: 692.85



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LOG OF BORING MW-5I

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 690.50
Date Completed : 5/21/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : J. Albert
Northing Coord. : 2025019.1832
Westing Coord. : 1086261.0772
Total Depth : 50.0
Well Screen : 41.5-46.5

Depth in Feet	Surf. Elev. 690.50	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
20	670						
21	669		CL				
22	668						
23	667						
24	666						
25	665						
26	664						
27	663						
28	662						
29	661						
30	660						Grout Riser
31	659		CH				
32	658						
33	657						
34	656						
35	655						
36	654						
37	653						
38	652						
39	651						
40							Filter Pack

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LOG OF BORING MW-5I

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 690.50
Date Completed : 5/21/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : J. Albert
Northing Coord. : 2025019.1832
Westing Coord. : 1086261.0772
Total Depth : 50.0
Well Screen : 41.5-46.5

Depth in Feet	Surf. Elev. 690.50	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS	Well: MW-5S Elev.: 692.85
40	650		CH					<p>Riser</p> <p>Screen</p> <p>Filter Pack</p>
41	649		SW					
42	648	Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace fine gravel, moist, stiff.	CL		SS - 1 42 - 44'	0	Poor recovery - gravel blocked sampler	
43	647		CL					
44	646	Dark gray (2.5y 4/1) silty CLAY, very stiff, moist.	CL		SS - 2 44 - 46'	0		
45	645		CL					
46	644	Gradational Dark gray (2.5y 4/1) SILT, saturated, medium dense.			SS - 3 46 - 48'	0		
47	643							
48	642		ML		SS - 4 48 - 50'	0		
49	641	Total depth of Boring at 50.0'.						
50	640							
51	639							
52	638							
53	637							
54	636							
55	635							
56	634							
57	633							
58	632							
59	631							
60								

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LOG OF BORING MW-6

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Surface Elevation : 695.53
Date Completed : 5/15/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025035.4831
Westing Coord. : 1086054.1227
Total Depth : 85.0

Project Number: 0161-001

Depth in Feet	Surf. Elev. 695.53	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS
0	695	Asphalt. Brown sandy gravel FILL.	FL					
1	694	Black (2.5y 2.5/1) organic top soil and gray (2.5y 5/1) silty clay FILL, stiff, medium plasticity, moist.	CL		0	SS - 1 1 - 3'	12"	qu = 1.2*
2	693				0	SS - 2 3 - 5'	14"	qu = 1.0*
3	692				0	SS - 3 5 - 7'	19"	qu = .8*
4	691				0	SS - 4 7 - 9	24"	qu = 1.75*
5	690	Sharp Contact						
6	689	Very dark grayish brown (2.5y 3/2) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.	CL		0	SS - 5 9 - 11	24"	qu = 1.3*
7	688				0	SS - 6 11 - 13	24"	qu = 1.8*
8	687	Gradational contact. Light olive brown (2.5y 5/4) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, stiff, moist.	CL		0	SS - 7 13 - 15	19"	
9	686				0	SS - 8 15 - 17	24"	qu = 4.5+*
10	685	Hard	CL		0	SS - 9 17 - 19	22"	qu = 2.1*
11	684				0	SS - 10 19 - 21	24"	qu = 2.2*
12	683	Gradational contact. Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, coarse to fine gravel, occasional cobbles, medium plasticity, very stiff, moist.	CL		0			
13	682				0			
14	681							
15	680							
16	679							
17	678							
18	677							
19	676							
20								

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 695.53
Date Completed : 5/15/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025035.4831
Westing Coord. : 1086054.1227
Total Depth : 85.0

Depth in Feet	Surf. Elev. 695.53	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS
20	675							
21	674					SS - 11 21 - 23	24"	qu = 2.0* k = 1.3 x 10 ⁻⁸ cm/sec
22	673				0			
23	672					SS - 12 23 - 25	24"	
24	671				0			
25	670		CL			SS - 13 25 - 27	20"	qu = 2.4*
26	669				0			
27	668					SS - 14 27 - 29	8"	Driven on a cobble at 27.6.
28	667							
29	666					SS - 15 29 - 31	6"	
30	665				0			
31	664	Dark gray (2.5y 4/1) coarse to fine SAND and coarse to fine gravel, some cobbles and boulders, interbedded with clay layers (< 2" T), saturated.				SS - 16 31 - 33	8"	Auger refusal at 31 bgs. Move over 6' east & redrill.
32	663				0			
33	662					SS - 17 33 - 35	8"	
34	661		SW					
35	660				0	SS - 18 35 - 37	3"	
36	659							
37	658	Gray (2.5y 5/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.				SS - 19 37 - 39	14"	qu = 3.4*
38	657				0			
39	656		CL			SS - 20 39 - 41	24"	qu = 3.4*
40					0			

Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 695.53
Date Completed : 5/15/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025035.4831
Westing Coord. : 1086054.1227
Total Depth : 85.0

Depth in Feet	Surf. Elev. 695.53	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS
60			ML					
61	635	Gray (2.5y 5/1) fine SAND, very dense, saturated.	SP		0	SS-31 61-63	19"	
62	634							
63	633	Gray (2.5y 5/1) SILT, very dense, saturated.	ML		0	SS-32 63-65	17"	
64	632							
65	631		ML		0	SS-33 65-67	11"	
66	630							
67	629	Gray (2.5y 5/1) silty CLAY, trace coarse to fine sand, low plasticity, very stiff, moist.			0	SS-34 67-69	19"	qu = 3.4*
68	628							qu = 2.1* Attempted shelly tube - refusal
69	627							
70	626					SS-35 69-71	24"	
71	625							
72	624	Hard				SS-36 71-73	14"	qu = 4.5+*
73	623		CL		0	SS-37 73-75	18"	qu = 4.5+*
74	622							qu = 4.5+*
75	621							qu = 4.5+*
76	620					SS-38 75-77	13"	qu = 4.5+*
77	619							qu = 4.5+*
78	618					SS-39 77-79	8"	qu = 4.5+*
79	617							qu = 4.5+*
80	616					SS-40 79-81	12"	qu = 4.5+*



LOG OF BORING MW-6

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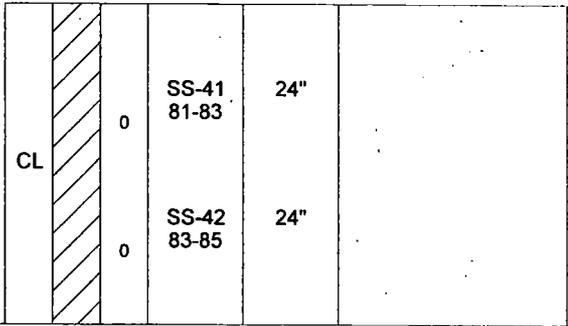
Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 695.53
Date Completed : 5/15/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafte Rep. : C. Smith
Northing Coord. : 2025035.4831
Westing Coord. : 1086054.1227
Total Depth : 85.0

Depth in Feet	Surf. Elev. 695.53	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS
80								
81	615							
82	614							
83	613							
84	612							
85	611	Total depth of Boring at 85.0'						
86	610							
87	609							
88	608							
89	607							
90	606							
91	605							
92	604							
93	603							
94	602							
95	601							
96	600							
97	599							
98	598							
99	597							
100	596							





LOG OF BORING MW-6I

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

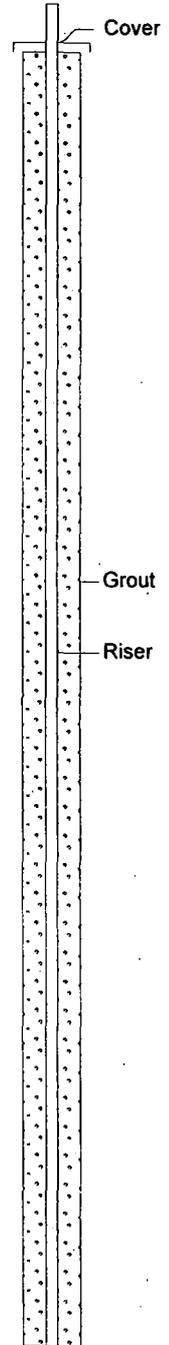
Project Number: 0161-001

Surface Elevation : 695.53
Date Completed : 6/6/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025035.4831
Westing Coord. : 1086054.1227
Total Depth : 63.0
Well Screen : 61-62

Depth in Feet	Surf. Elev. 695.53	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
0		MW-6I advanced to 59.0 feet without sampling. Please see MW-6 for stratigraphy.	FL				
1	695						
2	694						
3	693						
4	692						
5	691		CL				
6	690						
7	689						
8	688						
9	687						
10	686		CL				
11	685						
12	684						
13	683						
14	682						
15	681		CL				
16	680						
17	679						
18	678						
19	677		CL				
20	676						

Well: MW-6D
Elev.: 697.89





LOG OF BORING MW-6I

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 695.53
Date Completed : 6/6/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025035.4831
Westing Coord. : 1086054.1227
Total Depth : 63.0
Well Screen : 61-62

Depth in Feet	Surf. Elev. 695.53	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
20	675						
21	674						
22	673						
23	672						
24	671						
25	670		CL				
26	669						
27	668						
28	667						Grout
29	666						Riser
30	665						
31	664						
32	663						
33	662						
34	661		SW				
35	660						
36	659						
37	658						
38	657		CL				
39	656						
40							

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LOG OF BORING MW-6I

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 695.53
Date Completed : 6/6/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025035.4831
Westing Coord. : 1086054.1227
Total Depth : 63.0
Well Screen : 61-62

Well: MW-6D
Elev.: 697.89

Depth in Feet	Surf. Elev. 695.53	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
40	655						
41	654						
42	653		CL				
43	652						
44	651						
45	650		SW				
46	649						
47	648						Grout
48	647						
49	646						
50	645						Riser
51	644						
52	643						
53	642		ML				
54	641						
55	640						
56	639						
57	638						
58	637						Bentonite Chips
59	636	Gray (2.5y 4/1) clayey SILT, very dense, moist.			SS - 1 59-61' 24" R	0	Filter Pack
60							

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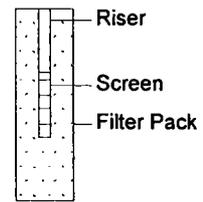
LOG OF BORING MW-6I

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Libertyville Training Site Sites 6A and 7 Vernon Hills, Illinois Project Number: 0161-001	Surface Elevation : 695.53 Date Completed : 6/6/02 Drilling Method : 4 1/4" ID HSA Sampling Method : Continuous Split Spoon Drilling Company : Patrick Drilling	Ensafe Rep. : C. Smith Northing Coord. : 2025035.4831 Westing Coord. : 1086054.1227 Total Depth : 63.0 Well Screen : 61-62
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Depth in Feet	Surf. Elev. 695.53	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS	
60								
61	635		ML					
62	634	Gray (2.5y 4/1) fine SAND, very dense, saturated.	SP		SS - 2 61-63' 22	0		
63	633	Gray (2.5y 4/1) SILT, very dense, moist.	ML					
63	632	Total Depth of Boring 63'.						
64	631							
65	630							
66	629							
67	628							
68	627							
69	626							
70	625							
71	624							
72	623							
73	622							
74	621							
75	620							
76	619							
77	618							
78	617							
79	616							
80								

Well: MW-6D
Elev.: 697.89



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LOG OF BORING MW-6S

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

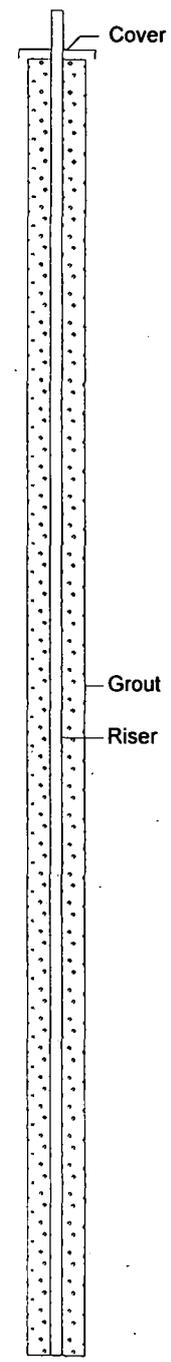
Project Number: 0161-001

Surface Elevation : 695.52
Date Completed : 6/03/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensaf Rep. : C. Smith
Northing Coord. : 2025028.4490
Westing Coord. : 1086052.5047
Total Depth : 39.0
Well Screen : 30-37.5

Depth in Feet	Surf. Elev. 695.52	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
0		MW-6S Advanced to 29.0 feet without sampling. Please see MW-6 for stratigraphy.	FL				
1	694		CL				
2	693		CL				
3	692		CL				
4	691		CL				
5	690		CL				
6	689		CL				
7	688		CL				
8	687		CL				
9	686		CL				
10	685		CL				
11	684		CL				
12	683		CL				
13	682		CL				
14	681		CL				
15	680		CL				
16	679		CL				
17	678		CL				
18	677		CL				
19	676		CL				
20							

Well: MW-6S
Elev.: 697.75



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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

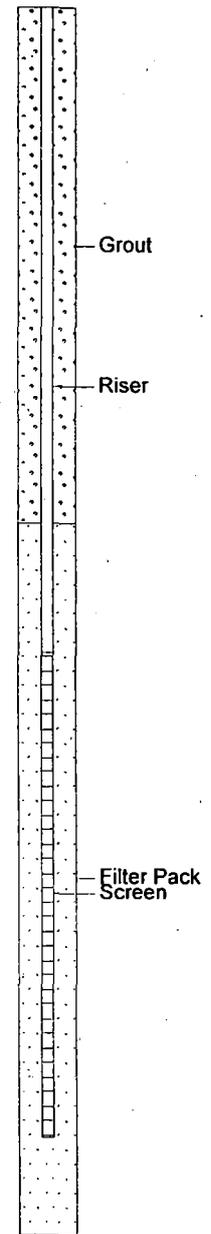
Project Number: 0161-001

Surface Elevation : 695.52
Date Completed : 6/03/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025028.4490
Westing Coord. : 1086052.5047
Total Depth : 39.0
Well Screen : 30-37.5

