

ARCADIS

**Appendix E**

Landfill L1 Investigation Supporting  
Information

## **Appendix E - Landfill L1 Investigation Summary Report**

### **Revitalizing Auto Communities Environmental Response Trust (RACER Trust)**

Former Delphi Harrison Thermal Systems Moraine Plant  
Former General Motors Powertrain Group, Moraine Engine Plant  
Former General Motors Truck Group, Moraine Assembly Plant

Moraine, Ohio

December 31, 2012

<b>1. Introduction</b>	<b>1</b>
1.1 Site Description and History	1
1.2 Landfill L1 Investigation Objectives	3
1.3 Document Organization	3
<b>2. Field Investigation Summary</b>	<b>4</b>
2.1 Health and Safety	5
2.2 Utility Clearance	5
2.3 Surveying	5
2.4 Boring Advancements in the Landfill	5
2.5 Soil Sampling Activities	7
2.6 Groundwater Sample Collection	8
2.7 Soil-Gas Sample Point Installation and Sampling	8
2.7.1 Soil-Gas Sample Point Installation	8
2.7.2 Soil-Gas Sampling	10
2.8 Pneumatic Slug Testing	11
2.9 Ambient Air Sampling	11
2.10 Dry Well Sampling	11
2.11 Decontamination Procedures	12
2.12 Boring Abandonment	12
2.13 Temporary Soil-Gas Point Abandonment	12
2.14 Investigation Derived Waste Management	13
2.15 Laboratory Analysis	13
2.16 Deviations from the Work Plan	14
<b>3. Investigation Findings</b>	<b>15</b>
3.1 Landfill L1 Location and Structure	15

3.1.1	Location	15
3.1.2	Surface Structure	15
3.1.3	Subsurface Structure	15
3.2	Landfill L1 Composition	16
3.2.1	Physical Composition	16
3.2.2	Physical Properties, Index Parameters and Hydraulic Parameters	16
3.2.3	Solid Chemical Composition	17
3.2.3.1	Waste Samples	17
3.2.3.2	Waste Sample CVOC Results	17
3.2.3.3	Waste Sample BTEX Results	17
3.2.3.4	Native Soil Samples	18
3.2.3.5	Native Soil Sample CVOC Results	18
3.2.3.6	Native Soil Sample BTEX Results	18
3.2.4	Groundwater Chemical Composition	18
3.2.4.1	Groundwater Sample CVOC Results	19
3.2.4.2	Groundwater Sample BTEX Results	19
3.2.4.3	Groundwater Sample Dissolved Methane Results	19
3.2.5	Soil-Gas Chemical Composition	20
3.2.5.1	Soil-Gas CVOC Results	20
3.2.5.2	Soil-Gas BTEX Results	21
3.2.5.3	Soil-Gas Methane Results	21
3.2.5.4	Soil-Gas Helium Results	21
3.2.6	Ambient Air	22
3.2.6.1	Ambient Air CVOC Results	22
3.2.6.2	Ambient Air BTEX Results	22
3.2.7	Dry Well Air Chemical Composition	22
3.2.7.1	Dry Well CVOC Results	23

3.2.7.2	Dry Well BTEX Results	23
3.2.7.3	Dry Well Methane Results	23
3.2.8	Interpretation of Soil-Gas Results	23
3.2.8.1	Comparison of Landfill Soil-Gas Data to Neighborhood Soil-Gas Data	24
3.2.8.2	Comparison of Landfill Soil-Gas Data to Ambient Air Data	25
3.2.8.3	Comparison of Landfill Soil-Gas Data to Dry Well Data	26
3.3	Waste to Groundwater Leaching	27
3.3.1	Pneumatic Slug Test Analyses and Results	28
3.3.2	Summary of Leaching Potential Calculations	28
3.3.3	Conclusion from Leaching Analysis	29
<b>4.</b>	<b>Conclusions</b>	<b>30</b>
<b>5.</b>	<b>References</b>	<b>32</b>

**Tables**

1	Vadose Zone Soil Properties Data
2	Saturated Zone Soil Properties Data
3	Summary of Landfill Waste Sampling Results
4	Summary of Native Soil Sampling Results
5	Summary of Groundwater Sampling Results
6	Site-Specific VOC, Methane, and Helium Soil-Gas Results
7	Ambient Air Results
8	Dry Well Results
9	Pneumatic Slug Test Results

**Figures**

1	Site Map
2	Landfill L1 Investigation Sample Location Map
3	Landfill L1 Investigation Topographic Map

4	Landfill L1 Investigation Potentiometric Surface (Upper Aquifer) September 2012
5	Landfill L1 Investigation Potentiometric Surface (Lower Aquifer) September 2012
6	Landfill L1 Investigation Cross-Sections
7	CVOCs in Soil-Gas in Landfill L1 and Riverview Plat Neighborhood
8	BTEX in Soil-Gas in Landfill L1 and Riverview Plat Neighborhood
9	CVOCs in Landfill L1 Soil-Gas, Ambient Air, and Dry Wells
10	BTEX in Landfill L1 Soil-Gas, Ambient Air, and Dry Wells

**Attachments**

E-1	Boring Logs
E-2	Soil-Gas Point Construction Diagrams
E-3	Soil-Gas Sampling Logs
E-4	Geotechnical Laboratory Report
E-5	Pneumatic Slug Test Analysis Reports
E-6	Supporting Documentation for the Leaching Potential Calculations

Air Toxics	Air Toxics, Limited
AOC	Administrative Order on Consent
bls	below land surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
cis-1,2-DCE	cis-1,2-dichloroethene
CVOCs	chlorinated VOCs
ft.	feet
ft./d	feet per day
GM Corporation	General Motors Corporation
HSO	Health and Safety Officer
in. Hg	inches of mercury
LEL	lower explosive limit
Microseeps	Microseeps, Inc.
MLC	Motors Liquidation Company
PCE	tetrachloroethene
PID	photoionization detector
ppbv	parts per billion by volume
PTS	PTS Laboratories, Inc.
QA/QC	quality assurance/quality control
RACER Trust	Revitalizing Auto Communities Environmental Response Trust
RCRA	Resource Conservation and Recovery Act
RSLs	Regional Screening Levels
Site	Moraine Facilities
TCE	trichloroethene
TestAmerica	TestAmerica Laboratories, Inc.
trans-1,2-DCE	trans-1,2-dichloroethene

U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
1,1,1-TCA	1,1,1-trichloroethane
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
%	percent

# Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

## 1. Introduction

This *Landfill L1 Investigation Summary Report* (Appendix E to the *Corrective Measures Proposal*) was completed for the Revitalizing Auto Communities Environmental Response Trust (RACER Trust) Moraine Facilities (Site) in Moraine, Ohio. The investigation was completed in accordance with the *Landfill L1 Investigation Work Plan* (Work Plan) dated October 27, 2011 (ARCADIS, Inc. 2011a). The Work Plan was approved by the United States Environmental Protection Agency (U.S. EPA) with conditions on November 1, 2011. *Landfill L1 Investigation Work Plan Addendums* were submitted to the U.S. EPA on November 29, 2011 (RACER Trust 2011) and July 17, 2012 (RACER Trust 2012).

Landfill L1 was originally used for the collection and disposal of wastes generated during the Frigidaire era that lasted over 20 years (from prior to 1950 to approximately 1973). The landfill is pre-Resource Conservation and Recovery Act (RCRA) and has no designed operational liner or cover. The landfill was assessed as a solid waste management unit during the RCRA Facility Investigation (ARCADIS Geraghty & Miller, Inc. 2000). The landfill is located at the downgradient property boundary (Figure 1).

### 1.1 Site Description and History

The RACER Trust Moraine Facilities have been used for industrial purposes since the property was acquired in the mid-1920s by former General Motors Corporation (GM Corporation). The former Moraine Engine and Moraine Assembly facilities occupy approximately 239 acres, while the adjacent former Delphi Thermal Moraine facility occupies approximately 124 acres. The facilities are located in the City of Moraine in Montgomery County in southwestern Ohio. A small portion of the Moraine Assembly facility is located in the City of Kettering. Figure 1 shows the location of each facility and site features.

Frigidaire (a former division of former GM Corporation) produced appliances at the Site from the late 1920's until former GM Corporation announced the shutdown of all Frigidaire operations in January 1979. During 1980 and 1981, the majority of the former Frigidaire Plant 2 was converted to the former Moraine Engine facility, and the former Frigidaire Plant 3 and the northeast corner of former Frigidaire Plant 2 were converted to the Moraine Assembly facility. Since 1981, former Moraine Engine operations have included the machining, painting (this operation was discontinued in September 1995), and assembly of diesel truck engines. Operations at the former Moraine Engine facility ceased in the fall of 2000. The plant building has been

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

decommissioned and demolished, and the majority of this Site has been covered with a parking surface. Former GM Corporation operated a regional haulaway at the location of the former Moraine Engine Plant, which was referred to as the Vehicle Distribution Center until December 2008 when operations ceased.

Since 1981, Moraine Assembly operations included the manufacture, assembly, and painting of small trucks and later sport utility vehicles (SUVs). Operations at the former Moraine Assembly ceased in December 2008.

Former Delphi Thermal Moraine's major operations, which began in 1941, included the machining and assembly of automotive air conditioning compressors, accumulator dehydrators, and miscellaneous air conditioning valves. Operations at the former Delphi Thermal Moraine Building 14 ceased in September 2003 and the building was decommissioned. Demolition of Building 14 was completed in 2005.

On June 1, 2009, former GM Corporation and certain subsidiaries filed voluntary petitions for relief under Chapter 11 of the Bankruptcy Code. An order was entered approving the sale of substantially all of former GM Corporation's assets to a new and independent company (now known as General Motors Company, LLC) under Section 363 of the Bankruptcy Code on June 5, 2009. The sale closed on July 10, 2009. At that time, GM Corporation changed its name to Motors Liquidation Company (MLC). RACER Trust was established on March 31, 2011 by a federal bankruptcy court to own, manage, remediate and revitalize the properties from the 2009 former GM Corporation bankruptcy.

On June 30, 2011, RACER Trust sold former Delphi Thermal Moraine, former Moraine Engine Plant, and former Moraine Assembly Plant to IRG Moraine, LLC. As part of the property transfer, RACER Trust retained environmental liability for these properties.

The closed South Settling Lagoon was not included in this property transaction. The closed South Settling Lagoon was retained by RACER Properties, LLC.

On September 29, 2011, the Administrative Order on Consent (AOC) for the Site was fully executed proceeding under Section 3008(h) of the Resource Conservation and Recovery Act, as amended, 42 U.S. C. Section 6928(h), U.S. EPA Docket No: RCRA-05-2011-0016. The performance-based AOC covers corrective action for past releases of hazardous contaminants at or from the Site.

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

### 1.2 Landfill L1 Investigation Objectives

The specific objectives of the Work Plan were to: 1) determine the volatile organic compound (VOC) concentrations of soil-gas along the western, eastern, and southern boundaries and within the landfill; 2) determine if the landfill is a potential contributing source for VOCs in the soil-gas beneath the Riverview Plat neighborhood to the west of the landfill and the City of Moraine Municipal Building property located to the south of the landfill; 3) characterize the waste within the landfill; 4) determine the relative contribution of waste containing site-specific VOCs to groundwater; and 5) confirm the vertical and horizontal extent of the waste.

The first phase of the field investigation was completed between November 14, 2011 and December 22, 2011. Due to the inability to penetrate relatively hard landfill material, the direct push drilling methodology was limited in the ability to define the vertical extent of the waste. Desired depths were not reached at all locations, and native soil was not encountered at several boring locations. Therefore, based on the evaluation of landfill materials from the initial drilling activities and as discussed with the U.S. EPA during a February 1, 2012 meeting, the *Landfill L1 Investigation Work Plan Addendum*, dated July 17, 2012, was prepared to describe advancement of two additional borings using sonic drilling methods.

The objectives of field work outlined in the Addendum were to: 1) further refine the vertical extent of the waste; 2) further characterize the waste and underlying native soil for site-specific VOCs; 3) determine the leaching potential of the waste to groundwater; 4) determine the influence the soil-gas present within the landfill has on the ambient air; and 5) assess the potential for VOC-containing soil-gas to migrate laterally from the landfill and collect within the storm sewer dry wells. The field work associated with the Addendum was completed from September 19 to 20, 2012.

### 1.3 Document Organization

The remainder of this document is organized into the following sections:

- Section 2 – Field Investigation Summary, describes the methods used to complete field investigation activities and notes and deviations from the Work Plan.
- Section 3 – Investigation Findings, describes the findings of the Landfill L1 Investigation.
- Section 4 - Conclusions, presents the conclusions of the Landfill L1 Investigation.
- Section 5 – References.

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

### 2. Field Investigation Summary

The field activities involved borehole installation, waste sampling, soil sampling, grab groundwater sampling, soil-gas point installation and sampling, ambient air sampling, dry well sampling, physical property data collection, pneumatic slug testing, and survey activities.

During the first phase of the field investigation, 35 borings (LF-1 through LF-35) were completed within and on the perimeter of the landfill. Due to refusal and/or the need to collect additional samples, an additional 11 borings were installed (LF-3A, LF-4A, LF-7A, LF-9A, LF-10A, LF-11A, LF-12A, LF-13A, LF-29A, LF-36, and LF-37). Due to access limitations of the drilling rig, six shallow hand auger borings (HA-LF-1, HA-LF-3A, HA-LF-5, HA-LF-7A, HA-LF-19, and HA-LF-29A) were completed on the perimeter of the landfill to determine if fill material was present. Along the perimeter of the landfill, seven borings were converted to soil-gas sample points (LF-SGP-1, LF-SGP-3A, LF-SGP-5, LF-SGP-7A, LF-SGP-19, LF-SGP-29A, and LF-SGP-35). In the central portion of the landfill, two borings were converted to soil-gas sample points (LF-SGP-13A and LF-SGP-15A). The locations of the borings, hand augers, and soil-gas sample points are shown on Figure 2.

The borings were completed on an established 100-foot (ft.) grid. Selected soil and/or waste material samples from each boring were collected for analysis of site-specific VOCs, based on field observations (e.g., elevated photoionization detector [PID] readings and/or visual staining). Borings were advanced to a depth where native, undisturbed soil was encountered or where refusal was encountered.

As outlined in the July 17, 2012 Addendum and during the second phase of the field investigation, borings LF-36 and LF-37 were added to the scope of work and were advanced with a sonic drill rig due to issues with refusal prior to encountering native soil in the borings installed during the first phase of the field investigation. The thickness and composition of the waste materials, and presence or absence of saturated waste (wastes present below groundwater) was documented. Additionally, soil-gas sample points SGP-2, SGP-5, SGP-8, and SGP-9, located in the Riverview Plat neighborhood and near the City of Moraine Municipal Building, and dry wells DW-1 through DW-5, located near the southern and western landfill perimeter, were sampled. The locations of the borings, soil-gas sample points, and dry wells installed and/or sampled during the second phase of the field investigation are shown on Figure 2.

# Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

The following sections present the methods that were utilized to complete both phases of the field investigation.

## **2.1 Health and Safety**

Field work was completed following the procedures identified in the site-specific Health and Safety Plan. During the advancement of the borings, there were a minimum of two field oversight personnel, in addition to the drilling crew. One person was assigned as the dedicated Health and Safety Officer (HSO) and the other person was the field geologist. The HSO continuously monitored the air for potentially hazardous gases (methane, hydrogen sulfide, carbon monoxide, and oxygen), VOCs, and the lower explosive limit (LEL). Details of the health and safety procedures utilized are included in the Work Plan.

## **2.2 Utility Clearance**

Prior to the implementation of the field activities, underground utilities were cleared and work locations were reviewed for overhead utilities. ARCADIS contacted the Ohio Utility Protection Service, reviewed available facility utility drawings (including the TW-2 effluent piping layout drawing), used facility employee knowledge, and conducted a detailed, visual site inspection.

## **2.3 Surveying**

Prior to the commencement of field activities, a professional surveyor (licensed in the State of Ohio) was subcontracted to complete a survey of Landfill L1. A grid with 50-ft. centers was established throughout the landfill and surveyed for northing, easting, and land surface elevations above mean sea level. The survey data were utilized to determine land surface elevation. A topographic map of the landfill is included as Figure 3.

## **2.4 Boring Advancements in the Landfill**

The borings were located along the same grid pattern established during surveying activities; however, the locations of borings were spaced approximately 100 ft. apart (Figure 2). Each boring was advanced until native, undisturbed soils or refusal was encountered. Since the landfill does not have a constructed base, the underlying native materials were identified by the absence of fill or waste, stratigraphic structure observed in the samples, and/or geology similar to adjacent known boring logs. The

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

borings were advanced through groundwater, when groundwater was encountered within waste materials.

Soil samples were collected using direct-push, hand auger, and sonic drilling techniques. The description of each of the techniques is presented below:

- Direct Push Drilling - This drilling technique was accomplished by using a hydraulic hammer to advance a 4-ft.-long single-use sampling sleeve attached to inner rods that were placed in an outer steel casing. During the retrieval of the soil core, only the inner rods were removed and the outer casing was left in-place to prevent collapse of the boring. The sequence for this type of drilling was as follows: 1) the 2-inch diameter outer steel casing with inner rods attached to the sampling sleeve was advanced; 2) inner rods with sampling sleeve were retrieved; 3) the sampling sleeve with the soil core was removed and a new unused sampling sleeve was inserted; 4) the inner rods with the new sampling sleeve were placed inside the outer casing; and 5) the outer casing with the inner rods with sampling sleeve were advanced to the next sampling interval. Non-disposable drilling equipment was decontaminated between borings.
- Hand Auger – A manually operated, stainless steel auger was utilized to penetrate the ground surface. Soil samples were obtained from the hand auger bucket. The hand auger equipment was decontaminated between boring locations.
- Sonic Drilling - This drilling technique was accomplished by imparting high-frequency vibrations from a sonic drill head to a dual string of drill pipe. The dual-pipe drill string consisted of a 4-inch diameter core barrel inside a larger diameter (i.e., 6- or 8-inch) casing. The outer casing was advanced to ensure that the boring remained open upon extraction of the core barrel, and it also minimized the potential for contaminants to be drawn down the borehole. The sequence for this type of drilling was as follows: 1) the 4-inch diameter inner core barrel was advanced; 2) the 6-inch outer casing was advanced over the 4-inch inner core barrel to the same depth; 3) the 4-inch inner core barrel with the unconsolidated material inside was retrieved while the outer casing remained in place; 4) the cored sample from the 4-inch inner core barrel was retrieved; and 5) the 4-inch core barrel was advanced to a depth 2 or 5 ft. beyond the end of the outer casing to obtain the sample. The core samples were extruded into a plastic sleeve or plastic sleeves were placed inside the 4-inch core barrel. Non-disposable drilling equipment was decontaminated between borings.

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

Soil samples were collected continuously throughout the entire depth of each boring until encountering native soils or refusal. At each sampling interval, a portion of the material retrieved was placed in laboratory-prepared containers prior to determining if the sample would be submitted for laboratory analysis. Another portion of the material retrieved was placed in sealable plastic bags for field screening with a PID.

Hydrophobic dye tests were completed on soil and waste samples that exhibited visual viscous or amorphous-solid characteristics and/or PID readings greater than 100 parts per million VOCs. The results of the field test(s) and observations were used in the selection of samples for laboratory analysis. Pertinent information (e.g., soil classification, results of field screen readings, percent (%) soil recovery, and sample collection time) was recorded on boring logs (Attachment E-1).

### 2.5 Soil Sampling Activities

Typically two soil samples from each boring were selected for laboratory analysis based on the following scenarios:

- Sample exhibited elevated PID readings,
- Sample exhibited visual staining,
- A waste sample was obtained in saturated conditions where groundwater was encountered, or
- A native soil sample was collected at the base of the fill material and or from the underlying native soil.

Pertinent information concerning the materials encountered in the boring as well as the rationale for sample selection for laboratory analysis were recorded on the boring logs (Attachment E-1).

Soil and waste samples were collected in soil jars rather than En Core® samplers due to the heterogeneity of the material encountered (i.e., bulky waste material and coarse geology). The soil and waste samples were submitted to TestAmerica Laboratories, Inc. (TestAmerica) in Dayton, Ohio for analyses of site-specific VOCs by U.S. EPA Method 8260B. The site-specific VOCs include: 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), benzene, cis-1,2-dichloroethene (cis-1,2-DCE), ethylbenzene, tetrachloroethene (PCE), toluene, trans-

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

1,2-dichloroethene (trans-1,2-DCE), trichloroethene (TCE), vinyl chloride, and xylenes. Each sample container was labeled by location, sample depth, date, and time. Samples were placed in a cooler with ice under chain-of-custody control following procedures outlined in the Work Plan.

Vadose zone soil samples from the 8 to 10-ft. interval, the 11 to 13-ft. interval, and the 16 to 18-ft. interval of boring LF-36 and soil samples from the 10 to 12-ft. interval and the 16 to 18-ft. interval of boring LF-37 were submitted to PTS Laboratories, Inc. (PTS) in Santa Fe Springs, California for analysis of moisture content, density, total organic carbon, fraction organic carbon, porosity, total pore fluid saturations, confining pressure, mean grain size description, median grain size, particle size distribution, Atterberg limits, Unified Soil Classification System group symbol name, and United State Department of Agriculture / Soil Conservation Service soil texture scheme. Saturated zone soil samples from the 37 to 39-ft. interval of boring LF-36 and the 24 to 26-ft. interval and 28 to 30-ft. interval of boring LF-37 were submitted to PTS for analysis of moisture content, density, total organic carbon, porosity, total pore fluid saturations, and confining stress.

### **2.6 Groundwater Sample Collection**

Grab groundwater samples were collected from borings LF-1, LF-2, LF-3, LF-5, LF-7, LF-19, LF-29A, LF-35, LF-36, and LF-37 using a temporary well point and low-flow sampling methodology (Figure 2). Once the boring reached the water table, a stainless steel well screen was extracted from the dual casing. A nominal amount of groundwater was purged from the well screen using a submersible pump. The groundwater removed during this development was three times the volume of water within the dual casing. The groundwater samples were submitted to TestAmerica for analysis of site-specific VOCs by U.S. EPA Method 8260B and to Microseeps, Inc. (Microseeps) of Pittsburgh, Pennsylvania for analysis of dissolved methane by Method AM20GAX. Grab groundwater samples collected from borings LF-36 and LF-37 were not analyzed for dissolved methane. Samples were placed in a cooler with ice under chain-of-custody control following procedures outlined in the Work Plan.

### **2.7 Soil-Gas Sample Point Installation and Sampling**

#### **2.7.1 Soil-Gas Sample Point Installation**

Borings LF-1, LF-3A, LF-5, LF-7A, LF-13A, LF-15A, LF-19, LF-29A, and LF-35 were converted into temporary soil-gas sample points LF-SGP-1, LF-SGP-3A, LF-SGP-5,

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

LF-SGP-7A, LF-SGP-13A, LF-SGP-15A, LF-SGP-19, LF-SGP-29A, and LF-SGP-35, respectively (Figure 2).

One to two soil-gas sample point screens were installed within each boring at discreet intervals. Deep soil-gas sample point screens were not installed at the two soil-gas sample point locations within the interior portion of the landfill (e.g., LF-SGP-13A and LF-SGP-15A). The soil-gas sample points installed along the perimeter of the landfill consisted of deep and shallow screened intervals.

Soil-gas sample points were installed after completion of the borings and collection of the grab groundwater samples. After boring completion, the tooling was pulled back to allow formation collapse and the first soil-gas sample point (i.e., the deeper soil-gas sample point at locations with multiple points) was installed. The deeper soil-gas sample points were installed above the maximum groundwater table elevation to collect soil-gas directly above the water table. The selection of screen interval for the shallower soil-gas sample points was dependent on the results of the PID readings. If the soil did not exhibit elevated PID readings or soil staining, the shallow soil-gas sample points along the perimeter of Landfill L1 were installed to correspond with the elevations of the soil-gas sample points in the Riverview Plat neighborhood. The shallow soil-gas sample points within the interior portion of Landfill L1 were installed based on visual observations (e.g., staining) and/or elevated soil screening data.

The soil-gas sample points were constructed of stainless steel. A 6-inch screen length was utilized for the deeper point and a 60-inch screen length was utilized for the shallower point. The rationale for installing a 60-inch length screen at the shallow point was to provide a greater sampling interval to allow collection of a representative sample of soil-gas.

As noted above, the soil-gas sample points were installed above the maximum groundwater elevation. Approximately 5 ft. of bentonite (hydrated on top of dry) was placed above the shallow sample points to prevent short-circuiting with ambient air. The soil-gas sample points were constructed of a stainless steel screen and connected to Teflon<sup>®</sup> tubing extending to the surface with a clean, brass needle valve and cap. After installation, sample points were allowed to equilibrate for 48-hours prior to sampling (CEPA 2010). Soil-gas sample point construction diagrams are included in Attachment E-2.

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

### 2.7.2 Soil-Gas Sampling

A field instrument was used on-site during sampling of the soil-gas sample points in the landfill to measure temperature, barometric pressure, and relative humidity. The soil-gas sample points were checked for leaks by administering helium gas as a tracer within a sealed manifold. One third of the soil-gas samples from the shallowest intervals of each location were analyzed for helium by Air Toxics, Limited (Air Toxics) in Folsom, California to determine if short-circuiting with ambient air had occurred.

Prior to purging the soil-gas sample points, a field reading for pressure was measured using a manometer and recorded on the sampling log. In addition, methane, carbon dioxide, and oxygen were measured using a Landtec GEM™ 500 landfill gas meter. After these readings were recorded, a total of three volumes of air (tubing plus screen, sand pack, and dry granular bentonite pore space) were purged prior to sampling with a flow rate not exceeding 50 milliliters per minute.

Flow controllers were obtained from Air Toxics which were certified, cleaned, and calibrated. During sampling, the duration of sampling was monitored to verify the flow controllers were working properly. All SUMMA®-type canisters received from Air Toxics were checked for correct vacuum and leak down tests were completed. The vacuum gauges provided by the analytical laboratory as part of the sample train (i.e., canister and flow controller) were used to record the initial and final vacuums in the air sampling canister. Pre-sampling vacuum in the canister was between -30 inches of mercury (in. Hg) and -25 in. Hg. Sampling was completed when the canister reached -5 in. Hg in vacuum or the sampling duration was completed (approximately 20 minutes), whichever came first. Soil-gas sampling logs are included in Attachment E-3.

Soil-gas sample points were sampled and analyzed using Method TO-15 for the expanded VOC list and Method ASTM D-1946 for helium (one third of soil-gas samples from shallow intervals) and methane. Each soil-gas sample was collected in a batch certified 1 Liter SUMMA®-type canister provided and analyzed by Air Toxics. Samples were placed in a container for shipping under chain-of-custody control following procedures outlined in the Work Plan.

Based on the results of the methane soil-gas analysis (see Section 3.2.5.3), additional investigation of the potential for methane was completed in December 2012. Soil-gas sample points SGP-2, SGP-5, SGP-8, and SGP-9, located in the Riverview Plat neighborhood and near the City of Moraine Municipal Building, were sampled for methane. Barometric pressure, air temperature, and initial gas pressure readings were

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

also collected (in addition to % LEL and % methane) at each of the three depth intervals (6 ft. below land surface [bls], 11 ft. bls, and greater than 14 ft. bls). Direct reading monitoring equipment was used to collect the aforementioned data. Purging of the soil-gas sample points was not necessary since the purpose was to determine if methane gas had accumulated within the soil-gas sample points.

### 2.8 Pneumatic Slug Testing

To estimate hydraulic conductivity within the upper aquifer and below the waste material, pneumatic slug testing was completed within temporary well screens in borings LF-36 (36 to 41 ft. bls ) and LF-37 (28 to 33 ft. bls) (Figure 2). Four tests were completed on each temporary well. Pneumatic slug tests were conducted by sealing the well head and applying air pressure to displace the water level. The air pressure acted like a slug to displace water for the hydraulic test. As air pressure was increased in the well, the water level fell until the water pressure and the air pressure returned to equilibrium. After the water level was stable, air was released from the sealed well head by opening an air release valve. The water level recovery was a rising head test that produces high quality data with little interference. A pressure transducer was used to monitor and record the change of the water level in the well during the pneumatic slug test.

### 2.9 Ambient Air Sampling

To evaluate whether the VOC-containing soil-gas present within the landfill influences the ambient air, ambient air sample were collected from the breathing zone (4 to 5 ft. above land surface) at two locations along the western perimeter of the Landfill (AA-LF-1 and AA-LF-2) (Figure 2). The samples were collected utilizing SUMMA<sup>®</sup>-type canisters equipped with regulating valves set to collect a 24-hour sample. Samples were submitted under chain-of-custody protocols to Air Toxics for laboratory analysis of an expanded list of VOCs in accordance with U.S. EPA Method TO-15 using low-level detection limits.

### 2.10 Dry Well Sampling

Air samples were collected from two storm sewer dry wells along Dryden Road (DW-1 and DW-2) (Figure 2) to further assess the potential for VOC-containing soil-gas to migrate laterally from the landfill and collect within the storm sewer dry wells. The samples were collected utilizing SUMMA<sup>®</sup>-type canisters equipped with regulating valves set to collect a 24-hour sample. The storm sewer dry wells were sampled

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

during dry weather conditions (although there was still water present in the bottom of the dry well) and coincided with the ambient air sampling. Teflon<sup>®</sup> tubing extended from the SUMMA<sup>®</sup>-type canister to approximately 2 ft. above the water that was present in both dry wells. Prior to sampling, the volume of air within the sample tubing was calculated and then purged to allow collection of a representative sample of the air present in the dry well. Samples were submitted under chain-of-custody protocols to Air Toxics for laboratory analysis of an expanded list of VOCs per U.S. EPA Method TO-15.

Dry wells DW-1 through DW-5, located near the southern and western landfill perimeter, was sampled for methane in December 2012. Barometric pressure, air temperature, initial gas pressure, % LEL, and % methane readings were collected during dry well sampling. Direct reading monitoring equipment was used to collect the aforementioned data.

### **2.11 Decontamination Procedures**

Between drilling locations, non-disposable drilling equipment was decontaminated in a temporary decontamination pad using a high-pressure washer. Non-disposable, reusable smaller equipment (e.g., transducers) were decontaminated as outlined in the Work Plan.

### **2.12 Boring Abandonment**

The borings not converted to soil-gas sample points were backfilled with a cement/bentonite grout mixture using a tremie pipe to seal the boring from the bottom to the top. The following day, the borings were inspected for settlement, and if any settlement was observed, the remaining annular space was backfilled using bentonite chips. Once the chips were placed, they were hydrated with potable water.

### **2.13 Temporary Soil-Gas Point Abandonment**

Currently, the soil-gas sample points are still in place and considered temporary. The soil-gas points are located within the boundary of the secured (locked) landfill and are not subject to tampering. If at a later time it is determined to be necessary, the temporary soil-gas sample points can be converted to permanent sample points by installing permanent flush-mount or stick-up well vaults. Temporary soil-gas sample points not converted to permanent points will be abandoned. Abandonment of the temporary soil-gas sample points will include extracting the point and sampling screens

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

from the borehole. If this is not possible, the tubing will be cut off below grade and the hole filled with bentonite.

### 2.14 Investigation Derived Waste Management

A designated on-site staging area was assigned in a secure area for drilling equipment, materials, and investigative derived waste (e.g., soil cuttings). Each drum was properly labeled with a pending analysis waste label identifying the type of waste (e.g., soil), sample designations for the contents contained, the generator information, boring number, and accumulation start and end date. The investigation derived waste was characterized as non-hazardous. Once the materials were characterized, the containers were labeled non-hazardous. The investigation derived waste has been profiled, transported, and disposed of off-site.

### 2.15 Laboratory Analysis

Soil samples were submitted to TestAmerica for analysis of site-specific VOCs by U.S. EPA Method 8260B. Groundwater samples were analyzed for site-specific VOCs by TestAmerica using U.S. EPA Method 8260B and dissolved methane by Microseeps using Method AM20GAX. Soil-gas samples were submitted to Air Toxics for analysis of an expanded list of VOCs by Method TO-15 and helium (selected samples) and methane by Method ASTM-D-1946. Ambient air and dry well samples were submitted to Air Toxics for analysis of an expanded list of VOCs using Method TO-15. The samples were submitted under a chain-of-custody and shipped or delivered directly to the laboratory by the field personnel. Laboratory methodology and quality assurance and quality control (QA/QC) information presented in the amended Quality Assurance Project Plan (ARCADIS, Inc. 2011b) were followed during this investigation. Additional samples (duplicates – 1 per 20 samples, equipment blanks – 1 per 20 samples, and matrix spike/matrix spike duplicate – 1 per 20 samples) for all non-screening type samples were collected and trip blanks added for QA/QC requirements. Additionally, after implementation of the field methodologies described in Section 2 and based on the validated analytical results including QA/QC results, it was determined that the data quality objectives were met, and the data was acceptable for use in the *Corrective Measures Proposal*.

## **2.16 Deviations from the Work Plan**

The field methods followed standard operating procedures outlined in the Work Plan except as noted below due to various circumstances during field implementation.

- The horizontal extent of the waste was not completely delineated due to limitations associated with working outside the landfill western perimeter (i.e., property fence and utilities outside of the fence) and refusal associated with encountering suspected buried concrete on the northern part of the landfill.
- The full vertical extent of the waste was not completely delineated at each location due to the limitations with the direct-push drilling methodology (refusal) during the first phase of the field investigation. During the second phase of the field investigation, two borings were completed at borings LF-36 and LF-37 using sonic methods and the full vertical extent of the waste at the central portion of the landfill was confirmed.
- The perimeter soil-gas sample points were to be installed outside of the waste boundary. However, due to the limits of waste extending beyond the landfill perimeter fence, the soil-gas sampling points were installed at locations with little to no waste. This reduced the number of soil-gas sample points along the western perimeter of the landfill from the proposed six locations to three.
- The interior landfill soil-gas sample points were decreased from three to two. In addition, groundwater samples were not collected from the interior soil-gas sample point locations since the vertical extent of the waste extended into the upper aquifer. However, groundwater samples were collected from borings LF-36 and LF-37, located within the interior portion of the landfill, since the sonic drilling methods allowed for boring installation to depths that were below the waste.
- Due to methane interference, the procedure for completing the helium leak test on the soil-gas sample points was modified from using a field instrument to detect helium within the soil-gas sample point to analyzing the soil-gas samples for helium in one-third of the shallow interval soil-gas samples using a laboratory. The results of the helium analyses indicated that the sample points were properly installed (less than five % helium in samples).

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

### 3. Investigation Findings

#### 3.1 Landfill L1 Location and Structure

##### 3.1.1 Location

The landfill is located at the southwest portion of the Site property boundary northeast of the intersection of Main Street and Dryden Road (Figure 1). The landfill is approximately 7.8 acres and is bounded to the east by a Norfolk Southern Railroad and to the north by a historic railroad spur. The City of Moraine Municipal Building is to the south and the Riverview Plat neighborhood is located to the west. Test well TW-2 was installed in 1989 and is located in the southwest corner of the landfill. This well is screened in the upper aquifer and was used to conduct a pump test and later to evaluate the presence of VOCs at the property boundary. Hydraulic controls were selected to achieve the interim measures objectives. The capture zone interim measure for the upper aquifer consisted of groundwater extraction from well TW-2, treatment through an air stripper tower, and discharge through a permitted outfall to the Great Miami River. Groundwater recovery from TW-2 began on January 31, 1996 and was discontinued on July 31, 2012 due to low concentrations of VOCs in groundwater.

The landfill is situated on the downgradient end of the Site boundary. Upper and lower aquifer groundwater in the vicinity of the landfill flows generally from northeast to southwest. The groundwater flow direction at the Site using data from 2012, is shown on Figures 4 and 5.

##### 3.1.2 Surface Structure

The landfill is shaped like a bowl that is built up relative to the surrounding land as depicted on the topographic map (Figure 3). The perimeter berm of the landfill is up to 13 ft. higher than the undisturbed land. The berm is not present in the northeast area of the landfill where the land surface gently slopes to the northeast. The bowl is a gentle slope with depressions of 2 ft. or less from the edge of the berm. A few slight high areas are present.

##### 3.1.3 Subsurface Structure

The subsurface of the landfill is shown in a series of cross sections (A-A' through F-F') (Figure 6). The cross sections show the extent of the fill material and the locations where native soil was encountered. Groundwater, native soil, waste material, and soil-

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

gas analytical results are presented on the cross sections. The landfill from west to east (C-C') is a bowl (thickness of waste is thinner around the perimeter of the landfill) with a maximum depth of approximately 34 ft. bls with the waste extending below the groundwater table. The landfill from north to south (E-E') is similar to the profile from east to west and shows the waste extending below the groundwater table. Cross section A-A' from west to east on the northern edge of the landfill depicts the northern extent with waste extending to approximately 34 ft. bls (below the groundwater table).

### 3.2 Landfill L1 Composition

#### 3.2.1 Physical Composition

The waste is made up of four main bulk components: 1) silt and sand with waste, 2) white clay/sludge, 3) tar, and 4) gray silt. Several other waste materials were also identified at various areas and amounts (e.g., gravel, wood, concrete, glass, plastic and metal). Based on field observations, there were limited zones of residual free phase liquid in borings LF-13 and LF-18. The fill material was mostly moist to dry with some wet zones that were considered perched groundwater.

The native materials, underlying the waste, consisted of clay, silty clay, and sand and gravel. The uppermost clay that is designated as brown clay on the cross sections (Figure 6) may reflect a buried soil horizon. The native material is consistent with native materials observed throughout the Site.

#### 3.2.2 Physical Properties, Index Parameters and Hydraulic Parameters

Vadose zone soil samples were submitted to PTS for analysis of moisture content, density, total organic carbon, fraction organic carbon, porosity, total pore fluid saturations, confining pressure, mean grain size description, median grain size, particle size distribution, Atterberg limits, Unified Soil Classification System group symbol name, and United States Department of Agriculture / Soil Conservation Service soil texture scheme. Saturated zone soil samples were submitted to PTS for analysis of moisture content, density, total organic carbon, porosity, total pore fluid saturations, and confining stress. The physical property data were used for leachability calculations (see Section 3.3). The results of the physical properties analysis completed by PTS are summarized on Table 1 (Vadose Zone Soil Properties) and Table 2 (Saturated Zone Soil Properties). The geotechnical laboratory report from PTS is included in Attachment E-4.

### 3.2.3 Solid Chemical Composition

#### 3.2.3.1 Waste Samples

Based on field screening readings and field observations, selected waste samples were submitted for analysis of site-specific VOCs. A summary of the sample results is present as Table 3 and on the cross sections (Figure 6). The discussion of the results was divided into two groups: 1) chlorinated VOCs (CVOCs) [1,1,1-TCA, 1,1-DCA, 1,1-DCE, cis-1,2-DCE, PCE, trans-1,2-DCE, TCE, and vinyl chloride] and 2) benzene, toluene, ethylbenzene and xylenes (BTEX).

#### 3.2.3.2 Waste Sample CVOC Results

Concentrations of 1,1,1-TCA were not detected above the laboratory detection limits. Concentrations of 1,1-DCA ranged from non-detect to 1,270 micrograms per kilogram ( $\mu\text{g}/\text{kg}$ ) in waste sample LF-21 (32 to 36 ft. bls). Concentrations of 1,1-DCE ranged from non-detect to 8.1J  $\mu\text{g}/\text{kg}$  in waste sample LF-1 (2 to 4 ft. bls). Concentrations of cis-1,2-DCE ranged from non-detect to 41,700  $\mu\text{g}/\text{kg}$  in waste sample LF-17 (16 to 18 ft. bls). Concentrations of PCE ranged from non-detect to 840  $\mu\text{g}/\text{kg}$  in waste sample LF-37 (10 to 12 ft. bls). Concentrations of trans-1,2-DCE ranged from non-detect to 947  $\mu\text{g}/\text{kg}$  in waste sample LF-21 (32 to 36 ft. bls). Concentrations of TCE ranged from non-detect to 148,000  $\mu\text{g}/\text{kg}$  in waste sample LF-21 (32 to 36 ft. bls). Concentrations of vinyl chloride ranged from non-detect to 1,580  $\mu\text{g}/\text{kg}$  in waste sample LF-11A (32 to 35 ft. bls). The maximum total CVOC concentration was detected in the waste sample from the 32 to 36-ft. interval of boring LF-21, located in the central portion of the landfill.

#### 3.2.3.3 Waste Sample BTEX Results

Concentrations of benzene ranged from non-detect to 100J  $\mu\text{g}/\text{kg}$  in waste sample LF-37 (24 to 26 ft. bls). Concentrations of toluene ranged from non-detect to 15,100,000  $\mu\text{g}/\text{kg}$  in waste sample LF-18 (8 to 12 ft. bls). Concentrations of ethylbenzene ranged from non-detect to 5,010,000  $\mu\text{g}/\text{kg}$  in waste sample LF-12A (28 to 32 ft. bls). Concentrations of xylenes ranged from non-detect to 17,900,000  $\mu\text{g}/\text{kg}$  in waste sample LF-12A (28 to 32 ft. bls). The maximum total BTEX concentration was detected in the waste sample from the 28 to 32-ft. interval of boring LF-12A, located in the central portion of the landfill.

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

### 3.2.3.4 *Native Soil Samples*

When encountered, the native soil beneath the waste was sampled and submitted for analysis for site-specific VOCs. A summary of the sample results is presented as Table 4 and on the cross sections (Figure 6). For discussion, the results have been divided into two groups: 1) CVOCs and 2) BTEX.

### 3.2.3.5 *Native Soil Sample CVOC Results*

Concentrations of 1,1,1-TCA, 1,1-DCA, 1,1-DCE, and trans-1,2-DCE were not detected in the native soil samples selected for analysis. Concentrations of cis-1,2-DCE ranged from non-detect to 210 µg/kg in soil sample LF-32 (12 to 14 ft. bls). Concentrations of PCE ranged from non-detect to 896 µg/kg in soil sample LF-18 (20 to 22 ft. bls). Concentrations of TCE ranged from non-detect to 58J µg/kg in soil sample LF-32 (12 to 14 ft. bls). Vinyl chloride was only detected in soil sample LF-37 (28 to 30 ft. bls) at a concentration of 1.1J µg/kg. The maximum CVOC concentration was detected in the 20 to 22-ft. interval of boring LF-18, located in the central portion of the landfill.

### 3.2.3.6 *Native Soil Sample BTEX Results*

Benzene was only detected in soil sample LF-37 (28 to 30 ft. bls) at a concentration of 0.67J µg/kg. Concentrations of toluene ranged from non-detect to 105,000 µg/kg in soil sample LF-18 (20 to 22 ft. bls). Concentrations of ethylbenzene ranged from non-detect to 76,300 µg/kg in soil sample LF-18 (20 to 22 ft. bls). Concentrations of xylenes ranged from non-detect to 372,000 µg/kg in soil sample LF-18 (20 to 22 ft. bls). The maximum total BTEX concentration was detected in the 20 to 22-ft. interval of boring LF-18, located in the central portion of the landfill.

### 3.2.4 *Groundwater Chemical Composition*

Groundwater table samples were collected using a temporary well screen at perimeter borings LF-01, LF-02, LF-03, LF-07, LF-19, LF-29A and LF-35 and borings LF-36 and LF-37, located in the central portion of the landfill. Samples were submitted to the laboratory for site-specific analysis of VOCs and methane. A summary of the sample results is presented as Table 5 and on the cross sections (Figure 6). For discussion, the results have been divided into three groups: 1) CVOCs, 2) BTEX, and 3) methane.

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

### 3.2.4.1 Groundwater Sample CVOC Results

Concentrations of 1,1,1-TCA ranged from non-detect to 0.28J micrograms per liter ( $\mu\text{g/L}$ ) in groundwater sample LF-19 (22 to 24 ft. bls). Concentrations of 1,1-DCA ranged from non-detect to 6.5  $\mu\text{g/L}$  in groundwater sample LF-03 (26 to 28 ft. bls). Concentrations of 1,1-DCE were not detected in the groundwater samples submitted for analysis. Concentrations of cis-1,2-DCE ranged from 0.65J  $\mu\text{g/L}$  in groundwater sample LF-36 (37 to 42 ft. bls) to 170  $\mu\text{g/L}$  in groundwater sample LF-37 (28 to 33 ft. bls). Concentrations of PCE ranged from non-detect to 5.1  $\mu\text{g/L}$  in groundwater sample LF-35 (20 to 22 ft. bls). Concentrations of trans-1,2-DCE ranged from non-detect to 2.2  $\mu\text{g/L}$  in groundwater sample LF-19 (22 to 24 ft. bls). Concentrations of TCE ranged from 0.65J  $\mu\text{g/L}$  in groundwater sample LF-36 (37 to 42 ft. bls) to 55  $\mu\text{g/L}$  in groundwater sample LF-37 (28 to 33 ft. bls). Concentrations of vinyl chloride ranged from non-detect to 4.0J  $\mu\text{g/L}$  in groundwater sample LF-37 (28 to 33 ft. bls). The maximum total CVOC concentration was detected in groundwater sample LF-37 (28 to 33 ft. bls), located in the central portion of the landfill.

### 3.2.4.2 Groundwater Sample BTEX Results

Concentrations of benzene ranged from non-detect to 5.6J  $\mu\text{g/L}$  in groundwater sample LF-37 (28 to 33 ft. bls). Concentrations of toluene ranged from non-detect to 260  $\mu\text{g/L}$  in groundwater sample LF-37 (28 to 33 ft. bls). Concentrations of ethylbenzene ranged from non-detect to 120  $\mu\text{g/L}$  in groundwater sample LF-37 (28 to 33 ft. bls). Concentrations of xylenes ranged from non-detect to 630  $\mu\text{g/L}$  in groundwater sample LF-37 (28 to 33 ft. bls). The maximum total BTEX concentration was detected in groundwater sample LF-37 (28 to 33 ft. bls), located in the central portion of the landfill.

### 3.2.4.3 Groundwater Sample Dissolved Methane Results

Concentrations of dissolved methane ranged from 3.2  $\mu\text{g/L}$  in groundwater sample LF-07 (26 to 28 ft. bls) to 8,200  $\mu\text{g/L}$  in groundwater sample LF-01 (22 to 24 ft. bls). A review of baseline groundwater data collected prior to initiation of interim measures was completed for upper aquifer monitoring wells WEST, EAST, GM-19S, GM-32, GM-21, GM-8, GM-6,4S, and GM-2. In September 1999 and prior to initiation of interim measures, groundwater in the vicinity of the landfill had methane concentrations that ranged from 0.571  $\mu\text{g/L}$  to 7,820  $\mu\text{g/L}$  (ARCADIS Geraghty & Miller, Inc. 2001). Therefore, current dissolved methane concentrations are comparable to the baseline dissolved methane concentrations. The dissolved methane concentrations at the

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

landfill may be contributing to the methane concentrations detected in landfill soil-gas (see Section 3.2.5.3). However, based on the results of the offsite methane monitoring (see Sections 3.2.5.3 and 3.2.7.3), soil-gas containing methane is not migrating from the landfill to the Riverview Plat neighborhood or to the nearby storm sewer dry wells.

### 3.2.5 Soil-Gas Chemical Composition

Soil-gas samples were collected from temporary soil-gas points LF-SGP-1, LF-SGP-3A, LF-SGP-5, LF-SGP-7A, LF-SGP-13A, LF-SGP-15A, LF-SGP-19, LF-SGP-29A, and LF-SGP-35. Soil-gas samples were collected from up to two depths at each boring. The soil-gas samples were submitted to Air Toxics for analysis of the expanded list of VOCs, methane, and helium (one third of soil-gas samples from shallow intervals for QA/QC purposes). The soil-gas analytical results are summarized on Table 6 and on the cross section (Figure 6). The discussion of the results was divided into four groups: 1) CVOCs, 2) BTEX, 3) methane, and 4) helium. The purpose of the soil-gas investigation within the landfill was to determine if the landfill was a potential contributing source of VOCs to the Riverview Plat neighborhood, located directly west of the landfill. Additionally, methane data were collected to determine if the waste within the landfill was generating concentrations of methane that may present a health and safety concern. Helium data were collected as a QA/QC measure during soil-gas sampling. For discussion, the results have been divided into three groups: 1) CVOCs, 2) BTEX, and 3) methane.

#### 3.2.5.1 Soil-Gas CVOC Results

Concentrations of 1,1,1-TCA ranged from non-detect to 27 parts per billion by volume (ppbv) in soil-gas sample LF-SGP-29A (12.33 to 17.33 ft. bls). Concentrations of 1,1-DCA ranged from non-detect to 1,800 ppbv in soil-gas sample LF-SGP-3A (7.08 to 12.08 ft. bls). Concentrations of 1,1-DCE ranged from non-detect to 82 ppbv in soil-gas sample LF-SGP-1 (4.88 to 9.88 ft. bls). Concentrations of cis-1,2-DCE ranged from non-detect to 14,000 ppbv in soil-gas sample LF-SGP-15A (6.0 to 11.0 ft. bls). Concentrations of PCE ranged from non-detect to 200 ppbv in soil-gas sample LF-SGP-1 (17.17 to 17.67 ft. bls). Concentrations of trans-1,2-DCE ranged from non-detect to 810 ppbv in soil-gas sample LF-SGP-19 (12.71 to 17.71 ft. bls). Concentrations of TCE ranged from 61 ppbv in soil-gas sample LF-SGP-29A (18.92 to 19.42 ft. bls) to 1,700 ppbv in soil-gas sample LF-SGP-19 (12.71 to 17.71 ft. bls). Concentrations of vinyl chloride ranged from non-detect to 11,000 ppbv in soil-gas sample LF-SGP-15A (6.0 to 11.0 ft. bls). The maximum total CVOC concentration was detected in soil-gas sample LF-SGP-15A (6.0 to 11.0 ft. bls), located in the central

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

portion of the landfill. An interpretation of the soil-gas results is provided in Section 3.2.8.

### *3.2.5.2 Soil-Gas BTEX Results*

Concentrations of benzene ranged from non-detect to 2,000 ppbv in soil-gas sample LF-SGP-15A (6.0 to 11.0 ft. bls). Concentrations of toluene ranged from non-detect to 97,000 ppbv in soil-gas sample LF-SGP-15A (6.0 to 11.0 ft. bls). Concentrations of ethylbenzene ranged from non-detect to 15,000 ppbv in soil-gas sample LF-SGP-15A (6.0 to 11.0 ft. bls). Concentrations of xylenes ranged from non-detect to 63,000 ppbv in soil-gas sample LF-SGP-15A (6.0 to 11.0 ft. bls). The maximum total BTEX concentration was detected in soil-gas sample LF-SGP-15A (6.0 to 11.0 ft. bls), located in the central portion of the landfill. An interpretation of the soil-gas results is provided in Section 3.2.8.

### *3.2.5.3 Soil-Gas Methane Results*

Concentrations of methane ranged from 0.000077J % in soil-gas sample LF-SGP-5 (7.08 to 12.08 ft. bls) to 14 % in soil-gas sample LF-SGP-15A (6.0 to 11.0 ft. bls).

Since the soil-gas methane concentrations in the landfill exceeded 5 % (i.e., 100 % LEL), soil-gas sample points SGP-2, SGP-5, SGP-8, and SGP-9, located in the Riverview Plat neighborhood and near the City of Moraine Municipal Building, were sampled for methane to determine if methane from the landfill was migrating offsite. Methane was not detected and LEL readings were 0 % during the sampling of the aforementioned soil-gas sample points. Since methane and LEL were not detected in the soil-gas sample points along the eastern portion of the neighborhood, soil-gas containing methane is not migrating from the landfill to the Riverview Plat neighborhood.

Dry wells DW-1 through DW-5, located near the southern and western perimeter of the landfill, were also sampled to determine if methane from the landfill was migrating offsite. Section 3.2.7.3 summarizes the results the dry well methane sampling.

### *3.2.5.4 Soil-Gas Helium Results*

Three of the shallow soil-gas samples were analyzed for helium to verify that the soil-gas sample points were not in communication with ambient air. Helium concentrations ranged from 0.080 % in soil-gas sample LF-SGP-3A (7.08 to 12.08 ft.

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

bls) to 0.082 % in soil-gas samples LF-SGP-13A (7.0 to 12.0 ft. bls) and LF-SGP-15A (6.0 to 11.0 ft. bls). The results indicated that the soil-gas sample points were installed correctly (less than 5% helium in the soil-gas samples).

### 3.2.6 Ambient Air

Two ambient air samples were collected from the western perimeter of the landfill. The ambient air samples were submitted to Air Toxics for analysis of the expanded list of VOCs. The ambient air analytical results are summarized on Table 7. The discussion of the results was divided into two groups 1) CVOCs and 2) BTEX. Ambient air data were collected to determine if the landfill soil-gas had an influence on ambient air. A discussion of how the ambient air data compares to the landfill soil-gas data is provided in Section 3.2.8.

#### 3.2.6.1 Ambient Air CVOC Results

Concentrations of 1,1,1-TCA, 1,1-DCA, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride were below laboratory reporting limits in the ambient air samples. PCE was not detected in ambient air sample AA-LF-1 but was detected in ambient air sample AA-LF-2 (0.032J ppbv). TCE was detected in ambient air samples AA-LF-1 (0.13J ppbv) and AA-LF-2 (0.088J ppbv). The detected concentrations of PCE and TCE were below the May 2012 U.S. EPA Regional Screening Levels (RSLs) for residential indoor air (Action Levels) calculated for the Site.

#### 3.2.6.2 Ambient Air BTEX Results

Benzene was detected in ambient air samples AA-LF-1 (0.34 ppbv) and AA-LF-2 (0.63 ppbv). Toluene was detected in ambient air samples AA-LF-1 (0.91 ppbv) and AA-LF-2 (0.81 ppbv). Ethylbenzene was detected in ambient air samples AA-LF-1 (0.093J ppbv) and AA-LF-2 (0.10J ppbv). Xylenes were detected in ambient air samples AA-LF-1 (0.48 ppbv) and AA-LF-2 (0.422 ppbv). The detected BTEX concentrations were below the residential indoor air Action Levels calculated for the Site.

### 3.2.7 Dry Well Air Chemical Composition

Air samples were collected from dry wells DW-1 and DW-2 located immediately to the west of the landfill, along Dryden Road. The dry well air samples were submitted to Air Toxics for analysis of the expanded list of VOCs. The dry well analytical results are summarized on Table 8. The discussion of the results was divided into two groups 1)

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

CVOCs and 2) BTEX. Dry well air data were collected to determine if the landfill soil-gas has migrated laterally to the dry wells. A discussion of how the dry well air data compares to the landfill soil-gas data is provided in Section 3.2.8.

### 3.2.7.1 Dry Well CVOC Results

Concentrations of 1,1,1-TCA, 1,1-DCA, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride were not detected in the dry well samples. PCE was detected in dry well sample DW-1 (0.031J ppbv) but was not detected in dry well sample DW-2. TCE was detected in dry well sample DW-1 (0.41 ppbv) but was not detected in dry well sample DW-2. The detected PCE and TCE concentrations were below the May 2012 U.S. EPA RSLs for residential soil-gas (Action Levels).

### 3.2.7.2 Dry Well BTEX Results

Benzene was detected in dry well samples DW-1 (0.52 ppbv) and DW-2 (1.8J ppbv). Toluene was detected in dry well samples DW-1 (9.2 ppbv) and DW-2 (0.82J ppbv). Ethylbenzene was detected in dry well sample DW-1 (0.15J ppbv) but was not detected in dry well sample DW-2. Xylenes were detected in dry well samples DW-1 (0.76 ppbv) and DW-2 (0.28J ppbv). The detected BTEX concentrations were below the Action Levels.

### 3.2.7.3 Dry Well Methane Results

Dry wells DW-1 through DW-5, located near the southern and western landfill perimeter, were sampled for methane to determine if methane from the landfill was migrating offsite. A concentration of 0.1 % methane was detected in dry well DW-5 and the LEL reading was 0 %. Methane was not detected and LEL readings were 0 % in the other dry wells sampled. The non-detect to low concentrations of methane and the lack of detectable % LEL indicates that soil-gas containing methane is not migrating from the landfill to the nearby storm sewer dry wells.

## 3.2.8 Interpretation of Soil-Gas Results

The highest observed total CVOC and total BTEX concentrations in soil-gas was from soil gas sample LF-SGP-15A (6 to 11 ft. bls), located in the central portion of the landfill. The highest total CVOC waste sample was collected from boring LF-21 (32 to 36 ft. bls), also located in the central portion of the landfill. The highest total BTEX waste sample was collected from boring LF-12A (28 to 32 ft. bls), located in the central

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

portion of the landfill. The correlation of the locations with the highest VOC soil-gas concentrations to the locations with the highest VOC waste sample concentrations is indicative of material within the waste being the primary source of soil-gas VOCs in the landfill. Additionally, VOC soil-gas concentrations in the landfill do not consistently increase with depth, and the highest VOC groundwater concentrations do not correlate with the highest VOC soil-gas concentrations. Based on the results of the waste samples, the soil-gas samples, and the groundwater samples, the primary source of VOCs in soil-gas appears to be the waste within the landfill. Since the soil-gas concentrations in the landfill are associated with the waste and not groundwater, off-site vapor intrusion issues associated with landfill soil-gas are not anticipated to be an issue.

A discussion of the landfill soil-gas results as compared to the soil-gas results from the neighborhood and the results of the ambient air and dry well sampling is presented below.

### *3.2.8.1 Comparison of Landfill Soil-Gas Data to Neighborhood Soil-Gas Data*

One of the objectives of the Landfill L1 Investigation was to determine if the landfill is a potential contributing source for VOCs in the soil-gas beneath the Riverview Plat neighborhood to the west and the City of Moraine Municipal Building property to the south. In November 2010 during the Vapor Intrusion Verification Investigation, soil-gas samples were collected from soil-gas sample points SGP-1 through SGP-8 in the Riverview Plat neighborhood and from soil-gas sample point SGP-9 at the City of Moraine Municipal Building property. An additional round of sampling was completed for soil-gas point SGP-9 in March 2011. Soil-gas samples were analyzed for site-specific VOCs. The *Vapor Intrusion Verification Report* can be found in Appendix D of the *Corrective Measures Proposal* for additional details pertaining to the soil-gas sampling completed in the Riverview Plat neighborhood and at the City of Moraine Municipal Building property.

CVOC and BTEX chemical distribution profiles for the soil-gas data collected from the landfill, the Riverview Plat neighborhood, and the City of Moraine Municipal Building property were generated. The profiles are represented on pie charts shown on Figures 7 and 8. The pie charts visually demonstrate the similarities and differences between the VOC compositions of the soil-gas samples collected. The pie charts are also sized to be representative of concentration. The following sections provide a discussion and interpretation of the chemical distribution profiles for CVOCs and BTEX.

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

### 3.2.8.1.1 Landfill, Neighborhood, and City of Moraine Municipal Building Property CVOC Soil-Gas Comparison

The soil-gas samples from the landfill consisted of a variety of CVOCs including vinyl chloride and cis-1,2-DCE. The soil-gas samples from the neighborhood and the City of Moraine Municipal Building property consisted primarily of PCE and TCE. The chemical distribution profiles were distinctly different, which indicates that the landfill is not a contributing source of CVOCs for the neighborhood. The chemical distribution profiles are represented on pie charts showing the percentages of CVOCs in each soil-gas sample (Figure 7).

### 3.2.8.1.2 Landfill, Neighborhood, and City of Moraine Municipal Building Property BTEX Soil-Gas Comparison

BTEX was detected in soil-gas samples from the landfill, the neighborhood, and the City of Moraine Municipal Building property. BTEX concentrations in the neighborhood and the City of Moraine Municipal Building property were generally lower than the BTEX concentrations detected in the landfill and were below the Action Levels for residential soil-gas. The specific constituents detected were variable and did not show a consistent pattern or profile. There was no similarity between the chemical distribution profiles for the constituents detected in the landfill and those detected in the neighborhood or near the City of Moraine Municipal Building property. Therefore, the landfill does not appear to be a contributing source of BTEX for the neighborhood or the City of Moraine Municipal Building property. The chemical distribution profiles are represented on pie charts showing the percentages of BTEX in each soil-gas sample (Figure 8).

### 3.2.8.2 Comparison of Landfill Soil-Gas Data to Ambient Air Data

One of the objectives of the Landfill L1 Investigation was to determine if the soil-gas present within the landfill was adversely affecting ambient air. Chemical distribution profiles for the soil-gas samples collected from the landfill were compared to chemical distribution profiles for the ambient air samples collected along the western perimeter of the landfill. The profiles are represented on pie charts shown on Figures 9 and 10 for CVOCs and BTEX, respectively. The pie charts visually demonstrate the similarities and differences between the VOC composition of the soil-gas and air samples collected. The pie charts are also sized to be representative of concentration. The following sections provide a discussion and interpretation of the chemical distribution profiles for CVOCs and BTEX.

#### 3.2.8.2.1 Landfill Soil-Gas and Ambient Air CVOC Comparison

The CVOC concentrations detected in ambient air were much lower in comparison to the CVOC concentrations detected in the landfill soil-gas. Additionally, concentrations of CVOCs in the ambient air samples were below the Action Levels established for residential indoor air. A consistent chemical distribution profile for the CVOCs in the ambient air samples and the CVOCs in the landfill soil-gas was not observed. Since the concentrations of CVOCs in the ambient air samples were below the residential indoor air Action Levels and a consistent chemical distribution profile was not observed between the landfill soil-gas and the ambient air samples, the impact that the landfill soil-gas has on ambient air, if any, is not significant. The chemical distribution profiles are represented on pie charts showing the percentages of CVOCs in the landfill soil-gas and ambient air samples (Figure 9).

#### 3.2.8.2.2 Landfill Soil-Gas and Ambient Air BTEX Comparison

The BTEX concentrations detected in ambient air were much lower in comparison to the BTEX concentrations detected in the landfill soil-gas. Moreover, concentrations of BTEX in the ambient air samples were below the Action Levels established for residential indoor air. A consistent chemical distribution profile for the BTEX concentrations detected in the ambient air samples and the BTEX concentrations detected in the landfill soil-gas was also not observed. Since the concentrations of BTEX in the ambient air samples were below the residential indoor air Action Levels and a consistent chemical distribution profile was not observed between the landfill soil-gas and the ambient air samples, the impact that the landfill soil-gas has on ambient air, if any, is not significant. The vehicle traffic along Dryden Road and the retail petroleum facility located directly west of the landfill within the neighborhood are potential background sources of BTEX in ambient air. The chemical distribution profiles are represented on pie charts showing the percentages of BTEX in the landfill soil-gas and ambient air samples (Figure 10).

#### 3.2.8.3 Comparison of Landfill Soil-Gas Data to Dry Well Data

One of the objectives of the Landfill L1 Investigation was to determine the influence the soil-gas present within the landfill has on the air within the dry wells. The chemical distribution profiles for the soil-gas samples collected from the landfill were compared to the chemical distribution profiles for the dry well samples collected to the west of the landfill. The profiles are represented on pie charts shown on Figures 9 and 10. The pie charts visually demonstrate the similarities and differences between the VOC

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

composition of the soil-gas and dry well samples collected. The pie charts are also sized to be representative of concentration. The following sections provide a discussion and interpretation of the chemical distribution profiles for CVOCs and BTEX.

### 3.2.8.3.1 Landfill Soil-Gas and Dry Well CVOC Comparison

The CVOC concentrations detected in dry well sample DW-1 were relatively low in comparison to the CVOC concentrations detected in the landfill soil-gas. Concentrations of CVOCs in dry well sample DW-2 were not detected. The CVOC concentrations detected in dry well sample DW-1 were below the Action Levels for soil-gas established for the Site. A consistent chemical distribution profile for the CVOCs in dry well sample DW-1 and the CVOCs in the landfill soil-gas was not observed. Since the dry well CVOC concentrations were either not detected or below the Action Levels and a consistent chemical distribution profile between the dry well samples and the landfill was not observed, the impact that the landfill soil-gas has on the dry wells, if any, is not significant. The chemical distribution profiles are represented on pie charts showing the percentages of CVOCs in the landfill soil-gas and dry well samples (Figure 9).

### 3.2.8.3.2 Landfill Soil-Gas and Dry Well BTEX Comparison

The BTEX concentrations detected in dry well samples DW-1 and DW-2 were below the Action Levels for soil-gas established for the Site. A consistent chemical distribution profile between the dry well samples and the landfill was not observed. Since the dry well BTEX concentrations were below the Action Levels and a consistent chemical distribution profile between the dry well samples and the landfill was not observed, the impact that the landfill soil-gas has on the dry wells, if any, is not significant. The chemical distribution profiles are represented on pie charts showing the percentages of BTEX in the landfill soil-gas and dry well samples (Figure 10).

## 3.3 Waste to Groundwater Leaching

To determine the leaching potential of the waste to groundwater, hydraulic testing (pneumatic slug tests) and calculations to predict leaching were completed. The following is a discussion of the pneumatic slug test results, the leaching calculations, and associated conclusions.

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

### 3.3.1 Pneumatic Slug Test Analyses and Results

To estimate hydraulic conductivity within the upper aquifer and below the waste material, pneumatic slug testing was completed within temporary well screens in borings LF-36 (36 to 41 ft. bls) and LF-37 (28 to 33 ft. bls). Four tests were completed at each location, and the collected slug test data were analyzed using AQTESOLV™ for Windows Pro 4.5. The primary solutions utilized to match the observed pneumatic slug test data were the Bouwer-Rice Unconfined Solution (1976), the Hyder et al. (KGS Model) Unconfined Solution (1994), and the Hvorslev Unconfined Solution (1951).

- The Bouwer-Rice Unconfined Solution (1976) is a straight-line solution for a single-well slug test in an unconfined aquifer with a partially penetrating well.
- The Hyder et al. (KGS Model) Unconfined Solution (1994) is a full transient solution for a single-well slug test in an unconfined aquifer with a partially penetrating well.
- The Hvorslev Unconfined Solution (1951) is a straight-line solution for a single-well slug test in an unconfined aquifer with a partially penetrating well.

When considering the various solutions used, the estimated hydraulic conductivities from temporary wells LF-36 and LF-37 ranged from 71.6 ft. per day (ft./d) (LF-36 Test 4, Bouwer-Rice Unconfined Solution) to 719.1 ft./d (LF-37 Test 1, Hvorslev Unconfined Solution). Much of the range in estimated hydraulic conductivities is due to the heterogeneous nature of the deposits. The resulting hydraulic conductivities of the pneumatic slug test data analyses are presented in Table 9 and the AQTESOLV™ reports are included as Attachment E-5.

### 3.3.2 Summary of Leaching Potential Calculations

The objective of the leaching potential calculations was to determine if organic constituents associated with the waste in the landfill could leach to the transmissive part of the saturated zone at concentrations that could increase over time. Data collected during the Landfill L1 Investigation (e.g., soil properties data, analytical data, etc.) and a model were used to estimate the contribution to groundwater of each of several VOCs over time. The method used to estimate the leach potential was a vadose zone computer model to compute VOC concentrations at the base of the vadose zone. The horizontal groundwater flow and the vertical percolation of vadose

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

zone pore water were compared to determine a dilution factor. This allowed the estimation of groundwater concentrations under the landfill over time.

Supporting documentation for the leaching potential calculations is included in Attachment E-6.

### 3.3.3 Conclusion from Leaching Analysis

The leaching potential calculations provided rationale as to why the concentrations of the site-specific VOCs are low in the monitoring wells downgradient of Landfill L1 when they are higher in some of the waste or soil samples from within the landfill. Advective flow is hindered by the low-permeability clay and sludge within the landfill. Transport is limited to vapor diffusion, which is too slow for leaching BTEX constituents before they can degrade. The chlorinated hydrocarbons will take so long to reach the saturated zone that it will take centuries to reach 1.0 µg/L in groundwater given dilution, even if the CVOCs could leach through the low-permeability layer in the upper saturated zone. Detectable VOCs in monitoring wells downgradient of the landfill are more likely to originate from sources upgradient of the landfill.

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

### 4. Conclusions

A summary of the conclusions of the investigation is presented below and a separate assessment of risk for Landfill L1 is presented in Section 3 of the *Corrective Measures Proposal*. The Landfill L1 investigation findings have been used to refine the conceptual site model and the corrective measures evaluation presented in Sections 2.7 and 4 of the *Corrective Measures Proposal*, respectively.

- The soil-gas VOC concentrations along on the western, eastern, and southern boundaries of the landfill were identified. Based on the results of the waste samples, the soil-gas samples, and the groundwater samples, the primary source of VOCs in landfill soil-gas appears to be the waste within the landfill. Since the soil-gas concentrations in the landfill are associated with the waste and not groundwater, offsite vapor intrusion issues associated with landfill soil-gas are not anticipated to be an issue.
- Methane was detected in landfill soil-gas at concentrations exceeding 5 % (i.e., 100 % LEL). The methane concentrations detected in the landfill soil-gas are not uncommon in landfill settings. To determine if methane was migrating offsite, the dry wells near the western and southern landfill perimeter and soil-gas points on the eastern portion of the Riverview Plat neighborhood were sampled for methane. Based on the results of the methane sampling activities, soil-gas containing methane is not migrating to the Riverview Plat neighborhood or the nearby storm sewer dry wells.
- Current dissolved methane groundwater concentrations in the landfill are comparable to the dissolved methane concentrations detected prior to initiation of interim measures. The dissolved methane concentrations at the landfill may be contributing to the methane concentrations detected in landfill soil-gas. However, as indicated above, soil-gas containing methane is not migrating to the Riverview Plat neighborhood or the nearby storm sewer dry wells.
- Based on a comparison of the chemical distribution profiles of the soil-gas samples from the landfill, the Riverview Plat neighborhood to the west, and the City of Moraine Municipal Building property to the south, the landfill does not appear to be a contributing source of VOCs for the soil-gas beneath the Riverview Plat neighborhood to the west or the City of Moraine Municipal Building property to the south.
- Based on a comparison of the chemical distribution profiles of the soil-gas samples from the landfill to the ambient air samples collected along the western

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

perimeter of the landfill and the dry well samples collected to the west of the landfill, the impact that the landfill soil-gas has on ambient air and the dry wells, if any, is not significant.

- The waste within the landfill was characterized. The maximum total CVOC concentration was detected in the waste sample from the 32 to 36-ft. interval of boring LF-21, located in the central portion of the landfill. The maximum total BTEX concentration was detected in the waste sample from the 28 to 32-ft. interval of boring LF-12A, located in the central portion of the landfill.
- Leaching potential calculations were completed and provided rationale as to why the concentrations of the site-specific VOCs are low in the monitoring wells downgradient of Landfill L1 when they are higher in some of the waste or soil samples from within the landfill. Advective flow is hindered by the low-permeability clay and sludge within the landfill. Transport is limited to vapor diffusion, which is too slow to leach BTEX constituents before they can degrade. The CVOCs will take so long to reach the saturated zone that it will take centuries to reach 1.0 µg/L in groundwater given dilution, even if the CVOCs could leach through the low-permeability layer in the upper saturated zone. Detectable VOCs in monitoring wells downgradient of the landfill are more likely to originate from sources upgradient of the landfill.
- The horizontal extent of waste within the landfill was generally delineated; however, due to limitations associated with working outside the landfill perimeter (e.g., property fence and utilities outside the fence), it appears the waste extends past the fence-line at some locations.
- The full vertical extent of the waste was delineated at several locations; however, the vertical extent of the waste was not delineated at every boring location due to the limitations with the direct push drilling methodology (i.e., refusal) during the first phase of the field investigation. During the second phase of the field investigation, borings were completed using sonic methods and the full vertical extent of the waste at the central portion of the landfill was confirmed.

## Landfill L1 Investigation Summary Report

RACER Trust  
Moraine, Ohio

### 5. References

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Table 1. Vadose Zone Soil Properties Data, Landfill L1, RACER Trust, Moraine, Ohio.