Depth in Feet	Surf. Elev. 695.52	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS	
20	675							
21	674							
22	673							
23	672							
24	671							
25	670		CL					
26	669							
27	668							
28	667							
29	666	Dark Gray (2.5y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist.			SS - 1 29-31 24" R		qu = 2.4*	
30	665							
31	664	Dark Gray (2.5y 4/1) coarse to fine SAND, with coarse to fine gravel, very dense, saturated.			SS - 2 31-33' 19" R			
32	663							
33	662		SW		SS - 3 33-35' 19" R			
34	661							
35	660							
36	659				SS - 4 35-37 24" R			
37	658							
38	657	Gray (2.5 5/1) CLAY, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist.	CL		SS - 5 37-39 22" R		qu = 3.4*	
39	656	Total depth of Boring at 39.0'						
40								

Well: MW-6S
Elev.: 697.75



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LOG OF BORING MW-7

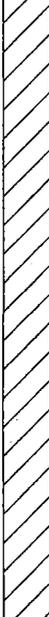
(Page 1 of 5)

Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 698.75
Date Completed : 6/7/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Compan : Patrick Drilling

Ensafep Rep. : C. Smith/G. Temple
Northing Coord. : 2025028.1172
Westing Coord. : 1086826.3514
Total Depth : 91.0

Depth in Feet	Surf. Elev. 698.75	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS
0								
1	698	Light olive brown (2.5y 5/4) silty CLAY, with gray and reddish brown (iron) mottling, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist, oxidized, leached.	CL		0	SS - 1	19"	qu = 3.4*
2	697					1 - 3'		
3	696					SS - 2	21"	
4	695					3 - 5'		
5	694	Little coarse to fine SAND, decreasing mottling with depth.	CL		0	SS - 3	24"	qu = 3.5*
6	693					5 - 7'		
7	692	Gradational contact.	CL		0	SS - 4	24"	qu = 2.4*
8	691					7 - 9		
9	690					SS - 5	24"	
10	689	Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist, vertical fractured with oxidization on fractures.	CL		0	9 - 11	24"	qu = 3.1*
11	688					SS - 6	1"	
12	687	No oxidations/no leaching below 13' bgs.	CL		0	11 - 13	1"	SS-6 Driven in coarse gravel.
13	686					SS - 7	24"	
14	685					13 - 15	qu = 2.7*	
15	684					SS - 8	22"	
16	683		CL		0	15 - 17	qu = 2.6*	
17	682					SS - 9	24"	
18	681					17 - 19	qu = 3.0*	
19	680		CL		0	SS - 10	24"	
20	679					19 - 21		

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LOG OF BORING MW-7

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 698.75
Date Completed : 6/7/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Compan : Patrick Drilling

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 2025028.1172
Westing Coord. : 1086826.3514
Total Depth : 91.0

Depth in Feet	Surf. Elev. 698.75	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS
20								qu = 3.2*
21	678					SS - 11 21 - 23	24"	qu = 2.0*
22	677					SS - 12 23 - 25	0"	SS-12 Driven in coarse gravel.
23	676					SS - 13 25 - 27	24"	qu = 3.2*
24	675					SS - 14 27 - 29	24"	qu = 2.7*
25	674					SS - 15 29 - 31	24"	qu = 2.4*
26	673		CL		0	SS - 16 31 - 33	24"	qu = 2.7*
27	672					SS - 17 33 - 35	21"	qu = 2.2*
28	671					SS - 18 35 - 37	24"	qu = 2.4*
29	670					SS - 19 37 - 39	24"	qu = 2.7*
30	669					SS - 20 39 - 41	24"	qu = 2.9*
31	668							
32	667							
33	666							
34	665							
35	664							
36	663							
37	662							
38	661							
39	660							
40	659							

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LOG OF BORING MW-7

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 698.75
Date Completed : 6/7/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Compan : Patrick Drilling

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 2025028.1172
Westing Coord. : 1086826.3514
Total Depth : 91.0

Depth in Feet	Surf. Elev. 698.75	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS
40								
41	658							
42	657				0	SS - 21 41 - 43	24"	qu = 3.9*
43	656							
44	655				0	SS - 22 43 - 45	24"	qu = 3.2*
45	654							
46	653				0	SS - 23 45 - 47	22"	qu = 2.8*
47	652		CL					
48	651	Hard			0	SS - 24 47 - 49	24"	qu = 4.2*
49	650							
50	649	Very stiff.			0	SS - 25 49 - 51	20"	qu = 2.8*
51	648							
52	647				0	SS - 26 51 - 53	24"	qu = 2.9*
53	646							
54	645	Sharp Contact Gray (2.5y 5/1) silty fine SAND, trace medium to fine sand, dense, saturated.	SP		0	SS - 27 53 - 55	23"	qu = 3.4*
55	644	Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist, unoxidized, unleached.	CL					
56	643	Sharp contact. Dark gray (2.5y 4/1) clayey SILT, dense, saturated.	ML		0	SS - 28 55 - 57	19"	qu = 3.2*
57	642							
58	641	Gray (2.5y 5/1) coarse to fine SAND, trace coarse to fine gravel, clay clasts, medium dense, saturated.	SW		0	SS - 29 57 - 59	19"	qu = 3.4*
59	640				0	SS - 30 59 - 61	24"	3' blowin
60	639							

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LOG OF BORING MW-7

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 698.75
Date Completed : 6/7/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Compan : Patrick Drilling

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 2025028.1172
Westing Coord. : 1086826.3514
Total Depth : 91.0

Depth in Feet	Surf. Elev. 698.75	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS
60								
61	638							Adding potable water to control
62	637				0	SS - 31 61 - 63	18"	7' blowin
63	636							
64	635		SW		0	SS - 32 63 - 65	9"	4' blowin
65	634							
66	633				0	SS - 33 65 - 67	11"	
67	632	Sharp contact.						
68	631	Dark gray (2.5y 4/1) silty CLAY, some coarse to fine sand, little coarse to fine gravel, low plasticity, very stiff, wet.	CL		0	SS - 34 67 - 69	14"	qu = 3.7*
69	630	Dark gray (2.5y 4/1) clayey SILT, little coarse to fine sand, trace coarse to fine gravel, very dense, moist.	ML					
70	629		ML		0	SS - 35 69 - 71	19"	qu = 4.2*
71	628	Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist.	CL		0	SS - 36 71 - 73	18"	qu = 4.3*
72	627							
73	626	Dark gray (2.5y 4/1) SILT, very dense, saturated.						
74	625		ML		0	SS - 37 73 - 75	24"	
75	624							
76	623	Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.	CL		0	SS - 38 75 - 77	11"	qu = 2.9*
77	622							
78	621		CL		0	SS - 39 77 - 79	14"	qu = 2.4*
79	620							
80	619	Hard.			0	SS - 40 79 - 81	4"	qu = 4.5+*

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LOG OF BORING MW-7

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 698.75
Date Completed : 6/7/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Compan : Patrick Drilling

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 2025028.1172
Westing Coord. : 1086826.3514
Total Depth : 91.0

Depth in Feet	Surf. Elev. 698.75	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS
80								
81	618							
82	617				0	SS - 41 81 - 83	19"	qu = 4.5+*
83	616							
84	615				0	SS - 42 83 - 85	14"	qu = 4.5+*
85	614							
86	613		CL		0	SS - 43 85 - 87	12"	qu = 4.5+*
87	612							
88	611				0	SS - 44 87 - 89	14"	qu = 4.5+*
89	610							
90	609				0	SS - 45 89 - 91	22"	qu = 4.5+*
91	608	Total Depth of Boring 91'.						
92	607							
93	606							
94	605							
95	604							
96	603							
97	602							
98	601							
99	600							
100	599							

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

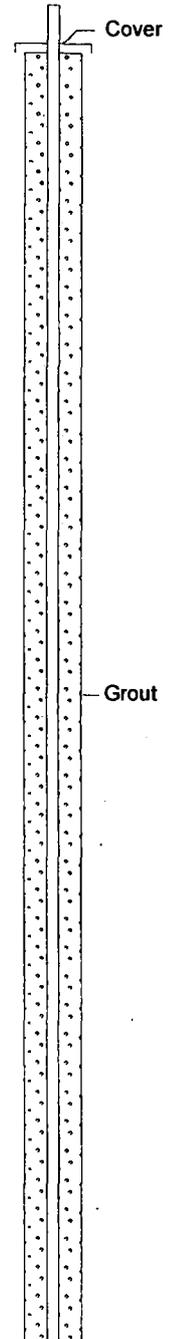
Project Number: 0161-001

Surface Elevation : 698.75
Date Completed : 6/10/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Method : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025028.1172
Westing Coord. : 1086826.3514
Total Depth : 71.0'
Well Screen : 61.5-69.0

Depth in Feet	Surf. Elev. 698.75	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
0		MW-7I advanced to 55.0 feet without sampling. Please see MW-7 for stratigraphy.					
1	698						
2	697						
3	696						
4	695						
5	694						
6	693						
7	692						
8	691						
9	690						
10	689		CL				
11	688						
12	687						
13	686						
14	685						
15	684						
16	683						
17	682						
18	681						
19	680						
20	679						

Well: MW-7I
Elev.: 701.28





LOG OF BORING MW-7I

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 698.75
Date Completed : 6/10/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Method : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025028.1172
Westing Coord. : 1086826.3514
Total Depth : 71.0'
Well Screen : 61.5-69.0

Depth in Feet	Surf. Elev. 698.75	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
20							
21	678						
22	677						
23	676						
24	675						
25	674						
26	673						
27	672						
28	671						
29	670						
30	669		CL				
31	668						
32	667						
33	666						
34	665						
35	664						
36	663						
37	662						
38	661						
39	660						
40	659						

Well: MW-7I
Elev.: 701.28

Grout



LOG OF BORING MW-71

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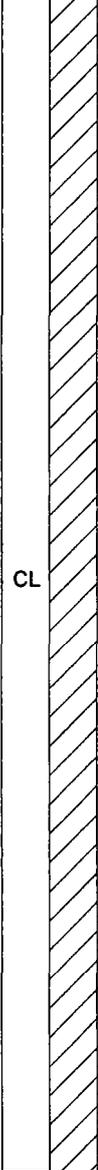
Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 698.75
Date Completed : 6/10/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Method : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025028.1172
Westing Coord. : 1086826.3514
Total Depth : 71.0'
Well Screen : 61.5-69.0

Well: MW-71
Elev.: 701.28

Depth in Feet	Surf. Elev. 698.75	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
40							
41	658						
42	657						
43	656						
44	655						
45	654						
46	653						
47	652						
48	651						
49	650		CL				
50	649						
51	648						
52	647						
53	646						
54	645						
55	644	Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.			SS - 1 55 - 57 24" R	0	qu = 3.8*
56	643						
57	642						
58	641	Sharp contact. Dark gray (2.5y 4/1) clayey SILT, very dense, saturated.	ML		SS - 2 57 - 59 24" R	0	qu = 3.4*
59	640						
60	639				SS - 3 59 - 61 21" R	0	

Grout

Filter Pack



LOG OF BORING MW-71

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

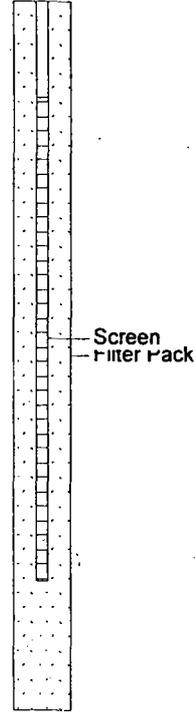
Project Number: 0161-001

Surface Elevation : 698.75
Date Completed : 6/10/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Method : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2025028.1172
Westing Coord. : 1086826.3514
Total Depth : 71.0'
Well Screen : 61.5-69.0

Depth in Feet	Surf. Elev. 698.75	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
60							
61	638		ML				
62	637	Gray (2.5y 5/1) coarse to fine sand, trace coarse to fine gravel, clay clasts, medium dense, saturated.			SS - 4 61 - 63 24" R	0	
63	636						
64	635				SS - 5 63 - 65 24" R	0	
65	634		SW				
66	633				SS - 6 65 - 66 18" R	0	
67	632						
68	631				SS - 7 67 - 69 20" R	0	
69	630	Dark Gray (2.5y 4/1) silty CLAY, some coarse to fine sand, trace coarse to fine gravel, hard, medium plasticity, moist.			SS - 8 69 - 71 19" R	0	qu = 4.5*
70	629		CL				
71	628	Total Depth of Boring 71'					
72	627						
73	626						
74	625						
75	624						
76	623						
77	622						
78	621						
79	620						
80	619						

Well: MW-71
Elev.: 701.28



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LOG OF BORING MW-8

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 704.68
Date Completed : 6/7/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2024849.8303
Westing Coord. : 1086945.8404
Total Depth : 95.0

Depth in Feet	Surf. Elev. 704.68	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS
20								qu = 2.4*
21	684							
22	683					SS - 11 21 - 23'	24"	qu = 2.4*
23	682							
24	681	Softer zone, stiff, 23 - 29'.				SS - 12 23 - 25'	24"	qu = 1.3*
25	680							
26	679					SS - 13 25 - 27'	24"	qu = 1.4*
27	678							
28	677					SS - 14 27 - 29'	0"	SS-14 Driven on coarse gravel at 27 feet
29	676	SAA with high plasticity below 29'.						
30	675		CL			SS - 15 29 - 31'	24"	qu = 3.1*
31	674							
32	673					SS - 16 31 - 33'	21"	qu = 3.0*
33	672							
34	671					SS - 17 33 - 35'	24"	qu = 3.4*
35	670							
36	669					SS - 18 35 - 37'	24"	qu = 2.7*
37	668							
38	667					SS - 19 37 - 39'	24"	qu = 2.5*
39	666							
40	665					SS - 20 39 - 41'	24"	qu = 2.8*