Sample ID.	Depth (ft. bls.)	Moisture Content		Density		Porosity				Total Pore Fluid <sup>1</sup> Saturations % Pv	25 PSI Confining Pressure					Total Organic Carbon mg/Kg	Fraction Organic Carbon g/g	Mean Grain Size Description (mm)	Median Grain Size (mm)	Particle Size Distribution, wt. percent				Silt & Clay	Atterberg Limits <sup>3</sup>			USCS/Plasticity Chart Symbol (Fines: <#40 Sieve)	USCS Classification Group Symbol: Name	USDA/SCS <sup>4</sup> Soil Texture Scheme		
				Dry Bulk (g/cm <sup>3</sup> )	Grain (g/cm <sup>3</sup> )	Total (cm <sup>3</sup> /cm <sup>3</sup> )	Air Filled (cm <sup>3</sup> /cm <sup>3</sup> )	Water Filled (cm <sup>3</sup> /cm <sup>3</sup> )	Effective (cm <sup>3</sup> /cm <sup>3</sup> )		Effective Permeability to Air (millidarcy)	Specific Permeability to Air (millidarcy)	Specific Permeability to Water (millidarcy)	Hydraulic Conductivity (cm/s)	Intrinsic Permeability to Water (cm <sup>2</sup> )					Gravel	Sand Size				Silt	Clay	Liquid Limit				Plastic Limit	Plasticity Index
		% weight	cm <sup>3</sup> /cm <sup>3</sup>	(g/cm <sup>3</sup> )	(g/cm <sup>3</sup> )	(cm <sup>3</sup> /cm <sup>3</sup> )	(cm <sup>3</sup> /cm <sup>3</sup> )	(cm <sup>3</sup> /cm <sup>3</sup> )	(cm <sup>3</sup> /cm <sup>3</sup> )	(cm <sup>3</sup> /cm <sup>3</sup> )	(cm <sup>3</sup> /cm <sup>3</sup> )	(millidarcy)	(millidarcy)	(millidarcy)	(cm/s)	(cm <sup>2</sup> )		Coarse	Medium	Fine												
LF-36 (8-10)-G/09202012/	8-10	38.2	0.387	1.01	2.21	0.542	0.156	0.387	0.386	71.3	41.4	277	80.0	8.10E-05	7.89E-10	17800	1.78E-02	Medium Sand	0.159	20.01	5.16	15.99	19.72	NM <sup>2</sup>	NM <sup>2</sup>	39.12	4.70	N/A	Non-Plastic	NP	SM: Silty sand wih gravel	Sandy Loam
LF-36 (11-13)-G/09212012/	11-13	22.2	0.317	1.43	2.95	0.516	0.198	0.317	0.315	61.5	105	454	71.3	7.19E-05	7.04E-10	12000	1.20E-02	Gravel	1.097	36.50	5.91	21.18	19.60	NM <sup>2</sup>	NM <sup>2</sup>	16.81	21.90	N/A	Non-Plastic	NP	SM: Silty sand wih gravel	Loamy Sand
LF-36 (16-18)-G/09212012/	16-18	63.6	0.501	0.79	2.24	0.648	0.147	0.501	0.487	77.3	4.78	423	140	1.41E-04	1.38E-09	11900	1.19E-02	Silt	0.036	0.00	0.00	1.75	20.13	72.53	5.59	78.12	51.10	N/A	Non-Plastic	NP	ML: Silt with sand	Silt Loam
LF-37 (10-12)-G/09212012/	10-12	37.7	0.446	1.18	2.41	0.509	0.062	0.446	0.255	87.7	0.09	80.2	16.2	1.63E-05	1.6E-10	>34000	>3.40E-02	Medium Sand	0.243	18.60	4.83	19.20	22.38	NM <sup>2</sup>	NM <sup>2</sup>	34.99	39.80	33.10	6.70	ML	SM: Silty sand wih gravel	Sandy Loam
LF-37 (16-18)-G/09212012/	16-18	29.6	0.389	1.31	2.47	0.468	0.079	0.389	0.177	83.0	0.0	68.2	10.8	1.08E-05	1.07E-10	32300	3.23E-02	Silt	0.016	0.00	0.00	0.00	13.88	61.57	24.55	86.12	34.10	25.90	8.20	ML	ML: Silt	Silt Loam

ft. - feet  
 bls. - below land surface  
 % - percent  
 cm<sup>2</sup> - square centimeters  
 cm<sup>3</sup> - cubic centimeters  
 g - gram  
 Pv - Pore volume  
 mm - millimeter  
 mg/Kg - milligram per kilogram  
 N/A - Not Applicable  
 USCS - Unified Soil Classification System  
 USDA - US Department of Agriculture  
 SCS - Soil Conservation Service  
 1 - Water = 0.9996 g/cm<sup>3</sup>  
 2 - Mechanical sieve does not differentiate silt/clay fractions  
 3 - Silt assumed as fine fraction for Non-Plastic (NP) samples  
 4 - Sand considered to be >No. 200 sieve for USDA Soil Texture Scheme



Table 2. Saturated Zone Soil Properties Data, Landfill L1, RACER Trust, Moraine, Ohio.

Sample ID.	Depth (ft bls)	Moisture Content % weight	Density		Total Organic Carbon mg/Kg	Porosity, %Vb		Total Pore Fluid Saturations <sup>1</sup> % Pv	25 PSI Confining Stress		
			Dry Bulk	Grain		Total	Air Filled		Effective Permeability to Water (millidarcy)	Hydraulic Conductivity (cm/s)	Effective Permeability to Air (millidarcy)
			(g/cm <sup>3</sup> )	(g/cm <sup>3</sup> )							
LF-36 (37-39)-G/09212012/	37-39	7.4	1.94	2.75	NM	29.2	14.8	49.5	28.3	2.84E-05	1570
LF-37 (24-26)-G/09212012/	24-26	21.2	1.56	2.63	14000	40.5	7.3	81.9	1.59	1.60E-06	0.44
LF-37 (28-30)-G/09212012/	28-30	8.7	1.92	2.71	930 J	29.3	12.7	56.8	562	5.65E-04	3420

ft. - feet

bls. - below land surface

% - percent

cm<sup>3</sup> - cubic centimeters

g - gram

mg/Kg - milligram per kilogram

NM - Not measured

Vb - Bulk volume, cm<sup>3</sup>

Pv - Pore volume

cm/s - centimeter per second

1 - Water = 0.9996 g/cm<sup>3</sup>



Table 3. Summary of Landfill Waste Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location	Landfill L1			
	Location Code	LF-01	LF-02	LF-03	LF-3A
	Sample Label Sample Date	LF-1(2-4)-W/11142011/ 11/14/2011	LF-2(4-8)-W/11212011/ 11/21/2011	LF-3(6-8)-W/11222011/ 11/22/2011	LF-3A(0-4)-W/12142011/ 12/14/2011
<b>Volatile Organic Compounds</b>	<b>Units</b>	<b>Laboratory Analytical Results</b>			
1,1,1-Trichloroethane	ug/kg	< 14 U	< 252 U	< 236 U	< 227 U
1,1-Dichloroethane	ug/kg	93	< 252 U	< 236 U	< 227 U
1,1-Dichloroethene	ug/kg	8.1 J	< 252 U	< 236 U	< 227 U
cis-1,2-Dichloroethene	ug/kg	240	821	3460	< 227 U
Tetrachloroethene	ug/kg	< 14 U	< 252 U	< 236 U	< 227 U
trans-1,2-Dichloroethene	ug/kg	49	< 252 U	< 236 U	< 227 U
Trichloroethene	ug/kg	140	39700	2190	< 227 U
Vinyl chloride	ug/kg	250	< 101 U	< 94.6 U	< 90.8 U
Benzene	ug/kg	17	< 252 U	< 236 U	< 227 U
Toluene	ug/kg	3.0 J	< 252 U	460	< 227 U
Ethylbenzene	ug/kg	< 14 U	< 252 U	1390	< 227 U
Xylenes	ug/kg	37	< 252 U	389	< 227 U
Total CVOCs	ug/kg	780.1	40521	5650	ND
Total BTEX	ug/kg	57	ND	2239	ND

Notes:

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

R - Sample result rejected as unusable. The compound may or may not be present in the sample.

ND - Not detected.



Table 3. Summary of Landfill Waste Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location	Landfill L1			
	Location Code	LF-04	LF-05	LF-07	LF-08
	Sample Label Sample Date	LF-4(6-8)-W/12082011/ 12/8/2011	LF-5(0-4)-W/12142011/ 12/14/2011	LF-7(4-6)-W/11222011/ 11/22/2011	LF-8(2-4)-W/11142011/ 11/15/2011
<b>Volatile Organic Compounds</b>	<b>Units</b>	<b>Laboratory Analytical Results</b>			
1,1,1-Trichloroethane	ug/kg	< 262 U	< 244 UJ	< 195 U	< 7.2 U
1,1-Dichloroethane	ug/kg	< 262 U	< 244 UJ	< 195 U	3.7 J
1,1-Dichloroethene	ug/kg	< 262 U	< 244 UJ	< 195 U	< 7.2 U
cis-1,2-Dichloroethene	ug/kg	547	< 244 U	< 195 U	6.2 J
Tetrachloroethene	ug/kg	< 262 U	< 244 UJ	< 195 U	1.2 J
trans-1,2-Dichloroethene	ug/kg	345	< 244 UJ	< 195 U	< 7.2 U
Trichloroethene	ug/kg	2420	< 244 UJ	< 195 U	2.3 J
Vinyl chloride	ug/kg	< 105 U	< 97.4 U	< 78.0 U	6.3 J
Benzene	ug/kg	< 262 U	< 244 UJ	< 195 U	1.4 J
Toluene	ug/kg	< 262 U	< 244 U	< 195 U	3.8 J
Ethylbenzene	ug/kg	< 262 U	< 244 U	< 195 U	2.9 J
Xylenes	ug/kg	744	< 244 U	< 195 U	22
Total CVOCs	ug/kg	3312	ND	ND	19.7
Total BTEX	ug/kg	744	ND	ND	30.1

Notes:

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

R - Sample result rejected as unusable. The compound may or may not be present in the sample.

ND - Not detected.



Table 3. Summary of Landfill Waste Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location	Landfill L1			
	Location Code	LF-09A	LF-09A	LF-10A	LF-10A
	Sample Label Sample Date	LF-9A(4-8)-W/12092011/ 12/9/2011	LF-9A(10-12)-W/12092011/ 12/9/2011	LF-10A(8-12)-W/12122011/ 12/12/2011	LF-10A(12-16)-W/12122011/ 12/12/2011
<b>Volatile Organic Compounds</b>	<b>Units</b>				
1,1,1-Trichloroethane	ug/kg	< 6780 U	< 308 U	< 314 U	< 1150 U
1,1-Dichloroethane	ug/kg	< 6780 U	< 308 U	< 314 U	< 1150 U
1,1-Dichloroethene	ug/kg	< 6780 U	< 308 U	< 314 U	< 1150 U
cis-1,2-Dichloroethene	ug/kg	< 6780 U	< 308 U	< 314 U	3660
Tetrachloroethene	ug/kg	< 6780 U	< 308 U	< 314 U	< 1150 U
trans-1,2-Dichloroethene	ug/kg	< 6780 U	< 308 U	< 314 U	< 1150 U
Trichloroethene	ug/kg	< 6780 U	420	< 314 U	< 1150 U
Vinyl chloride	ug/kg	< 2710 U	< 123 U	< 126 U	< 459 U
Benzene	ug/kg	< 6780 U	< 308 U	< 314 U	< 1150 U
Toluene	ug/kg	< 6780 U	364	921	4340
Ethylbenzene	ug/kg	10600	438	1520	6090
Xylenes	ug/kg	63700	1820	9020	36300
Total CVOCs	ug/kg	ND	420	ND	3660
Total BTEX	ug/kg	74300	2622	11461	46730

Notes:

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

R - Sample result rejected as unusable. The compound may or may not be present in the sample.

ND - Not detected.



Table 3. Summary of Landfill Waste Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location	Landfill L1			
	Location Code	LF-11A	LF-11A	LF-12A	LF-12A
	Sample Label Sample Date	LF-11A(24-28)-W/12122011/ 12/12/2011	LF-11A(32-35)-W/12122011/ 12/12/2011	LF-12A(2-4)-W/12122011/ 12/12/2011	LF-12A(28-32)-W/12122011/ 12/12/2011
<b>Volatile Organic Compounds</b>	<b>Units</b>	<b>Laboratory Analytical Results</b>			
1,1,1-Trichloroethane	ug/kg	< 66000 U	< 928 U	< 188 U	< 1480000 U
1,1-Dichloroethane	ug/kg	< 66000 U	< 928 U	< 188 U	< 1480000 U
1,1-Dichloroethene	ug/kg	< 66000 U	< 928 U	< 188 U	< 1480000 U
cis-1,2-Dichloroethene	ug/kg	< 66000 U	12500	1360	< 1480000 U
Tetrachloroethene	ug/kg	< 66000 U	< 928 U	< 188 U	< 1480000 U
trans-1,2-Dichloroethene	ug/kg	< 66000 U	< 928 U	194	< 1480000 U
Trichloroethene	ug/kg	< 66000 U	1750	267	< 1480000 U
Vinyl chloride	ug/kg	< 26400 U	1580	185	< 594000 U
Benzene	ug/kg	< 66000 U	< 928 U	< 188 U	< 1480000 U
Toluene	ug/kg	325000	20000	223	2110000
Ethylbenzene	ug/kg	388000	23000	327	5010000
Xylenes	ug/kg	1810000	91200	1410	17900000
Total CVOCs	ug/kg	ND	15830	2006	ND
Total BTEX	ug/kg	2523000	134200	1960	25020000

Notes:

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

R - Sample result rejected as unusable. The compound may or may not be present in the sample.

ND - Not detected.



Table 3. Summary of Landfill Waste Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location	Landfill L1			
	Location Code	LF-13A	LF-14	LF-14	LF-15
	Sample Label Sample Date	LF-13A(4-8)-W/12132011/ 12/13/2011	LF-14(6-8)-W/11302011/ 11/30/2011	LF-14(20-24)-W/11302011/ 11/30/2011	LF-15(8-12)-W/12092011/ 12/9/2011
<b>Volatile Organic Compounds</b>	<b>Units</b>	<b>Laboratory Analytical Results</b>			
1,1,1-Trichloroethane	ug/kg	< 1150 U	< 248 U	< 563 U	< 570 U
1,1-Dichloroethane	ug/kg	< 1150 U	< 248 U	< 563 U	< 570 U
1,1-Dichloroethene	ug/kg	< 1150 U	< 248 U	< 563 U	< 570 U
cis-1,2-Dichloroethene	ug/kg	< 1150 U	< 248 U	1350	< 570 U
Tetrachloroethene	ug/kg	< 1150 U	< 248 U	< 563 U	< 570 U
trans-1,2-Dichloroethene	ug/kg	< 1150 U	< 248 U	< 563 U	< 570 U
Trichloroethene	ug/kg	< 1150 U	< 248 U	4260	< 570 U
Vinyl chloride	ug/kg	< 458 U	< 99.0 U	< 225 U	< 228 U
Benzene	ug/kg	< 1150 U	< 248 U	< 563 U	< 5700 U
Toluene	ug/kg	< 1150 U	3360	976	16300
Ethylbenzene	ug/kg	8560	3290	983	12100
Xylenes	ug/kg	39400	19100	5830	66500
Total CVOCs	ug/kg	ND	ND	5610	ND
Total BTEX	ug/kg	47960	25750	7789	94900

Notes:

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

R - Sample result rejected as unusable. The compound may or may not be present in the sample.

ND - Not detected.



Table 3. Summary of Landfill Waste Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location	Landfill L1			
	Location Code	LF-15	LF-16	LF-16	LF-17
	Sample Label Sample Date	LF-15(22-24)-W/12092011/ 12/9/2011	LF-16(0-2)-W/12092011/ 12/9/2011	LF-16(6-8)-W/12092011/ 12/9/2011	LF-17(10-12)-W/12052011/ 12/5/2011
<b>Volatile Organic Compounds</b>	<b>Units</b>	<b>Laboratory Analytical Results</b>			
1,1,1-Trichloroethane	ug/kg	< 252 U	< 311 U	< 613 U	< 6620 U
1,1-Dichloroethane	ug/kg	< 252 U	< 311 U	< 613 U	< 6620 U
1,1-Dichloroethene	ug/kg	< 252 U	< 311 U	< 613 U	< 6620 U
cis-1,2-Dichloroethene	ug/kg	< 252 U	< 311 U	< 613 U	< 6620 U
Tetrachloroethene	ug/kg	< 252 U	< 311 U	< 613 U	< 6620 U
trans-1,2-Dichloroethene	ug/kg	< 252 U	< 311 U	< 613 U	< 6620 U
Trichloroethene	ug/kg	< 252 U	< 311 U	< 613 U	< 6620 U
Vinyl chloride	ug/kg	< 101 U	< 124 U	< 245 U	< 2650 U
Benzene	ug/kg	< 252 U	< 311 U	< 613 U	< 6620 U
Toluene	ug/kg	1820 J	< 311 U	4170	64300
Ethylbenzene	ug/kg	620 J	421	3250	51300
Xylenes	ug/kg	2240 J	3570	17100	286000
Total CVOCs	ug/kg	ND	ND	ND	ND
Total BTEX	ug/kg	4680	3991	24520	401600

Notes:

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

R - Sample result rejected as unusable. The compound may or may not be present in the sample.

ND - Not detected.



Table 3. Summary of Landfill Waste Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location	Landfill L1				
	Location Code	LF-17	LF-17	LF-18	LF-18	LF-18
	Sample Label Sample Date	LF-17(16-18)-W/12052011/ 12/5/2011	LF-17(18-20)-W/12052011/ 12/5/2011	LF-18(0-2)-W/11182011/ 11/18/2011	LF-18(2-4)-W/11182011/ 11/18/2011	LF-18(4-8)-W/11182011/ 11/18/2011
<b>Volatile Organic Compounds</b>	<b>Units</b>	<b>Laboratory Analytical Results</b>				
1,1,1-Trichloroethane	ug/kg	< 11200 U	< 12600 U	< 525 U	< 1360 U	< 135000 U
1,1-Dichloroethane	ug/kg	< 11200 U	< 12600 U	< 525 U	< 1360 U	< 135000 U
1,1-Dichloroethene	ug/kg	< 11200 U	< 12600 U	< 525 U	< 1360 U	< 135000 U
cis-1,2-Dichloroethene	ug/kg	41700	14100	< 525 U	< 1360 U	< 135000 U
Tetrachloroethene	ug/kg	< 11200 U	< 12600 U	< 525 U	< 1360 U	< 135000 U
trans-1,2-Dichloroethene	ug/kg	< 11200 U	< 12600 U	< 525 U	< 1360 U	< 135000 U
Trichloroethene	ug/kg	20100	< 12600 U	< 525 U	< 1360 U	< 135000 U
Vinyl chloride	ug/kg	< 4460 U	< 5040 U	< 210 U	< 545 U	< 54100 U
Benzene	ug/kg	< 11200 U	< 12600 U	< 525 U	< 1360 U	< 135000 U
Toluene	ug/kg	288000	45600	2000	22000	3840000
Ethylbenzene	ug/kg	41100	< 12600 U	< 525 U	< 1360 U	967000
Xylenes	ug/kg	206000	34500	1350	14700	4140000
Total CVOCs	ug/kg	61800	14100	ND	ND	ND
Total BTEX	ug/kg	535100	80100	3350	36700	8947000

Notes:

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

R - Sample result rejected as unusable. The compound may or may not be present in the sample.

ND - Not detected.



Table 3. Summary of Landfill Waste Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location	Landfill L1			
	Location Code	LF-18	LF-18	LF-18	LF-18
	Sample Label Sample Date	LF-18(8-12)-W/11182011/ 11/18/2011	LF-18(12-14)-W/11182011/ 11/18/2011	LF-18(14-16)-W/11182011/ 11/18/2011	LF-18(16-18)-W/11182011/ 11/18/2011
<b>Volatile Organic Compounds</b>	<b>Units</b>	<b>Laboratory Analytical Results</b>			
1,1,1-Trichloroethane	ug/kg	< 147000 U	< 1270 U	< 1120 U	< 437 U
1,1-Dichloroethane	ug/kg	< 147000 U	< 1270 U	< 1120 U	< 437 U
1,1-Dichloroethene	ug/kg	< 147000 U	< 1270 U	< 1120 U	< 437 U
cis-1,2-Dichloroethene	ug/kg	< 147000 U	< 1270 U	< 1120 U	< 437 U
Tetrachloroethene	ug/kg	< 147000 U	< 1270 U	< 1120 U	< 437 U
trans-1,2-Dichloroethene	ug/kg	< 147000 U	< 1270 U	< 1120 U	< 437 U
Trichloroethene	ug/kg	< 147000 U	< 1270 U	< 1120 U	< 437 U
Vinyl chloride	ug/kg	< 58700 U	< 507 U	< 447 U	< 175 U
Benzene	ug/kg	< 147000 U	< 1270 U	< 1120 U	< 437 U
Toluene	ug/kg	15100000	36900	6310	7850
Ethylbenzene	ug/kg	1440000	10800	1940	4540
Xylenes	ug/kg	5990000	48500	8840	22800
Total CVOCS	ug/kg	ND	ND	ND	ND
Total BTEX	ug/kg	22530000	96200	17090	35190

Notes:

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

R - Sample result rejected as unusable. The compound may or may not be present in the sample.

ND - Not detected.



Table 3. Summary of Landfill Waste Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location	Landfill L1			
	Location Code	LF-18	LF-19	LF-21	LF-21
	Sample Label Sample Date	LF-18(18-20)-W/11182011/ 11/18/2011	LF-19(4-6)-W/12072011/ 12/7/2011	LF-21(6-8)-W/11292011/ 11/29/2011	LF-21(32-36)-W/11302011/ 11/30/2011
<b>Volatile Organic Compounds</b>	<b>Units</b>	<b>Laboratory Analytical Results</b>			
1,1,1-Trichloroethane	ug/kg	< 908 U	< 629 U	< 642 U	< 603 U
1,1-Dichloroethane	ug/kg	< 908 U	< 629 U	< 642 U	1270
1,1-Dichloroethene	ug/kg	< 908 U	< 629 U	< 642 U	< 603 U
cis-1,2-Dichloroethene	ug/kg	< 908 U	< 629 U	< 642 U	11700
Tetrachloroethene	ug/kg	< 908 U	< 629 U	< 642 U	< 603 U
trans-1,2-Dichloroethene	ug/kg	< 908 U	< 629 U	< 642 U	947
Trichloroethene	ug/kg	< 908 U	< 629 U	< 642 U	148000
Vinyl chloride	ug/kg	< 363 U	< 251 U	< 257 U	< 241 U
Benzene	ug/kg	< 908 U	< 629 U	< 642 U	< 603 U
Toluene	ug/kg	2650	< 629 U	11500	25500
Ethylbenzene	ug/kg	3790	< 629 U	17600	14100
Xylenes	ug/kg	17100	3300	84600	67700
Total CVOCs	ug/kg	ND	ND	ND	161917
Total BTEX	ug/kg	23540	3300	113700	107300

Notes:

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

R - Sample result rejected as unusable. The compound may or may not be present in the sample.

ND - Not detected.



Table 3. Summary of Landfill Waste Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location	Landfill L1			
	Location Code	LF-21	LF-22	LF-22	LF-23
	Sample Label Sample Date	DUP-01/11302011/ 11/30/2011	LF-22(2-4)-W/12062011/ 12/6/2011	LF-22(8-12)-W/12062011/ 12/6/2011	LF-23(12-14)-W/12062011/ 12/6/2011
<b>Volatile Organic Compounds</b>	<b>Units</b>	<b>Laboratory Analytical Results</b>			
1,1,1-Trichloroethane	ug/kg	< 631 U	< 586 U	< 262 U	< 6530 U
1,1-Dichloroethane	ug/kg	< 631 U	< 586 U	< 262 U	< 6530 U
1,1-Dichloroethene	ug/kg	< 631 U	< 586 U	< 262 U	< 6530 U
cis-1,2-Dichloroethene	ug/kg	4400	< 586 U	< 262 U	< 6530 U
Tetrachloroethene	ug/kg	< 631 U	< 586 U	< 262 U	< 6530 U
trans-1,2-Dichloroethene	ug/kg	< 631 U	< 586 U	< 262 U	< 6530 U
Trichloroethene	ug/kg	102000	< 586 U	< 262 U	< 6530 U
Vinyl chloride	ug/kg	< 252 U	< 234 U	< 105 U	< 2610 U
Benzene	ug/kg	< 631 U	< 5860 U	< 262 U	< 6530 U
Toluene	ug/kg	15500	< 5860 U	339	8060
Ethylbenzene	ug/kg	12400	7290	473	< 6530 U
Xylenes	ug/kg	61000	51500	1240	24700
Total CVOCs	ug/kg	106400	ND	ND	ND
Total BTEX	ug/kg	88900	58790	2052	32760

Notes:

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

R - Sample result rejected as unusable. The compound may or may not be present in the sample.

ND - Not detected.



Table 3. Summary of Landfill Waste Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location	Landfill L1			
	Location Code	LF-23	LF-23	LF-24	LF-25
	Sample Label Sample Date	LF-23(22-24)-W/12062011/ 12/6/2011	LF-23(28-32)-W/12062011/ 12/6/2011	LF-24(8-12)-W/12062011/ 12/6/2011	LF-25(8-12)-W/11292011/ 11/29/2011
<b>Volatile Organic Compounds</b>	<b>Units</b>	<b>Laboratory Analytical Results</b>			
1,1,1-Trichloroethane	ug/kg	< 273 UJ	< 263 U	< 6440 U	< 285 U
1,1-Dichloroethane	ug/kg	< 273 UJ	< 263 U	< 6440 U	< 285 U
1,1-Dichloroethene	ug/kg	R	< 263 U	< 6440 U	< 285 U
cis-1,2-Dichloroethene	ug/kg	727	< 263 U	< 6440 U	< 285 U
Tetrachloroethene	ug/kg	< 273 UJ	< 263 U	< 6440 U	< 285 U
trans-1,2-Dichloroethene	ug/kg	< 273 UJ	< 263 U	< 6440 U	< 285 U
Trichloroethene	ug/kg	< 273 UJ	< 263 U	< 6440 U	< 285 U
Vinyl chloride	ug/kg	< 109 U	< 105 U	< 2570 U	< 114 U
Benzene	ug/kg	<273 UJ	< 263 U	< 6440 U	< 285 U
Toluene	ug/kg	1010 J	435 J	< 6440 U	333
Ethylbenzene	ug/kg	342	< 263 U	< 6440 U	1150
Xylenes	ug/kg	1660	1310 J	18500	5830
Total CVOCs	ug/kg	727	ND	ND	ND
Total BTEX	ug/kg	3012	1745	18500	7313

Notes:

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

R - Sample result rejected as unusable. The compound may or may not be present in the sample.

ND - Not detected.



Table 3. Summary of Landfill Waste Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location	Landfill L1			
	Location Code	LF-26	LF-26	LF-27	LF-27
	Sample Label Sample Date	LF-26(2-4)-W/11292011/ 11/29/2011	LF-26(20-24.5)-W/11292011/ 11/29/2011	LF-27(4-8)-W/11292011/ 11/29/2011	LF-27(14-15.5)-W/11292011/ 11/29/2011
<b>Volatile Organic Compounds</b>	<b>Units</b>	<b>Laboratory Analytical Results</b>			
1,1,1-Trichloroethane	ug/kg	< 617 U	< 729 U	< 842 U	< 561 U
1,1-Dichloroethane	ug/kg	< 617 U	< 729 U	< 842 U	< 561 U
1,1-Dichloroethene	ug/kg	< 617 U	< 729 U	< 842 U	< 561 U
cis-1,2-Dichloroethene	ug/kg	< 617 U	< 729 U	< 842 U	< 561 U
Tetrachloroethene	ug/kg	< 617 U	< 729 U	< 842 U	< 561 U
trans-1,2-Dichloroethene	ug/kg	< 617 U	< 729 U	< 842 U	< 561 U
Trichloroethene	ug/kg	< 617 U	< 729 U	< 842 U	< 561 U
Vinyl chloride	ug/kg	< 247 U	< 292 U	< 337 U	< 224 U
Benzene	ug/kg	< 617 U	< 729 U	< 842 U	< 2800 U
Toluene	ug/kg	119000	1900	2260	3730
Ethylbenzene	ug/kg	310000	12100	5400	13800
Xylenes	ug/kg	1700000	81700	34600	158000
Total CVOCs	ug/kg	ND	ND	ND	ND
Total BTEX	ug/kg	2129000	95700	42260	175530

Notes:

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

R - Sample result rejected as unusable. The compound may or may not be present in the sample.

ND - Not detected.



Table 3. Summary of Landfill Waste Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location	Landfill L1			
	Location Code	LF-28	LF-29	LF-29A	LF-30
	Sample Label Sample Date	LF-28(4-8)-W/11282011/ 11/28/2011	LF-29(8-10)-W/11282011/ 11/28/2011	LF-29A(10-12)-W/12072011/ 12/7/2011	LF-30(2-4)-W/11162011/ 11/16/2011
<b>Volatile Organic Compounds</b>	<b>Units</b>	<b>Laboratory Analytical Results</b>			
1,1,1-Trichloroethane	ug/kg	< 597 U	< 259 U	< 248 U	< 5.8 U
1,1-Dichloroethane	ug/kg	< 597 U	< 259 U	< 248 U	< 5.8 U
1,1-Dichloroethene	ug/kg	< 597 U	< 259 U	< 248 U	< 5.8 U
cis-1,2-Dichloroethene	ug/kg	< 597 U	< 259 U	< 248 U	3.4 J
Tetrachloroethene	ug/kg	< 597 U	< 259 U	< 248 U	0.62 J
trans-1,2-Dichloroethene	ug/kg	< 597 U	< 259 U	< 248 U	< 5.8 U
Trichloroethene	ug/kg	< 597 U	< 259 U	< 248 U	14
Vinyl chloride	ug/kg	< 239 U	< 103 U	< 99.0 U	< 5.8 U
Benzene	ug/kg	< 2980 U	< 259 U	< 248 U	1.4 J
Toluene	ug/kg	54700	< 259 U	< 248 U	15
Ethylbenzene	ug/kg	82000	< 259 U	< 248 U	8.9
Xylenes	ug/kg	471000	< 259 U	< 248 U	50
Total CVOCs	ug/kg	ND	ND	ND	18.02
Total BTEX	ug/kg	607700	ND	ND	75.3

Notes:

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

R - Sample result rejected as unusable. The compound may or may not be present in the sample.

ND - Not detected.



Table 3. Summary of Landfill Waste Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location	Landfill L1				
	Location Code	LF-31	LF-32	LF-33	LF-34	LF-35
	Sample Label Sample Date	LF-31(6-8)W/11162011/ 11/16/2011	LF-32(4-6)-W/11162011/ 11/16/2011	LF-33(6-8)-W/11162011/ 11/16/2011	LF-34(4-6)-W/11162011/ 11/16/2011	LF-35(2-4)-W/11162011/ 11/16/2011
<b>Volatile Organic Compounds</b>	<b>Units</b>	<b>Laboratory Analytical Results</b>				
1,1,1-Trichloroethane	ug/kg	< 280 U	< 1500 U	< 84 U	< 61 U	< 6.4 U
1,1-Dichloroethane	ug/kg	< 280 U	< 1500 U	< 84 U	< 61 U	< 6.4 U
1,1-Dichloroethene	ug/kg	< 280 U	< 1500 U	< 84 U	< 61 U	< 6.4 U
cis-1,2-Dichloroethene	ug/kg	300	< 1500 U	12 J	< 61 U	3.5 J
Tetrachloroethene	ug/kg	< 280 U	< 1500 U	< 84 U	< 61 U	< 6.4 U
trans-1,2-Dichloroethene	ug/kg	< 280 U	< 1500 U	< 84 U	< 61 U	0.61 J
Trichloroethene	ug/kg	390	< 1500 U	32 J	5.3 J	4.5 J
Vinyl chloride	ug/kg	160 J	< 1500 U	< 84 U	< 61 U	2.6 J
Benzene	ug/kg	< 280 U	< 1500 U	< 84 U	< 61 U	< 6.4 U
Toluene	ug/kg	2400	18000	1300	6.2 J	1.8 J
Ethylbenzene	ug/kg	3900	13000	410	30 J	< 6.4 U
Xylenes	ug/kg	22000	81000	2800	200	< 13 U
Total CVOCs	ug/kg	850	ND	44	5.3	11.21
Total BTEX	ug/kg	28300	112000	4510	236.2	1.8

Notes:

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

R - Sample result rejected as unusable. The compound may or may not be present in the sample.

ND - Not detected.



Table 3. Summary of Landfill Waste Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location	Landfill L1				
	Location Code	LF-36	LF-36	LF-36	LF-37	LF-37
	Sample Label Sample Date	LF-36(8-10)-W/09192012/ 9/19/2012	LF-36(28-30)-W/09192012/ 9/19/2012	LF-36(34-36)-W/09202012/ 9/20/2012	LF-37(4-5)-W/09202012/ 9/20/2012	LF-37(10-12)-W/09202012/ 9/20/2012
<b>Volatile Organic Compounds</b>	<b>Units</b>	<b>Laboratory Analytical Results</b>				
1,1,1-Trichloroethane	ug/kg	< 3800 UJ	< 6.2 U	< 5.4 U	< 16 U	< 42 U
1,1-Dichloroethane	ug/kg	< 3800 UJ	< 6.2 U	< 5.4 U	2.8 J	< 42 U
1,1-Dichloroethene	ug/kg	< 3800 UJ	2.1 J	< 5.4 U	< 16 U	< 42 U
cis-1,2-Dichloroethene	ug/kg	640 J	55	23 J	240	65
Tetrachloroethene	ug/kg	< 3800 UJ	< 6.2 U	< 5.4 U	210	840
trans-1,2-Dichloroethene	ug/kg	< 3800 UJ	6.9	1.2 J	< 16 U	< 42 U
Trichloroethene	ug/kg	1800 J	23	70 J	130	320
Vinyl chloride	ug/kg	< 3800 UJ	6.2	1.7 J	< 16 U	4.7 J
Benzene	ug/kg	< 3800 UJ	2.1 J	1.5 J	9.3 J	12 J
Toluene	ug/kg	38000 J	7.6	92 J	270	540
Ethylbenzene	ug/kg	35000 J	6.9	55 J	140	440
Xylenes	ug/kg	190000 J	68	190 J	1200	3300
Total CVOCs	ug/kg	2440	93.2	95.9	582.8	1229.7
Total BTEX	ug/kg	263000	84.6	338.5	1619.3	4292

Notes:

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

R - Sample result rejected as unusable. The compound may or may not be present in the sample.

ND - Not detected.



Table 3. Summary of Landfill Waste Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location	Landfill L1		
	Location Code	LF-37	LF-37	LF-37
	Sample Label Sample Date	LF-37(16-18)-W/09202012/ 9/20/2012	LF-37(24-26)-W/09202012/ 9/20/2012	LF-37(26-28)-W/09202012/ 9/20/2012
<b>Volatile Organic Compounds</b>	<b>Units</b>	<b>Laboratory Analytical Results</b>		
1,1,1-Trichloroethane	ug/kg	< 6200 UJ	< 280 U	< 71 U
1,1-Dichloroethane	ug/kg	< 6200 UJ	< 280 U	< 71 U
1,1-Dichloroethene	ug/kg	< 6200 UJ	< 280 U	< 71 U
cis-1,2-Dichloroethene	ug/kg	38000 J	6400	510
Tetrachloroethene	ug/kg	< 6200 UJ	< 280 U	< 71 U
trans-1,2-Dichloroethene	ug/kg	< 6200 UJ	58 J	< 71 U
Trichloroethene	ug/kg	100000 J	57 J	110
Vinyl chloride	ug/kg	< 6200 UJ	200 J	31 J
Benzene	ug/kg	< 6200 UJ	100 J	14 J
Toluene	ug/kg	230000 J	7800	1800
Ethylbenzene	ug/kg	95000 J	640	180
Xylenes	ug/kg	420000 J	3400	1100
Total CVOCs	ug/kg	138000	6715	651
Total BTEX	ug/kg	745000	11940	3094

Notes:

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

R - Sample result rejected as unusable. The compound may or may not be present in the sample.

ND - Not detected.



Table 4. Summary of Native Soil Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location	Landfill L1			
	Location Code Sample Label Sample Date	LF-01 LF-1(4-6)-S/11142011/ 11/14/2011	LF-02 LF-2(12-14)-S/11212011/ 11/21/2011	LF-03 LF-3(12-14)-S/11222011/ 11/22/2011	LF-04 LF-4(12-16)-S/12082011/ 12/8/2011
<b>Volatile Organic Compounds</b>	<b>Units</b>	<b>Laboratory Analytical Results</b>			
1,1,1-Trichloroethane	ug/kg	< 6.0 U	< 240 U	< 239 U	< 222 U
1,1-Dichloroethane	ug/kg	< 6.0 U	< 240 U	< 239 U	< 222 U
1,1-Dichloroethene	ug/kg	< 6.0 U	< 240 U	< 239 U	< 222 U
cis-1,2-Dichloroethene	ug/kg	2.2 J	< 240 U	< 239 U	< 222 U
Tetrachloroethene	ug/kg	1.3 J	< 240 U	< 239 U	< 222 U
trans-1,2-Dichloroethene	ug/kg	< 6.0 U	< 240 U	< 239 U	< 222 U
Trichloroethene	ug/kg	8.9	< 240 U	< 239 U	< 222 U
Vinyl chloride	ug/kg	< 6.0 U	< 95.9 U	< 95.5 U	< 88.8 U
Benzene	ug/kg	< 6.0 U	< 240 U	< 239 U	< 222 U
Toluene	ug/kg	< 6.0 U	< 240 U	< 239 U	< 222 U
Ethylbenzene	ug/kg	< 6.0 U	< 240 U	< 239 U	< 222 U
Xylenes	ug/kg	< 12 U	< 240 U	< 239 U	< 222 U
Total CVOCs	ug/kg	12.4	ND	ND	ND
Total BTEX	ug/kg	ND	ND	ND	ND

**Notes:**

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

ND - Not detected.



Table 4. Summary of Native Soil Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location	Landfill L1		
	Location Code Sample Label Sample Date	LF-05 LF-5(6-8)-S/12142011/ 12/14/2011	LF-06 LF-6(6-8)-S/12082011/ 12/8/2011	LF-06 LF-6(8-10)-S/12082011/ 12/8/2011
<b>Volatile Organic Compounds</b>	<b>Units</b>			
1,1,1-Trichloroethane	ug/kg	< 225 U	< 268 U	< 222 U
1,1-Dichloroethane	ug/kg	< 225 U	< 268 U	< 222 U
1,1-Dichloroethene	ug/kg	< 225 U	< 268 U	< 222 U
cis-1,2-Dichloroethene	ug/kg	< 225 U	< 268 U	< 222 U
Tetrachloroethene	ug/kg	< 225 U	< 268 U	< 222 U
trans-1,2-Dichloroethene	ug/kg	< 225 U	< 268 U	< 222 U
Trichloroethene	ug/kg	< 225 U	< 268 U	< 222 U
Vinyl chloride	ug/kg	< 90.0 U	< 107 U	< 89.0 U
Benzene	ug/kg	< 225 U	< 268 U	< 222 U
Toluene	ug/kg	< 225 U	< 268 U	< 222 U
Ethylbenzene	ug/kg	< 225 U	< 268 U	< 222 U
Xylenes	ug/kg	< 225 U	< 268 U	< 222 U
Total CVOCs	ug/kg	ND	ND	ND
Total BTEX	ug/kg	ND	ND	ND

Notes:

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

ND - Not detected.



Table 4. Summary of Native Soil Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location	Landfill L1			
	Location Code Sample Label Sample Date	LF-07 LF-7(11-12)-S/11222011/ 11/22/2011	LF-08 LF-8(10-12)-S/11152011/ 11/15/2011	LF-13 LF-13(28-30)-S/11172011/ 11/17/2011	LF-18 LF-18(20-22)-S/11182011/ 11/18/2011
<b>Volatile Organic Compounds</b>	<b>Units</b>	<b>Laboratory Analytical Results</b>			
1,1,1-Trichloroethane	ug/kg	< 220 U	< 5.3 U	< 217 U	< 597 U
1,1-Dichloroethane	ug/kg	< 220 U	< 5.3 U	< 217 U	< 597 U
1,1-Dichloroethene	ug/kg	< 220 U	< 5.3 U	< 217 U	< 597 U
cis-1,2-Dichloroethene	ug/kg	< 220 U	0.81 J	< 217 U	< 597 U
Tetrachloroethene	ug/kg	< 220 U	4.4 J	< 217 U	896
trans-1,2-Dichloroethene	ug/kg	< 220 U	< 5.3 U	< 217 U	< 597 U
Trichloroethene	ug/kg	< 220 U	8.4	< 217 U	< 597 U
Vinyl chloride	ug/kg	< 88.0 U	< 5.3 U	< 86.7 U	< 239 U
Benzene	ug/kg	< 220 U	< 5.3 U	< 217 U	< 597 U
Toluene	ug/kg	< 220 U	4.0 J	< 217 U	105000
Ethylbenzene	ug/kg	< 220 U	39	< 217 U	76300
Xylenes	ug/kg	< 220 U	60	< 217 U	372000
Total CVOCs	ug/kg	ND	5.21	ND	896
Total BTEX	ug/kg	ND	4.0	ND	553300

**Notes:**

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

ND - Not detected.



Table 4. Summary of Native Soil Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Landfill L1				
	Location	Landfill L1			
	Location Code Sample Label Sample Date	LF-18 LF-18(22-24)-S/11182011/ 11/18/2011	LF-19 LF-19(12-14)-S/12072011/ 12/7/2011	LF-24 LF-24(26-28)-S/12062011/ 12/6/2011	LF-25 LF-25(24-28)-S/11292011/ 11/29/2011
<b>Volatile Organic Compounds</b>	<b>Units</b>	<b>Laboratory Analytical Results</b>			
1,1,1-Trichloroethane	ug/kg	< 278 U	< 225 U	< 273 U	< 225 U
1,1-Dichloroethane	ug/kg	< 278 U	< 225 U	< 273 U	< 225 U
1,1-Dichloroethene	ug/kg	< 278 U	< 225 U	< 273 U	< 225 U
cis-1,2-Dichloroethene	ug/kg	< 278 U	< 225 U	< 273 U	< 225 U
Tetrachloroethene	ug/kg	< 278 U	< 225 U	< 273 U	< 225 U
trans-1,2-Dichloroethene	ug/kg	< 278 U	< 225 U	< 273 U	< 225 U
Trichloroethene	ug/kg	< 278 U	< 225 U	< 273 U	< 225 U
Vinyl chloride	ug/kg	< 111 U	< 90.0 U	< 109 U	< 89.9 U
Benzene	ug/kg	< 278 U	< 225 U	< 273 U	< 225 U
Toluene	ug/kg	< 278 U	< 225 U	< 273 U	< 225 U
Ethylbenzene	ug/kg	312	< 225 U	1610	< 225 U
Xylenes	ug/kg	2240	< 225 U	7450	< 225 U
Total CVOCs	ug/kg	ND	ND	ND	ND
Total BTEX	ug/kg	2552	ND	7450	ND

**Notes:**

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

ND - Not detected.



Table 4. Summary of Native Soil Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Landfill L1				
	Location				
	Location Code Sample Label Sample Date	LF-28 LF-28(24-28)-S/11282011/ 11/28/2011	LF-29 LF-29(14-16)-S/11282011/ 11/28/2011	LF-29A LF-29A(16-18)-W/12072011/ 12/7/2011	LF-30 LF-30(8-10)-S/11162011/ 11/16/2011
<b>Volatile Organic Compounds</b>	<b>Units</b>	<b>Laboratory Analytical Results</b>			
1,1,1-Trichloroethane	ug/kg	< 227 U	< 217 U	< 213 U	< 5.3 U
1,1-Dichloroethane	ug/kg	< 227 U	< 217 U	< 213 U	< 5.3 U
1,1-Dichloroethene	ug/kg	< 227 U	< 217 U	< 213 U	< 5.3 U
cis-1,2-Dichloroethene	ug/kg	< 227 U	< 217 U	< 213 U	4.2 J
Tetrachloroethene	ug/kg	< 227 U	< 217 U	< 213 U	6.2
trans-1,2-Dichloroethene	ug/kg	< 227 U	< 217 U	< 213 U	< 5.3 U
Trichloroethene	ug/kg	< 227 U	< 217 U	< 213 U	41
Vinyl chloride	ug/kg	< 90.9 U	< 87.0 U	< 85.1 U	< 5.3 U
Benzene	ug/kg	< 227 U	< 217 U	< 213 U	< 5.3 U
Toluene	ug/kg	< 227 U	< 217 U	< 213 U	0.72 J
Ethylbenzene	ug/kg	< 227 U	< 217 U	< 213 U	< 5.3 U
Xylenes	ug/kg	< 227 U	< 217 U	< 213 U	< 11 U
Total CVOCs	ug/kg	ND	ND	ND	4.2
Total BTEX	ug/kg	ND	ND	ND	0.72

**Notes:**

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

ND - Not detected.



Table 4. Summary of Native Soil Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location	Landfill L1				
	Location Code Sample Label Sample Date	LF-31 LF-31(8-10)-S/11162011/ 11/16/2011	LF-32 LF-32(12-14)-S/11162011/ 11/16/2011	LF-33 LF-33(12-14)-S/11162011/ 11/16/2011	LF-34 LF-34(14-16)-S/11162011/ 11/16/2011	LF-35 LF-35(6-8)-S/11162011/ 11/16/2011
<b>Volatile Organic Compounds</b>	<b>Units</b>	<b>Laboratory Analytical Results</b>				
1,1,1-Trichloroethane	ug/kg	< 6.5 U	< 63 U	< 6.3 U	< 6.2 U	< 6.0 U
1,1-Dichloroethane	ug/kg	< 6.5 U	< 63 U	< 6.3 U	< 6.2 U	< 6.0 U
1,1-Dichloroethene	ug/kg	< 6.5 U	< 63 U	< 6.3 U	< 6.2 U	< 6.0 U
cis-1,2-Dichloroethene	ug/kg	14	210	3.2 J	< 6.2 U	< 6.0 U
Tetrachloroethene	ug/kg	< 6.5 U	24 J	< 6.3 U	< 6.2 U	< 6.0 U
trans-1,2-Dichloroethene	ug/kg	< 6.5 U	< 63 U	< 6.3 U	< 6.2 U	< 6.0 U
Trichloroethene	ug/kg	2.7 J	58 J	4.3 J	0.64 J	4.1 J
Vinyl chloride	ug/kg	< 6.5 U	< 63 U	< 6.3 U	< 6.2 U	< 6.0 U
Benzene	ug/kg	< 6.5 U	< 63 U	< 6.3 U	< 6.2 U	< 6.0 U
Toluene	ug/kg	9.3	650	4.0 J	< 6.2 U	< 6.0 U
Ethylbenzene	ug/kg	23	310	2.0 J	< 6.2 U	< 6.0 U
Xylenes	ug/kg	120	2000	14	1.2 J	< 12 U
Total CVOCs	ug/kg	2.7	82	7.5	0.64	4.1
Total BTEX	ug/kg	152.3	2960	6.0	1.2	ND

**Notes:**

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

ND - Not detected.



Table 4. Summary of Native Soil Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location		Landfill L1	
	Location Code	LF-36	LF-37	
	Sample Label Sample Date	LF-36(37-39)-S/09192012/ 9/19/2012	LF-37(28-30)-S/09202012/ 9/19/2012	
Volatile Organic Compounds	Units	Laboratory Analytical Results		
1,1,1-Trichloroethane	ug/kg	< 5.4 U	< 5.5 U	
1,1-Dichloroethane	ug/kg	< 5.4 U	< 5.5 U	
1,1-Dichloroethene	ug/kg	< 5.4 U	< 5.5 U	
cis-1,2-Dichloroethene	ug/kg	1.6 J	11	
Tetrachloroethene	ug/kg	< 5.4 U	< 5.5 U	
trans-1,2-Dichloroethene	ug/kg	< 5.4 U	< 5.5 U	
Trichloroethene	ug/kg	1.9 J	8.5	
Vinyl chloride	ug/kg	< 5.4 U	1.1 J	
Benzene	ug/kg	< 5.4 U	0.67 J	
Toluene	ug/kg	5.7	17	
Ethylbenzene	ug/kg	3.0 J	110	
Xylenes	ug/kg	16	480	
Total CVOCs	ug/kg	3.5	20.60	
Total BTEX	ug/kg	24.7	607.67	

Notes:

ug/kg - Micrograms per kilogram.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

ND - Not detected.



Table 5. Summary of Groundwater Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location		Landfill L1			
	Location Code		LF-01	LF-02	LF-03	LF-05
	Sample Label	Sample Date	LF-1(22-24)-GW/11142011/ 11/14/2011	LF-2(26-28)-GW/11212011/ 11/21/2011	LF-3(26-28)-GW/11222011/ 11/22/2011	LF-5(22-24)-GW/12142011/ 12/14/2011
Volatile Organic Compounds	Units	MCL	Laboratory Analytical Results			
1,1,1-Trichloroethane	ug/L	200	< 1.0 U	< 1.0 U	< 1.4 U	< 1.0 U
1,1-Dichloroethane	ug/L	NA	3.8	5.9	6.5	3.3
1,1-Dichloroethene	ug/L	7	< 1.0 U	< 1.0 U	< 1.4 U	< 1.0 U
cis-1,2-Dichloroethene	ug/L	70	3.1	4.1	32	2.7
Tetrachloroethene	ug/L	5	< 1.0 U	< 1.0 U	1.2 J	1.9
trans-1,2-Dichloroethene	ug/L	100	0.47 J	0.44 J	0.65 J	< 1.0 U
Trichloroethene	ug/L	5	0.75 J	<b>6.9</b>	<b>14</b>	<b>21</b>
Vinyl chloride	ug/L	2	1	0.29 J	<b>2.1</b>	< 1.0 U
Benzene	ug/L	5	< 1.0 U	0.26 J	0.42 J	< 1.0 U
Toluene	ug/L	1000	0.17 J	0.24 J	0.27 J	< 1.0 UB
Ethylbenzene	ug/L	700	< 1.0 U	< 1.0 U	< 1.4 U	< 1.0 U
Xylenes	ug/L	10,000	< 2.0 U	< 2.0 U	< 2.9 U	< 2.0 U
Total CVOCs	ug/L	NA	9.12	17.63	56.45	28.9
Total BTEX	ug/L	NA	0.17	0.5	0.69	ND
Methane	ug/L	NA	8200	6900	5000	1400

Notes:

ug/L - Micrograms per Liter.

MCL - United States Environmental Protection Agency, Maximum Contaminant Level.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

NA - No action level.

ND - Not detected.

NS - Not sampled



Table 5. Summary of Groundwater Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location		Landfill L1			
	Location Code		LF-07	LF-19	LF-29A	LF-35
	Sample Label	Sample Date	LF-7(26-28)-GW/11222011/ 11/22/2011	LF-19(22-24)-GW/12072011/ 12/7/2011	LF-29A(24-26)-GW/12072011/ 12/7/2011	LF-35(20-22)-GW/11162011/ 11/16/2011
Volatile Organic Compounds	Units	MCL	Laboratory Analytical Results			
1,1,1-Trichloroethane	ug/L	200	< 1.0 U	0.28 J	< 1.0 U	< 1.0 U
1,1-Dichloroethane	ug/L	NA	0.70 J	1	< 1.0 U	0.40 J
1,1-Dichloroethene	ug/L	7	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
cis-1,2-Dichloroethene	ug/L	70	2.1	8.3	1.7	0.90 J
Tetrachloroethene	ug/L	5	2.2	2.4	0.61 J	5.1
trans-1,2-Dichloroethene	ug/L	100	< 1.0 U	2.2	< 1.0 U	< 1.0 U
Trichloroethene	ug/L	5	10	37	10	10
Vinyl chloride	ug/L	2	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Benzene	ug/L	5	< 1.0 U	< 1.0 U	0.15 J	< 1.0 U
Toluene	ug/L	1000	0.38 J	< 1.0 UB	< 1.0 UB	0.36 J
Ethylbenzene	ug/L	700	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Xylenes	ug/L	10,000	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U
Total CVOCs	ug/L	NA	15	51.18	12.31	16.4
Total BTEX	ug/L	NA	3.58	6.2	24.15	130.36
Methane	ug/L	NA	3.2	6.2	24	130

Notes:

ug/L - Micrograms per Liter.

MCL - United States Environmental Protection Agency, Maximum Contaminant Level.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

NA - No action level.

ND - Not detected.

NS - Not sampled



Table 5. Summary of Groundwater Sampling Results, Landfill L1, RACER Trust, Moraine, Ohio.

	Location		Landfill L1	
	Location Code		LF-36	LF-37
	Sample Label		LF-36(37-42)-GW/09202012/ 9/20/2012	LF-37(28-33)-GW/09212012/ 9/21/2012
<b>Volatile Organic Compounds</b>	<b>Units</b>	<b>MCL</b>		
1,1,1-Trichloroethane	ug/L	200	< 1.0 U	< 11 U
1,1-Dichloroethane	ug/L	NA	0.40 J	< 11 U
1,1-Dichloroethene	ug/L	7	< 1.0 U	< 11 U
cis-1,2-Dichloroethene	ug/L	70	0.65 J	<b>170</b>
Tetrachloroethene	ug/L	5	< 1.0 U	< 11 U
trans-1,2-Dichloroethene	ug/L	100	0.50 J	< 11 U
Trichloroethene	ug/L	5	0.65 J	<b>55</b>
Vinyl chloride	ug/L	2	0.23 J	<b>4.0 J</b>
Benzene	ug/L	5	2.3	<b>5.6 J</b>
Toluene	ug/L	1000	0.31 J	260
Ethylbenzene	ug/L	700	7.8	120
Xylenes	ug/L	10,000	9.3	630
Total CVOCs	ug/L	NA	2.43	229
Total BTEX	ug/L	NA	19.71	1015.6
Methane	ug/L	NA	NS	NS

Notes:

ug/L - Micrograms per Liter.

MCL - United States Environmental Protection Agency, Maximum Contaminant Level.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

NA - No action level.

ND - Not detected.

NS - Not sampled



Table 6. Site-Specific VOC, Methane, and Helium Soil Gas Results, Landfill L1, RACER Trust, Moraine, Ohio.

Volatile Organic Compounds	Location		Landfill L1				
	Location Code	LF-SGP-1	LF-SGP-1	LF-SGP-3A	LF-SGP-3A	LF-SGP-5	
	Sample Label Sample Date	LF-SGP-1(4.88-9.88)-SG/12232011/ 12/23/2011	LF-SGP-1(17.17-17.67)-SG/12232011/ 12/23/2011	LF-SGP-3A(7.08-12.08)-SG/12222011/ 12/22/2011	LF-SGP-3A(14.75-15.25)-SG/12222011/ 12/22/2011	LF-SGP-5(7.08-12.08)-SG/12222011/ 12/22/2011	
Units	Laboratory Analytical Results						
1,1,1-Trichloroethane	ppbv	3.8 J	4.4	< 16 U	0.60 J	3.3 J	
1,1-Dichloroethane	ppbv	650	280	1800	490	13	
1,1-Dichloroethene	ppbv	82	37	64	< 2.2 U	< 3.4 U	
cis-1,2-Dichloroethene	ppbv	620	370	1100	150	14	
Tetrachloroethene	ppbv	140	200	< 19 UB	66	67	
trans-1,2-Dichloroethene	ppbv	120	49	320	1.9 J	< 3.4 U	
Trichloroethene	ppbv	1100	1200	220	230	1200	
Vinyl chloride	ppbv	3300	1100	4800	3	< 3.4 U	
Benzene	ppbv	34	2.7 J	110	0.97 J	1.7 J	
Toluene	ppbv	< 11 UB	0.95 J	14 J	1.3 J	0.85 J	
Ethylbenzene	ppbv	< 11 U	< 4.1 U	< 16 U	< 2.2 U	< 3.4 U	
Xylenes (total)	ppbv	9.9	< 4.1 U	6.4	< 2.2 U	< 3.4 U	
Total CVOCs	ppbv	6015.8	3240.4	8304	941.5	1297.3	
Total BTEX	ppbv	43.9	3.65	130.4	2.27	2.55	
Methane	%	13	7.4	4.6	0.0015	0.000077 J	
Helium	%	NA	NA	0.080	NA	NA	

Notes:

ppbv - Parts per billion by volume.

% - Percent

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

B - The chemical of concern has been found in the sample as well as its associated blank.

UB - Chemical of concern considered non-detect at the listed value due to associated blank contamination.

UJ - The chemical of concern was not detected above the reported sample quantitation limit. However, the reported limit is approximate and may or may not represent the actual limit of quantitation.

J - Value estimated.

NA - Not analyzed.

ND - Not detected.



Table 6. Site-Specific VOC, Methane, and Helium Soil Gas Results, Landfill L1, RACER Trust, Moraine, Ohio.

Volatile Organic Compounds	Location		Landfill L1			
	Location Code	LF-SGP-5	LF-SGP-7A	LF-SGP-7A	LF-SGP-7A	
	Sample Label Sample Date	LF-SGP-5(14.75-15.25)-SG/12222011/ 12/22/2011	LF-SGP-7A(8.1-13.1)-SG/12222011/ 12/22/2011	LF-SGP-DUP-1/12222011/ 12/22/2011	LF-SGP-7A(16.8-17.3)-SG/12222011/ 12/22/2011	
Units	Laboratory Analytical Results					
1,1,1-Trichloroethane	ppbv	4.0 J	7.5	7.8	11	
1,1-Dichloroethane	ppbv	32	2.6	3	11	
1,1-Dichloroethene	ppbv	< 4.8 U	< 0.80 U	< 0.84 U	< 1.7 U	
cis-1,2-Dichloroethene	ppbv	37	2	2.1	13	
Tetrachloroethene	ppbv	94	48	50	100	
trans-1,2-Dichloroethene	ppbv	< 4.8 U	0.86	0.85	2.6	
Trichloroethene	ppbv	1500	270	280	530	
Vinyl chloride	ppbv	< 4.8 U	< 0.80 U	< 0.84 U	1.0 J	
Benzene	ppbv	1.1 J	0.57 J	0.67 J	0.81 J	
Toluene	ppbv	1.5 J	0.53 J	0.39 J	0.70 J	
Ethylbenzene	ppbv	< 4.8 U	< 0.80 U	< 0.84 U	< 1.7 U	
Xylenes (total)	ppbv	< 4.8 U	0.22	0.18	< 1.7 U	
Total CVOCs	ppbv	1667	330.96	343.75	668.6	
Total BTEX	ppbv	2.6	1.32	1.24	1.51	
Methane	%	0.00014 J	0.000097 J	0.00010 J	0.00011 J	
Helium	%	NA	NA	NA	NA	

Notes:

ppbv - Parts per billion by volume.

% - Percent

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

B - The chemical of concern has been found in the sample as well as its associated blank.

UB - Chemical of concern considered non-detect at the listed value due to associated blank contamination.

UJ - The chemical of concern was not detected above the reported sample quantitation limit. However, the reported limit is approximate and may or may not represent the actual limit of quantitation.

J - Value estimated.

NA - Not analyzed.

ND - Not detected.



Table 6. Site-Specific VOC, Methane, and Helium Soil Gas Results, Landfill L1, RACER Trust, Moraine, Ohio.

Volatile Organic Compounds	Location		Landfill L1			
	Location Code	LF-SGP-13A	LF-SGP-15A	LF-SGP-19	LF-SGP-19	
	Sample Label Sample Date	LF-SGP-13A(7.0-12.0)-SG/12222011/ 12/22/2011	LF-SGP-15A(6.0-11.0)-SG/12222011/ 12/22/2011	LF-SGP-19(12.71-17.71)-SG/12232011/ 12/23/2011	LF-SGP-19(19.58-20.08)-SG/12232011/ 12/23/2011	
Units	Laboratory Analytical Results					
1,1,1-Trichloroethane	ppbv	< 28 U	< 410 U	12	17	
1,1-Dichloroethane	ppbv	< 28 U	740	26	31	
1,1-Dichloroethene	ppbv	< 28 U	< 410 U	< 8.2 U	< 8.3 U	
cis-1,2-Dichloroethene	ppbv	< 28 U	14000	2300	170	
Tetrachloroethene	ppbv	< 28 U	< 410 U	58	91	
trans-1,2-Dichloroethene	ppbv	< 28 U	< 410 U	810	140	
Trichloroethene	ppbv	89	150 J	1700	1400	
Vinyl chloride	ppbv	370	11000	50	47	
Benzene	ppbv	750	2000	14	< 8.3 U	
Toluene	ppbv	130	97000	6.0 J	< 8.3 UB	
Ethylbenzene	ppbv	1500	15000	< 8.2 U	< 8.3 U	
Xylenes (total)	ppbv	6320.00	63000.00	4.10	< 8.3 U	
Total CVOCs	ppbv	459	25890	4956	1896	
Total BTEX	ppbv	8700	177000	24.1	ND	
Methane	%	9.8	14	0.0097	0.00026	
Helium	%	0.082	0.082	NA	NA	

Notes:

ppbv - Parts per billion by volume.

% - Percent

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

B - The chemical of concern has been found in the sample as well as its associated blank.

UB - Chemical of concern considered non-detect at the listed value due to associated blank contamination.

UJ - The chemical of concern was not detected above the reported sample quantitation limit. However, the reported limit is approximate and may or may not represent the actual limit of quantitation.

J - Value estimated.

NA - Not analyzed.

ND - Not detected.



Table 6. Site-Specific VOC, Methane, and Helium Soil Gas Results, Landfill L1, RACER Trust, Moraine, Ohio.

Volatile Organic Compounds	Location		Landfill L1			
	Location Code	LF-SGP-29A	LF-SGP-29A	LF-SGP-35	LF-SGP-35	
	Sample Label	LF-SGP-29A(12.33-17.33)-SG/12232011/ Sample Date 12/23/2011	LF-SGP-29A(18.92-19.42)-SG/12232011/ 12/23/2011	LF-SGP-35(7-12)-SG/12232011/ 12/23/2011	LF-SGP-35(14.92-15.42)-SG/12232011/ 12/23/2011	
Units	Laboratoy Analytical Results					
1,1,1-Trichloroethane	ppbv	27	6.3	16	20	
1,1-Dichloroethane	ppbv	22	15	5.1	7.6	
1,1-Dichloroethene	ppbv	2.8	< 1.7 U	< 4.4 U	< 5.6 U	
cis-1,2-Dichloroethene	ppbv	25	12	92	83	
Tetrachloroethene	ppbv	23	14	50	95	
trans-1,2-Dichloroethene	ppbv	3.7	1.2 J	11	9.7	
Trichloroethene	ppbv	220	61	1400	1600	
Vinyl chloride	ppbv	13	12	1.9 J	4.1 J	
Benzene	ppbv	2.9	6.4	1.9 J	< 5.6 U	
Toluene	ppbv	9.4	140	5.2	< 5.6 U	
Ethylbenzene	ppbv	3.8	68	1.6 J	< 5.6 U	
Xylenes (total)	ppbv	19.00	690.00	8.20	< 5.6 U	
Total CVOCs	ppbv	336.5	121.5	1576	1819.4	
Total BTEX	ppbv	35.1	904.4	16.9	ND	
Methane	%	0.48	0.18	0.00034	0.00025	
Helium	%	NA	NA	NA	NA	

Notes:

ppbv - Parts per billion by volume.

% - Percent

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

B - The chemical of concern has been found in the sample as well as its associated blank.

UB - Chemical of concern considered non-detect at the listed value due to associated blank contamination.

UJ - The chemical of concern was not detected above the reported sample quantitation limit. However, the reported limit is approximate and may or may not represent the actual limit of quantitation.

J - Value estimated.

NA - Not analyzed.

ND - Not detected.



Table 7. Ambient Air Results, Landfill L1, RACER Trust, Moraine, Ohio.

Volatile Organic Compounds	Location		Landfill L1	
	Location Code	Sample Label	AA-LF-1	AA-LF-2
	Sample Date	Sample Date	AA-LF-1/10042012/ 10/5/2012	AA-LF-2/10042012/ 10/5/2012
Units	Action Level*	Laboratory Analytical Results		
1,1,1-Trichloroethane	ppbv	955	< 0.18 U	< 0.20 U
1,1-Dichloroethane	ppbv	3.8	< 0.18 U	< 0.20 U
1,1-Dichloroethene	ppbv	53	< 0.18 U	< 0.20 U
cis-1,2-Dichloroethene	ppbv	NA	< 0.18 U	< 0.20 U
Tetrachloroethene	ppbv	6.2	< 0.18 U	0.032 J
trans-1,2-Dichloroethene	ppbv	15.79	< 0.18 U	< 0.20 U
Trichloroethene	ppbv	0.39	0.13 J	0.088 J
Vinyl chloride	ppbv	0.63	< 0.18 U	< 0.20 U
Benzene	ppbv	0.97	0.34	0.63
Toluene	ppbv	1380	0.91	0.81
Ethylbenzene	ppbv	2.2	0.093 J	0.10 J
Xylenes (total)	ppbv	23	0.48	0.422
Total CVOCs	ppbv	NA	0.13	0.12
Total BTEX	ppbv	NA	1.82	1.96

Notes:

ppbv - Parts per billion by volume.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

NA - Not available or not applicable.

\* - Action Levels were based on May 2012 U.S. EPA Regional Screening Levels for residential indoor air.



Table 8. Dry Well Results, Landfill L1, RACER Trust, Moraine, Ohio.

Volatile Organic Compounds	Location		Landfill L1		
	Location Code	Sample Label	DW-1	DW-1	DW-2
	Sample Date	Sample Date	DW-1/10042012/ 10/5/2012	DW-DUP-1/10042012/ 10/5/2012	DW-2/10042012/ 10/5/2012
Units	Action Level*	Laboratory Analytical Results			
1,1,1-Trichloroethane	ppbv	95,500	< 0.17 U	< 0.18 U	< 1.9 U
1,1-Dichloroethane	ppbv	380	< 0.17 U	< 0.18 U	< 1.9 U
1,1-Dichloroethene	ppbv	5300	< 0.17 U	< 0.18 U	< 1.9 U
cis-1,2-Dichloroethene	ppbv	Not Available	< 0.17 U	< 0.18 U	< 1.9 U
Tetrachloroethene	ppbv	620	0.031 J	0.035 J	< 1.9 U
trans-1,2-Dichloroethene	ppbv	1579	< 0.17 U	< 0.18 U	< 1.9 U
Trichloroethene	ppbv	39	0.41	0.42	< 1.9 U
Vinyl chloride	ppbv	63	< 0.17 U	< 0.18 U	< 1.9 U
Benzene	ppbv	100	0.52	0.41	1.8 J
Toluene	ppbv	137990	9.2	1.1	0.82 J
Ethylbenzene	ppbv	220	0.15 J	0.15 J	< 1.9 U
Xylenes (total)	ppbv	2300	0.76	0.63	0.28 J
Total CVOCs	ppbv	Not Available	0.441	0.455	ND
Total BTEX	ppbv	Not Available	9.87	1.66	2.90

Notes:

ppbv - Parts per billion by volume.

< - Chemical of concern not detected above laboratory reporting limit shown.

U - Chemical of concern not detected above laboratory reporting limit shown.

J - Value estimated.

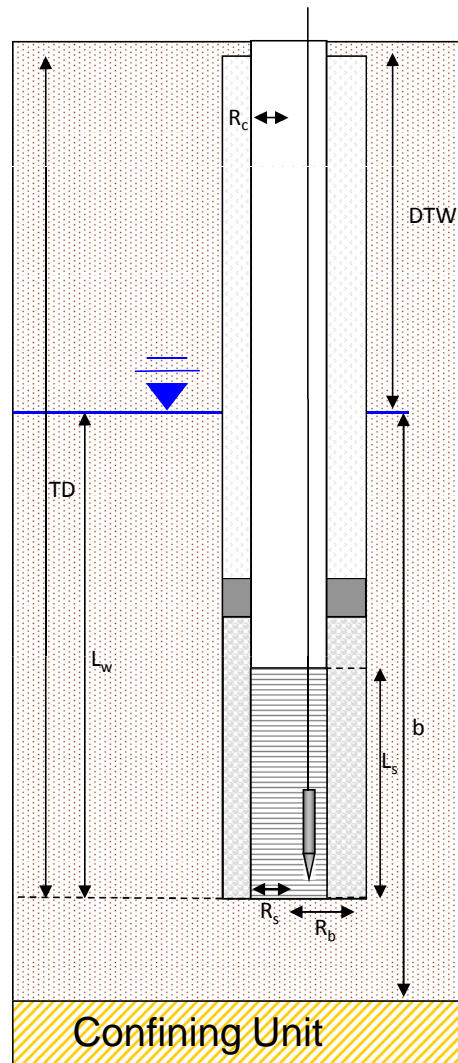
ND - Not detected.

\* - Action Levels were based on May 2012 U.S. EPA Regional Screening Levels for soil-gas in a residential area.

Table 9. Pneumatic Slug Test Results, Landfill L1, RACER Trust, Moraine, Ohio.

Test ID	Test Number	Estimated Hydraulic Conductivity (ft/day)			Geometric Mean (ft/day)	Interval Geometric Mean (ft/day)	Screened Interval (ft bgs)	Aquifer Condition	General Screened Interval Lithologic Description
		Solution							
		Bouwer and Rice	KGS Model	Hvorslev					
LF-36 (36-41)	1	118.2	141.6	151.8	136.5	119.7	36-41	unconfined	sand with pebbles and some silt
	2	137.5	153.0	172.7					
	3	106.0	120.1	133.2					
	4	71.6	84.1	91.9					
LF-37 (28-33)	1	564.7	549.4	719.1	606.5	581.3	28-33	unconfined	sand with pebbles and some silt
	2	541.4	598.3	699.5					
	3	521.9	579.6	687.9					
	4	459.0	517.5	596.0					

cm/sec - centimeters per second  
NA - not applicable



Well	Ls	Lw	Rs	Rc	DTW	TD	b	'
LF-36(36-41)	5.00	13.47	0.08	0.19	27.38	40.85	13.47	
LF-37(28-33)	5.00	13.00	0.08	0.19	20.18	33.18	13.00	

All units in ft

- L<sub>s</sub> True screen length
- L<sub>w</sub> Length of water column in Well (TD-SWL)
- R<sub>s</sub> Screen radius
- R<sub>c</sub> Casing radius
- DTW Static depth to water
- TD Total depth of well screen
- b Saturated thickness of aquifer

**References**

Bouwer, H., 1989. The Bouwer and Rice slug test--an update, *Ground Water*, vol. 27, no. 3, pp. 304-309.

Bouwer, H. and R.C. Rice, 1976. A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, *Water Resources Research*, vol. 12, no. 3, pp. 423-428.

Butler, J.J., Jr., 1998. *The Design, Performance, and Analysis of Slug Tests*, Lewis Publishers, Boca Raton, 252p.

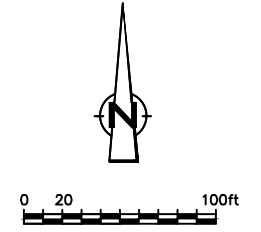
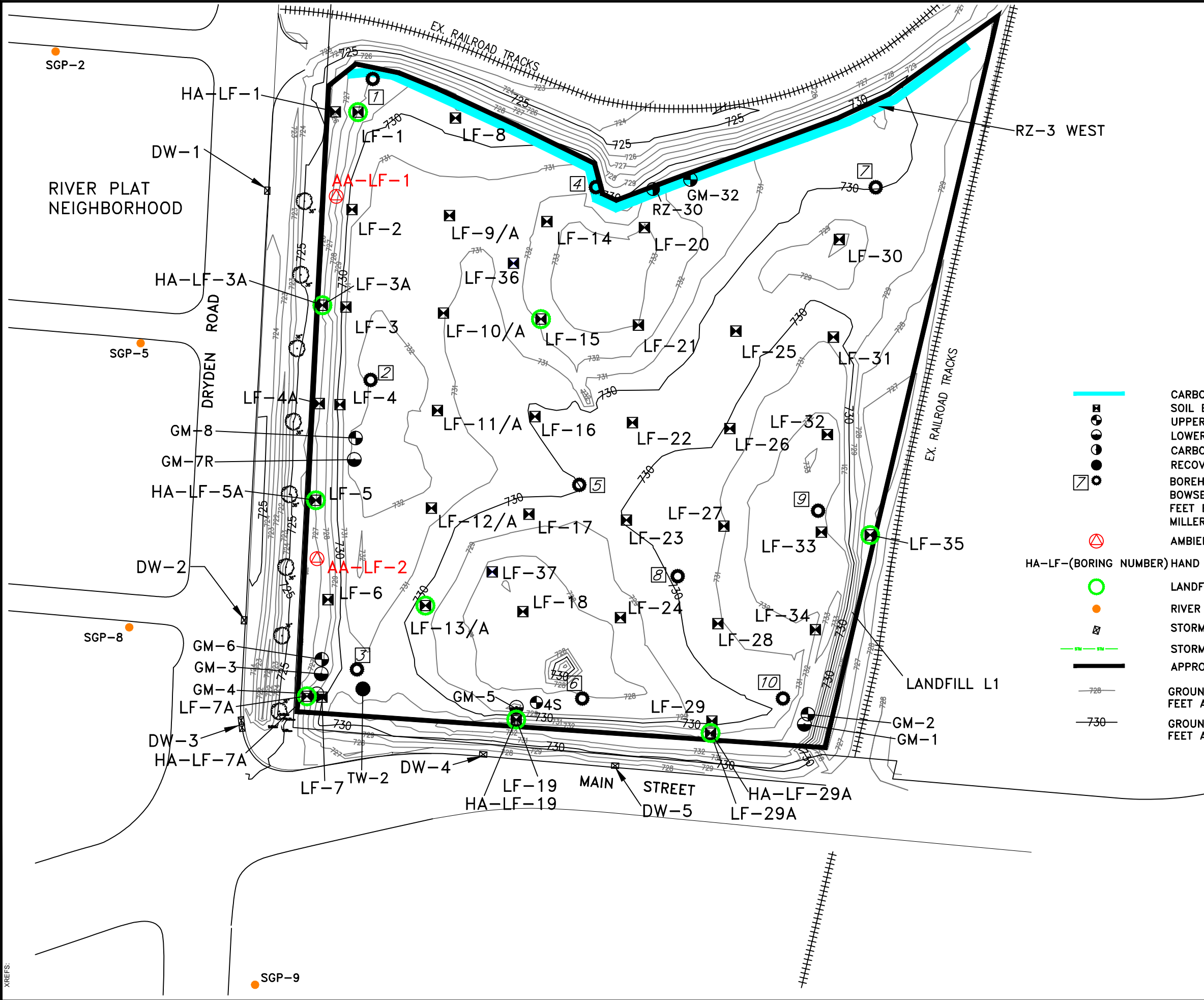
Hvorslev, M.J., 1951. Time Lag and Soil Permeability in Ground-Water Observations, Bull. No. 36, *Waterways Exper. Sta. Corps of Engrs, U.S. Army, Vicksburg, Mississippi*, pp. 1-50.

Hyder, Z, J.J. Butler, Jr., C.D. McElwee and W. Liu, 1994. Slug tests in partially penetrating wells, *Water Resources Research*, vol. 30, no. 11, pp. 2945-2957.