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LOG OF BORING MW-8

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 704.68
Date Completed : 6/7/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2024849.8303
Westing Coord. : 1086945.8404
Total Depth : 95.0

Depth in Feet	Surf. Elev. 704.68	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS
40								
41	664							
42	663				0	SS - 21 41 - 43'	23"	Collect Shelby tube k = 2.8 x 10 ⁻⁸ cm/sec
43	662							
44	661				0	SS - 22 43 - 45'	24"	qu = 3.8*
45	660							
46	659				0	SS - 23 45 - 47'	24"	qu = 2.9*
47	658							
48	657				0	SS - 24 47 - 49'	22"	qu = 3.8*
49	656							
50	655				0	SS - 25 49 - 51'	22"	qu = 3.8*
51	654							
52	653	Hard			0	SS - 26 51 - 53'	9"	qu = 4.4*
53	652							
54	651				0	SS - 27 53 - 55'	17"	qu = 4.3*
55	650							
56	649				0	SS - 28 55 - 57'	24"	qu = 4.4*
57	648							
58	647				0	SS - 29 57 - 59'	24"	qu = 4.5*
59	646							
60	645	Gray (2.5y 5/1) silty fine SAND, dense, saturated.	SM		0	SS - 30 59 - 61'	24"	

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LOG OF BORING MW-8

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 704.68
Date Completed : 6/7/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith
Northing Coord. : 2024849.8303
Westing Coord. : 1086945.8404
Total Depth : 95.0

Depth in Feet	Surf. Elev. 704.68	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS		
80		Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, little coarse to fine gravel, trace cobbles, hard, medium plasticity, moist, unleached, unoxidized. Trace gravel below 81'. Total Depth of Boring 95'.	CL		0	SS - 41	24"	qu = 4.5+*		
81	624					81 - 83'	SS - 42		11"	83 - 85'
82	623					SS - 43	9"		85 - 87'	
83	622					SS - 44	19"		87 - 89'	
84	621					SS - 45	21"		89 - 91'	
85	620					SS - 46	22"		91 - 93'	
86	619					SS - 47	19"		93 - 95'	
87	618									
88	617									
89	616									
90	615									
91	614									
92	613									
93	612									
94	611									
95	610									
96	609									
97	608									
98	607									
99	606									
100	605									

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LOG OF BORING MW-8I

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

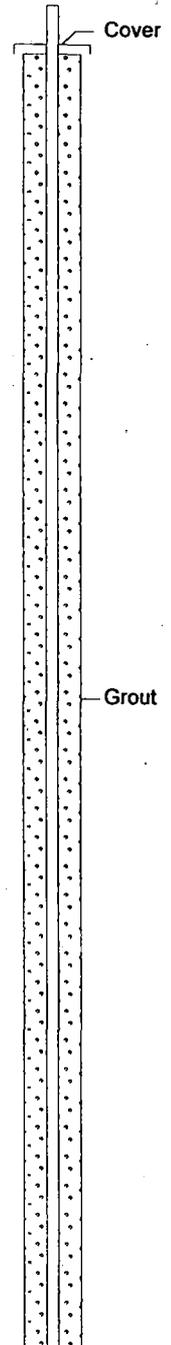
Project Number: 0161-001

Surface Elevation : 704.68
Date Completed : 6/9/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : D. Feller
Northing Coord. : 2024849.8303
Westing Coord. : 1086945.8404
Total Depth : 70.0
Well Screen : 65-70'

Depth in Feet	Surf. Elev. 704.68	DESCRIPTION	USCS	GRAPHIC	Sample No:	PPM	REMARKS
0		MW-8I advanced to 62.0 feet without sampling. Please see MW-8 for stratigraphy.	OL				
1	704						
2	703		CL				
3	702						
4	701		CL				
5	700						
6	699		CL				
7	698						
8	697		CL				
9	696						
10	695		CL				
11	694						
12	693		CL				
13	692						
14	691		ML				
15	690						
16	689		CL				
17	688						
18	687		CL				
19	686						
20	685						

Well: MW-8I
Elev.: 707.09





LOG OF BORING MW-8I

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Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 704.68
 Date Completed : 6/9/02
 Drilling Method : 4 1/4" ID HSA
 Sampling Method : Continuous Split Spoon
 Drilling Company : Patrick Drilling

Ensafe Rep. : D. Felter
 Northing Coord. : 2024849.8303
 Westing Coord. : 1086945.8404
 Total Depth : 70.0
 Well Screen : 65-70'

Well: MW-8I
 Elev.: 707.09

Depth in Feet	Surf. Elev. 704.68	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
20							
21	684						
22	683						
23	682						
24	681						
25	680						
26	679						
27	678						
28	677						
29	676						
30	675		CL				
31	674						
32	673						
33	672						
34	671						
35	670						
36	669						
37	668						
38	667						
39	666						
40	665						

Grout



LOG OF BORING MW-8I

(Page 3 of 4)

Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 704.68
Date Completed : 6/9/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : D. Felter
Northing Coord. : 2024849.8303
Westing Coord. : 1086945.8404
Total Depth : 70.0
Well Screen : 65-70'

Depth in Feet	Surf. Elev. 704.68	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
40							
41	664						
42	663						
43	662						
44	661						
45	660						
46	659						
47	658						
48	657						
49	656						
50	655		CL				
51	654						
52	653						
53	652						
54	651						
55	650						
56	649						
57	648						
58	647						
59	646						
60	645		SM				

Well: MW-8I
Elev.: 707.09

Grout

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LOG OF BORING MW-8I

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

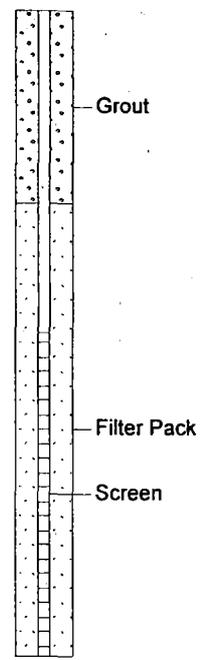
Project Number: 0161-001

Surface Elevation : 704.68
Date Completed : 6/9/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : D. Felter
Northing Coord. : 2024849.8303
Westing Coord. : 1086945.8404
Total Depth : 70.0
Well Screen : 65-70'

Well: MW-8I
Elev.: 707.09

Depth in Feet	Surf. Elev. 704.68	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
60							
61	644						
62	643	Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace fine gravel, medium dense, medium plasticity, moist.	CL		SS-1 62-64' 24" R	0	4' blowing sand in hole.
63	642						
64	641						
65	640						
66	639	Sharp contact.					
67	638	Gray (2.5y 5/1) silty coarse to fine sand, trace fine gravel, dense, saturated.	SM		SS-3 66-68' 24" R	0	
68	637						
69	636						
70	635						
71	634	Total Depth of Boring 70'.					
72	633						
73	632						
74	631						
75	630						
76	629						
77	628						
78	627						
79	626						
80	625						



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LOG OF BORING MW-8S

(Page 1 of 1)

Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 704.58
Date Completed : 6/7/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 2024855.0054
Westing Coord. : 1086942.9319
Total Depth : 20.0
Well Screen : 10-20'

Depth in Feet	Surf. Elev. 704.58	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS	Well: MW-8S Elev.: 707.23
0	704	Bare reworked topsoil.	OL					Cover
1	703	Black (2.5y 2.5/1) and grayish brown (2.5 5/2) silty clay FILL, stiff, medium plasticity, moist.	CL		SS - 1	0	qu = 1.2*	Grout
2	702				1 - 3' 9" R			
3	701	SS - 2	0	qu = 3.7*				
4	700	3 - 5' 11" R						
5	699	SS - 3	0	qu = 3.2*				
6	698	5 - 7' 14" R						
7	697	Light olive brown (2.5y 5/4) silty CLAY, some gray and reddish brown (iron) mottling, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist, oxidized, leached. Native.	CL		SS - 4	0	qu = 3.4*	
8	696				7 - 9' 24" R			
9	695				SS - 5			
10	694	Dark gray (2.5y 4/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, medium plasticity, very stiff, moist.	CL		SS - 6	0	qu = 2.8*	
11	693				9 - 11' 24" R			
12	692	Olive brown (2.5y 4/3) clayey SILT, dense, saturated.	ML		SS - 7	0	qu = 2.1*	
13	691				13 - 15' 24" R			
14	690	Dark grayish brown (2.5y 4/2) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist, unoxidized, unleached. Gradual color change to dark gray (2.5y 4/1) below 17.3 bgs.	CL		SS - 8	0	qu = 2.3*	
15	689				15 - 17' 24" R			
16	688				SS - 9			
17	687				17 - 19' 24" R			
18	686	Total depth of Boring 20.0'			SS - 10	0	2.7*	
19	685				19 - 21' 24" R			
20								Filter Pack
								Screen

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LOG OF BORING MW-9

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 699.50
Date Completed : 5/15/02
Drilling Method : 4 1/4" HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafte Rep. : C. Smith/G. Temple
Northing Coord. : 2024756.7712
Westing Coord. : 1086826.2462
Total Depth : 91.0

Depth in Feet	Surf. Elev. 699.50	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS							
0	699	Light olive brown (2.5y 5/4) silty CLAY, little coarse to fine sand, occasional cobbles, trace coarse to fine gravel, very stiff, medium plasticity, moist, oxidized, leached.	CL		0	SS - 1 1 - 3	14"	qu = 2.6*							
1	698														
2	697														
3	696														
4	695														
5	694								Little coarse to fine GRAVEL, trace fractioning of clay with oxidized surface. (Iron staining and hematite)	CL		0	SS - 2 3 - 5	9"	qu = 4.5*
6	693														
7	692														
8	691														
9	690														
10	689														
11	688														
12	687	Gray (2.5y 5/1) silty CLAY, little coarse to fine sand, trace coarse to fine gravel, very stiff, medium plasticity, moist, unoxidized.	CL		0	SS - 4 7 - 9	19"	qu = 4.5*							
13	686														
14	685														
15	684														
16	683	Dark gray (2.5y 4/1) CLAY, trace coarse to fine sand, trace coarse to fine gravel, stiff, high plasticity, unoxidized, unleached.	CH		0	SS - 5 9 - 11	18"	qu = 2.7*							
17	682														
18	681														
19	680	Dark gray (2.5y 4/1) CLAY, trace coarse to fine sand, trace coarse to fine gravel, stiff, high plasticity, unoxidized, unleached.	CH		0	SS - 6 11 - 13'	24"	qu = 1.7*							
20	680														
						SS - 7 13 - 15	24"	qu = 1.8*							
						SS - 8 15 - 17	24"	qu = 1.3*							
						3T-1 17 - 19	24"	Collect shelly tube k = 2.7 x 10 ⁻⁸ cm/sec qu = 1.3*							
						SS - 10 19 - 21	24"	qu = 1.3*							

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LOG OF BORING MW-9

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 699.50
Date Completed : 5/15/02
Drilling Method : 4 1/4" HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 2024756.7712
Westing Coord. : 1086826.2462
Total Depth : 91.0

Depth in Feet	Surf. Elev. 699.50	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS
20	679							
21	678				0	SS - 11 21 - 23	19"	qu = 4.5+*
22	677							
23	676				0	SS - 12 23 - 25	21"	qu = 4.5+*
24	675							
25	674		CH		0	SS - 13 25 - 27	23"	qu = 3.7*
26	673							
27	672				0	SS - 14 27 - 29	24"	qu = 4.1*
28	671							
29	670				0	SS - 15 29 - 31	19"	qu = 4.5+*
30	669	Gradational contact.						
31	668	Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, hard, moist.			0	SS - 16 31 - 33	24"	qu = 3.7+*
32	667							
33	666				0	SS - 17 33 - 35	24"	qu = 4.5+*
34	665							
35	664		CL		0	SS - 18 35 - 37	24"	qu = 4.5+*
36	663							
37	662				0	SS - 19 37 - 39	19"	qu = 4.5+*
38	661							
39	660				0	SS - 20 39 - 41	24"	qu = 4.5+*
40								

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LOG OF BORING MW-9

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 699.50
Date Completed : 5/15/02
Drilling Method : 4 1/4" HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 2024756.7712
Westing Coord. : 1086826.2462
Total Depth : 91.0

Depth in Feet	Surf. Elev. 699.50	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS
40	659							
41	658				0	SS - 21 41 - 43	19"	qu = 4.3+*
42	657				0	SS - 22 43 - 45	24"	qu = 4.4*
43	656				0	SS - 23 45 - 47	19"	qu = 4.5+*
44	655		CL		0	SS - 24 47 - 49	21"	qu = 4.3*
45	654				0	SS - 25 49 - 51	24"	qu = 4.1*
46	653				0	SS - 26 51 - 53	24"	
47	652				0	SS - 27 53 - 55	24"	qu = 4.5+*
48	651				0	SS - 28 55 - 57	9"	qu = 4.5+*
49	650				0	SS - 29 57 - 59	14"	
50	649				0	SS - 30 59 - 61	19"	
51	648	Light gray (2.5y 7/1) fine SAND, dense, saturated.	SP					
52	647							
53	646	Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, hard, moist.	CL					
54	645							
55	644							
56	643							
57	642	Gray (2.5y 5/1) coarse to fine SAND, trace coarse to fine gravel, trace clay clasts, dense, saturated.	SW					
58	641							
59	640							
60								