CITY: DUBLIN, OH DIV: GROUP / (SER1) DB: (R. SMITH) LD: (Opt) PIC: (Opt) PK: (N. GILLOTT) TM: (Opt) LVR: (Opt) ON: "OFF" REF: G:\ENVCAD\Columbus-OH\ACTO\H000294 - RACER\294-2012-006\A\29412-05A-01.dwg LAYOUT: FIG 3 L1 INVESTIGATION TOPOGRAPHIC MAP XREFS: BOB



**LEGEND**

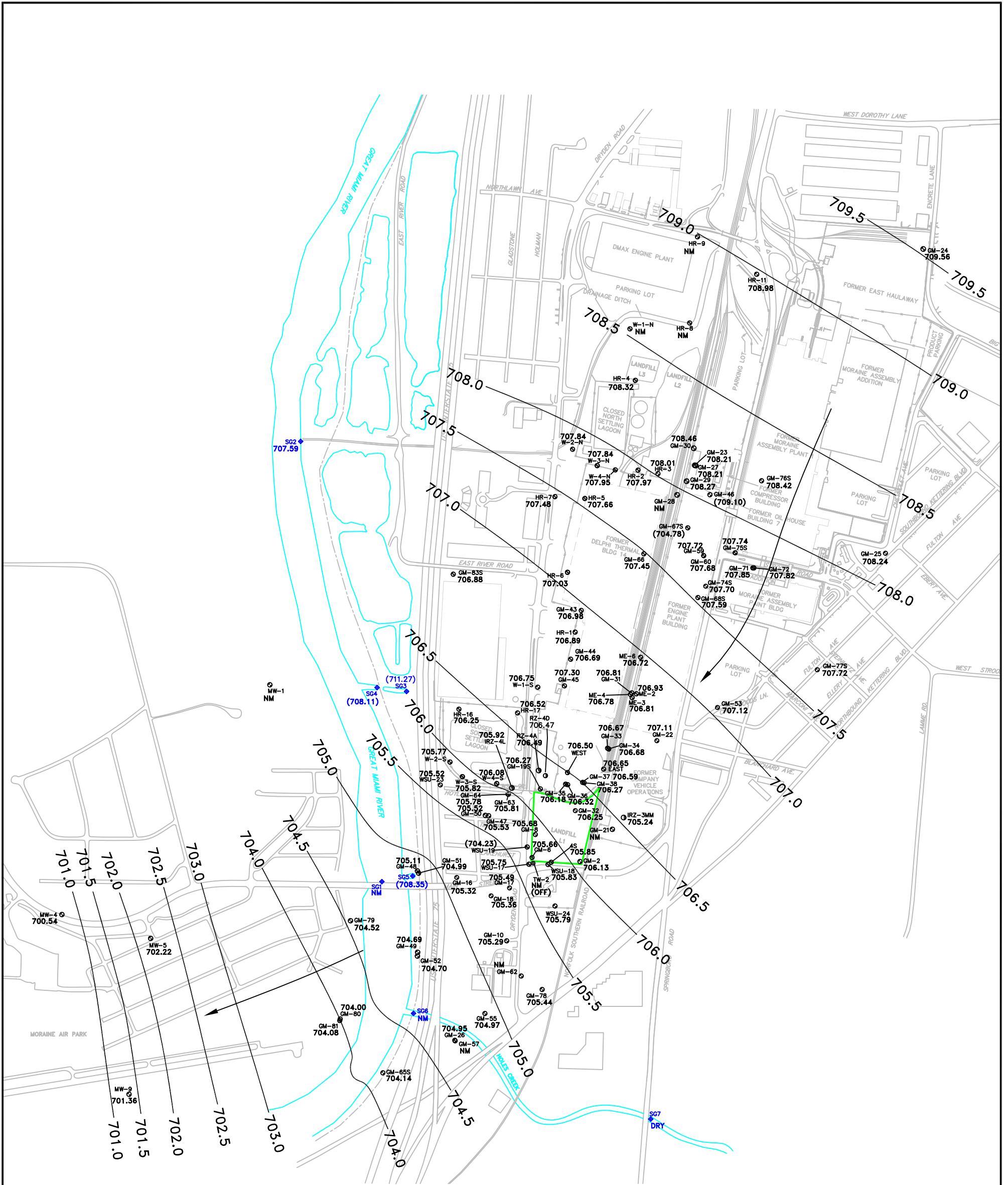
- CARBON SOURCE INTRODUCTION WELLS, REACTIVE ZONE 3 WEST
- SOIL BORING LOCATIONS; BORING ID = LF-(BORING NUMBER)
- UPPER AQUIFER MONITORING WELL
- LOWER AQUIFER MONITORING WELL
- CARBON SOURCE INTRODUCTION WELL
- RECOVERY WELL (TW-2)
- BOREHOLE ADVANCEMENT COMPLETED BY BOWSER-MORNER IN 1979 (DEPTH OF FILL BASE IN FEET BELOW GROUND SURFACE [BGS]) (GERAGHTY & MILLER, INC. 1991a)
- AMBIENT AIR SAMPLE LOCATION
- HA-LF-(BORING NUMBER) HAND AUGER BORING
- LANDFILL SOIL-GAS SAMPLE POINT
- RIVER PLAT NEIGHBORHOOD SOIL GAS SAMPLE POINT
- STORM SEWER DRY WELL
- STORM SEWER LINE
- APPROXIMATE LANDFILL L1 BOUNDARY
- GROUND SURFACE TOPOGRAPHIC CONTOUR (1-FOOT INTERVAL) FEET ABOVE MEAN SEA LEVEL
- GROUND SURFACE TOPOGRAPHIC CONTOUR (5-FOOT INTERVAL) FEET ABOVE MEAN SEA LEVEL

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**LANDFILL L1 INVESTIGATION  
TOPOGRAPHIC MAP**

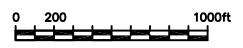
**ARCADIS**

FIGURE  
**3**



**LEGEND**

- ⊙ MONITORING WELL (UPPER AQUIFER)
- RECOVERY WELL (TW-2)
- ◆ 707.94 STREAM GAUGE AND STREAM GAUGE MEASUREMENT; NOT USED FOR CONTOURING
- ⊕ CARBON INTRODUCTION WELL
- RIVER LEVEL
- 701.36 GROUNDWATER ELEVATION (FEET MSL)
- 706.0 — GROUNDWATER CONTOUR (FEET MSL) (DASHED WHERE INFERRED)
- ( ) NOT USED FOR CONTOURING
- NM NOT MEASURED
- DRY LOW STREAM LEVEL, NO MEASURABLE WATER
- FLOW DIRECTION
- ON/OFF INDICATES WHETHER RECOVERY WELL IS IN OPERATION
- CONE OF DEPRESSION AT RECOVERY WELL TW-2 (ESTIMATED INDIVIDUAL CONTOURS NOT SHOWN)
- FORMER BUILDING FOOTPRINT
- SURFACE WATER FEATURE
- CONTOUR INTERVAL = 0.5 FOOT
- LANDFILL L1 INVESTIGATION AREA



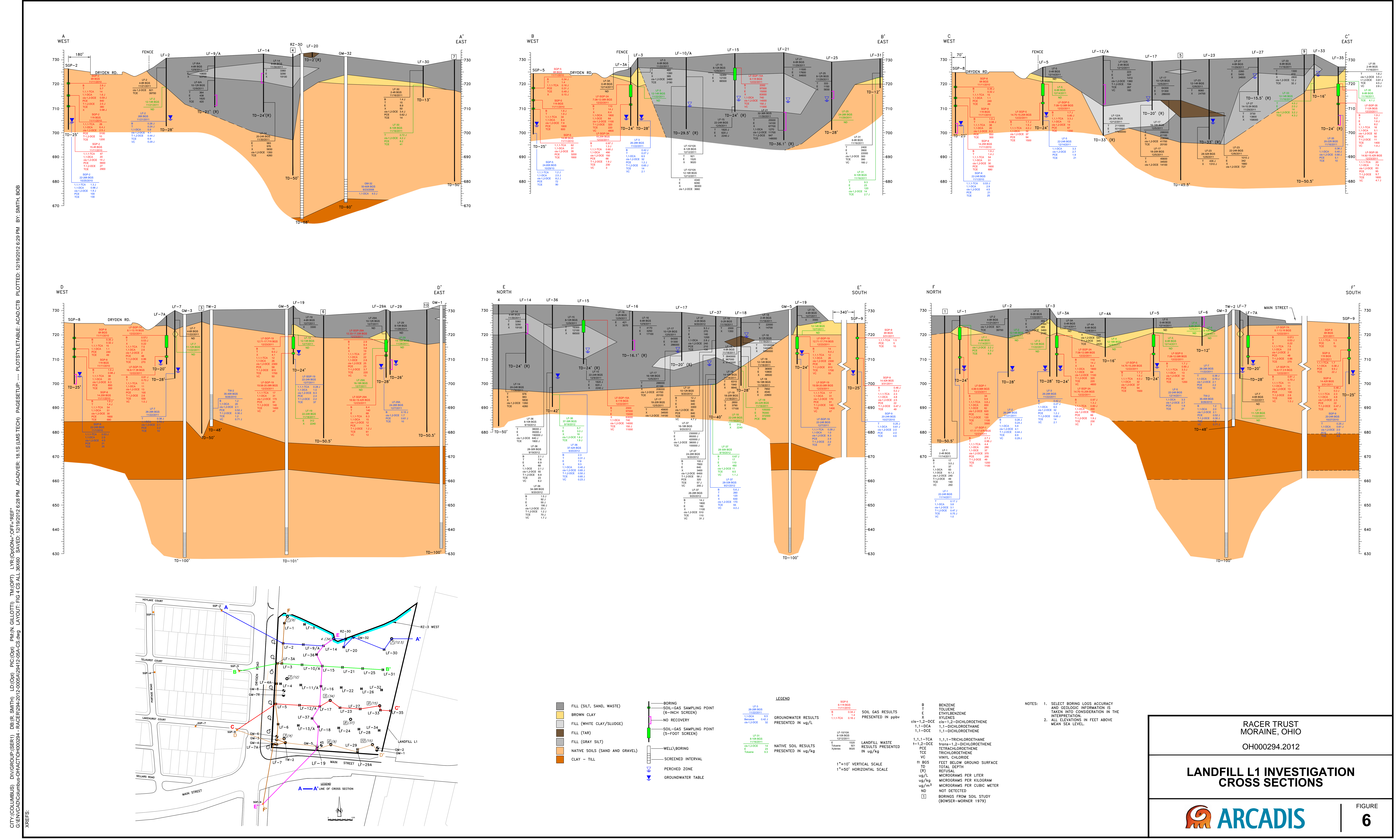
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**LANDFILL L1 INVESTIGATION  
 POTENTIOMETRIC SURFACE  
 (UPPER AQUIFER)  
 SEPTEMBER 2012**

**ARCADIS**

FIGURE  
**4**



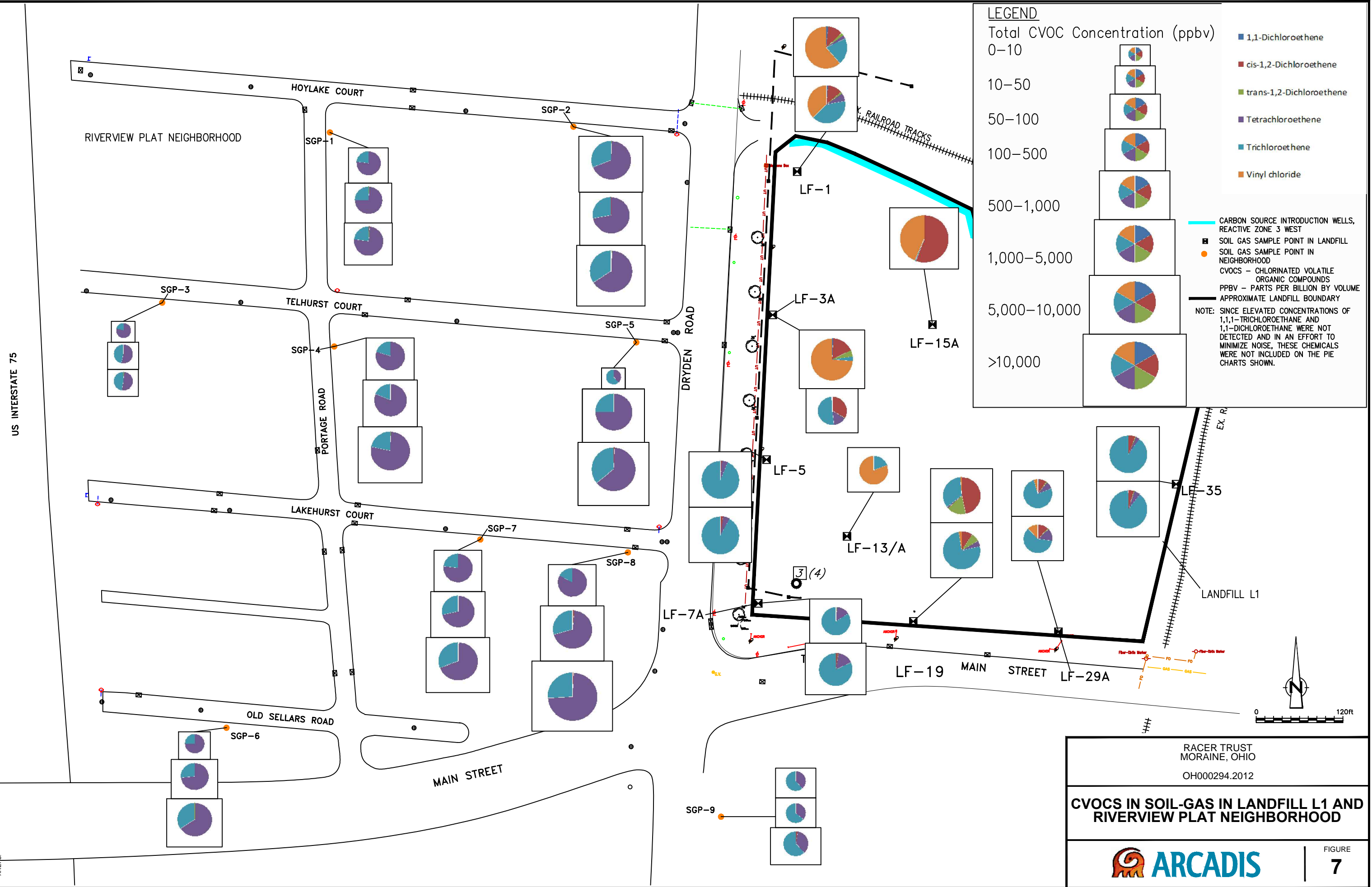


CITY/COLUMBUS) DIV(GROUP/SEER) DB(RN SMITH) LD(OPI) PM(IN GILLOTT) TM(OPT) LVR(OPTION-OFF-REF- G/ENVCAD/Columbus/OMACT/CT/0000294 - RACER2012-005A/2012-05A-CS.dwg LAYOUT: FIG 4 CS ALL 38X60) SAVED: 12/19/2012 6:28 PM ACADVER: 18.1S (LMS TECH) PAGES: 1 UP: 1 OF 1 PLOTTED: 12/19/2012 6:29 PM BY: SMITH, BOB XREFS:

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 MORAIN, OHIO  
 OH00294.2012

**LANDFILL L1 INVESTIGATION  
 CROSS SECTIONS**

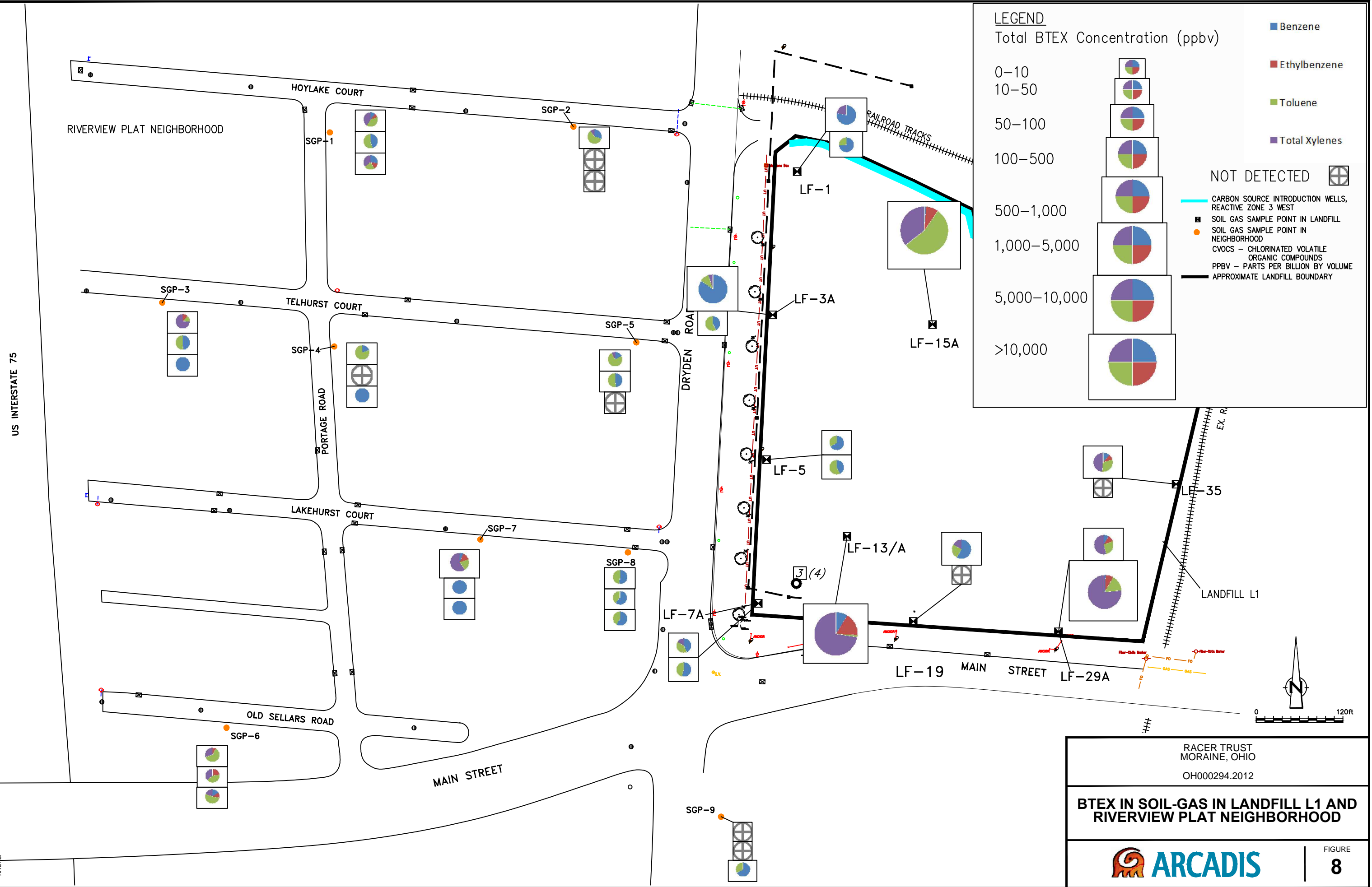
FIGURE  
**6**



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**CVOCs IN SOIL-GAS IN LANDFILL L1 AND RIVERVIEW PLAT NEIGHBORHOOD**

**ARCADIS** | FIGURE 7



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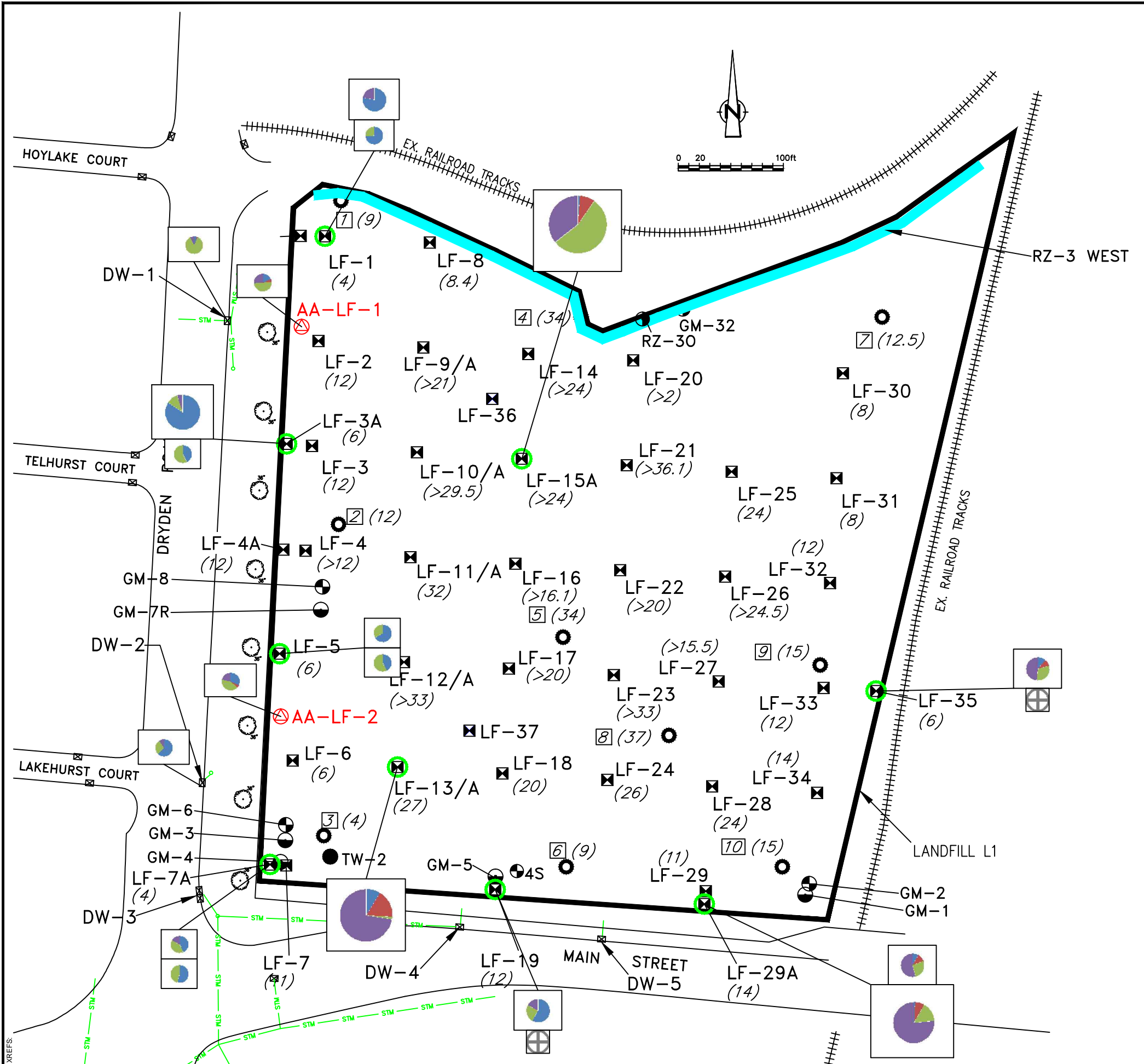
**BTEX IN SOIL-GAS IN LANDFILL L1 AND RIVERVIEW PLAT NEIGHBORHOOD**

**ARCADIS**

FIGURE **8**



CITY: DUBLIN, OH DIV: GROUP: (SER) 1 DB: (R. SMITH) LD: (OP) PIC: (OP) PM: (N. GILLOTT) TM: (OP) L: (OP) ON: OFF: REF  
 G:\PUBLIC\CMO\TORS\06-Landfill 1 Investigation\Summary Report\Soil Gas Pie Charts ppbv\Fig. 9 & 10.dwg LAYOUT: FIG 10 BTEX SAVER: 12/20/2012 10:00 AM ACADVER: 18.15 (LMS TECH) PLOTSETUP: PLOTSTYLETABLE: PLOTTED: 12/20/2012 10:06 AM BY: PRENGER, BRIAN XREFS:



**LEGEND**

Total BTEX Concentration (ppbv)

0-10		Benzene
10-50		Ethylbenzene
50-100		Toluene
100-500		Total Xylenes
500-1,000		
1,000-5,000		
5,000-10,000		
>10,000		
Not Detected		

BTEX - BENZENE, TOLUENE, ETHYLBENZENE, XYLENES  
 PPBV - PARTS PER BILLION BY VOLUME

- CARBON SOURCE INTRODUCTION WELLS, REACTIVE ZONE 3 WEST
- SOIL BORING LOCATIONS; BORING ID = LF-(BORING NUMBER)
- UPPER AQUIFER MONITORING WELL
- LOWER AQUIFER MONITORING WELL
- CARBON SOURCE INTRODUCTION WELL
- RECOVERY WELL (TW-2)
- BOREHOLE ADVANCEMENT COMPLETED BY BOWSER-MORNER IN 1979 (DEPTH OF FILL BASE IN FEET BELOW GROUND SURFACE [BGS]) (GERAGHTY & MILLER, INC. 1991a)
- AMBIENT AIR SAMPLE LOCATION
- SOIL-GAS SAMPLE POINT INSTALLED
- STORM SEWER DRY WELL
- STORM SEWER LINE
- APPROXIMATE LANDFILL L1 BOUNDARY
- THICKNESS OF WASTE (FEET BGS) - GREATER THAN SIGN (>) INDICATES NATIVE NOT ENCOUNTERED DUE TO REFUSAL

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 OH000294.2012

**BTEX IN LANDFILL L1 SOIL-GAS,  
 AMBIENT AIR, AND DRY WELLS**

**ARCADIS**

FIGURE  
**10**

ARCADIS

**Attachment E-1**

Boring Logs



# BORING LOG

**BORING NO.:** LF-1

**TOTAL DEPTH:** 24 feet bls

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 11/14/2011  
**DATE COMPLETED:** 11/14/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Chris Rismiller/Adam Whitt  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 727.98 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 620192.972813  
**EASTING:** 1482953.402492

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		0.1		FILL	(0.0 - 4.0) FILL: Silty sand, fine to coarse, some large pebbles, black, moist, (waste includes: glass [1 inch], wood, metal fibrous material).
2	26	*6.0			
4		*0.2		FILL	(4.0 - 8.3) FILL: Clay, medium plasticity, moist, medium stiff, some sand, fine to medium grain, some silt, dark yellowish brown, moist.
6	26	0.0			
8		0.0		SW	(8.3 - 20.0) SAND: Medium to coarse, moderately sorted, some medium to large pebbles, trace silt, grayish brown, dry.  NOTE: Dry to moist from 16 to 20 feet.
10	28	0.0			
12		0.0			
14	30	0.0			
16		0.0			
18	34	0.7		SW	(20.0 - 24.0) SAND: Fine to coarse, well sorted, some small pebbles, trace silt, grayish brown, moist from 20 to 22 feet.  NOTE: Wet from 22 to 24 feet. End of boring at 24 feet.
20		0.6			
22	30	0.3			
24					Note: Soil-gas sampling point LF-SGP-1 installed with screens at 4 ft 10.5 inches to 9 ft 10.5 inches and 17 ft 2 inches to 17 ft 8 inches. Screen set from 22-24 feet below land surface and groundwater sampled via low-flow methodology on 11/14/2011.



# BORING LOG

**BORING NO.: LF-2**

**TOTAL DEPTH: 28 feet bls**

## PROJECT INFORMATION

**CLIENT: RACER Trust**  
**PROJECT: Landfill L1 Investigation**  
**SITE LOCATION: Moraine, Ohio**  
**PROJECT NUMBER: OH000294.2011.00005**  
**LOGGED BY: Lauren Baumgartner**  
**DATE STARTED: 11/21/2011**  
**DATE COMPLETED: 11/21/2011**

## DRILLING INFORMATION

**DRILLING CO.: EnviroCore**  
**DRILLER: Adam Whitt/Jeremy Amick**  
**DRILLING METHOD: Direct Push**  
**GROUND ELEVATION: 730.72 (ft. AMSL)**  
**COORDINATES, STATE PLANE:**  
**NORTHING: 620093.182026**  
**EASTING: 1482947.235601**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		0.7		FILL	(0.0 - 8.0) FILL: Sand, medium to coarse, some medium pebbles, poorly sorted, some silt, pulverized rock, brown-red, moist, (waste includes: metal).  NOTE: Black-brown, moist from 4 to 8 feet.
2	24	6.8			
4				FILL	(8.0 - 12.0) FILL: Sand, fine to coarse, some angular large pebbles, some clay, soft, reddish brown to light tan, poorly sorted, moist to dry, loose.
6	10	*12.9			
8				SW	(12.0 - 28.0) SAND: Fine to coarse, poorly sorted, medium to large rounded pebbles, brown-tan, dry, loose to moderately dense.  NOTE: Tan from 16 to 24 feet.  NOTE: Wet at 25 feet.  End of boring at 28 feet.  Note: Screen set from 26-28 feet below land surface and groundwater sampled via low-flow methodology on 11/21/2011.
10	12	4.5			
12		*9.8			
14	28	4.5			
16		3.7			
18	32	2.2			
20		6.0			
22	26	4.7			
24					
26	20	4.3			
28					



# BORING LOG

**BORING NO.: LF-3**

**TOTAL DEPTH: 28 feet bls**

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 11/22/2011  
**DATE COMPLETED:** 11/22/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Adam Whitt/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 730.89 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619993.364423  
**EASTING:** 1482941.072201

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION	
0		0.0		FILL	(0.0 - 4.0) FILL: Silt, sand, medium, well sorted, moderately stiff, some medium pebbles, rounded to angular, brown-red, moist, (waste includes: glass, brick).	
2	22	0.0				
4		2.4		FILL	(4.0 - 7.0) FILL: Clay, some medium sand, trace medium pebbles, round to angular, well sorted, moist, dark brown, (waste includes: wire).	
6	28	*4.0				
8				FILL	(7.0 - 8.0) FILL: Sand, could have been pulverized rock, well sorted, medium grain, color change from yellow-orange-black, moist.	
10	12	0.0		FILL	(8.0 - 12.0) FILL: Clay, soft, medium plasticity, trace small pebbles, brown, moist.	
12		*0.0		SW	(12.0 - 28.0) SAND: Fine to coarse, small to medium round pebbles, poorly sorted, tan-brown, dry.	
14	30	0.0				
16		0.0				NOTE: Tan from 16 to 20 feet.
18	30	1.2				
20		0.0				NOTE: Dense from 20 to 24 feet.
22	28	0.8				
24		0.0				NOTE: More large pebbles, round, slight odor, wet at 25 feet.
26	30	0.8				End of boring at 28 feet.
28						Note: Screen set from 26-28 feet below land surface and groundwater sampled via low-flow methodology on 11/22/2011.



# BORING LOG

**BORING NO.: LF-3A**

**TOTAL DEPTH: 24 feet bls**

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 12/14/2011  
**DATE COMPLETED:** 12/14/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Adam Whitt/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 727.98 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619994.6180  
**EASTING:** 1482919.3800

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0				FILL	(0.0 - 4.0) FILL: Silt, some medium sand, few small angular pebbles, moist, brown, (waste includes: brick, wood, glass).
2	26	*NM			
4				CL	(4.0 - 6.0) CLAY: Soft, brown, trace medium sand, moist.
6	26	NM		SW	(6.0 - 24.0) SAND: Medium to coarse, some medium to large pebbles, round, dry.
8					NOTE: Tan, dry from 8 to 16 feet.
10	33	NM			
12					
14	32	NM			
16					NOTE: Moist to wet from 16 to 20 feet.
18	21	NM			
20					NOTE: Wet at 21 feet.
22	NM	NM			
24					End of boring at 24 feet. Note: Soil-gas sampling point LF-SGP-3A installed with screens at 7 ft 1 inch to 12 ft 1 inch and 14 ft 11 inches to 15 ft 4 inches.



# BORING LOG

**BORING NO.: LF-4**

**TOTAL DEPTH: 12 feet bls**

## PROJECT INFORMATION

**CLIENT: RACER Trust**  
**PROJECT: Landfill L1 Investigation**  
**SITE LOCATION: Moraine, Ohio**  
**PROJECT NUMBER: OH000294.2011.00005**  
**LOGGED BY: Lauren Baumgartner**  
**DATE STARTED: 11/22/2011**  
**DATE COMPLETED: 11/22/2011**

## DRILLING INFORMATION

**DRILLING CO.: EnviroCore**  
**DRILLER: Adam Whitt/Jeremy Amick**  
**DRILLING METHOD: Direct Push**  
**GROUND ELEVATION: 730.59 (ft. AMSL)**  
**COORDINATES, STATE PLANE:**  
**NORTHING: 619893.569448**  
**EASTING: 1482934.963878**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		0.0		FILL	(0.0 - 12.0) FILL: Clay, medium sand, trace large round pebbles, moderately stiff, low plasticity, some silt, brown, moist, (waste includes: brass valves, wire, glass, brick).  NOTE: Wet, black, slight odor from 4 to 8 feet.  NOTE: Strong odor from 8 to 12 feet.  End of boring at 12 feet, stopped drilling due to strong odor.
2	46	0.0			
4		0.0			
6	6	0.0			
8					
10	4	NM			
12					



# BORING LOG

**BORING NO.: LF-4A**

**TOTAL DEPTH: 16 feet bls**

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 12/8/2011  
**DATE COMPLETED:** 12/8/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Adam Whitt/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 727.98 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619894.0110  
**EASTING:** 1482915.0900

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		1.2		FILL	(0.0 - 8.0) FILL: Silt, clay, stiff, low plasticity, some medium sand, trace angular medium pebbles, moist, (waste includes: glass, wood, metal, wire, black-brown).  NOTE: Black from 4 to 8 feet.
2	38	1.1			
4		3.5			
6	16	*7.8			
8				CL	(8.0 - 12.0) CLAY: Trace sand, wood, medium plasticity, soft, reddish-brown, moist.
10	10	0.5			
12				SW	(12.0 - 16.0) SAND: Medium to coarse, medium to large round pebbles, trace silt, tan, loose, dry.  End of boring at 16 feet.
14	6	*0.6			
16					



# BORING LOG

**BORING NO.: LF-5**

**TOTAL DEPTH: 24 feet bls**

## PROJECT INFORMATION

**CLIENT: RACER Trust**  
**PROJECT: Landfill L1 Investigation**  
**SITE LOCATION: Moraine, Ohio**  
**PROJECT NUMBER: OH000294.2011.00005**  
**LOGGED BY: Lauren Baumgartner**  
**DATE STARTED: 12/14/2011**  
**DATE COMPLETED: 12/14/2011**

## DRILLING INFORMATION

**DRILLING CO.: EnviroCore**  
**DRILLER: Adam Whitt/Jeremy Amick**  
**DRILLING METHOD: Direct Push**  
**GROUND ELEVATION: 727.98 (ft. AMSL)**  
**COORDINATES, STATE PLANE:**  
**NORTHING: 619794.0150**  
**EASTING: 1482911.0790**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0				FILL	(0.0 - 4.0) FILL: Silt, clay, moderately dense, little medium sand, some medium to large angular pebbles, brown, tan, dry, (waste includes: wood, metal, glass).
2	32	*0.3			
4		0.3		CL	(4.0 - 6.0) CLAY: Soft, brown, moist.
6	30	*0.3		SW	(6.0 - 24.0) SAND: Medium to coarse, medium to large pebbles, tan, dry, loose.  NOTE: Moist at 18 feet. NOTE: Wet at 20 feet.  End of boring at 24 feet.
8		0.7			
10	31	0.2			
12		0.6			
14	27	0.7			
16		0.6			
18	24	0.4			
20		0.7			
22	28	0.3			
24					

Note: Soil-gas sampling point LF-SGP-5 installed with screens at 7 ft 1 inch to 12 ft 1 inch and 14 ft 9 inches to 15 ft 3 inches. Screen set from 22-24 feet below land surface and groundwater sampled via low-flow methodology on 12/14/2011.



# BORING LOG

**BORING NO.: LF-6**

**TOTAL DEPTH: 12 feet bls**

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 12/8/2011  
**DATE COMPLETED:** 12/8/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Adam Whitt/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 727.57 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619693.942289  
**EASTING:** 1482922.618364

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0	0				(0.0 - 4.0) No recovery from 0 to 4 feet.
4	58	0.0		CL	(4.0 - 8.0) CLAY: Stiff, some silt, little sand, medium to coarse from 7 to 8 feet, medium subround pebbles, brown, low plasticity, moist.
		*0.3			
8	31	*0.4		SW	(8.0 - 12.0) SAND: Medium to coarse, medium to large round pebbles, trace silt, loose, dry, tan.
		0.0			
12					End of boring at 12 feet.



# BORING LOG

**BORING NO.: LF-7**

**TOTAL DEPTH: 28 feet bls**

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 11/22/2011  
**DATE COMPLETED:** 11/22/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Adam Whitt/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 729.84 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619594.106850  
**EASTING:** 1482916.519610

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		0.0		FILL	(0.0 - 4.0) FILL: Clay, soft, medium plasticity, some medium to coarse sand, round medium to large pebbles, poorly sorted, brown to tan, moist.
2	20	0.0			
4		*0.3		FILL	(4.0 - 8.0) FILL: Clay, some silt, moderately stiff, trace medium sand, brown, moist, (waste includes: brick).
6	38	0.0			
8		0.0		CL	(8.0 - 11.0) CLAY: Brown-red, moist.
10	28	0.0			
12		*0.0		SW	(11.0 - 24.0) SAND: Medium to coarse, medium round pebbles, poorly sorted, loose, tan-brown, dry.  NOTE: Tan from 12 to 20 feet.        NOTE: Larger pebbles to cobbles from 20 to 24 feet.
14	28	0.1			
16		0.0			
18	30	0.0			
20		0.4			
22	26	0.0			
24		0.0			
26	12	0.0			
28		0.0			

Note: Screen set from 26-28 feet below land surface and groundwater sampled via low-flow methodology on 11/22/2011.



# BORING LOG

**BORING NO.: LF-7A**

**TOTAL DEPTH: 20 feet bls**

## PROJECT INFORMATION

**CLIENT: RACER Trust**  
**PROJECT: Landfill L1 Investigation**  
**SITE LOCATION: Moraine, Ohio**  
**PROJECT NUMBER: OH000294.2011.00005**  
**LOGGED BY: Lauren Baumgartner**  
**DATE STARTED: 12/8/2011**  
**DATE COMPLETED: 12/8/2011**

## DRILLING INFORMATION

**DRILLING CO.: EnviroCore**  
**DRILLER: Chris Rismiller/Jeremy Amick**  
**DRILLING METHOD: Direct Push**  
**GROUND ELEVATION: 727.50 (ft. AMSL)**  
**COORDINATES, STATE PLANE:**  
**NORTHING: 619595.1010**  
**EASTING: 1482899.1050**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0			[Hatched Pattern]	FILL	(0.0 - 4.0) FILL: Silt, some medium sand, large angular pebbles, stiff, some clay, brown, moist, (waste includes: glass).
2	16	NM			
4			[Dotted Pattern]	SW	(4.0 - 20.0) SAND: Medium to coarse, round medium to large pebbles, brown-tan, dry.
6	14	NM			
8					
10	24	NM			
12					
14	20	NM			
16					
18	36	NM			
20					NOTE: Wet at 20 feet. End of boring at 20 feet.  Note: Soil-gas sampling point LF-SGP-7A installed with screens at 8 ft 10 inches to 13 ft 10 inches and 16 ft 9 inches to 17 ft 3 inches.



# BORING LOG

**BORING NO.: LF-8**

**TOTAL DEPTH: 16 feet bls**

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 11/15/2011  
**DATE COMPLETED:** 11/15/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Chris Rismiller/Adam Whitt  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 729.29 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 620186.87033  
**EASTING:** 1483053.15082

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0	36	0.1		FILL	(0.0 - 1.5) FILL: Silty sand, fine to coarse, few large pebbles, very dark gray, moist, slight odor, (waste includes: coal, glass).
2		*13.0		FILL	(1.5 - 3.0) FILL: Silt some fine sand, dark gray, wet.
4				FILL	(3.0 - 3.7) FILL: Silt some coarse sand, trace large pebbles, dark gray, moist, slight odor.
6	24	10.2		FILL	(3.7 - 4.0) FILL: Silt trace fine sand, light gray, moist, slight odor.
8		1.1		FILL	(4.0 - 8.4) FILL: Clay, medium plasticity, medium stiff, trace silt, trace medium pebbles, subrounded, very dark grayish brown, moist, (waste includes: rubber, metal, glass).
10	24	2.8		SW	(8.4 - 16.0) SAND: Fine to coarse, subround, small to large pebbles, subround, loose, trace silt, dark grayish brown, dry.
12		*1.3			
14	36	0.2		SW	NOTE: Wet at 13 feet.
16		1.1			



# BORING LOG

**BORING NO.:** LF-9

**TOTAL DEPTH:** 20.3 feet bls

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 11/15/2011  
**DATE COMPLETED:** 11/15/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Chris Rismiller/Adam Whitt  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 731.49 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 620087.02331  
**EASTING:** 1483047.05312

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION	
0	36	1.2		FILL	(0.0 - 2.0) FILL: Sand, fine to coarse, subround, some medium pebbles, angular, trace silt, reworked material, moist, dark brown, (waste includes: brick, coal, metal).	
2		36.3			FILL	(2.0 - 3.0) FILL: Sand, trace fine sand, round, gray, slight odor, dense, wet.
4		18			9.8	FILL
6	8.5		FILL	(4.0 - 8.0) FILL: Silt, trace very fine sand, subround, soft, dark gray, moist, odor.		
8	28	4.1		FILL	(8.0 - 16.0) FILL: Silt, some medium to coarse sand, some small pebbles, subrounded, moist, dark gray, dense, (waste includes: glass, metal, wood, fiber).	
10		7.4				
12		7.7				
14	16	6.9		FILL	NOTE: No recovery from 12 to 16 feet, offset boring 1.5 feet northeast of original location, dense, moist, (waste includes: glass, fiber).	
16						
18	0	NM			(16.0 - 20.3) No recovery.	
20					Refusal at 20.3 feet.	

**Notes:**

\*Sample submitted for laboratory analysis.  
 NM: Not Measured  
 USCS: Unified Soil Classification System

ppm: parts per million  
 NR: No Recovery  
 bls: below land surface

PID: Photo-ionization Detector  
 ft: feet  
 AMSL: Above Mean Sea Level

Date: 9/27/2012  
 Page: 1 of 1



# BORING LOG

**BORING NO.: LF-9A**

**TOTAL DEPTH: 21 feet bls**

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 11/15/2011  
**DATE COMPLETED:** 12/9/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Adam Whitt/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 731.49 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 620087.02331  
**EASTING:** 1483047.05312

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		0.6		FILL	(0.0 - 3.0) FILL: Sand, medium angular pebbles, medium to large, loose, trace silt, pulverized rock, black-reddish, moist, slight odor, (waste includes: wood, glass, metal).
2	28	1.2			
4				FILL	(3.0 - 16.0) FILL: Silt, loose, gray, dry.  NOTE: Wet, glass from 8 to 12 feet.
6	6	*108.2			
10	24	*1.1			
14	0	NM			
16					(16.0 - 21.0) No recovery.
18	0	NM			
20					Refusal at 21 feet.



# BORING LOG

**BORING NO.: LF-10**

**TOTAL DEPTH: 29.5 feet bls**

## PROJECT INFORMATION

**CLIENT: RACER Trust**  
**PROJECT: Landfill L1 Investigation**  
**SITE LOCATION: Moraine, Ohio**  
**PROJECT NUMBER: OH000294.2011.00005**  
**LOGGED BY: Lauren Baumgartner**  
**DATE STARTED: 11/15/2011**  
**DATE COMPLETED: 11/15/2011**

## DRILLING INFORMATION

**DRILLING CO.: EnviroCore**  
**DRILLER: Chris Rismiller/Jeremy Whitt**  
**DRILLING METHOD: Direct Push**  
**GROUND ELEVATION: 731.05 (ft. AMSL)**  
**COORDINATES, STATE PLANE:**  
**NORTHING: 619987.20122**  
**EASTING: 1483040.87726**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		5.9		FILL	(0.0 - 5.0) FILL: Sand, medium to coarse, subangular, some medium to large pebbles, poorly sorted, trace silt, moist to wet, dark reddish brown, (waste includes: glass, coal).
2	38	40.8			
4		324		FILL	(5.0 - 20.0) FILL: Silt, moderately loose, gray, dry.
6	24	2.8			
8		4.3		FILL	(5.0 - 20.0) FILL: Silt, moderately loose, gray, dry.
10	26	11.6			
12		3.8		FILL	(5.0 - 20.0) FILL: Silt, moderately loose, gray, dry.
14	26	9.8			
16		6.5		FILL	(5.0 - 20.0) FILL: Silt, moderately loose, gray, dry.
18	12	6.9			
20				FILL	(5.0 - 20.0) FILL: Silt, moderately loose, gray, dry.
22	24	0.4			
24		1.4		FILL	(5.0 - 20.0) FILL: Silt, moderately loose, gray, dry.
26	6	0.8			
28		0.8		FILL	(5.0 - 20.0) FILL: Silt, moderately loose, gray, dry.
29.5	4	0.8			

NOTE: Dark grayish brown, (waste includes: wood, fiber/fabric) from 11.6 to 12 feet.

NOTE: Moist to wet from 16 to 20 feet.

NOTE: Wet at 19.8 feet.

(20.0 - 29.5) FILL: Silt, sand medium to coarse, small to large pebbles, subround to subangular, dense, stiff, very dark gray, wet, (waste includes: wood, glass).

NOTE: Unable to sample due to low recovery from 28 to 29.5 feet. Refusal at 29.5 feet.



# BORING LOG

**BORING NO.: LF-10A**

**TOTAL DEPTH: 33 feet bls**

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 12/12/2011  
**DATE COMPLETED:** 12/12/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Adam Whitt/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 731.05 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619987.20122  
**EASTING:** 1483040.87726

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		2.2		FILL	(0.0 - 4.0) FILL: Silt, moderately dense, some medium sand, some medium to large angular pebbles, brown, wet, (waste includes: metal, glass, cinders).
2	29	68.5			
4					(4.0 - 8.0) No recovery.
6	0	NM			
8				FILL	(8.0 - 12.0) FILL: Silt, loose, gray, dry, (waste includes: wood, clay like material, white-yellow).
10	15	*135.6			
12				FILL	(12.0 - 20.0) FILL: Silt, loose, dry, dark brown, slight odor, (waste includes: fabric, wood).
14	10	*49.1			
16					NOTE: Brown from 16 to 20 feet.
18	8	93.1			
20					(20.0 - 33.0) No recovery.
22					
24					
26	0	NM			
28					
30					
32					Refusal at 33 feet.

**Notes:**

\*Sample submitted for laboratory analysis.  
 NM: Not Measured  
 USCS: Unified Soil Classification System

ppm: parts per million  
 NR: No Recovery  
 bls: below land surface

PID: Photo-ionization Detector  
 ft: feet  
 AMSL: Above Mean Sea Level

Date: 9/27/2012  
 Page: 1 of 1



# BORING LOG

**BORING NO.: LF-11**

**TOTAL DEPTH: 19.3 feet bls**

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 11/17/2011  
**DATE COMPLETED:** 11/17/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Chris Rismiller/Adam Whitt  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 731.57 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619887.38937  
**EASTING:** 1483034.70314

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		3.4		FILL	(0.0 - 7.0) FILL: Sand, medium to coarse, medium to large pebbles, subangular, silt, moist to wet, brown to black, slight odor, dense, (waste includes: wood, glass).  NOTE: More silt, gray to black, moist from 4 to 7 feet.
2	40	12.7			
4		29.0		FILL	(7.0 - 8.0) FILL: Sand, fine to coarse, large angular pebbles, rock fragments, dry, (waste includes: brick).
6	36	251			
8		439		FILL	(8.0 - 16.0) FILL: Sand, coarse, large cobbles and pulverized rock, poorly sorted, loose, wet, black to brown.  NOTE: Unable to sample due to low recovery, field screen.  NOTE: Black-gray, moist, large angular cobbles from 12 to 16 feet.  NOTE: Unable to sample due to low recovery.
10	8				
12	12	457			
14					
16					(16.0 - 19.3) No recovery.
18	0	NM			Refusal at 19.3 feet.



# BORING LOG

**BORING NO.: LF-11A**

**TOTAL DEPTH: 35 feet bls**

## PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Landfill L1 Investigation**  
 SITE LOCATION: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.2011.00005**  
 LOGGED BY: **Lauren Baumgartner**  
 DATE STARTED: **12/12/2011**  
 DATE COMPLETED: **12/12/2011**

## DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Adam Whitt/Jeremy Amick**  
 DRILLING METHOD: **Direct Push**  
 GROUND ELEVATION: **731.57** (ft. AMSL)  
 COORDINATES, STATE PLANE:  
 NORTHING: **619887.38937**  
 EASTING: **1483034.70314**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0					
2	17	2.1		FILL	(0.0 - 4.0) FILL: Silt, stiff, trace medium sand, some medium to large angular pebbles, pulverized rock, brown-gray, slight odor, wet, (waste includes: wood, metal).
6	27	9.8		FILL	(4.0 - 12.0) FILL: Silt, some medium angular pebbles, little sand, moderately dense, gray, moist, (waste includes: light blue and yellow silt material).  NOTE: More large angular pebbles, black-yellow, dry from 8 to 12 feet.
8		34.8			
10	2	105.1			
14	0	NM			(12.0 - 16.0) No recovery.
18	0	NM			(16.0 - 20.0) No recovery.
22	0	NM			(20.0 - 24.0) No recovery.
26	9	*776		FILL	(24.0 - 32.0) FILL: Silt, soft, large angular pebbles, sheen, strong odor, wet, black (waste includes: wood, nails).
30	36	515			
32		191.5			
34	10	*218.4		SW	(32.0 - 35.0) SAND: medium to coarse grain, medium to large pebbles, tan-black, wet, sheen.  Refusal at 35 feet.



# BORING LOG

**BORING NO.: LF-12**

**TOTAL DEPTH: 21.4 feet bls**

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 11/17/2011  
**DATE COMPLETED:** 11/17/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Chris Rismiller/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 731.79 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619787.58524  
**EASTING:** 1483028.58462

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		6.2		FILL	(0.0 - 4.0) FILL: Sand, fine to coarse, angular, poorly sorted, some silt, angular medium pebbles, black-gray, moist, some pulverized rock.
2	44	21.2			
4		68.9		FILL	(4.0 - 12.0) FILL: Silt, medium sand, angular, poorly sorted, medium to large angular pebbles, dense, black-gray, moist, (waste includes: wood, glass, nails, fiber, wire).  NOTE: Waste includes: plastic bag, strong odor from 8 to 12 feet.
6	44	47.9			
8		6419			(12.0 - 16.0) No recovery.
10	8				
12		NM			(16.0 - 20.0) No recovery.
14	0				
16		NM			(20.0 - 21.4) No recovery. Note: Metal shards found in shoe with white sludge.
18	0				
20					Refusal at 21.4 feet.



# BORING LOG

**BORING NO.:** LF-12A

**TOTAL DEPTH:** 33 feet bls

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 12/9/2011  
**DATE COMPLETED:** 12/9/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Adam Whitt/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 731.79 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619787.58524  
**EASTING:** 1483028.58462

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		1.4		FILL	(0.0 - 8.0) FILL: Silt, trace medium sand, dense, stiff, medium to large pebbles, gray-black, pulverized rock, dry, (waste includes: rubber, wire, glass).  NOTE: Moist, black from 4 to 8 feet.
2	33	*1.6			
4		7.8			
6	6	26.8			
8					(8.0 - 12.0) No recovery.
10	0	NM			
12					(12.0 - 16.0) No recovery.
14	0	NM			
16					(16.0 - 20.0) No recovery.
18	0	NM			
20					(20.0 - 24.0) No recovery.
22	0	NM			
24					(24.0 - 28.0) No recovery.
26	0	NM			
28					(28.0 - 33.0) FILL: Clay material, very soft, sticky, black, strong odor, wet, (waste includes: fabric, nails).
30	7	*686.4		FILL	Refusal at 33 feet.
32	2	656			

**Notes:**

\*Sample submitted for laboratory analysis.  
 NM: Not Measured  
 USCS: Unified Soil Classification System

ppm: parts per million  
 NR: No Recovery  
 bls: below land surface

PID: Photo-ionization Detector  
 ft: feet  
 AMSL: Above Mean Sea Level

Date: 9/27/2012  
 Page: 1 of 1



# BORING LOG

**BORING NO.: LF-13**

**TOTAL DEPTH: 32 feet bls**

## PROJECT INFORMATION

**CLIENT: RACER Trust**  
**PROJECT: Landfill L1 Investigation**  
**SITE LOCATION: Moraine, Ohio**  
**PROJECT NUMBER: OH000294.2011.00005**  
**LOGGED BY: Lauren Baumgartner**  
**DATE STARTED: 11/17/2011**  
**DATE COMPLETED: 11/17/2011**

## DRILLING INFORMATION

**DRILLING CO.: EnviroCore**  
**DRILLER: Chris Rismiller/Adam Whitt**  
**DRILLING METHOD: Direct Push**  
**GROUND ELEVATION: 729.42 (ft. AMSL)**  
**COORDINATES, STATE PLANE:**  
**NORTHING: 619687.79914**  
**EASTING: 1483022.51078**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		25.1		FILL	(0.0 - 4.0) FILL: Silt, fine to medium sand, angular, poorly sorted, medium pebbles, subround, dense, loose at 3 feet, moist, brown to black, (waste includes: glass, wood, pulverized rock).
2	36	76.7			
4					(4.0 - 8.0) No recovery.
6	0	NM			
8				FILL	(8.0 - 12.0) FILL: Silt, very fine sand, gray, strong odor, trace small pebbles.
10	8	310			
12					(12.0 - 16.0) No recovery.
14	0	NM			
16					(16.0 - 20.0) No recovery.
18	0	NM			
20				FILL	(20.0 - 27.0) FILL: Black waste, tar like, very dense, immisible fluid, sheen, wet.
22	18	112			
24					NOTE: Tar like, black from 24 to 27 feet.
26	6	51.7			
28				SW	(27.0 - 28.0) SAND: Fine to coarse, some small pebbles, wet, brown-tan.
30	39	*19.8		SW	(28.0 - 32.0) SAND: Fine to coarse, poorly sorted, medium pebbles, subround, wet, brown-tan.
32					End of boring at 32 feet.



# BORING LOG

**BORING NO.: LF-13A**

**TOTAL DEPTH: 28 feet bls**

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 12/13/2011  
**DATE COMPLETED:** 12/13/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Adam Whitt/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 729.42 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619687.79914  
**EASTING:** 1483022.51078

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0	31	NM		FILL	(0.0 - 4.0) FILL: Silt, some medium sand, some medium to large angular gravel, pulverized rock, black gray, moderately dense, moist, (waste includes: metal and fabric).
2		86			
4	20	*16.4		FILL	(4.0 - 10.5) FILL: Silt, gray, loose, dry, little sand, medium to small pebbles, angular, (waste includes: metal).  NOTE: Gray, dry, dense.
6		0.2			
8	26	4.3		FILL	(10.5 - 12.0) FILL: Medium sand, few small pebbles, angular, loose, dry, pulverized rock, (waste includes: metal, fabric).
10					
12	0	NM			(12.0 - 16.0) No recovery.
14	0	NM			(16.0 - 20.0) No recovery.
16	0	NM			(20.0 - 28.0) No recovery.
18	0	NM			End of boring at 28 feet.
20	0	NM			Soil-gas sampling point LF-SGP-13A installed with screen at 7 ft to 12 ft .
22					
24					
26					
28					



# BORING LOG

**BORING NO.:** LF-14

**TOTAL DEPTH:** 24 feet bls

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 11/30/2011  
**DATE COMPLETED:** 11/30/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Chris Rismiller/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 732.46 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 620080.93236  
**EASTING:** 1483146.87455

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0	19	6.0		FILL	(0.0 - 4.0) FILL: Sand, medium to coarse, medium pebbles, angular, some silt, dry, black-brown-red, loose, (waste includes: wood, metal, wire).
2		77.3			
4	21	229		FILL	(4.0 - 8.0) FILL: Silt, trace fine sand, loose, moist, black, odor.
6		*300			
8	0	123		FILL	(8.0 - 12.0) No recovery.
10					
12	33	141		FILL	(12.0 - 16.0) FILL: Medium sand, some large angular pebbles, some silt, loose, black, dry, odor (waste includes: metal, wood, glass).  NOTE: Pulverized rock, yellow-black at 14 feet.
14		130			
16	12	0		FILL	(16.0 - 24.0) FILL: Silt, moderately dense, trace medium sand, trace large angular pebbles, black-dark gray, moist, dry.  NOTE: More dense, black from 20 to 24 feet.
18					
20	4	*30.2		FILL	Refusal at 24 feet.
22					
24					



# BORING LOG

**BORING NO.: LF-15/A**

**TOTAL DEPTH: 24 feet bls**

## PROJECT INFORMATION

**CLIENT: RACER Trust**  
**PROJECT: Landfill L1 Investigation**  
**SITE LOCATION: Moraine, Ohio**  
**PROJECT NUMBER: OH000294.2011.00005**  
**LOGGED BY: Kari Eldridge**  
**DATE STARTED: 12/9/2011**  
**DATE COMPLETED: 12/9/2011**

## DRILLING INFORMATION

**DRILLING CO.: EnviroCore**  
**DRILLER: Adam Whitt/Jeremy Amick**  
**DRILLING METHOD: Direct Push**  
**GROUND ELEVATION: 732.08 (ft. AMSL)**  
**COORDINATES, STATE PLANE:**  
**NORTHING: 619981.15121**  
**EASTING: 1483140.66329**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0	45	1.6		FILL	(0.0 - 2.0) FILL: Silt and sand with large gravel and pulverized rock, black-brown-gray, moist, (waste includes: glass, metal).
2		37.2			FILL
4	19	107.7		FILL	(4.0 - 6.0) FILL: Silt and sand with small to large angular to round gravel, gray and black, moist, (waste includes: metal, glass).
6		290			FILL
8	14	*223.9		FILL	(8.0 - 12.0) FILL: Silt, loose, dry, trace sand and medium angular gravel, odor, black, (waste includes: cloth, very small metal fibers).
10					
12	30	134.4		FILL	(12.0 - 24.0) FILL: Silt, loose, moist, black, gray, (waste includes: metal, plastic like yellow waste, cloth, and metal).  NOTE: Waste includes: some white-green plastic like material at 14 feet.
14		47.2			
16	27	19.4		FILL	NOTE: Water at 19 feet.
18		14.8			
20	48	5.9		FILL	NOTE: Wet from 20 to 22 feet.
22		*3.9			
24					NOTE: Gravel, glass, yellow plastic, nails at 23 feet. Some white clay at 23.5 feet. Refusal at 24 feet.  Note: Soil-gas sampling point LF-SGP-15A installed with screen at 6 ft to 11 ft.

**Notes:**

\*Sample submitted for laboratory analysis.  
 NM: Not Measured  
 USCS: Unified Soil Classification System

ppm: parts per million  
 NR: No Recovery  
 bls: below land surface

PID: Photo-ionization Detector  
 ft: feet  
 AMSL: Above Mean Sea Level

Date: 11/7/2012  
 Page: 1 of 1



# BORING LOG

**BORING NO.: LF-16**

**TOTAL DEPTH: 16.1 feet bls**

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Kari Eldridge  
**DATE STARTED:** 12/9/2011  
**DATE COMPLETED:** 12/9/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Adam Whitt/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 729.80 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619881.26622  
**EASTING:** 1483134.59406

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0	24	*89.6		FILL	(0.0 - 2.0) FILL: Sand and silt, medium sand, some angular and rounded medium and large gravel, gray-brown, moist, (waste includes: metal and wood).
2	24	68.7		FILL	(2.0 - 4.0) FILL: Silt and sand, medium sand with pulverized rock, medium and large angular gravel, black, moist, (waste includes: metal and wood).
4	18	45.2		FILL	(4.0 - 6.0) FILL: Silt, moist, odor, white to light pink-tan, (waste includes: glass, fiberglass).
6	18	*127.6		FILL	(6.0 - 8.0) FILL: Silt, moist, odor, (waste includes: glass, fiberglass, coal). NOTE: Light gray, black 1" thick seam at 6.2 feet.
8	4	1020		FILL	(8.0 - 12.0) FILL: Silt with some medium sand, trace angular medium gravel, black-gray, moist, odor, (waste includes: metal, nails, screws, wood).
10	0	NM			(12.0 - 16.1) No recovery.
12					Refusal at 16.1 feet.
14					
16					



# BORING LOG

**BORING NO.: LF-17**

**TOTAL DEPTH: 20 feet bls**

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 12/5/2011  
**DATE COMPLETED:** 12/5/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Chris Rismiller/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 729.36 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619781.50779  
**EASTING:** 1483128.49512

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0	21	2.4		FILL	(0.0 - 8.0) FILL: Silt, trace medium sand, trace large round pebbles, trace clay, soft, brown, moist, (waste includes: wood, metal, glass).  NOTE: Trace clay, odor, gray-black, cobbles, wet (waste includes: large twisted metal) from 4 to 8 feet.
2		7.5			
4	48	87.7		FILL	(8.0 - 12.0) FILL: Silt, trace sand, trace gravel, wet, white-pink-black-gray, (waste includes: plastic sheeting with paint, insulator, metal, plastic, wire, wood).
6					
8	12	NM		FILL	(12.0 - 16.0) FILL: Solidified paint, white, strong odor.
10					
12	48	*246.7		FILL	(16.0 - 20.0) FILL: Clay, sludge, soft, white-gray, moist-wet, strong odor.  Refusal at 20 feet.
14					
16					
18					
20					



# BORING LOG

**BORING NO.: LF-18**

**TOTAL DEPTH: 28 feet bls**

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 11/18/2011  
**DATE COMPLETED:** 11/18/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Chris Rismiller/Adam Whitt  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 727.14 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619681.62764  
**EASTING:** 1483122.27943

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		*580		FILL	(0.0 - 4.0) FILL: Sand, fine to coarse, well sorted, few angular pebbles, black, slight odor, dry.
2	26	*899			
4		*NM		FILL	(4.0 - 12.0) FILL: Silt, dense, medium to coarse sand, well sorted, some medium angular gravel, (waste includes: rubber, degraded product, brown liquid, strong odor, saturated by brown thick liquid, tar like-asphalt).  NOTE: Strong odor, tar like, black, wet from 8 to 12 feet.
6	12				
8					
10	8	*4935			
12		*NM		FILL	(12.0 - 20.0) FILL: Clay sludge, soft, white and black, strong odor, moist.
14	38	*402			
16		*NM			
18	16	*NM			
20		*NM		SW	(20.0 - 24.0) SAND: Medium to coarse, large pebbles, round, poorly sorted, strong odor, wet, black.
22		*NM			
24				SW	(24.0 - 28.0) SAND: Medium, medium pebbles, rounded, well sorted, wet, gray-black, strong odor.  End of boring at 28 feet.
26					
28					



# BORING LOG

**BORING NO.: LF-19**

**TOTAL DEPTH: 24 feet bls**

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 12/7/2011  
**DATE COMPLETED:** 12/7/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Chris Rismiller/Adam Whitt  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 732.00 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619569.9260  
**EASTING:** 1483114.1260

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		0.3		FILL	(0.0 - 8.0) FILL: Silt, medium to coarse sand, some medium to large angular pebbles, pulverized rock, stiff, brown-black, dry.  NOTE: Odor, moist from 4 to 8 feet (waste includes: metal, wire, green plastic fragment).
2	36	9.0			
4		*20.2		FILL	(8.0 - 12.0) FILL: Clay, silt, brown-tan, some medium pebbles, moist, more silt from 10 to 12 feet.
6	23	14.6			
8				SW	(12.0 - 24.0) SAND: Medium to coarse, some medium to large round pebbles, trace silt, loose, well sorted, tan, dry.  NOTE: Moist from 16 to 20 feet.  NOTE: More medium pebbles, wet from 20 to 24 feet.
10	14	2.2			
12		*1.2		SW	(12.0 - 24.0) SAND: Medium to coarse, some medium to large round pebbles, trace silt, loose, well sorted, tan, dry.  NOTE: Moist from 16 to 20 feet.  NOTE: More medium pebbles, wet from 20 to 24 feet.
14	24	0.7			
16		0.3		SW	(12.0 - 24.0) SAND: Medium to coarse, some medium to large round pebbles, trace silt, loose, well sorted, tan, dry.  NOTE: Moist from 16 to 20 feet.  NOTE: More medium pebbles, wet from 20 to 24 feet.
18	36	1.1			
20		0.5		SW	(12.0 - 24.0) SAND: Medium to coarse, some medium to large round pebbles, trace silt, loose, well sorted, tan, dry.  NOTE: Moist from 16 to 20 feet.  NOTE: More medium pebbles, wet from 20 to 24 feet.
22	36	0.7			
24					End of boring at 24 feet.

Note: Soil-gas sampling point LF-SGP-19 installed with screens at 12 ft 8.5 inches to 17 ft 8.5 inches and 10 ft 4.5 inches to 10 ft 10.5 inches. Screen set from 22-24 feet below land surface and groundwater sampled via low-flow methodology on 12/7/2011.



# BORING LOG

**BORING NO.: LF-20**

**TOTAL DEPTH: 2 feet bls**

## PROJECT INFORMATION

**CLIENT: RACER Trust**  
**PROJECT: Landfill L1 Investigation**  
**SITE LOCATION: Moraine, Ohio**  
**PROJECT NUMBER: OH000294.2011.00005**  
**LOGGED BY: Lauren Baumgartner**  
**DATE STARTED: 11/29/2011**  
**DATE COMPLETED: 11/29/2011**

## DRILLING INFORMATION

**DRILLING CO.: EnviroCore**  
**DRILLER: Adam Whitt/Jeremy Amick**  
**DRILLING METHOD: Direct Push**  
**GROUND ELEVATION: (ft. AMSL)**  
**COORDINATES, STATE PLANE:**  
**NORTHING:**  
**EASTING:**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0	0	NM			(0.0 - 2.0) No recovery due to concrete.
2					End of boring at 2 feet.



# BORING LOG

**BORING NO.: LF-21**

**TOTAL DEPTH: 36.1 feet bls**

## PROJECT INFORMATION

**CLIENT: RACER Trust**  
**PROJECT: Landfill L1 Investigation**  
**SITE LOCATION: Moraine, Ohio**  
**PROJECT NUMBER: OH000294.2011.00005**  
**LOGGED BY: Lauren Baumgartner**  
**DATE STARTED: 11/29/2011**  
**DATE COMPLETED: 11/30/2011**

## DRILLING INFORMATION

**DRILLING CO.: EnviroCore**  
**DRILLER: Chris Rismiller/Jeremy Amick**  
**DRILLING METHOD: Direct Push**  
**GROUND ELEVATION: 733.00 (ft. AMSL)**  
**COORDINATES, STATE PLANE:**  
**NORTHING: 619974.96219**  
**EASTING: 1483240.53798**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0				FILL	(0.0 - 7.0) FILL: Silt, trace medium sand, well sorted, trace small pebbles, pulverized rock present, moist, moderately dense, slight odor, black-gray, (waste includes: wood, glass).
2	40	NM			
4					NOTE: Dense from 4 to 7 feet.
6	32	NM			
8		*NM		FILL	(7.0 - 8.0) FILL: Silt, red-green-yellow, dense, moist.
10	24	NM		FILL	(8.0 - 20.0) FILL: Silt, trace medium sand, well sorted, light gray, soft, loose, dry.
12					NOTE: Gray-black, odor, unable to sample due to low recovery from 12 to 16 feet.
14	6	NM			
16					NOTE: More dense, black-orange, waste, odor from 16 to 20 feet.
18	8	NM			
20				FILL	(20.0 - 24.0) FILL: Silt, moderately dense, trace medium sand, well sorted, trace medium gravel, subround, black-gray, moist, odor, (waste includes: plastic, wood).
22	29	NM			
24					(24.0 - 28.0) No recovery.
26	0	NM			
28					(28.0 - 32.0) No recovery.
30	0	NM			
32				FILL	(32.0 - 36.1) FILL: Sand, fine to coarse, poorly sorted, medium to large gravel, round, some clay (reworked material), strong odor and sheen, wet, black, dense, (waste includes: metal latch, copper wire, glass).
34	46	*NM			
36					Refusal at 36.1 feet. Note: Unable to collect PID readings due to equipment malfunction.



# BORING LOG

**BORING NO.:** LF-22

**TOTAL DEPTH:** 20 feet bls

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 12/6/2011  
**DATE COMPLETED:** 12/6/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Adam Whitt/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 729.11 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619875.16445  
**EASTING:** 1483234.39488

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		6.9		FILL	(0.0 - 8.0) FILL: Silt, trace medium sand, few small pebbles, angular, loose, black, (waste includes: wood, metal).
2	36	*120.6			
4				FILL	(8.0 - 12.0) FILL: Silt, medium sand, black, moist (waste includes: paper, metal, wood, light brown, sand).
6	14	26.4			
8				FILL	(8.0 - 12.0) FILL: Silt, medium sand, black, moist (waste includes: paper, metal, wood, light brown, sand).
10	12	*8.3			
12					(12.0 - 14.0) No recovery.
14	0	NM			(14.0 - 20.0) No recovery.
16					
18	0	NM			
20					End of boring at 20 feet.



# BORING LOG

**BORING NO.:** LF-23

**TOTAL DEPTH:** 33 feet bls

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 12/6/2011  
**DATE COMPLETED:** 12/6/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Adam Whitt/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 730.21 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619775.29108  
**EASTING:** 1483228.56529

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		0.7		FILL	(0.0 - 20.0) FILL: Silt, trace medium sand, few large angular pebbles, small amount of white clay sludge, moist, black-brown, (waste includes: wood, metal).  NOTE: Black, (waste includes: large amount of wood, styrofoam from 4 to 8 feet).  NOTE: Dense powder at 10 feet.  NOTE: Black-green staining from 12 to 16 feet.  NOTE: Black, (waste includes: large amount of wood), unable to sample from 16 to 20 feet.
2	26	11.4			
4					
6	18	303.3			
8					
10	15	240.7			
12		206.9			
14	20	*317			
16		294			
18	3	599			
20			FILL	(20.0 - 28.0) FILL: Silt, trace medium angular pebbles, moist, black, thick tar, (waste includes: wood, nails).  NOTE: Wet, black sheen at 26 feet.	
22	38	54.2			
24		*25.0			
26	38	16.5			
28		25.0	FILL	(28.0 - 32.0) FILL: Sand, medium to coarse, angular large pebbles, silt, sheen, wet, (waste includes: metal, wood).  (32.0 - 33.0) No recovery.  Refusal at 33 feet.  Soil-gas sampling point LF-SGP-23 installed with screen at 14 ft to 19 ft.	
30	11	*12.4			
32					



# BORING LOG

**BORING NO.:** LF-24

**TOTAL DEPTH:** 28 feet bls

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 12/6/2011  
**DATE COMPLETED:** 12/6/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Adam Whitt/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 728.17 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619675.57783  
**EASTING:** 1483222.08377

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		5.4		FILL	(0.0 - 12.0) FILL: Silt, some medium sand, trace large angular pebbles, trace clay, soft, brown-black, pulverized rock at bottom, moist, (waste includes: plastic, metal, wood, wire).  NOTE: Black from 4 to 8 feet.  NOTE: Wet from 8 to 12 feet.
2	25	20.2			
4		24.7		FILL	(12.0 - 14.0) FILL: Clay, soft, sticky, white-black, wet.
6	16	71.2			
8		2.7		FILL	(14.0 - 20.0) FILL: Silt, trace medium sand, few pebbles, angular, wet, (waste includes: wood).  NOTE: Gray, sheen from 16 to 20 feet.
10	12	70.7			
12		1.7		FILL	(20.0 - 24.0) No recovery.
14	48	0			
16		0.3		FILL	(24.0 - 26.0) FILL: Silt, black, wet, sheen.
18	24	0			
20		*141.3		SW	(26.0 - 28.0) SAND: Medium to coarse, some small round pebbles, tan-light brown, wet.
22	0	0			
24		*0.4		SW	(26.0 - 28.0) SAND: Medium to coarse, some small round pebbles, tan-light brown, wet.
26	36	0			
28					End of boring at 28 feet.



# BORING LOG

**BORING NO.: LF-25**

**TOTAL DEPTH: 28 feet bls**

## PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Landfill L1 Investigation**  
 SITE LOCATION: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.2011.00005**  
 LOGGED BY: **Lauren Baumgartner**  
 DATE STARTED: **11/29/2011**  
 DATE COMPLETED: **11/29/2011**

## DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller/Jeremy Amick**  
 DRILLING METHOD: **Direct Push**  
 GROUND ELEVATION: **729.19** (ft. AMSL)  
 COORDINATES, STATE PLANE:  
 NORTHING: **619968.79617**  
 EASTING: **1483340.27886**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0				FILL	(0.0 - 4.0) FILL: Silt, loose, trace medium sand, well sorted, few medium pebbles, brown-black, dry, (waste includes: wood, nails, metal scraps, cardboard).  NOTE: More dense, wet, black-gray from 2 to 4 feet.
2	36	NM			
4				FILL	(4.0 - 12.0) FILL: Silt, moderately dense, some medium to large pebbles, round to angular, poorly sorted, gray, wet.  NOTE: Waste includes: metal, styrofoam like material and wood from 8 to 12 feet.
6	22	NM			
8					
10	8	*NM			
12					(12.0 - 16.0) No recovery.
14	0	NM			
16				FILL	(16.0 - 24.0) FILL: Silt, some medium sand, trace large pebbles, black, wet, (waste includes: metal, wood).
18	12	NM			
20					
22	4	NM			
24				SW	(24.0 - 28.0) SAND: Medium to coarse, small to medium pebbles, well sorted, brown-tan, wet.  End of boring at 28 feet. Note: Unable to collect PID readings due to equipment malfunction.
26	32	*NM			
28					

**Notes:**

\*Sample submitted for laboratory analysis.  
 NM: Not Measured  
 USCS: Unified Soil Classification System

ppm: parts per million  
 NR: No Recovery  
 bls: below land surface

PID: Photo-ionization Detector  
 ft: feet  
 AMSL: Above Mean Sea Level

Date: 11/7/2012  
 Page: 1 of 1



# BORING LOG

**BORING NO.: LF-26**

**TOTAL DEPTH: 24.5 feet bls**

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 11/29/2011  
**DATE COMPLETED:** 11/29/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Chris Rismiller/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 730.23 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619869.01106  
**EASTING:** 1483334.17735

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		149.3		FILL	(0.0 - 3.0) FILL: Silt, loose, some medium to coarse sand, medium angular pebbles, well sorted, black, moist, (waste includes: plastic, wood).
2	35	*328			
4		12.2		FILL	(3.0 - 16.0) FILL: Silt, gray, loose, dry.
6	26	138			
8		7.3			
10	22	4.0			
12					
14	8	5.7			
16					(16.0 - 19.5) No recovery.
18	0				
20				FILL	(19.5 - 24.5) FILL: Silt, black, wet.
22	24	*97.1			
24					Refusal at 24.5 feet.