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LOG OF BORING MW-9

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 699.50
Date Completed : 5/15/02
Drilling Method : 4 1/4" HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafte Rep. : C. Smith/G. Temple
Northing Coord. : 2024756.7712
Westing Coord. : 1086826.2462
Total Depth : 91.0

Depth in Feet	Surf. Elev. 699.50	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS
60	639	Little coarse to fine GRAVEL, very dense.	SW		0	SS - 31 61 - 63	14"	4' blowin
61	638							
62	637							
63	636							
64	635							
65	634							
66	633							
67	632							
68	631							
69	630							
70	629							
71	628							
72	627							
73	626							
74	625							
75	624							
76	623							
77	622							
78	621							
79	620				0	SS - 37 73 - 75	19"	
80	620							

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LOG OF BORING MW-9

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Libertyville Training Site
 Sites 6A and 7
 Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 699.50
 Date Completed : 5/15/02
 Drilling Method : 4 1/4" HSA
 Sampling Method : Continuous Split Spoon
 Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith/G. Temple
 Northing Coord. : 2024756.7712
 Westing Coord. : 1086826.2462
 Total Depth : 91.0

Depth in Feet	Surf. Elev. 699.50	DESCRIPTION	USCS	GRAPHIC	PPM	Sample No.	Recovery	REMARKS
80	619							
81	618				0	SS - 41 81 - 83	14"	
82	617							
83	616				0	SS - 42 83 - 85	17"	
84	615							
85	614		ML		0	SS - 43 85 - 87	18"	
86	613							
87	612				0	SS - 44 87 - 89	13"	
88	611							
89	610				0	SS - 45 89 - 91	14"	
90	609	Total depth of boring 91.0'						
91	608							
92	607							
93	606							
94	605							
95	604							
96	603							
97	602							
98	601							
99	600							
100								



LOG OF BORING MW-9D

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

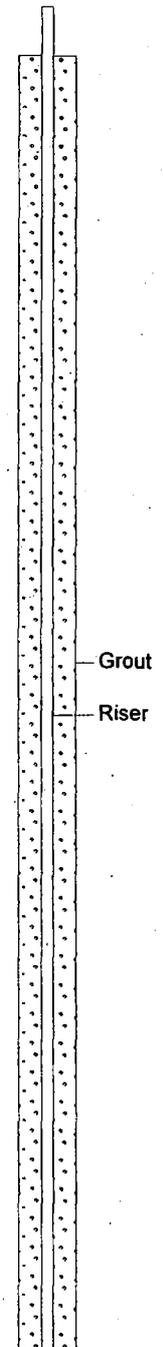
Project Number: 0161-001

Surface Elevation : 699.50
Date Completed : 5/15/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 2024745.6884
Westing Coord. : 1086827.8567
Total Depth : 69.0
Well Screen : 58-68'

Depth in Feet	Surf. Elev. 699.50	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
0	699	MW-9D advanced to 55.0 feet without sampling. Please see MW-9 for stratigraphy.					
1	698						
2	697						
3	696						
4	695		CL				
5	694						
6	693						
7	692						
8	691						
9	690						
10	689						
11	688						
12	687						
13	686		CL				
14	685						
15	684						
16	683						
17	682						
18	681						
19	680		CH				
20							

Well: MW-9S
Elev.: 701.89





LOG OF BORING MW-9D

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 699.50
Date Completed : 5/15/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 2024745.6884
Westing Coord. : 1086827.8567
Total Depth : 69.0
Well Screen : 58-68'

Well: MW-9S
Elev.: 701.89

Depth in Feet	Surf. Elev. 699.50	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
20	679						
21	678						
22	677						
23	676						
24	675						
25	674		CH				
26	673						
27	672						
28	671						
29	670						
30	669						Grout
31	668						Riser
32	667						
33	666						
34	665						
35	664		CL				
36	663						
37	662						
38	661						
39	660						
40							

Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

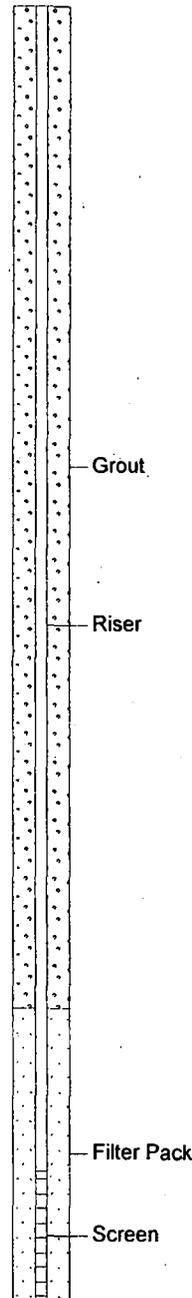
Project Number: 0161-001

Surface Elevation : 699.50
Date Completed : 5/15/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 2024745.6884
Westing Coord. : 1086827.8567
Total Depth : 69.0
Well Screen : 58-68'

Well: MW-9S
Elev.: 701.89

Depth in Feet	Surf. Elev. 699.50	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
40	659						
41	658						
42	657						
43	656						
44	655						
45	654						
46	653		CL				
47	652						
48	651						
49	650						
50	649						
51	648						
52	647		SP				
53	646						
54	645	Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, hard, moist.	CL		SS-1 55-57' 19" R		qu = 4.3*
55	644						
56	643						
57	642	Gray (2.5y 5/1) coarse to fine SAND, trace coarse to fine gravel, trace clay clasts, very dense, saturated.	SW		SS-2 57-59' 24" R		
58	641						
59	640						
60							





LOG OF BORING MW-9D

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

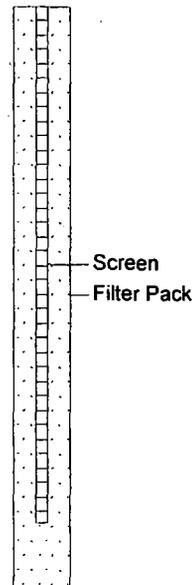
Project Number: 0161-001

Surface Elevation : 699.50
Date Completed : 5/15/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 2024745.6884
Westing Coord. : 1086827.8567
Total Depth : 69.0
Well Screen : 58-68'

Well: MW-9S
Elev.: 701.89

Depth in Feet	Surf. Elev. 699.50	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
60							
61	639				SS-3 59-61 22" R		
62	638						
63	637				SS-4 61-63 24" R		
64	636		SW				
65	635				SS-5 63-65 19" R		
66	634						
67	633				SS-6 65-67 18" R		
68	632	Gray (2.5y 5/1) SILT, very dense, saturated.					
69	631		ML		SS-7 67-69 24" R		
70	630	Total depth of Boring 69.0'					
71	629						
72	628						
73	627						
74	626						
75	625						
76	624						
77	623						
78	622						
79	621						
80	620						





LOG OF BORING MW-9I

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

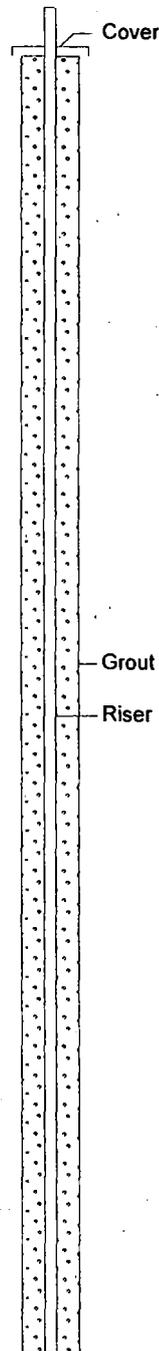
Project Number: 0161-001

Surface Elevation : 699.21
Date Completed : 5/15/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 2024751.6112
Westing Coord. : 1086826.6774
Total Depth : 53.0
Well Screen : 50.5-53

Depth in Feet	Surf. Elev.	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
0	699	MW-9I advanced to 49 feet without sampling. Please see MW-9 for stratigraphy.	CL				
1	698						
2	697						
3	696						
4	695						
5	694						
6	693						
7	692						
8	691						
9	690						
10	689						
11	688						
12	687						
13	686						
14	685						
15	684						
16	683						
17	682						
18	681	CH					
19	680						
20							

Well: MW-9S
Elev.: 701.63





LOG OF BORING MW-9I

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Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 699.21
Date Completed : 5/15/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafte Rep. : C. Smith/G. Temple
Northing Coord. : 2024751.6112
Westing Coord. : 1086826.6774
Total Depth : 53.0
Well Screen : 50.5-53

Depth in Feet	Surf. Elev. 699.21	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS
20	679						
21	678						
22	677						
23	676						
24	675						
25	674		CH				
26	673						
27	672						
28	671						
29	670						
30	669						Grout
31	668						Riser
32	667						
33	666						
34	665						
35	664		CL				
36	663						
37	662						
38	661						
39	660						
40							

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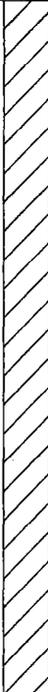
Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

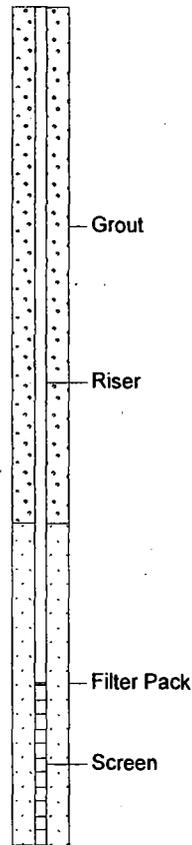
Project Number: 0161-001

Surface Elevation : 699.21
Date Completed : 5/15/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : C. Smith/G. Temple
Northing Coord. : 2024751.6112
Westing Coord. : 1086826.6774
Total Depth : 53.0
Well Screen : 50.5-53

Well: MW-9S
Elev.: 701.63

Depth in Feet	Surf. Elev. 699.21	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS	
40	659							
41	658							
42	657							
43	656							
44	655							
45	654							
46	653							
47	652							
48	651	Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist.	CL		SS-1 49-51 24" R		qu = 3.8*	
49	650							
50	649							
51	648	Light gray (2.5y 7/1) fine SAND, trace silt, dense, saturated.	SP		SS-2 51-53 24" R			
52	647							
53	646	Dark gray (2.5y 4/1) silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, hard, moist.	CL					
54	645	Total depth of Boring 53.0'						
55	644							
56	643							
57	642							
58	641							
59	640							
60								





LOG OF BORING MW-9S

(Page 1 of 1)

Libertyville Training Site
Sites 6A and 7
Vernon Hills, Illinois

Project Number: 0161-001

Surface Elevation : 699.16
Date Completed : 5/15/02
Drilling Method : 4 1/4" ID HSA
Sampling Method : Continuous Split Spoon
Drilling Company : Patrick Drilling

Ensafe Rep. : D. Felter
Northing Coord. : 2024756.7712
Westing Coord. : 1086826.2462
Total Depth : 20.0
Well Screen : 10-20

Depth in Feet	Surf. Elev. 699.16	DESCRIPTION	USCS	GRAPHIC	Sample No.	PPM	REMARKS	Well: MW-9S Elev.: 701.93	
								Cover	Grout
0	699	MW-9S advanced to 20.0 feet without sampling. Please see MW-9 for stratigraphy.	CL						Cover
1	698								
2	697								
3	696								
4	695								
5	694								
6	693								
7	692								
8	691								
9	690	Total depth of Boring 20.0'	CL					Grout	
10	689								
11	688								
12	687								
13	686								
14	685								
15	684								
16	683								
17	682								
18	681								
19	680	Total depth of Boring 20.0'	CH					Filter Pack	
20	680								Screen

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July 17, 2002

Craig R. Smith, PG
Ensafe Inc.
201 North Palafox Street, Suite 200
Pensacola, FL 32501

Reference: Patrick Project No. 7069.C0
Ensafe Project Nos. 0161-001-09-070-00; 0161-001-09-080-00

Dear Mr. Smith:

Attached are the results of testing conducted on the samples delivered to our lab. The following procedures were used for this testing:

- Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter (ASTM D 5084)
- Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils (ASTM D 2974)
- Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass (ASTM D 2216)
- Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) (ASTM D 2488)

We will dispose of the remainder of your sample in 90 days unless notified of your desire to make other arrangements.

Thank you for letting us serve you on this project. If you have any questions or if we can be of additional assistance, please do not hesitate to call.

Sincerely,

PATRICK ENGINEERING INC.



Michael J. Stewart
Lab Manager

ms/slc

Enclosures: Summary of Laboratory Testing
Logs of Shelby Tubes Extruded
Hydraulic Conductivity Calculation Sheets
Analytical Report of ASTM D 2974

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**SUMMARY OF LABORATORY TESTING
LIBERTYVILLE TRAINING CENTER**

JOB NOS.