# BORING LOG

**BORING NO.: LF-27**

**TOTAL DEPTH: 15.5 feet bls**

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 11/29/2011  
**DATE COMPLETED:** 11/29/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Chris Rismiller/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 730.80 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619769.12166  
**EASTING:** 1483328.07685

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		37.5		FILL	(0.0 - 6.0) FILL: Silt, dense, some medium to coarse sand, poorly sorted, some medium to large pebbles, angular, moist, black-gray, odor.
2	36	NM			
4				FILL	NOTE: Waste includes: paper, plastic, wood from 4 to 6 feet. White clay present at 4 feet.
6	15	*271.4			
8		36.7		FILL	NOTE: Wet at 8 feet.
10	30	126.5			
12		79.9		FILL	Refusal at 15.5 feet.
14	12	*151.4			



# BORING LOG

**BORING NO.:** LF-28

**TOTAL DEPTH:** 28 feet bls

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 11/28/2011  
**DATE COMPLETED:** 11/28/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Chris Rismiller/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 730.86 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619669.37633  
**EASTING:** 1483321.89822

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		23.6		FILL	(0.0 - 4.0) FILL: Silt, dense, some medium sand with trace small angular pebbles around 3 to 4 feet, black-gray, wet, odor, (waste includes: plastic).
2	32	43.2			
4				FILL	(4.0 - 20.0) FILL: Sand, fine to medium, well sorted, small angular pebbles, loose, black, odor, dry.  NOTE: Large pebbles to cobbles preventing recovery from 16 to 20 feet.
6	8	*363			
8					
10	17	89.7			
12					
14	4	235.5		FILL	(20.0 - 24.0) FILL: Clay, silt, soft, some medium to coarse sand, some angular medium pebbles, strong odor, white-gray-black, wet.
16		0			
18	6	13.8		SW	(24.0 - 28.0) SAND: Fine to coarse, well sorted, small to large pebbles round, trace silt, tan-brown, wet.  End of boring at 28 feet.
20					
22	30	0			
24				SW	(24.0 - 28.0) SAND: Fine to coarse, well sorted, small to large pebbles round, trace silt, tan-brown, wet.  End of boring at 28 feet.
26	15	*0			
28					



# BORING LOG

**BORING NO.:** LF-29

**TOTAL DEPTH:** 26 feet bls

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 11/28/2011  
**DATE COMPLETED:** 11/28/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Chris Rismiller/Jeremy Amick  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 729.56 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619569.548113  
**EASTING:** 1483315.805753

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		0.0		FILL	(0.0 - 8.0) FILL: Fine to coarse sand, well sorted, medium to large pebbles, angular, some silt, moderately dense, brown-light gray, moist, slight odor.  NOTE: Gray, slight odor from 4 to 8 feet.
2	20	0.0			
4		0.0			
6	6	0.0			
8		*0.0		FILL	(8.0 - 11.0) FILL: Sand, medium, well sorted, some medium to large pebbles, angular, moderately dense, some silt, trace clay (white), gray-brown, moist, (waste includes: wood).
10	20	0.0			
12		0.0		SW	(11.0 - 14.0) SAND: Medium to coarse, well sorted, some clay, trace medium gravel, soft, brown, moist.
14	18	0.0			
16		*0.0		SW	(14.0 - 16.0) SAND: Medium to coarse, well sorted, medium to large pebbles, round, loose, brown-tan, dry.
18	24	0.0			
20		0.0		SW	(16.0 - 20.0) SAND: Medium, well sorted, trace medium pebbles, round, brown-tan, moist.
22	0	NM			
24				SW	(24.0 - 26.0) SAND: Medium, well sorted, trace medium pebbles-round, moderately dense, brown, wet. End of boring at 26 feet.
26	6	0.0			



# BORING LOG

**BORING NO.: LF-29A**

**TOTAL DEPTH: 28 feet bls**

## PROJECT INFORMATION

**CLIENT: RACER Trust**  
**PROJECT: Landfill L1 Investigation**  
**SITE LOCATION: Moraine, Ohio**  
**PROJECT NUMBER: OH000294.2011.00005**  
**LOGGED BY: Lauren Baumgartner**  
**DATE STARTED: 12/7/2011**  
**DATE COMPLETED: 12/7/2011**

## DRILLING INFORMATION

**DRILLING CO.: EnviroCore**  
**DRILLER: Chris Rismiller/Jeremy Amick**  
**DRILLING METHOD: Direct Push**  
**GROUND ELEVATION: 731.50 (ft. AMSL)**  
**COORDINATES, STATE PLANE:**  
**NORTHING: 619555.6050**  
**EASTING: 1483315.0760**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0	34	0.3		FILL	(0.0 - 8.0) FILL: Silt, clay, medium sand, trace small round pebbles, brown, moist, loose, (waste includes: plastic, metal, nails).  NOTE: More clay, loose, yellow, brown, soft, wood from 4 to 8 feet.
2		0.1			
4	8	0.2			
6					
8	15	0.3		FILL	(8.0 - 12.0) FILL: Clay, soft, trace medium to coarse sand, few angular, small to large pebbles, white clay throughout, brown-gray, moist.
10		*0.5			
12	14	0.0		FILL	(12.0 - 14.0) FILL: Clay, soft, brown, moist, (waste includes: wood).
14		0.0			
16	32	*0.0		SW	(14.0 - 28.0) SAND: Medium to coarse, small to medium pebble, round, tan, moist.  NOTE: Dry from 16 to 20 feet.  NOTE: Moist from 20 to 24 feet.  NOTE: Wet at 24 feet.  End of boring at 28 feet.
18		0.0			
20	26	0.0			
22		0.0			
24	36	0.0			
26		0.0			
28					

Note: Soil-gas sampling point LF-29A installed with screens at 12 ft. 4 inches to 17 ft 4 inches and 18 ft 11 inches to 19 ft 5 inches. Screen set from 24-26 feet below land surface and groundwater sampled via low-flow methodology on 12/7/2011.



# BORING LOG

**BORING NO.: LF-30**

**TOTAL DEPTH: 13 feet bls**

## PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Landfill L1 Investigation**  
 SITE LOCATION: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.2011.00005**  
 LOGGED BY: **Lauren Baumgartner**  
 DATE STARTED: **11/16/2011**  
 DATE COMPLETED: **11/16/2011**

## DRILLING INFORMATION

DRILLING CO.: **EnviroCore**  
 DRILLER: **Chris Rismiller/Adam Whitt**  
 DRILLING METHOD: **Direct Push**  
 GROUND ELEVATION: **727.60** (ft. AMSL)  
 COORDINATES, STATE PLANE:  
 NORTHING: **620062.53145**  
 EASTING: **1483446.27466**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0	42	0.4		FILL	(0.0 - 2.0) FILL: Silt, soft, some clay, some sand, medium grain, some angular medium pebbles, poorly sorted, moist-wet, dark brown.
2		*43.9		FILL	(2.0 - 8.0) FILL: Silt, dense, some sand, medium grain, white silt like material throughout, slight odor, well sorted, very dark gray, moist.
4	28	0.6		FILL	NOTE: Increasing sand and pebbles, angular, wet from 4 to 8 feet.
6		1.6			
8	NM	*3.1		CL	(8.0 - 9.0) CLAY: Moderately stiff, low plasticity, some sand, medium grain, some round medium to large pebbles, very dark grayish brown.
10		NM		SW	(9.0 - 13.0) SAND: Fine to coarse grain, some medium to large pebbles, round, loose, brown, moist.
12		NM			End of boring at 13 feet.



# BORING LOG

**BORING NO.: LF-31**

**TOTAL DEPTH: 12 feet bls**

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 11/16/2011  
**DATE COMPLETED:** 11/16/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Chris Rismiller/Adam Whitt  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 730.85 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619962.70124  
**EASTING:** 1483440.16778

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0					
18	0.9			FILL	(0.0 - 6.0) FILL: Sand, medium to coarse, small to large pebbles, subangular, poorly sorted, loose to moderately stiff, dark grayish brown, dry, (waste includes: brick fragments).
	0.8				
22	2.1				NOTE: Wood from 4 to 6 feet.
		*141		FILL	(6.0 - 7.0) FILL: Silt, dense, white, dry, odor, (waste includes: wood).
				FILL	(7.0 - 8.0) FILL: Silt, dense, some clay, medium stiff, moist, black.
36		*3.6		CL	(8.0 - 10.5) CLAY: Moderately stiff, medium plasticity, trace medium sand, few angular small pebbles, moist, brown.
	4.1			SW	(10.5 - 12.0) SAND: Fine to coarse, small pebbles, rounded, poorly sorted, moist, brown.
12					End of boring at 12 feet.



# BORING LOG

**BORING NO.: LF-32**

**TOTAL DEPTH: 16 feet bls**

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 11/16/2011  
**DATE COMPLETED:** 11/16/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Chris Rismiller/Adam Whitt  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 732.84 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619862.84954  
**EASTING:** 1483434.12141

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0	41	0.1		FILL	(0.0 - 2.0) FILL: Sand, medium, subangular, some silt, some medium pebbles, dense, moderately sorted, reddish brown.
2		118		FILL	(2.0 - 3.0) FILL: Silt, stiff, trace sand, fine grain, black, moist.
4	22	*32.1		FILL	(4.0 - 8.0) FILL: Sand, fine to coarse, poorly sorted, large pebbles, angular, silt, dense, white to pink, slight odor, moist, brown, reddish brown, white, slight odor, (waste includes: wood).
6		79.6		FILL	
8	36	27.6		FILL	(8.0 - 12.0) FILL: Clay, soft, some silt, slight odor, very dark gray, wet.
10		13.5		FILL	
12	38	*11.4		CL	(12.0 - 14.0) CLAY: Wet, very dark gray.
14		1.6		SW	(14.0 - 16.0) SAND: Fine to coarse, small to large subrounded pebbles, some clay, stiff, poorly sorted, wet, grayish brown.
16	End of boring at 16 feet.				



# BORING LOG

**BORING NO.: LF-33**

**TOTAL DEPTH: 16 feet bls**

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 11/16/2011  
**DATE COMPLETED:** 11/16/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Chris Rismiller/Adam Whitt  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 732.24 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619763.09047  
**EASTING:** 1483427.90380

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		0.0		FILL	(0.0 - 1.5) FILL: Silt, dense, trace sand, fine grain, slight odor, white and dark gray, moist.
2	34	2.3		FILL	(1.5 - 5.0) FILL: Silt, very dense, some medium to coarse grain sand, moderately sorted, small to large pebbles, subround, very dark grayish brown.
4		8.8		FILL	(5.0 - 6.0) FILL: Silt, dense, white and gray, dry, purple-blue staining.
6	23	*30.0		FILL	(6.0 - 8.5) FILL: Silt, dense, some waste, red fibrous, slight odor, slight sheen, black, dry.
8		23.6		FILL	NOTE: Wet, (waste includes: wood) from 8 to 8.5 feet.
10	38	0.1		FILL	(8.5 - 12.0) FILL: Clay, soft, sticky, brown, moist-wet at 8.5 feet.
12		*0.3		CL	(12.0 - 14.0) CLAY: Moderately stiff, trace coarse angular sand, brown, moist to wet.
14	36	0.2		SW	(14.0 - 16.0) SAND: Fine to coarse, subangular, small to large angular pebbles, poorly sorted, wet, brown.
16					End of boring at 16 feet.



# BORING LOG

**BORING NO.: LF-34**

**TOTAL DEPTH: 16 feet bls**

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 11/16/2011  
**DATE COMPLETED:** 11/16/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Chris Rismiller/Adam Whitt  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 731.97 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619663.28653  
**EASTING:** 1483421.72575

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		0.0		FILL	(0.0 - 2.0) FILL: Sand, medium to coarse, medium to large pebbles, moderately dense, poorly sorted, some silt, dense, dark grayish brown, wet.
2	33	0.0		FILL	(2.0 - 3.0) FILL: Silt, dense, large pulverized rock, angular, some medium sand, well sorted, pale yellowish green, moist, odor.
4				FILL	(3.0 - 4.0) FILL: Sand, medium to coarse, some medium to large pebbles, loose, moist, dark grayish brown, (waste includes: glass, fibers).
6	26	*23.3		FILL	
8		3.5			(4.0 - 8.0) FILL: Silt, trace medium sand, few small pebbles, moist, sorted, loose, very dark gray, dry.
10	48	0.3		FILL	(8.0 - 12.0) FILL: Clay, soft, sticky, odor, trace small pebbles, black, wet, (waste includes: cardboard).
12		0.0			
14	34	0.0		CL	(12.0 - 14.0) CLAY: Moderately stiff, some pulverized rock, dark brown, moist.
16		*0.0		SW	(14.0 - 16.0) SAND: Fine to coarse, some small to large pebbles, moderately loose, poorly sorted, brown, moist.
End of boring at 16 feet.					



# BORING LOG

**BORING NO.:** LF-35

**TOTAL DEPTH:** 24 feet bls

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 11/16/2011  
**DATE COMPLETED:** 11/16/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Chris Rismiller/Adam Whitt  
**DRILLING METHOD:** Direct Push  
**GROUND ELEVATION:** 726.56 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** 619760.058101  
**EASTING:** 1483477.777844

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0		0.0		FILL	(0.0 - 4.0) FILL: Silt, some medium sand, some medium angular pebbles, poorly sorted, moist, very dark gray, (waste includes: wood, glass).  NOTE: Some white silt, dry to moist from 2 to 4 feet.
2	24	*0.8			
4		0.2		FILL	(4.0 - 6.0) FILL: Clay, soft, medium plasticity, trace small round pebbles, brown, moist.
6	48	*0.1			
8		3.4		CL	(6.0 - 8.0) CLAY: Moderately stiff, trace medium sand, trace small gravel, brown, moist.
10	28	0.4			
12		0.0		SW	(8.0 - 20.0) SAND: Fine to medium, some medium pebbles, round, poorly sorted, tan, dry.
14	24	0.0			
16		0.0			
18	22	0.0			
20		0.0			(20.0 - 24.0) No recovery.
22	0				End of boring at 24 feet.
24					Note: Soil-gas sampling point LF-SGP-35 installed with screens at 7 ft to 12 ft and 14 ft 11 inches to 15 ft 5 inches. Screen set from 20-22 feet below land surface and groundwater sampled via low-flow methodology on 11/16/2011.



## BORING LOG

BORING NO.: **LF-36**

TOTAL DEPTH: **42** feet bls

### PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Landfill L1 Investigation**  
 SITE LOCATION: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.2012.0005A**  
 LOGGED BY: **Lauren Baumgartner**  
 DATE STARTED: **9/19/2012**  
 DATE COMPLETED: **9/19/2012**

### DRILLING INFORMATION

DRILLING CO.: **Boart Longyear**  
 DRILLER: **Jason Greer**  
 DRILLING METHOD: **Rotosonic**  
 GROUND ELEVATION: **732.40 feet AMSL**  
 NORTHING: **620038.1295**  
 EASTING: **1483112.5999**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
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0		3.6		FILL	<p>(0.0 - 11.0) FILL, silt with medium sand, few small to medium pebbles, loose to moderate stiff, dry, black, odor, (waste includes: metal, fabric, wire, plastic).</p> <p>Note: negative result for NAPL test from 2 to 4 feet.</p> <p>Note: negative result for NAPL test from 4 to 6 feet.</p> <p>Note: oil substance, odor, moist from 5 to 10 feet.</p> <p>Note: negative result for NAPL test from 6 to 8 feet.</p> <p>Note: negative result for NAPL test from 8 to 10 feet.</p> <p>Note: waste includes: metal, odor, dry from 10 to 11 feet.</p>
2	58	95.9			
4		121			
6	35	243			
8		*481			
10	54	327	FILL		
12		38.4			
14		20.6			
16	57	26.9			
18		8.1			
20	58	8.1	FILL		
22		6.3			
24		11.6			
26		9.5			
28	60	*6.8			

**Notes:**  
 bls: below land surface      NR: No Recovery      ppm: parts per million      Date: 12/28/2012  
 NR: No Recovery      NM: Not Measured      PID: Photo-ionization Detector      Page: 1 of 2  
 \*Sample submitted for laboratory analysis.      USCS: Unified Soil Classification System      ft: feet      HK: Hydroknife      AMSL: Above mean sea level



## BORING LOG

BORING NO.: **LF-36**

TOTAL DEPTH: **42** feet bls

### PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Landfill L1 Investigation**  
 SITE LOCATION: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.2012.0005A**  
 LOGGED BY: **Lauren Baumgartner**  
 DATE STARTED: **9/19/2012**  
 DATE COMPLETED: **9/19/2012**

### DRILLING INFORMATION

DRILLING CO.: **Boart Longyear**  
 DRILLER: **Jason Greer**  
 DRILLING METHOD: **Rotosonic**  
 GROUND ELEVATION: **732.40 feet AMSL**  
 NORTHING: **620038.1295**  
 EASTING: **1483112.5999**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
30		16.8		FILL	(30.0 - 37.0) FILL, sand, medium to coarse grain, some silt, little small to medium round pebbles, poorly sorted, stiff, wet at 30 feet, black, (waste includes: wood, metal, wire).
32	62	5.6			
34		*4.2			
36		1.3			
38	70	1.3		SW	(37.0 - 42.0) SAND, medium to coarse grain, some silt, some small to medium round pebbles, poorly sorted, loose, wet, olive brown.  Note: Screen set from 37 to 42 feet below land surface and groundwater sample via low flow methodology on 9/19/2012.
40		*0.5			
42	NM	NM			
End of boring at 42 feet.					

**Notes:**  
 bls: below land surface      NR: No Recovery      ppm: parts per million      Date: 12/28/2012  
 NR: No Recovery      NM: Not Measured      PID: Photo-ionization Detector      Page: 2 of 2  
 \*Sample submitted for laboratory analysis.      USCS: Unified Soil Classification System      ft: feet      HK: Hydroknife      AMSL: Above mean sea level

## BORING LOG

BORING NO.: **LF-37**








TOTAL DEPTH: **40** feet bls

### PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Landfill L1 Investigation**  
 SITE LOCATION: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.2012.0005A**  
 LOGGED BY: **Lauren Baumgartner**  
 DATE STARTED: **9/20/2012**  
 DATE COMPLETED: **9/20/2012**

### DRILLING INFORMATION

DRILLING CO.: **Boart Longyear**  
 DRILLER: **Jason Greer**  
 DRILLING METHOD: **Rotosonic**  
 GROUND ELEVATION: **727.73 feet AMSL**  
 NORTHING: **619722.3249**  
 EASTING: **1483090.8531**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0	29	3.0		FILL	(0.0 - 3.0) FILL, sand with silt, medium grain, some small round pebbles, poorly sorted, loose, dry, olive brown, odor (waste includes: wood, brick). Note: negative result for NAPL test from 2 to 4 feet.
2		150			
4	NR	*289		FILL	(3.0 - 5.0) FILL, coal fragments, loose to stiff, dry, black, odor.  (5.0 - 10.0) NO RECOVERY.
6		NR			
8		NR			
10	38	*14.6		FILL	(10.0 - 16.0) FILL, white to gray clay with some black silt, wet, (waste includes: metal, wire). Note: some brown fluid.  Note: positive result for NAPL test from 10 to 12 feet.  Note: sand sized fragments from 14 to 16 feet.
12		36.4			
14		57.4			
16	29	*>8000		FILL	(16.0 - 20.0) FILL, silt with medium sand, stiff, dry, black, (waste includes: metal, wood, wire). Note: positive result for NAPL test from 16 to 18 feet.
18		908			
20	38	317		FILL	(20.0 - 24.0) FILL, silt with medium sand, some white clay, moderate stiff, wet at 20 feet, black, (waste includes: wood, wire, metal).  Note: red and white fibers at 18 feet. Note: positive result for NAPL test from 18 to 20 feet.
22		241			
24		*78			
26	42	*2.0		FILL	(24.0 - 26.0) FILL, silt with white clay, some black tar substance, soft to medium stiff, some brown fluid, wet, (waste includes: metal).  (26.0 - 28.0) FILL, silt with medium sand, some medium round pebbles, poorly sorted, stiff, wet, black, (waste includes: metal, wire, brick).
28		*10.0			
30	51	9.7		GW	(28.0 - 33.0) PEBBLES, small round with medium to coarse sand, some silt, poorly sorted, loose, wet, brown to black.
32		3.1			



## BORING LOG

BORING NO.: **LF-37**

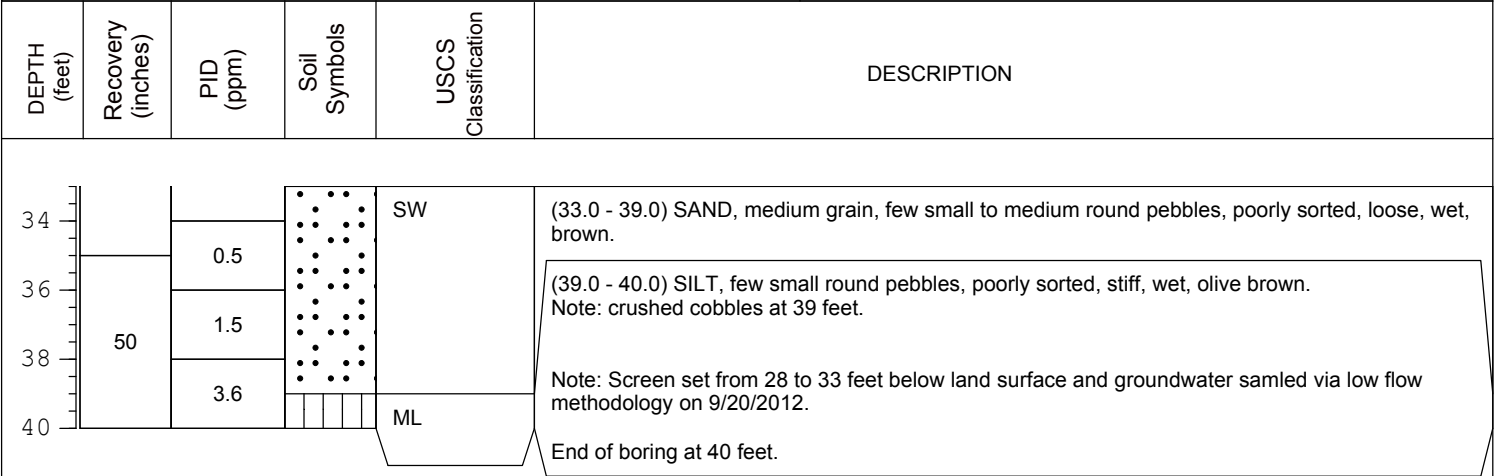
TOTAL DEPTH: **40** feet bls

### PROJECT INFORMATION

CLIENT: **RACER Trust**  
 PROJECT: **Landfill L1 Investigation**  
 SITE LOCATION: **Moraine, Ohio**  
 PROJECT NUMBER: **OH000294.2012.0005A**  
 LOGGED BY: **Lauren Baumgartner**  
 DATE STARTED: **9/20/2012**  
 DATE COMPLETED: **9/20/2012**

### DRILLING INFORMATION

DRILLING CO.: **Boart Longyear**  
 DRILLER: **Jason Greer**  
 DRILLING METHOD: **Rotosonic**  
 GROUND ELEVATION: **727.73 feet AMSL**  
 NORTHING: **619722.3249**  
 EASTING: **1483090.8531**





# BORING LOG

**BORING NO.:** HA-LF-1

**TOTAL DEPTH:** 5 feet bls

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 11/30/2011  
**DATE COMPLETED:** 11/30/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Jeremy Amick  
**DRILLING METHOD:** Hand Auger  
**GROUND ELEVATION:** 727.00 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** NM  
**EASTING:** NM

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0					
1.0 - 4.5	60	NM	[Symbol: horizontal dashes]	FILL	(1.0 - 4.5) FILL: Silty clay, soft, brown, trace sand, trace gravel, (waste includes: glass). NOTE: Waste includes: nails from 2 to 4 feet.
4.5 - 5.0			[Symbol: dots]	SW	(4.5 - 5.0) SAND: Medium grain, well sorted, loose, moist, red-brown. Refusal at 5 feet. Note: Boring location directly west of LF-1 along the fence.



# BORING LOG

**BORING NO.:** HA-LF-3A

**TOTAL DEPTH:** 5.5 feet bls

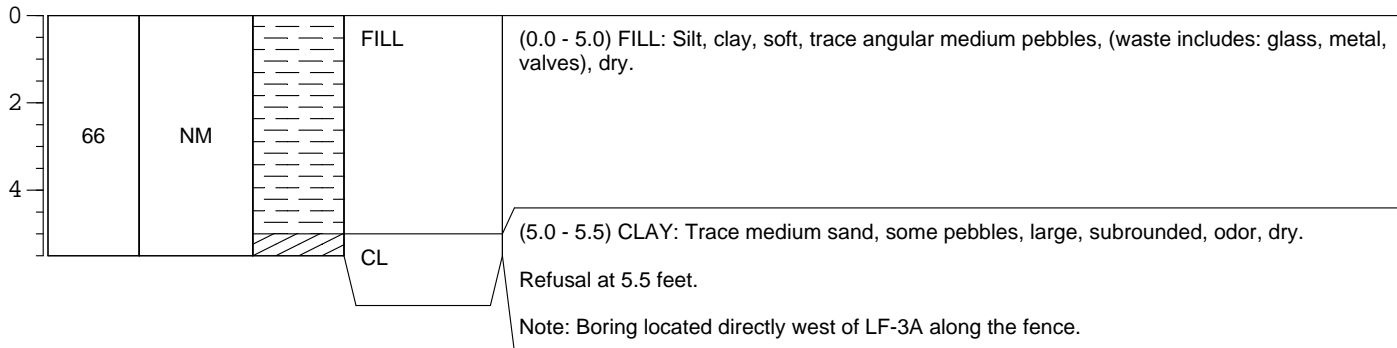
## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 11/30/2011  
**DATE COMPLETED:** 11/30/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Jeremy Amick  
**DRILLING METHOD:** Hand Auger  
**GROUND ELEVATION:** 727.98 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** NM  
**EASTING:** NM

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
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# BORING LOG

**BORING NO.:** HA-LF-5

**TOTAL DEPTH:** 3 feet bls

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 12/1/2011  
**DATE COMPLETED:** 12/1/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Jeremy Amick  
**DRILLING METHOD:** Hand Auger  
**GROUND ELEVATION:** 727.98 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** NM  
**EASTING:** NM

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0				CL	(0.0 - 0.3) CLAY: Medium sand, well sorted, soft, dark brown, dry.
2	36	NM		SW	(0.3 - 3.0) SAND: Medium to coarse, well sorted, loose, small pebbles to large cobbles, dry.
End of boring at 3 feet.					
Note: Boring located directly west of LF-5 along the fence.					



# BORING LOG

**BORING NO.:** HA-LF-7A

**TOTAL DEPTH:** 6 feet bls

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 12/1/2011  
**DATE COMPLETED:** 12/1/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Jeremy Amick  
**DRILLING METHOD:** Hand Auger  
**GROUND ELEVATION:** 727.50 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** NM  
**EASTING:** NM

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0	72	NM		CL	(0.0 - 3.5) CLAY: Trace medium sand, some small round pebbles, dark brown, dry.
2				CL	(3.5 - 6.0) CLAY: Trace medium to coarse sand, some small round pebbles, reddish-brown, some round cobbles, dry.
4					End of boring at 6 feet.
6					Note: Boring located directly west of LF-7A along the fence.



# BORING LOG

**BORING NO.:** HA-LF-19

**TOTAL DEPTH:** 2.5 feet bls

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 12/1/2011  
**DATE COMPLETED:** 12/1/2011

## DRILLING INFORMATION

**DRILLING CO.:** EnviroCore  
**DRILLER:** Jeremy Amick  
**DRILLING METHOD:** Hand Auger  
**GROUND ELEVATION:** 732.00 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** NM  
**EASTING:** NM

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0	30	NM		CL	(0.0 - 2.5) CLAY: Medium sand, well sorted, soft, large pebbles to cobbles, brown, dry, glass found at 1 foot.
2					End of boring at 2.5 feet.

Note: Boring located directly south of LF-19 along the fence.



# BORING LOG

**BORING NO.:** HA-LF-29A

**TOTAL DEPTH:** 2.5 feet bls

## PROJECT INFORMATION

**CLIENT:** RACER Trust  
**PROJECT:** Landfill L1 Investigation  
**SITE LOCATION:** Moraine, Ohio  
**PROJECT NUMBER:** OH000294.2011.00005  
**LOGGED BY:** Lauren Baumgartner  
**DATE STARTED:** 12/1/2011  
**DATE COMPLETED:** 12/1/2011

## DRILLING INFORMATION

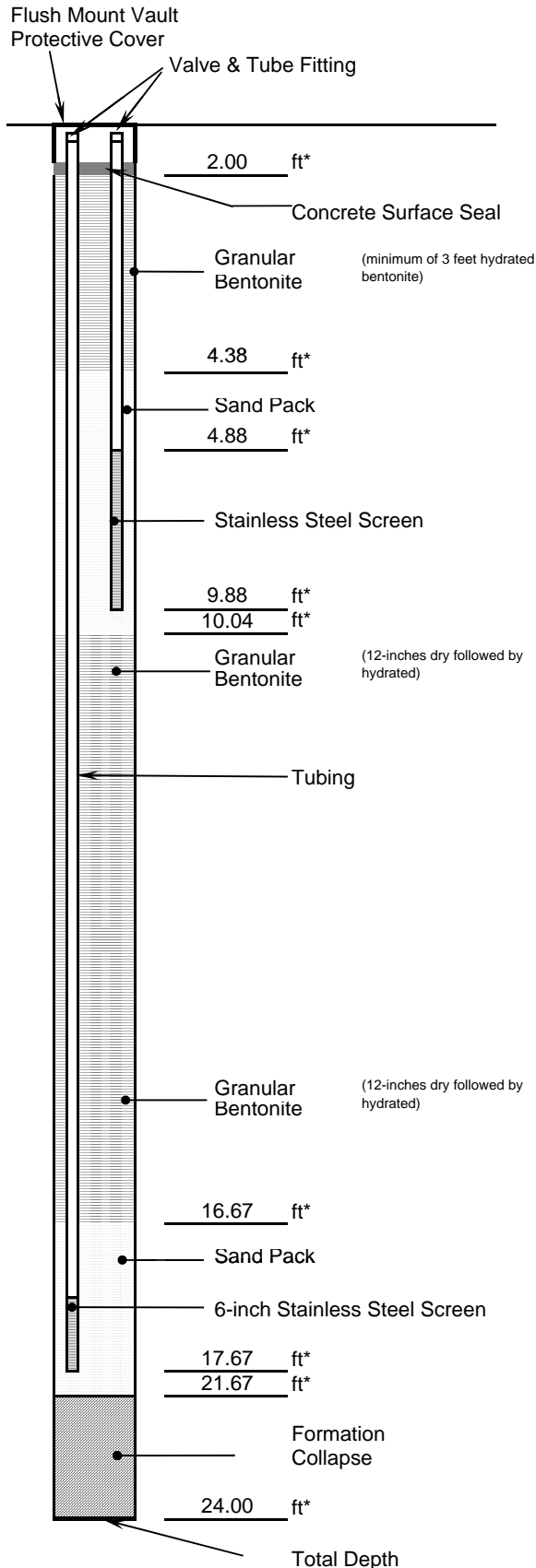
**DRILLING CO.:** EnviroCore  
**DRILLER:** Jeremy Amick  
**DRILLING METHOD:** Hand Auger  
**GROUND ELEVATION:** 731.50 (ft. AMSL)  
**COORDINATES, STATE PLANE:**  
**NORTHING:** NM  
**EASTING:** NM

DEPTH (feet)	Recovery (inches)	PID (ppm)	Soil Symbols	USCS Classification	DESCRIPTION
0				CL	(0.0 - 0.5) CLAY: Trace sand, medium grain, soft, brown, some small pebbles, dry.
2	30	NM		SW	(0.5 - 2.5) SAND: Medium to coarse grain, small to large pebbles, rounded, loose, brown-tan, moist.
End of boring at 2.5 feet.					
Note: Boring located directly south of LF-29A along the fence.					