0161-001-09-070-00

0161-001-09-080-00

Sample Identification	Depth (Feet)	Soil Description	Hydraulic Conductivity (cm/sec)	Total Organic Carbon (%)	Dry Density (Pcf)	Moisture Content (%)
MW-3	45' - 47'	Dark gray silty clay, CL	1.8×10^{-8}	1.14	115.5	17.3
MW-4	39' - 41'	Dark gray silty clay, CL	1.9×10^{-8}		122.2	15.0
MW-5	67' - 69'	Dark gray silty clay, CL	2.8×10^{-8}		109.5	20.0
MW-6I	21' - 23'	Dark gray silty clay, CL	1.3×10^{-8}	1.16	119.8	15.3
MW-8	41' - 43'	Dark gray silty clay, CL	2.8×10^{-8}		124.6	13.4
MW-9	17' - 19'	Dark gray silty clay, CL	2.7×10^{-8}	1.23	112.0	19.3

Hydraulic Conductivity - Calculation Sheet

	Tech. - MS	MS
Job No.	7069.C0	JCS
Boring Number:	MW-3	07/15/2002
Sample No.	ST-3/45-47'	
Description:	Dark Gray Silty Clay	

	Initial WC%	Final WC%
Tare no.		
Tare wt. (g)		
Wt. wet soil & tare (g)		
Wt. dry soil & tare (g)		
Moisture Content (%)	17.30	ERR
Diameter (cm)	7.27	
Height (cm)	14.23	
Volume (cm ³)	590.7	
Wet Wt. (g)	1282.84	
Dry Density (pcf)	115.5	
B-Value after saturation	0.96	

Dimensional Change During Consolidation (assuming isotropic consolidation)

Manom. Chg., 3/8" dia. (in)=	Top:2.65	Bottom:2.4
Volume change (cm ³):	9.1	
Consolidated volume (cm ³):	581.6	
Dry weight of sample (g):	1093.64	
% change each dimension / 100:	0.00516	
Consolidated diameter (cm):	7.23	2.85 in.
Consolidated height (cm):	14.16	5.57 in.
Consolidated area (cm ²):	41.1	6.37 in ²
Consolidated dry density (pcf):	117.3	

Note - 0.005 CaSO₄ solution used as permeant

	TRIAL 1	TRIAL 2	TRIAL 3	TRIAL 4
Cell pressure (psi):	70.3	69.9	69.6	69.8
Top pressure (psi):	58.8	58.6	58.4	58.3
Bottom pressure (psi):	61.6	61.4	61.9	61.6
Gradient:	14	14	17	16
Confining Pressure (psi):	10.10	9.90	9.45	9.85
Date initial reading:	07/11/02	07/12/02	07/15/02	07/15/02
Time initial reading:	09:05 AM	07:25 AM	05:30 AM	05:30 AM
Date final reading:	07/11/02	07/12/02	07/15/02	07/15/02
Time final reading:	12:58 PM	10:43 AM	07:36 AM	10:20 AM
Initial man. rdg. (in)	Top= 67.1	67.3	67.95	67.95
	Bottom= 62.75	62.05	59.8	59.8
Final man. rdg. (in)	Top= 67.2	67.35	68	68.05
	Bottom= 62.65	62	59.75	59.7
Chg. Top (in.)	0.1	0.05	0.05	0.1
Chg. Bottom (in.)	0.1	0.05	0.05	0.1
Chg. Time (hrs.)	3.88	3.30	2.10	4.83
Top "K" value (cm/sec) =	2.4E-08	1.4E-08	1.8E-08	1.7E-08
Bottom "K" value (cm/sec) =	2.4E-08	1.4E-08	1.8E-08	1.7E-08

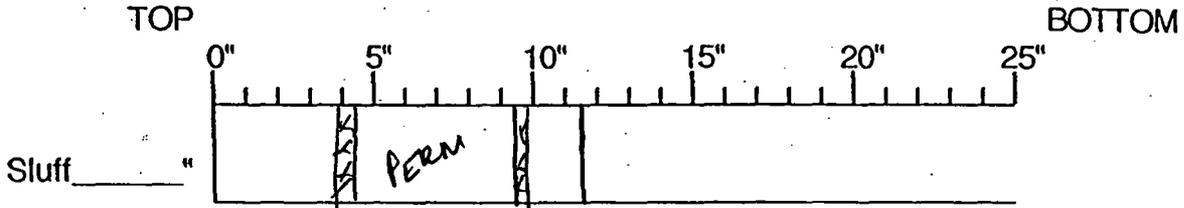
HYDRAULIC CONDUCTIVITY (CM/SEC.) = 1.8E-08	Conf. Pres. (psi) = 9.45
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LOG OF SHELBY TUBE EXTRUDED IN LAB

PROJECT NO. 7069-CO

Boring Number MW-3 Shelby Tube Number 3T-1
 Depth (ft.) 45-47' Logged By MLB Date 7/2/02
 Length of sample after extrusion (in.) 11.25 Dia. (in.) 2.75
 Condition of sample: GOOD

Soil description based on visual examination and classification using the Unified Soil Classification System (USCS)



DARK GRAY SILTY CLAY, LITTLE C-F SAND, TRACE FINE GRAVEL, VERY STIFF, MEDIUM PLASTICITY, MOIST CL

	WC% #1	WC% #2	WC% #3
Tare No.	<u>136</u>	<u>99</u>	
Tare Wt.	<u>21.40</u>	<u>21.45</u>	
Wet Wt. & Tare	<u>97.39</u>	<u>113.99</u>	
Dry Wt. & Tare	<u>86.49</u>	<u>99.91</u>	
Moisture Content	<u>16.7</u>	<u>17.9</u>	

Hydraulic Conductivity - Calculation Sheet

Tech. - MS
Check - JCS
Date - 07/11/2002

Job No. 7069.C0
Boring Number: MW-4
Sample No. 39-41'
Description: Dark Gray Silty Clay

	Initial WC%	Final WC%
Tare no.	135	
Tare wt. (g)	21.42	
Wt. wet soil & tare (g)	204.72	
Wt. dry soil & tare (g)	180.86	
Moisture Content (%)	14.96	ERR
Diameter (cm)	7.23	
Height (cm)	12.63	
Volume (cm ³)	518.5	
Wet Wt. (g)	1167.83	
Dry Density (pcf)	122.2	
B-Value after saturation	0.98	

Dimensional Change During Consolidation (assuming isotropic consolidation)

Manom. Chg., 3/8" dia. (in)=	Top:0.2	Bottom:-2.9
Volume change (cm ³):	-4.9	
Consolidated volume (cm ³):	523.4	
Dry weight of sample (g):	1015.81	
% change each dimension / 100:	-0.00314	
Consolidated diameter (cm):	7.25	2.86 in.
Consolidated height (cm):	12.67	4.99 in.
Consolidated area (cm ²):	41.3	6.40 in ²
Consolidated dry density (pcf):	121.1	

Note - 0.005 CaSO₄ solution used as permeant

	TRIAL 1	TRIAL 2	TRIAL 3	TRIAL 4
Cell pressure (psi):	69.3	69.4	69.7	70.3
Top pressure (psi):	58.3	58.3	58	58.6
Bottom pressure (psi):	60.9	60.9	60.6	61.3
Gradient:	14	14	14	15
Confining Pressure (psi):	9.70	9.80	10.40	10.35
Date initial reading:	07/08/02	07/10/02	07/10/02	07/11/02
Time initial reading:	10:30 AM	01:00 PM	01:00 PM	10:44 AM
Date final reading:	07/10/02	07/11/02	07/11/02	07/11/02
Time final reading:	01:00 PM	06:35 AM	10:44 AM	01:00 PM
Initial man. rdg. (in)	Top= 60.9	61.4	61.4	61.75
	Bottom= 61.5	60.9	60.9	60.55
Final man. rdg. (in)	Top= 61.4	61.75	61.75	61.8
	Bottom= 60.9	60.55	60.55	60.5
Chg. Top (in.)	0.5	0.35	0.35	0.05
Chg. Bottom (in.)	0.6	0.35	0.35	0.05
Chg. Time (hrs.)	50.50	17.58	21.73	2.27
Top "K" value (cm/sec) =	8.9E-09	1.8E-08	1.5E-08	1.9E-08
Bottom "K" value (cm/sec) =	1.1E-08	1.8E-08	1.5E-08	1.9E-08

HYDRAULIC CONDUCTIVITY (CM/SEC.) = 1.9E-08

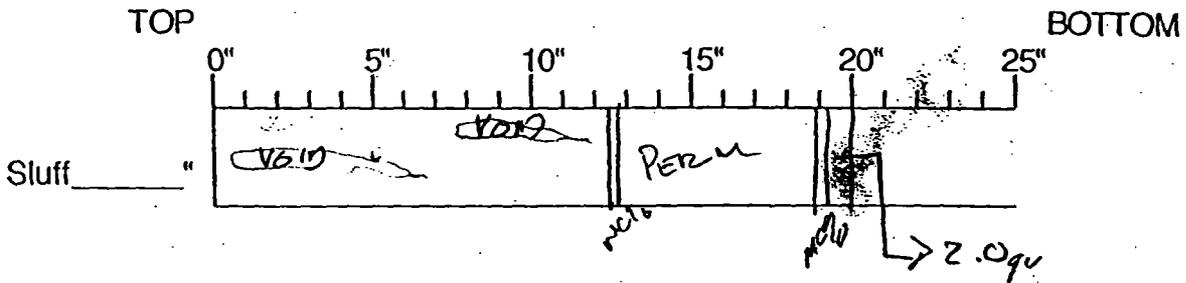
Conf. Pres. (psi) = 10.35

LOG OF SHELBY TUBE EXTRUDED IN LAB

PROJECT NO. 7069.00

Boring Number NW-4 Shelby Tube Number _____
 Depth (ft.) 39-41' Logged By MB Date 6/17/02
 Length of sample after extrusion (in.) 20 Dia. (in.) 2 3/4"
 Condition of sample: Fair

Soil description based on visual examination and classification using the Unified Soil Classification System (USCS)



DARK GRAY SILTY CLAY, LITTLE FINE GRAVEL, LITTLE C-F SAND, STIFF, M PLASTICITY, MOIST CL

	WC% #1	WC% #2	WC% #3
Tare No.	<u>135</u>	_____	_____
Tare Wt.	<u>21.42</u>	_____	_____
Wet Wt. & Tare	<u>204.72</u>	_____	_____
Dry Wt. & Tare	<u>180.86</u>	_____	_____
Moisture Content	<u>15.0</u>	_____	_____

PATRICK ENGINEERING, INC.

Hydraulic Conductivity - Calculation Sheet

Tech. - MS
 Check - JCS
 Date - 06/19/2002

Job No. 7069.C0
 Boring Number: MW-5
 Sample No. 3T-1/67-69'
 Description: Dark Gray Silty Clay

	<u>Initial WC%</u>	<u>Final WC%</u>	
Tare no.	139		
Tare wt. (g)	21.29		
Wt. wet soil & tare (g)	119.60		
Wt. dry soil & tare (g)	103.20		
Moisture Content (%)	20.02	ERR	
Diameter (cm)	7.16		
Height (cm)	14.11		
Volume (cm ³)	568.1		
Wet Wt. (g)	1196.91		
Dry Density (pcf)	109.5		
B-Value after saturation	0.95		

Dimensional Change During Consolidation (assuming isotropic consolidation)

Manom. Chg., 3/8" dia. (in)=	Top:2		Bottom:2.55
Volume change (cm ³):		8.2	
Consolidated volume (cm ³):		559.9	
Dry weight of sample (g):		997.24	
% change each dimension / 100:		0.00483	
Consolidated diameter (cm):		7.13	2.81 in.
Consolidated height (cm):		14.04	5.53 in.
Consolidated area (cm ²):		39.9	6.18 in ²
Consolidated dry density (pcf):		111.1	

Note - 0.005 CaSO₄ solution used as permeant

	TRIAL 1	TRIAL 2	TRIAL 3	TRIAL 4
Cell pressure (psi):	110	109.8	109.8	
Top pressure (psi):	98.5	98.3	98.3	
Bottom pressure (psi):	101.3	101.1	101.1	
Gradient:	14	14	14	0
Confining Pressure (psi):	10.10	10.10	10.10	0.00
Date initial reading:	06/18/02	06/19/02	06/18/02	
Time initial reading:	03:29 PM	08:24 AM	03:29 PM	
Date final reading:	06/19/02	06/19/02	06/19/02	
Time final reading:	08:24 AM	10:13 AM	10:13 AM	
Initial man. rdg. (in)				
Top=	60.8	61.3	60.8	
Bottom=	60.9	60.45	60.9	
Final man. rdg. (in)				
Top=	61.3	61.35	61.35	
Bottom=	60.45	60.4	60.4	
Chg. Top (in.)	0.5	0.05	0.55	0
Chg. Bottom (in.)	0.45	0.05	0.5	0
Chg. Time (hrs.)	16.92	1.82	18.73	0.00
Top "K" value (cm/sec) =	2.8E-08	2.6E-08	2.8E-08	ERR
Bottom "K" value (cm/sec) =	2.6E-08	2.6E-08	2.6E-08	ERR

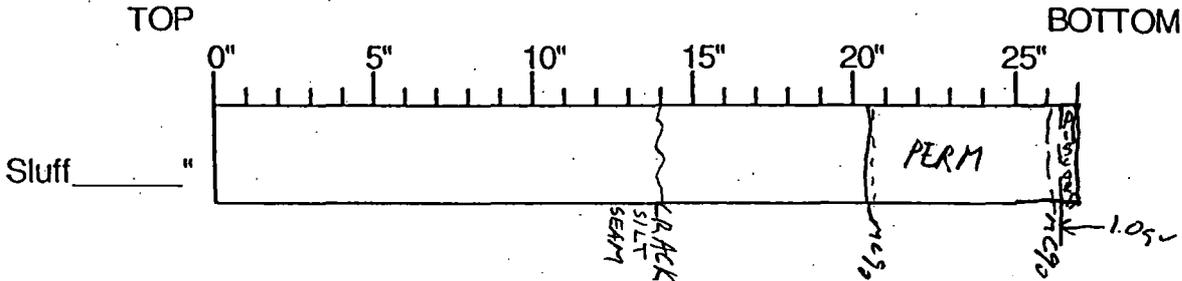
HYDRAULIC CONDUCTIVITY (CM/SEC.) = 2.8E-08	Conf. Pres. (psi) = 10.1
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LOG OF SHELBY TUBE EXTRUDED IN LAB

PROJECT NO. 7069, LO

Boring Number MW-5 Shelby Tube Number 3T-1
 Depth (ft.) 67-69' Logged By MS Date 6/15/02
 Length of sample after extrusion (in.) 27" Dia. (in.) 2 3/4"
 Condition of sample: Good

Soil description based on visual examination and classification using the Unified Soil Classification System (USCS)



Dark Gray Silty Clay, Trace C-F sand, Stiff, Medium Plasticity, Moist CL

	WC% #1	WC% #2	WC% #3
Tare No.	<u>139</u>	_____	_____
Tare Wt.	<u>21.29</u>	_____	_____
Wet Wt. & Tare	<u>119.60</u>	_____	_____
Dry Wt. & Tare	<u>103.20</u>	_____	_____
Moisture Content	<u>20.0</u>	_____	_____

Hydraulic Conductivity - Calculation Sheet

Job No. 7069.C0
Boring Number: MW-6I
Sample No. 3T-1
Description: Dark Gray Silty Clay

Tech. - MS
Check - JCS
Date - 06/28/2002

	<u>Initial WC%</u>	<u>Final WC%</u>
Tare no.	133	
Tare wt. (g)	21.93	
Wt. wet soil & tare (g)	131.68	
Wt. dry soil & tare (g)	117.10	
Moisture Content (%)	15.32	ERR
Diameter (cm)	7.22	
Height (cm)	14.32	
Volume (cm3)	586.3	
Wet Wt. (g)	1298.01	
Dry Density (pcf)	119.8	
B-Value after saturation	0.99	

Dimensional Change During Consolidation (assuming isotropic consolidation)

Manom. Chg., 3/8" dia. (in)=	Top:0.5	Bottom: 1.1
Volume change (cm3):	2.9	
Consolidated volume (cm3):	583.4	
Dry weight of sample (g):	1125.57	
% change each dimension / 100:	0.00165	
Consolidated diameter (cm):	7.21	2.84 in.
Consolidated height (cm):	14.30	5.63 in.
Consolidated area (cm2):	40.8	6.33 in2
Consolidated dry density (pcf):	120.4	

Note - 0.005 CaSO4 solution used as permeant

	TRIAL 1	TRIAL 2	TRIAL 3	TRIAL 4
Cell pressure (psi):	110	110.1	110.1	
Top pressure (psi):	98.4	98.5	98.5	
Bottom pressure (psi):	101.4	101.5	101.5	
Gradient:	15	15	15	0
Confining Pressure (psi):	10.10	10.10	10.10	0.00
Date initial reading:	06/27/02	06/28/02	06/27/02	
Time initial reading:	04:40 PM	09:38 AM	04:40 PM	
Date final reading:	06/28/02	06/28/02	06/28/02	
Time final reading:	09:38 AM	01:20 PM	01:20 PM	
Initial man. rdg. (in)	Top= 58.6 Bottom= 59.1	Top= 58.85 Bottom= 58.9	Top= 58.6 Bottom= 59.1	
Final man. rdg. (in)	Top= 58.85 Bottom= 58.9	Top= 58.9 Bottom= 58.85	Top= 58.9 Bottom= 58.85	
Chg. Top (in.)	0.25	0.05	0.3	0
Chg. Bottom (in.)	0.2	0.05	0.25	0
Chg. Time (hrs.)	16.97	3.70	20.67	0.00
Top "K" value (cm/sec) =	1.3E-08	1.2E-08	1.3E-08	ERR
Bottom "K" value (cm/sec) =	1.1E-08	1.2E-08	1.1E-08	ERR

HYDRAULIC CONDUCTIVITY (CM/SEC.) = 1.3E-08

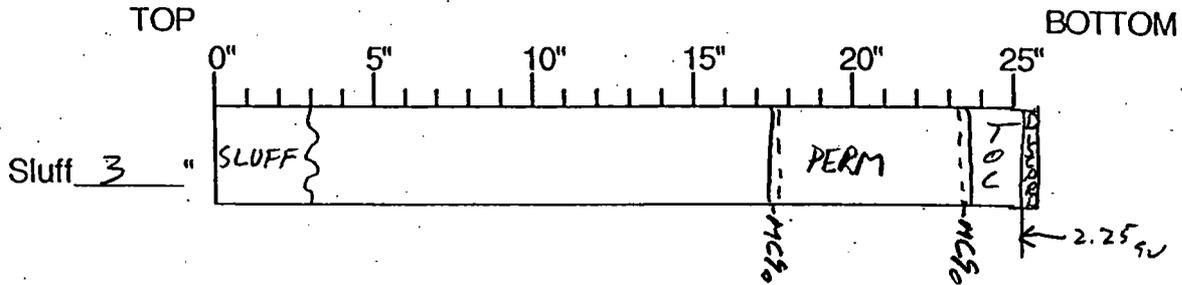
Conf. Pres. (psi) = 10.1

LOG OF SHELBY TUBE EXTRUDED IN LAB

PROJECT NO. 7069.CØ

Boring Number MW-62 Shelby Tube Number 3T-1
 Depth (ft.) 21-23' Logged By MS Date 6/20/02
 Length of sample after extrusion (in.) 23" Dia. (in.) 2 3/4"
 Condition of sample: Good

Soil description based on visual examination and classification using the Unified Soil Classification System (USCS)



Dark Gray Silty Clay, Little Coarse to Fine Sand, Very Stiff, Medium Plasticity, Moist CL

	WC% #1	WC% #2	WC% #3
Tare No.	<u>133</u>	_____	_____
Tare Wt.	<u>21.93</u>	_____	_____
Wet Wt. & Tare	<u>131.68</u>	_____	_____
Dry Wt. & Tare	<u>117.10</u>	_____	_____
Moisture Content	<u>15.32</u>	_____	_____

Hydraulic Conductivity - Calculation Sheet

Job No. 7069.C0
Boring Number: MW-8
Sample No. 3T-1
Description: Dark Gray Silty Clay

Tech. - MS
Check - JCS
Date - 06/25/2002

	<u>Initial WC%</u>	<u>Final WC%</u>
Tare no.	144	
Tare wt. (g)	21.62	
Wt. wet soil & tare (g)	146.12	
Wt. dry soil & tare (g)	131.44	
Moisture Content (%)	13.37	ERR
Diameter (cm)	7.24	
Height (cm)	12.90	
Volume (cm3)	531.1	
Wet Wt. (g)	1202.36	
Dry Density (pcf)	124.6	
B-Value after saturation	0.98	

Dimensional Change During Consolidation (assuming isotropic consolidation)

Manom. Chg., 3/8" dia. (in)=	Top: No data	Bottom: No data
Volume change (cm3):	0.0	
Consolidated volume (cm3):	531.1	
Dry weight of sample (g):	1060.59	
% change each dimension / 100:	0.00000	
Consolidated diameter (cm):	7.24	2.85 in.
Consolidated height (cm):	12.90	5.08 in.
Consolidated area (cm2):	41.2	6.38 in2
Consolidated dry density (pcf):	124.6	

Note - 0.005 CaSO4 solution used as permeant

	TRIAL 1	TRIAL 2	TRIAL 3	TRIAL 4
Cell pressure (psi):	89.6	89.9	90.5	
Top pressure (psi):	78.1	78.6	78.6	
Bottom pressure (psi):	81.1	81.2	81.7	
Gradient:	16	14	17	0
Confining Pressure (psi):	10.00	10.00	10.35	0.00
Date initial reading:	06/21/02	06/24/02	06/25/02	
Time initial reading:	02:36 PM	10:57 AM	10:13 AM	
Date final reading:	06/23/02	06/24/02	06/25/02	
Time final reading:	02:19 PM	04:13 PM	11:35 AM	
Initial man. rdg. (in)	Top= 61.05	62.05	62.25	
	Bottom= 59.2	58.25	58.1	
Final man. rdg. (in)	Top= 61.85	62.1	62.3	
	Bottom= 58.6	58.2	58.05	
Chg. Top (in.)	0.8	0.05	0.05	0
Chg. Bottom (in.)	0.6	0.05	0.05	0
Chg. Time (hrs.)	47.72	5.27	1.37	0.00
Top "K" value (cm/sec) =	1.3E-08	8.7E-09	2.8E-08	ERR
Bottom "K" value (cm/sec) =	1.0E-08	8.7E-09	2.8E-08	ERR

HYDRAULIC CONDUCTIVITY (CM/SEC.) = 2.8E-08

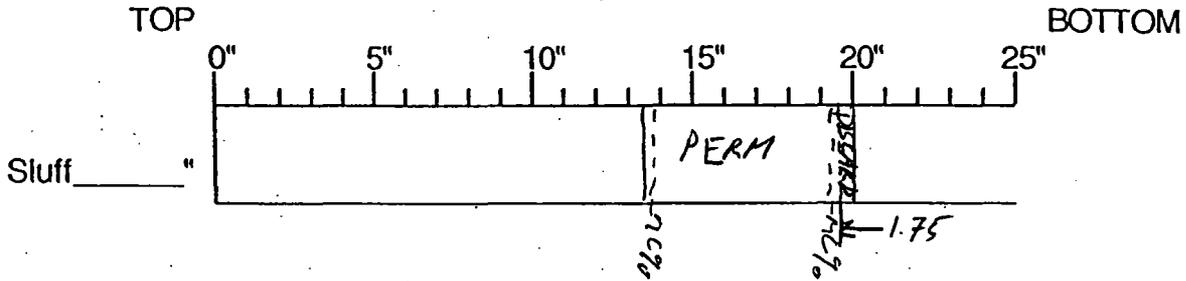
Conf. Pres. (psi) = 10.35

LOG OF SHELBY TUBE EXTRUDED IN LAB

PROJECT NO. 7069.00

Boring Number MW-8 Shelby Tube Number 37-1
 Depth (ft.) 41-43' Logged By MG Date 6/17/02
 Length of sample after extrusion (in.) 20" Dia. (in.) 2 3/4"
 Condition of sample: EXCELLENT

Soil description based on visual examination and classification using the Unified Soil Classification System (USCS)



DARK GRAY Silty Clay, Little C-F Sand, Trace Fine Gravel,
Stiff, Medium Plasticity, Moist CL

	WC% #1	WC% #2	WC% #3
Tare No.	<u>144</u>	_____	_____
Tare Wt.	<u>21.62</u>	_____	_____
Wet Wt. & Tare	<u>146.12</u>	_____	_____
Dry Wt. & Tare	<u>131.44</u>	_____	_____
Moisture Content	<u>13.4</u>	_____	_____

Hydraulic Conductivity - Calculation Sheet

Job No. 7069.C0
Boring Number: MW-9
Sample No. 3T-1/17-19'
Description: Dark Gray Silty Clay

Tech. - MS
Check - JCS
Date - 07/01/2002

	<u>Initial WC%</u>	<u>Final WC%</u>
Tare no.	139	
Tare wt. (g)	21.29	
Wt. wet soil & tare (g)	107.13	
Wt. dry soil & tare (g)	93.26	
Molsture Content (%)	19.27	ERR
Diameter (cm)	7.26	
Height (cm)	14.22	
Volume (cm3)	588.7	
Wet Wt. (g)	1260.65	
Dry Density (pcf)	112.0	
B-Value after saturation	0.95	

Dimensional Change During Consolidation (assuming isotropic consolidation)

Manom. Chg., 3/8" dia. (in)=	Top:0.2	Bottom:1.2
Volume change (cm3):	2.5	
Consolidated volume (cm3):	586.1	
Dry weight of sample (g):	1056.95	
% change each dimension / 100:	0.00143	
Consolidated diameter (cm):	7.25	2.85 in.
Consolidated height (cm):	14.20	5.59 in.
Consolidated area (cm2):	41.3	6.40 in2
Consolidated dry density (pcf):	112.5	

Note - 0.005 CaSO4 solution used as permeant

	TRIAL 1	TRIAL 2	TRIAL 3	TRIAL 4
Cell pressure (psi):	100	99.8	99.8	
Top pressure (psi):	89.3	89.2	89.2	
Bottom pressure (psi):	91.4	91.2	91.2	
Gradient:	10	10	10	0
Confining Pressure (psi):	9.65	9.60	9.60	0.00
Date initial reading:	06/28/02	06/28/02	06/28/02	
Time initial reading:	09:43 AM	01:30 PM	09:43 AM	
Date final reading:	06/28/02	06/28/02	06/28/02	
Time final reading:	01:30 PM	05:06 PM	05:06 PM	
Initial man. rdg. (in)	Top= 62.65	62.75	62.65	
	Bottom= 62.1	62	62.1	
Final man. rdg. (in)	Top= 62.75	62.8	62.8	
	Bottom= 62	61.95	61.95	
Chg. Top (in.)	0.1	0.05	0.15	0
Chg. Bottom (in.)	0.1	0.05	0.15	0
Chg. Time (hrs.)	3.78	3.60	7.38	0.00
Top "K" value (cm/sec) =	3.3E-08	1.8E-08	2.7E-08	ERR
Bottom "K" value (cm/sec) =	3.3E-08	1.8E-08	2.7E-08	ERR

HYDRAULIC CONDUCTIVITY (CM/SEC.) = 2.7E-08

Conf. Pres. (psi) = 9.6



**First
Environmental
Laboratories, Inc.**

1600 Shore Road • Naperville, Illinois 60563 • Phone (630) 778-1200 • Fax (630) 778-1233
IEPA Certification #100292

Analytical Report

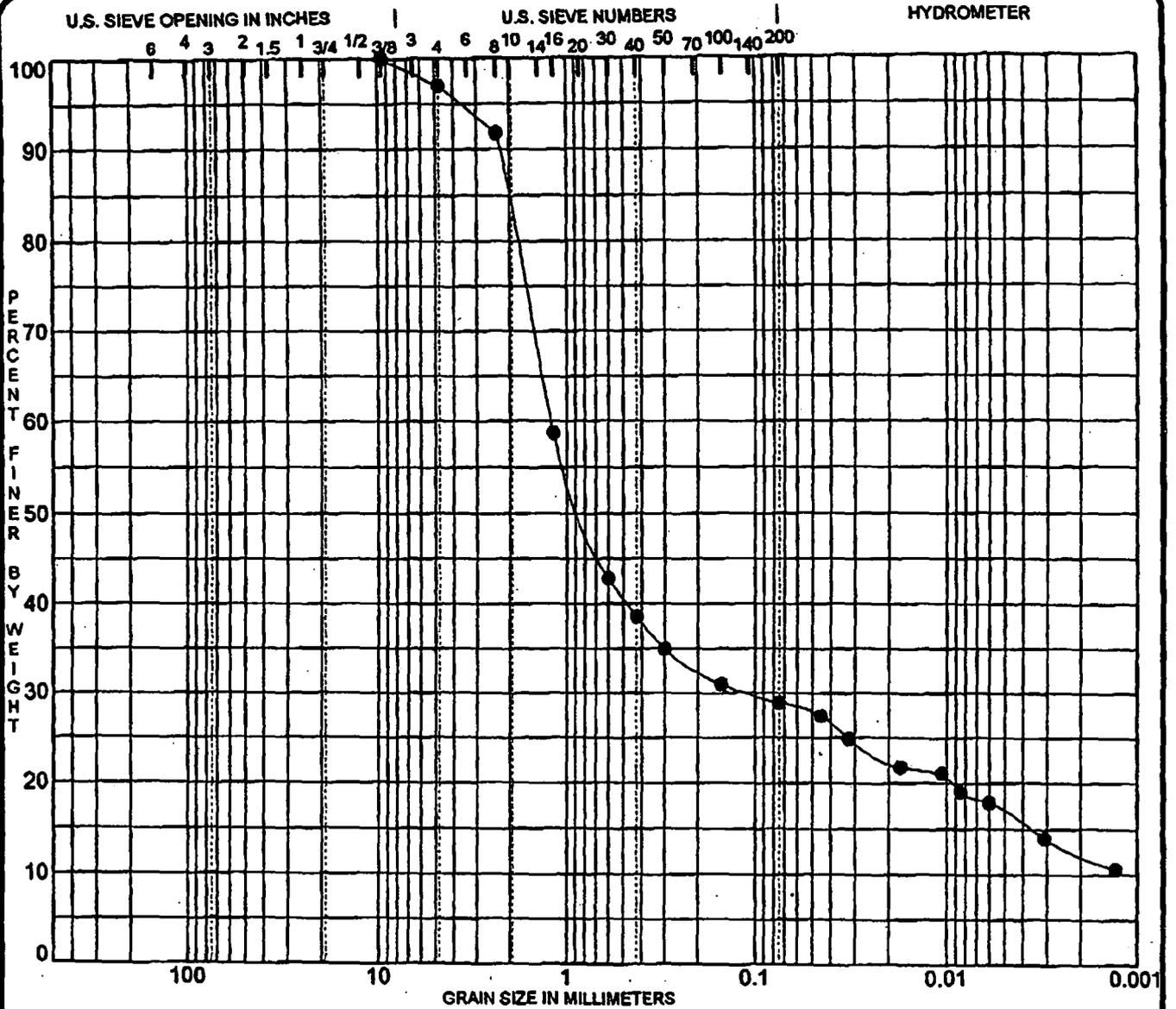
Client: PATRICK ENGINEERING, INC.
Project ID: Proj. #7069.CO; Libertyville Training Center
Lab File ID: 62377-79

Date Received: 07/03/02
Date Reported: 07/09/02

FOC Method D2974-87

Date Analyzed: 07/08/02

<u>Lab Sample Number</u>	<u>Sample Description</u>	<u>Date & Time Taken</u>	<u>FOC %</u>
62377	MW-3 ST-3 45-47'	Not Provided	1.14
62378	MW-6I 3T-1; 21-23'	Not Provided	1.16
62379	MW-9 3T-1; 17-19'	Not Provided	1.23



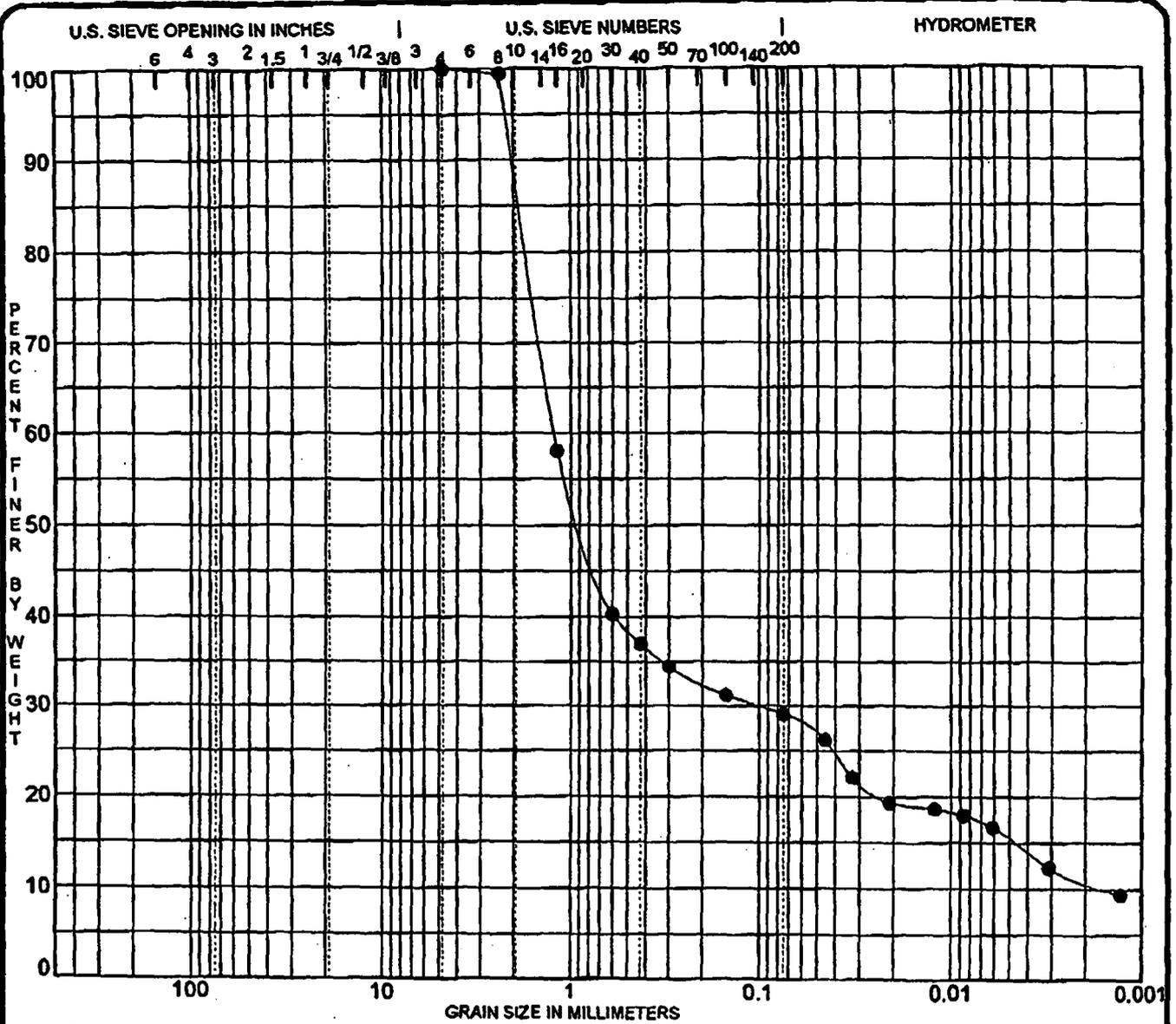
COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

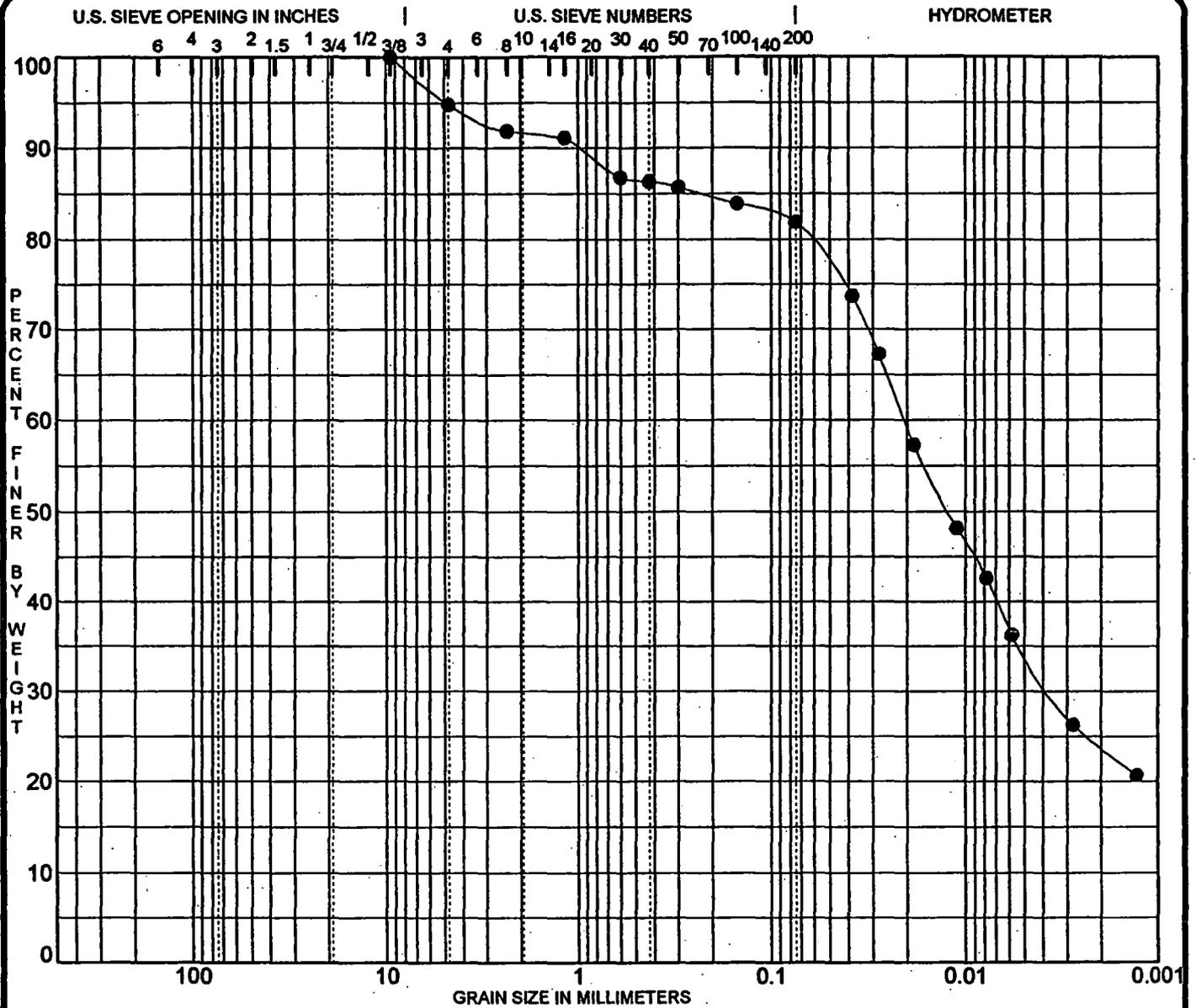
Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● STRAT1 GSZ	Dark Gray C to F Sand, Some Silt, Trace F						
43-44'	Gravel SM						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● STRAT1 GS243.0	9.50	1.21	0.106		3.0	68.0	16.7	12.3

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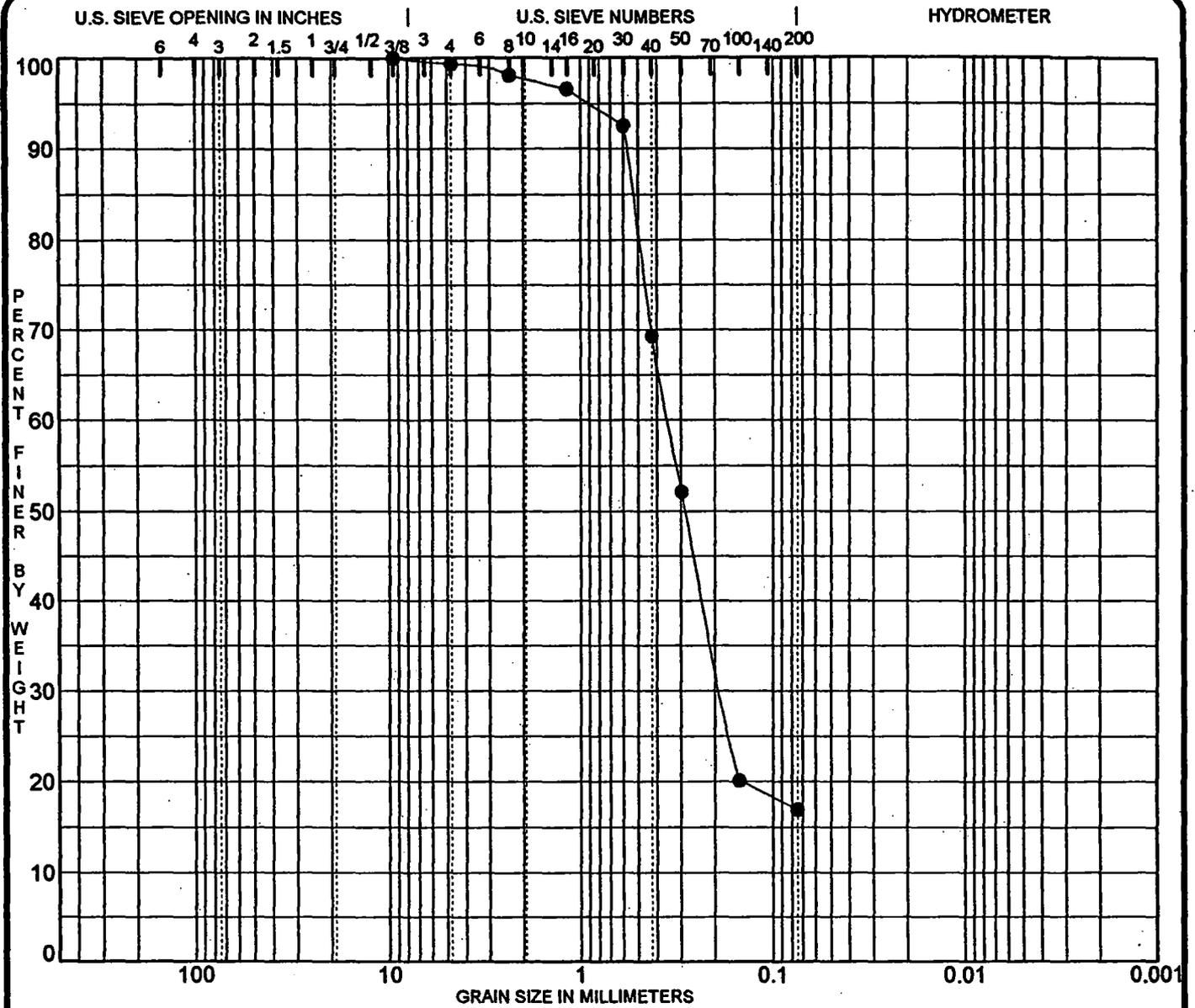
COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● STRAT1 GS4	Gray Clayey Silty, Little C to F Sand, Trace						
81-82'	F Gravel CL-ML						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● STRAT1 GS481.0	9.50	0.02	0.004		5.2	12.8	58.1	23.8

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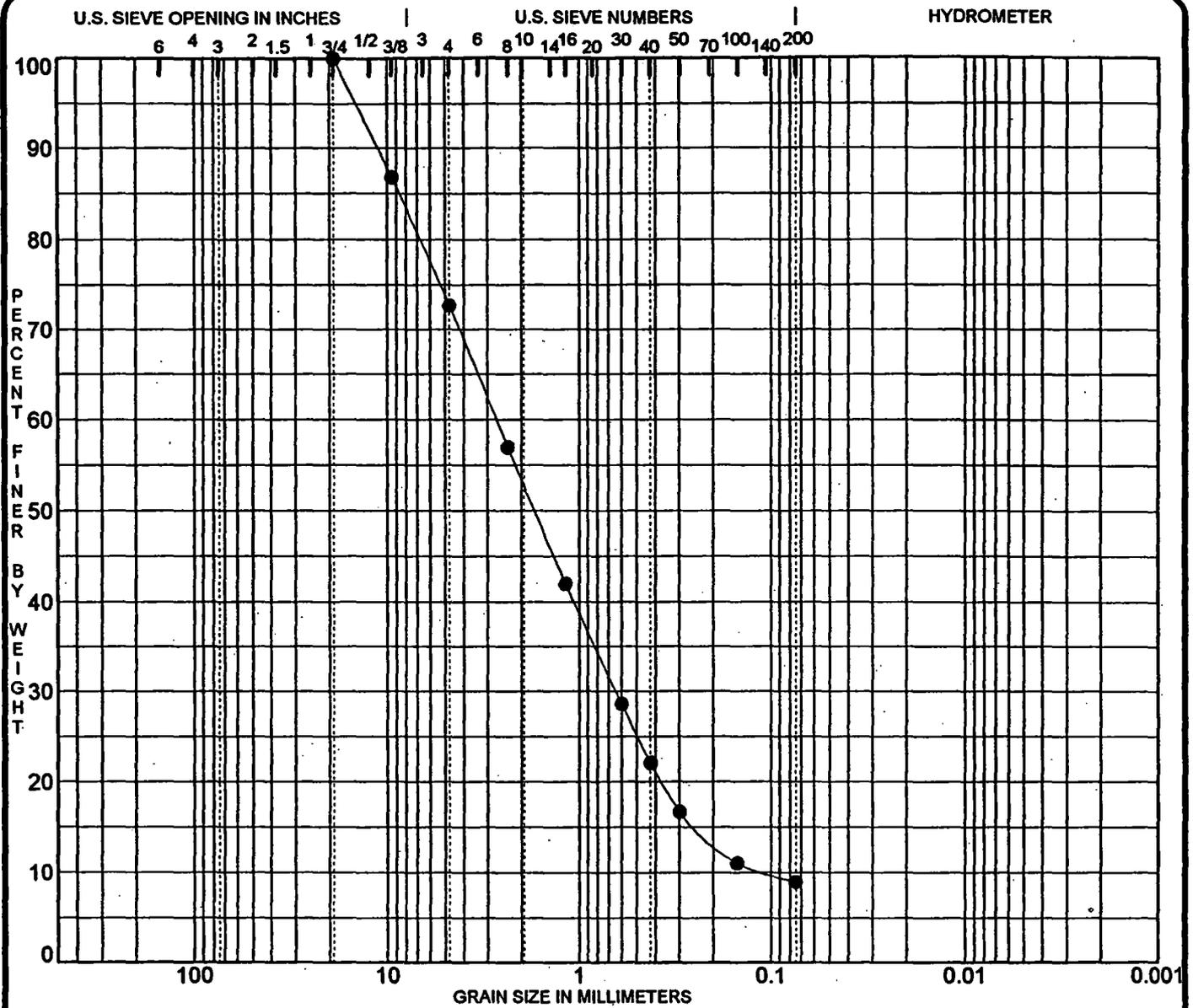
COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● ST-2 GS-1	Brown C to F Sand Little Silt, Trace F						
50.4-51'	Gravel SM						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● ST-2 GS-1 50.4	9.50	0.35	0.186		0.7	82.4	16.9	

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COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

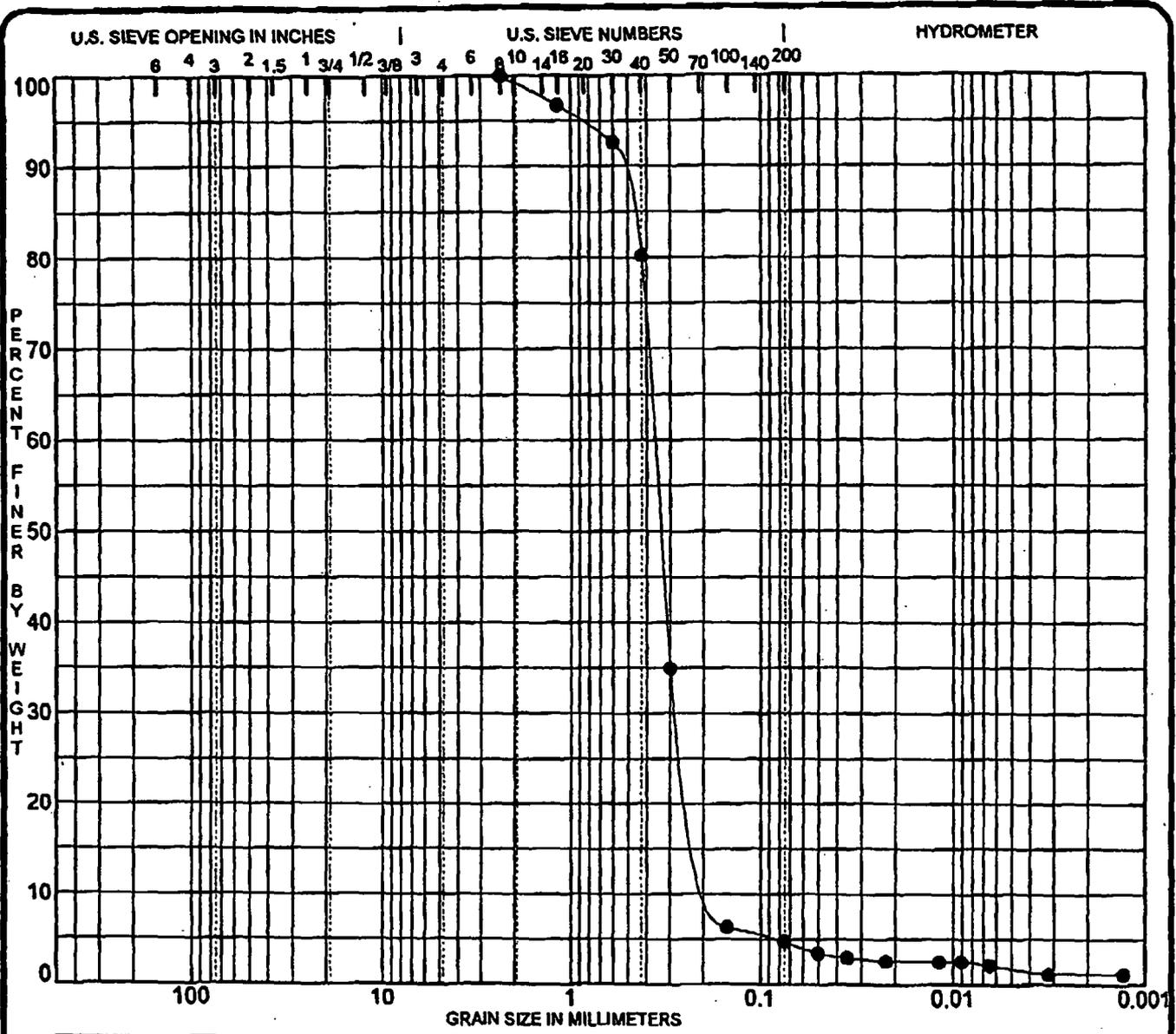
Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● STRAT3 GS1 86-86.6'	Gray C to F Sand, Some F Gravel, Trace Silt SW-SM					1.44	25.4

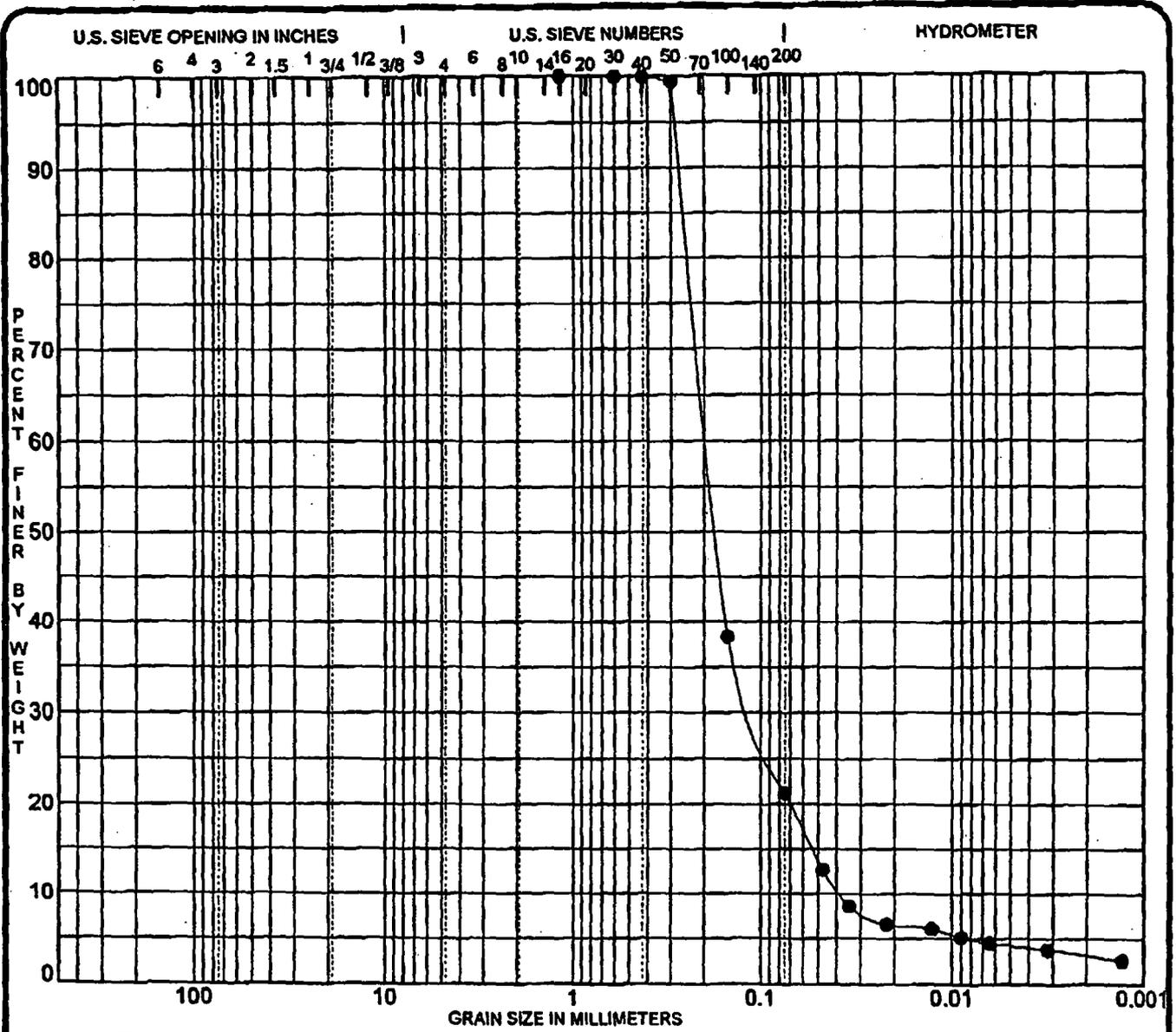
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● STRAT3 GS186.0	19.00	2.70	0.643	0.1064	27.3	63.8	9.0	

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COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● STRAT4 GS2	Light Gray Medium to Fine Sand, Some Silt					1.56	5.0
118-119'	SM						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● STRAT4 GS218.0	1.18	0.19	0.107	0.0383	0.0	78.8	18.0	3.2

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