**Attachment E-2**

Soil-Gas Point Construction  
Diagrams

# SOIL-GAS POINT CONSTRUCTION DIAGRAM



\* Depth in Feet Below Land Surface

Project: RACER Trust-Landfill Investigation Point: LF-SGP-1

City: Moraine

County: Montgomery State: OH

Survey Coordinates:  
 Northing: 620192.972813

Easting: 1482953.402492

Land-Surface Elevation (surveyed): 727.98 feet  
 (above mean sea level)

Historic Maximum Groundwater Elevation: 708.75 feet  
 (above mean sea level)

Groundwater Encountered During Drilling: 21.78 feet bls

Installation Dates: 11/14/2011

Weather Conditions at Installation: Clear, 60s

Drilling Contractor: EnviroCore

Driller: Chris Rismiller/Adam Whitt

Drilling Method: Geoprobe

Screen Construction: Type: Stainless Steel - 6 inches  
 Diameter: 0.4375-inch OD, 0.3125-inch ID  
 Type: Stainless steel - 60 inches  
 Diameter: 0.5-inch ID

Tubing Construction: Type: Teflon®  
 Diameter: 0.25-inch OD, 0.17-inch ID

**Volume Calculation (mL):**

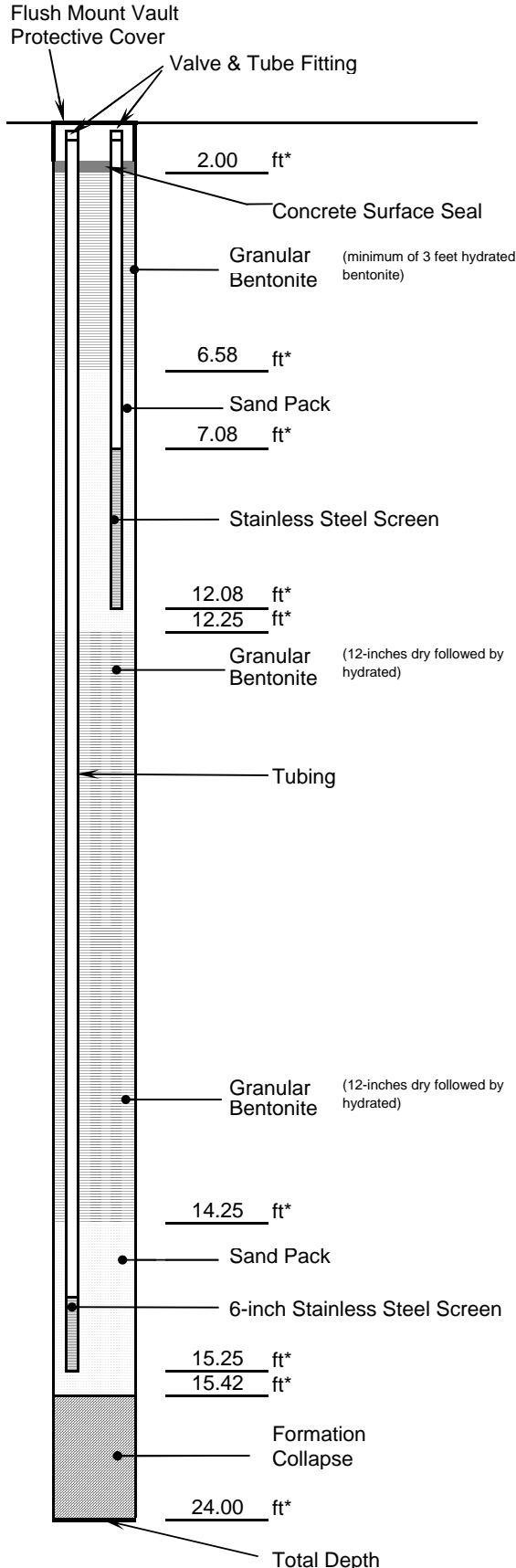
	Shallow	Deep
$V_1$	<u>193</u>	<u>7.5</u>
$V_2$	<u>22</u>	<u>77</u>
$V_3$	<u>2086</u>	<u>1877</u>
$V_t$	<u>2301</u>	<u>1962</u>

Remarks: \_\_\_\_\_

Prepared by: L. Baumgartner

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter                      12-inches = 1 foot  
 ID - inner diameter                      1 cubic inch = 16.39 mL  
 bls - below land surface                 $\pi = 3.1416$   
 mL - milliliters



\* Depth in Feet Below Land Surface

Project: RACER Trust-Landfill Investigation Point: LF-SGP-3A

City: Moraine

County: Montgomery

State: OH

Survey Coordinates:

Northing: 619994.6180

Easting: 1482919.3800

Land-Surface Elevation (surveyed): 727.98 feet  
(above mean sea level)

Historic Maximum Groundwater Elevation: 708.75 feet  
(above mean sea level)

Groundwater Encountered During Drilling: 21 feet bls

Installation Dates: 12/14/2011

Weather Conditions at Installation: Clear, 30s

Drilling Contractor: EnviroCore

Driller: Adam Whitt/Jeremy Amick

Drilling Method: Geoprobe

Screen Construction: Type: Stainless Steel - 6 inches  
Diameter: 0.4375-inch OD, 0.3125-inch ID  
Type: Stainless steel - 60 inches  
Diameter: 0.5-inch ID

Tubing Construction: Type: Teflon®  
Diameter: 0.25-inch OD, 0.17-inch ID

Volume Calculation (mL):	Shallow	Deep
$V_1$	<u>193</u>	<u>7.5</u>
$V_2$	<u>32</u>	<u>66</u>
$V_3$	<u>2086</u>	<u>677</u>
$V_t$	<u>2311</u>	<u>751</u>

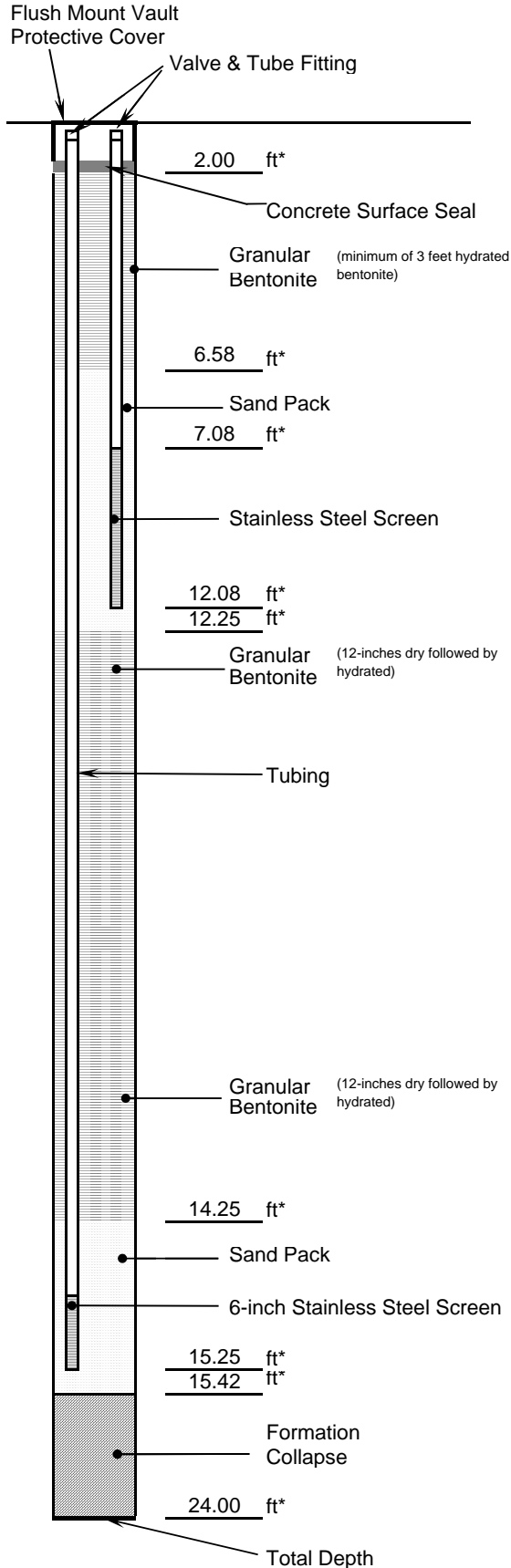
Remarks: \_\_\_\_\_

Prepared by: L. Baumgartner

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter                      12-inches = 1 foot  
ID - inner diameter                      1 cubic inch = 16.39 mL  
bls - below land surface                 $\pi = 3.1416$   
mL - milliliters

# SOIL-GAS POINT CONSTRUCTION DIAGRAM



\* Depth in Feet Below Land Surface

Project: RACER Trust-Landfill Investigation Point: LF-SGP-5

City: Moraine

County: Montgomery

State: OH

Survey Coordinates:

Northing: 619794.0150

Easting: 1482911.0790

Land-Surface Elevation (surveyed): 727.98 feet  
(above mean sea level)

Historic Maximum Groundwater Elevation: 708.75 feet  
(above mean sea level)

Groundwater Encountered During Drilling: 20.00 feet bls

Installation Dates: 12/14/2011

Weather Conditions at Installation: Clear, 40s

Drilling Contractor: EnviroCore

Driller: Adam Whitt /Jeremy Amick

Drilling Method: Geoprobe

Screen Construction: Type: Stainless Steel - 6 inches  
Diameter: 0.4375-inch OD, 0.3125-inch ID  
Type: Stainless steel - 60 inches  
Diameter: 0.5-inch ID

Tubing Construction: Type: Teflon®  
Diameter: 0.25-inch OD, 0.17-inch ID

Volume Calculation (mL):	Shallow	Deep
$V_1$	<u>193</u>	<u>7.5</u>
$V_2$	<u>32</u>	<u>66</u>
$V_3$	<u>2086</u>	<u>677</u>
$V_t$	<u>2311</u>	<u>751</u>

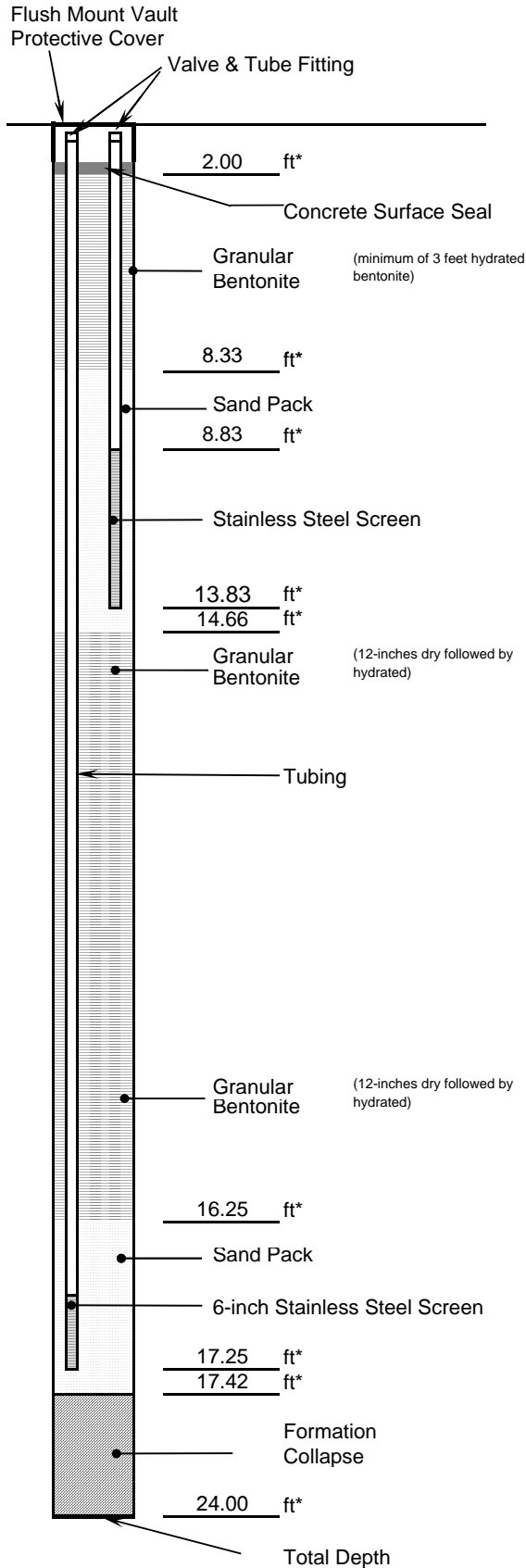
Remarks: \_\_\_\_\_

Prepared by: L. Baumgartner

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter                      12-inches = 1 foot  
 ID - inner diameter                      1 cubic inch = 16.39 mL  
 bls - below land surface                 $\pi = 3.1416$   
 mL - milliliters

# SOIL-GAS POINT CONSTRUCTION DIAGRAM



\* Depth in Feet Below Land Surface

Project: RACER Trust-Landfill Investigation Point: LF-SGP-7A

City: Moraine

County: Montgomery State: OH

Survey Coordinates:

Northing: 619595.1010

Easting: 1482899.1050

Land-Surface Elevation (surveyed): 727.50 feet  
(above mean sea level)

Historic Maximum Groundwater Elevation: 708.76 feet  
(above mean sea level)

Groundwater Encountered During Drilling: 20.00 feet bls

Installation Dates: 12/8/2011

Weather Conditions at Installation: Clear 30's

Drilling Contractor: EnviroCore

Driller: Adam Whitt/Jeremy Amick

Drilling Method: Geoprobe

Screen Construction: Type: Stainless Steel - 6 inches  
Diameter: 0.4375-inch OD, 0.3125-inch ID  
Type: Stainless steel - 60 inches  
Diameter: 0.5-inch ID

Tubing Construction: Type: Teflon<sup>®</sup>  
Diameter: 0.25-inch OD, 0.17-inch ID

Volume Calculation (mL):	Shallow	Deep
$V_1$	<u>193</u>	<u>7.5</u>
$V_2$	<u>39</u>	<u>75</u>
$V_3$	<u>2295</u>	<u>677</u>
$V_t$	<u>2527</u>	<u>760</u>

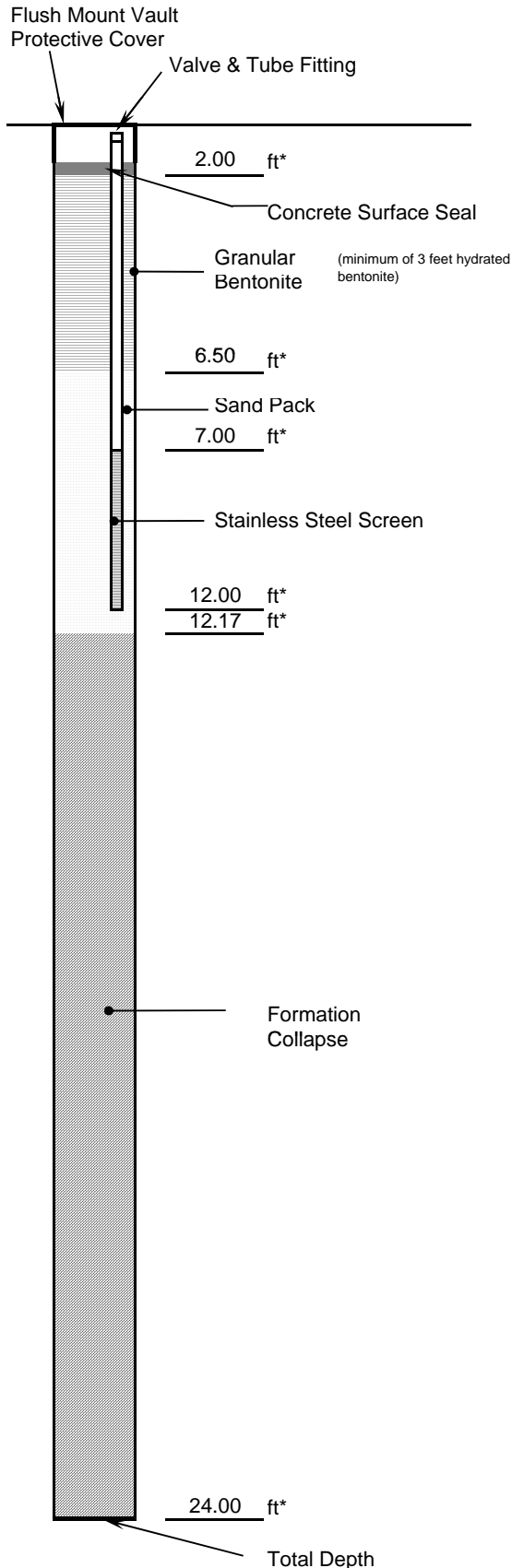
Remarks: \_\_\_\_\_

Prepared by: L. Baumgartner

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter                      12-inches = 1 foot  
ID - inner diameter                      1 cubic inch = 16.39 mL  
bls - below land surface                 $\pi = 3.1416$   
mL - milliliters

# SOIL-GAS POINT CONSTRUCTION DIAGRAM



\* Depth in Feet Below Land Surface

Project: RACER Trust-Landfill Investigation Point: LF-SGP-13/A

City: Moraine

County: Montgomery State: OH

Survey Coordinates:

Northing: 619687.79914

Easting: 1483022.51078

Land-Surface Elevation (surveyed): 729.42 feet  
(above mean sea level)

Historic Maximum Groundwater Elevation: 709.11 feet  
(above mean sea level)

Groundwater Encountered During Drilling: N/A feet bls

Installation Dates: 12/13/2011

Weather Conditions at Installation: Clear, 30s

Drilling Contractor: EnviroCore

Driller: Adam Whitt/Jeremy Amick

Drilling Method: Geoprobe

Screen Construction: Type: Stainless steel - 60 inches  
Diameter: 0.5-inch ID

Tubing Construction: Type: Teflon®  
Diameter: 0.25-inch OD, 0.17-inch ID

Volume Calculation (mL):	Shallow	Deep
$V_1$	193	N/A
$V_2$	31	N/A
$V_3$	2086	N/A
$V_t$	2310	N/A

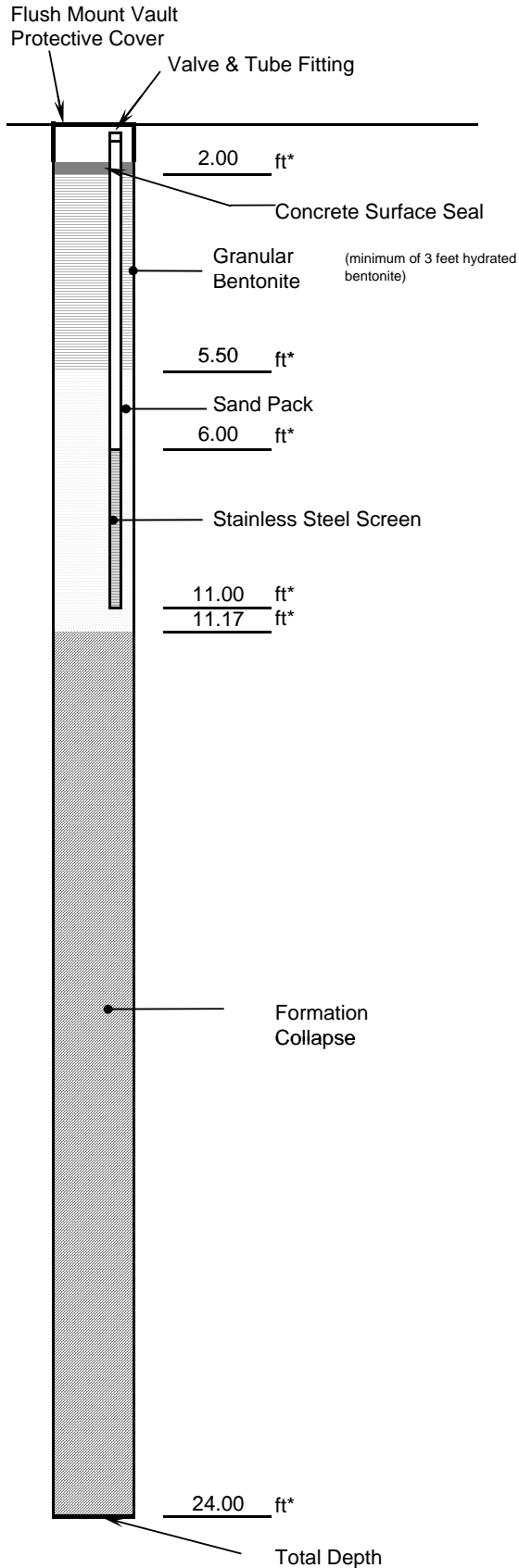
Remarks: \_\_\_\_\_

Prepared by: L. Baumgartner

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter                      12-inches = 1 foot  
 ID - inner diameter                      1 cubic inch = 16.39 mL  
 bls - below land surface                 $\pi = 3.1416$   
 mL - milliliters

# SOIL-GAS POINT CONSTRUCTION DIAGRAM



\* Depth in Feet Below Land Surface

Project: RACER Trust-Landfill Investigation Point: LF-SGP-15

City: Moraine

County: Montgomery State: OH

Survey Coordinates:

Northing: 619981.15121

Easting: 1483140.66329

Land-Surface Elevation (surveyed): 732.08 feet  
(above mean sea level)

Historic Maximum Groundwater Elevation: 708.75 feet  
(above mean sea level)

Groundwater Encountered During Drilling: N/A feet bls

Installation Dates: 12/13/2011

Weather Conditions at Installation: Clear, 30s

Drilling Contractor: EnviroCore

Driller: Adam Whitt/Jeremy Amick

Drilling Method: Geoprobe

Screen Construction: Type: Stainless steel - 60 inches  
Diameter: 0.5-inch ID

Tubing Construction: Type: Teflon®  
Diameter: 0.25-inch OD, 0.17-inch ID

Volume Calculation (mL):	Shallow	Deep
$V_1$	193	N/A
$V_2$	27	N/A
$V_3$	2086	N/A
$V_t$	2306	N/A

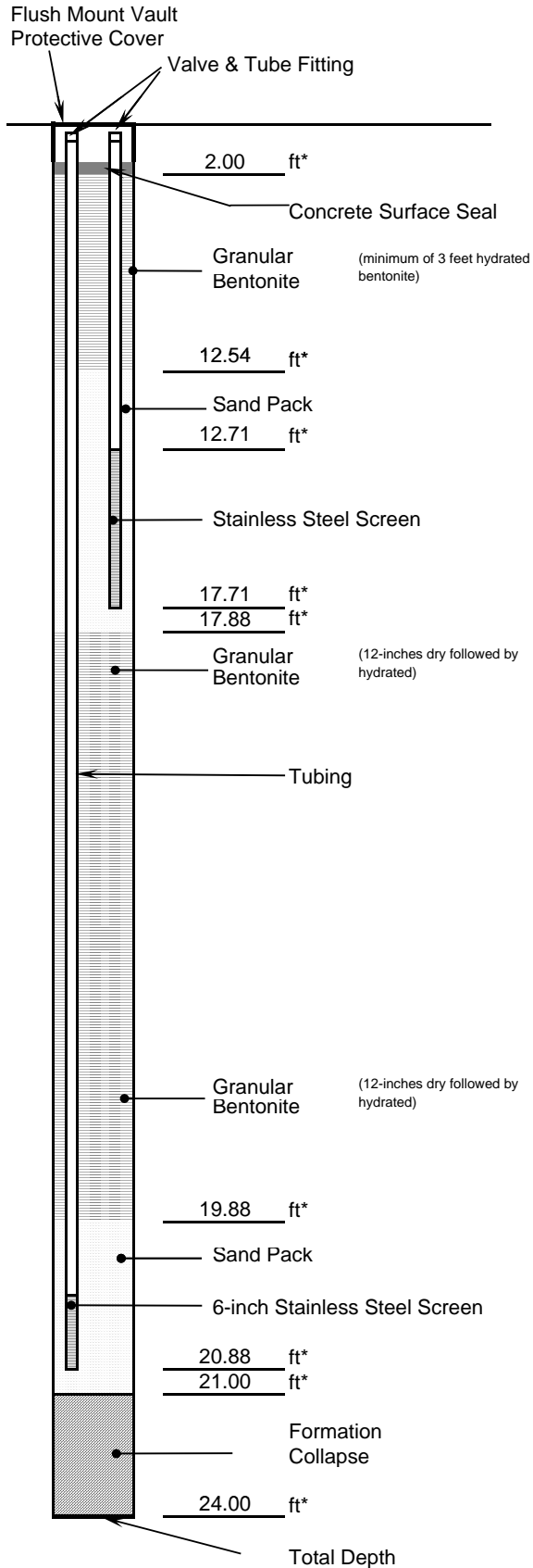
Remarks: \_\_\_\_\_

Prepared by: L. Baumgartner

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter                      12-inches = 1 foot  
 ID - inner diameter                      1 cubic inch = 16.39 mL  
 bls - below land surface                 $\pi = 3.1416$   
 mL - milliliters

# SOIL-GAS POINT CONSTRUCTION DIAGRAM



\* Depth in Feet Below Land Surface

Project: RACER Trust-Landfill Investigation Point: LF-SGP-19

City: Moraine

County: Montgomery State: OH

Survey Coordinates:

Northing: 619569.9260

Easting: 1483114.1260

Land-Surface Elevation (surveyed): 732.00 feet  
(above mean sea level)

Historic Maximum Groundwater Elevation: 709.11 feet  
(above mean sea level)

Groundwater Encountered During Drilling: 22.00 feet bls

Installation Dates: 12/7/2011

Weather Conditions at Installation: Overcast, 30's

Drilling Contractor: EnviroCore

Driller: Chris Rismiller/Adam Whitt

Drilling Method: Geoprobe

Screen Construction: Type: Stainless Steel - 6 inches  
Diameter: 0.4375-inch OD, 0.3125-inch ID  
Type: Stainless steel - 60 inches  
Diameter: 0.5-inch ID

Tubing Construction: Type: Teflon<sup>®</sup>  
Diameter: 0.25-inch OD, 0.17-inch ID

Volume Calculation (mL):	Shallow	Deep
$V_1$	193	7.5
$V_2$	57	91
$V_3$	1982	663
$V_t$	2232	762

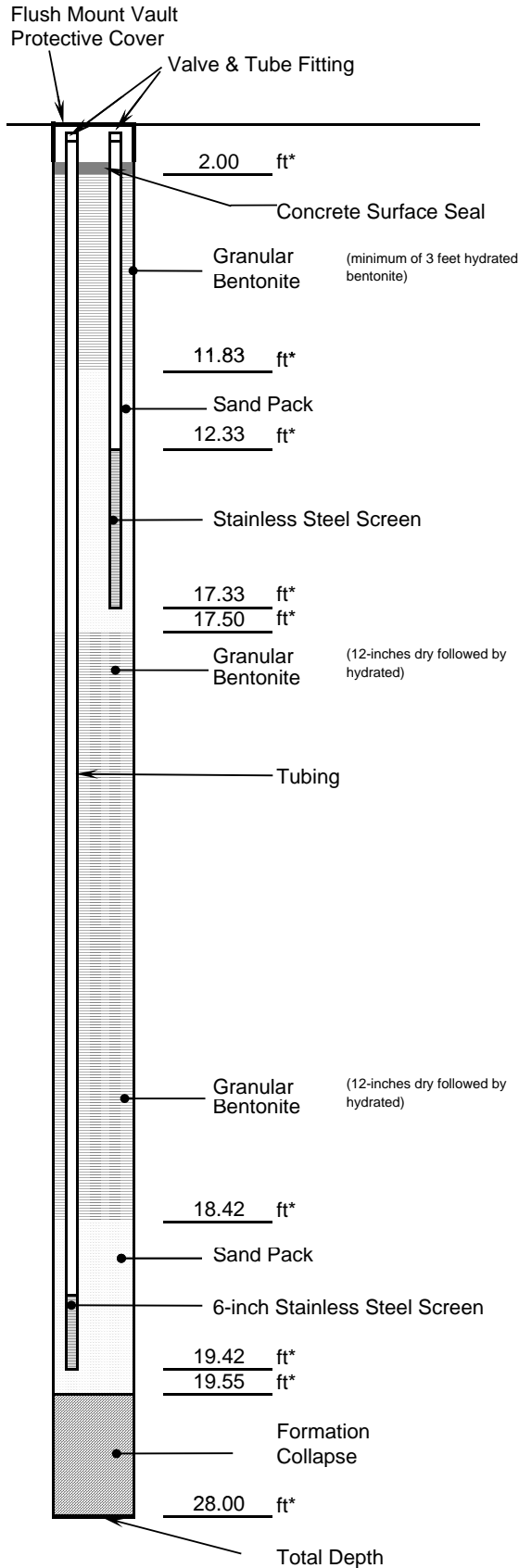
Remarks: \_\_\_\_\_

Prepared by: L. Baumgartner

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter                      12-inches = 1 foot  
ID - inner diameter                      1 cubic inch = 16.39 mL  
bls - below land surface                 $\pi = 3.1416$   
mL - milliliters

# SOIL-GAS POINT CONSTRUCTION DIAGRAM



\* Depth in Feet Below Land Surface

Project: RACER Trust-Landfill Investigation Point: LF-SGP-29A

City: Moraine

County: Montgomery State: OH

Survey Coordinates:

Northing: 619555.6050

Easting: 1483315.0760

Land-Surface Elevation (surveyed): 731.50 feet  
(above mean sea level)

Historic Maximum Groundwater Elevation: 709.51 feet  
(above mean sea level)

Groundwater Encountered During Drilling: 24.00 feet bls

Installation Dates: 12/7/2011

Weather Conditions at Installation: Snow, 30's

Drilling Contractor: EnviroCore

Driller: Chris Rismiller/Adam Whitt

Drilling Method: Geoprobe

Screen Construction: Type: Stainless Steel - 6 inches  
Diameter: 0.4375-inch OD, 0.3125-inch ID  
Type: Stainless steel - 60 inches  
Diameter: 0.5-inch ID

Tubing Construction: Type: Teflon<sup>®</sup>  
Diameter: 0.25-inch OD, 0.17-inch ID

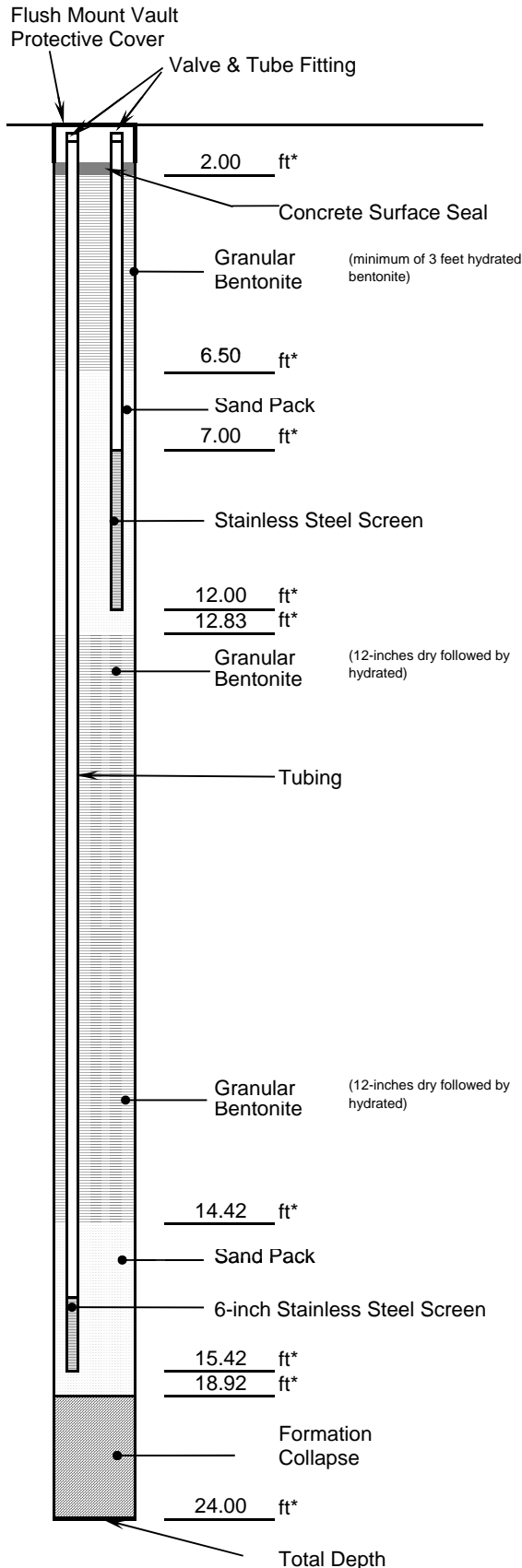
Volume Calculation (mL):	Shallow	Deep
$V_1$	<u>193</u>	<u>7.5</u>
$V_2$	<u>55</u>	<u>84</u>
$V_3$	<u>2086</u>	<u>666</u>
$V_t$	<u>2334</u>	<u>758</u>

Remarks: \_\_\_\_\_

Prepared by: L. Baumgartner

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  
 $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter                      12-inches = 1 foot  
 ID - inner diameter                      1 cubic inch = 16.39 mL  
 bls - below land surface                 $\pi = 3.1416$   
 mL - milliliters



\* Depth in Feet Below Land Surface

Project: RACER Trust-Landfill Investigation Point: LF-SGP-35

City: Moraine

County: Montgomery State: OH

Survey Coordinates:

Northing: 619760.058101

Easting: 1483477.777844

Land-Surface Elevation (surveyed): 726.56 feet  
(above mean sea level)

Historic Maximum Groundwater Elevation: 709.51 feet  
(above mean sea level)

Groundwater Encountered During Drilling: 20.00 feet bls

Installation Dates: 11/17/2011

Weather Conditions at Installation: Clear, 30s

Drilling Contractor: EnviroCore

Driller: Chris Rismiller/Adam Whitt

Drilling Method: Geoprobe

Screen Construction: Type: Stainless Steel - 6 inches  
Diameter: 0.4375-inch OD, 0.3125-inch ID  
Type: Stainless steel - 60 inches  
Diameter: 0.5-inch ID

Tubing Construction: Type: Teflon®  
Diameter: 0.25-inch OD, 0.17-inch ID

Volume Calculation (mL):	Shallow	Deep
$V_1$	<u>193</u>	<u>7.5</u>
$V_2$	<u>31</u>	<u>67</u>
$V_3$	<u>2295</u>	<u>1721</u>
$V_t$	<u>2519</u>	<u>1796</u>

Remarks: \_\_\_\_\_

Prepared by: L. Baumgartner

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h \rho$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $\rho$  = porosity of sand pack and dry bentonite seal (40%).

OD - outer diameter      12-inches = 1 foot  
ID - inner diameter      1 cubic inch = 16.39 mL  
bls - below land surface       $\pi = 3.1416$   
mL - milliliters

ARCADIS

**Attachment E-3**

Soil-Gas Sampling Logs



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> LF-SGP-1(4.88-9.88)-SG/12232011/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> 5/8-inch Drill Bit
<b>Project:</b> Landfill LF1	<b>Sealant:</b> Cement Grout
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00005	<b>Miscellaneous Equipment:</b> PID, He Detector, Multigas Meter
<b>Samplers:</b> K. Nawrath	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 4.88 - 9.88	<b>Moisture Content of Sampling Zone:</b> Not Applicable
<b>Time and Date of Installation:</b> 11/14/2011	<b>Approximate Purge Volume:</b> 200mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
12/19/2011	7:43		45.1	62.0	2.4	29.29	
	8:53						
12/23/2011	8:58	-28.5	36.2	100	2.4	29.49	NM
12/23/2011	9:28	-7.5					

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	8025
<b>Flow Controller ID:</b>	FC00763
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	94.1%
<b>Final Helium Shroud:</b>	25.0%
<b>Tracer Test Passed:</b>	<input checked="" type="radio"/> Yes <input type="radio"/> No
<b>Notes:</b>	Tracer Test He detected at 2.3%

**General Observations/Notes:**

Landtec purging at 430mL/min. He measured at 8:25 = 28% re-introduced to 97%.
12/23/2011 at 8:46 - purged 200mL at 50mL/min. End Purge at 8:50.

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b>		LF-SGP-1(17.17-17.67)-SG/12232011/	
<b>Client:</b>	RACER Trust	<b>Boring Equipment:</b>	5/8-inch Drill Bit
<b>Project:</b>	Landfill LF1	<b>Sealant:</b>	Cement Grout
<b>Location:</b>	Moraine, Ohio	<b>Tubing Information:</b>	0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b>	OH000294.2011.00005	<b>Miscellaneous Equipment:</b>	PID, He Detector, Multigas Meter
<b>Samplers:</b>	K. Nawrath	<b>Subcontractor:</b>	None
		<b>Equipment:</b>	SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b>	17.17 - 17.67	<b>Moisture Content of Sampling Zone:</b>	Not Applicable
<b>Time and Date of Installation:</b>	11/14/2011	<b>Approximate Purge Volume:</b>	1L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
12/20/2011	10:14		40.4	60.4	1.7	29.28	
	10:39						
12/23/2011	8:59	-30	36.2	100	2.4	29.49	NM
12/23/2011	9:29	-8.5					

(a) Record canister information at a minimum at the beginning and end of sampling

### SUMMA® Canister Information:

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	37663
<b>Flow Controller ID:</b>	FC00456
<b>Notes:</b>	

### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	NA	
<b>Final Helium Shroud:</b>	NA	
<b>Tracer Test Passed:</b>	Yes	No
<b>Notes:</b>		

### General Observations/Notes:

12/23/2011 at 8:46 purged 1L at 50mL/min. End purge at 8:54

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> LF-SGP-3A(7.08-12.08)-SG/12222011/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> 5/8-inch Drill Bit
<b>Project:</b> Landfill LF1	<b>Sealant:</b> Cement Grout
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00005	<b>Miscellaneous Equipment:</b> PID, He Detector, Multigas Meter
<b>Samplers:</b> K. Nawrath	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 7.08 - 12.08	<b>Moisture Content of Sampling Zone:</b> Not Applicable
<b>Time and Date of Installation:</b> 11/14/2011	<b>Approximate Purge Volume:</b> 200mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
12/19/2011	16:52						
	18:01						
12/22/2011	10:55	-26.5	45.2	73.5	5.0	29.3	NM
	11:28	-5.5					

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	34629
<b>Flow Controller ID:</b>	FC00826
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	NA - Methane Detect 91.1% (12/22/2011)
<b>Final Helium Shroud:</b>	NA - Methane Detect 75.4% (12/22/2011)
<b>Tracer Test Passed:</b>	Yes                  No
<b>Notes:</b>	

**General Observations/Notes:**

12/22/11 - 10:40 - 200mL purged @ 50mL/min prior to sampling.
At 10:59 - check shroud reading: 69%: re-introduced He to 83%
17:00 - CH4 = 3.7%, CO2 = 3.8%, O2 = 3.0%

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> LF-SGP-3A(14.75-15.25)-SG/12222011/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> 5/8-inch Drill Bit
<b>Project:</b> Landfill LF1	<b>Sealant:</b> Cement Grout
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00005	<b>Miscellaneous Equipment:</b> PID, He Detector, Multigas Meter
<b>Samplers:</b> K. Nawrath	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 14.75 - 15.25	<b>Moisture Content of Sampling Zone:</b> Not Applicable
<b>Time and Date of Installation:</b> 12/14/2011	<b>Approximate Purge Volume:</b> 1 L

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
12/20/2011	10:08		40.4	60.8	1.2	29.28	
	10:31						
12/22/2011	10:54	-26.5	45.2	73.5	5.0	29.30	NM
	11:26	-6.5					

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	8045
<b>Flow Controller ID:</b>	FC00939
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	NA	
<b>Final Helium Shroud:</b>	NA	
<b>Tracer Test Passed:</b>	Yes	No
<b>Notes:</b>		

**General Observations/Notes:**

12/22/11 - 10:40 - 1L purged @ 50mL/min prior to sampling.

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> LF-SGP-5(7.08-12.08)-SG/12222011/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> 5/8-inch Drill Bit
<b>Project:</b> Landfill LF1	<b>Sealant:</b> Cement Grout
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00005	<b>Miscellaneous Equipment:</b> PID, He Detector, Multigas Meter
<b>Samplers:</b> K. Nawrath	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 7.08 - 12.08	<b>Moisture Content of Sampling Zone:</b> Not Applicable
<b>Time and Date of Installation:</b> 12/14/2011	<b>Approximate Purge Volume:</b> 200mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
12/19/2011	15:30						
12/19/2011	16:39						
12/22/2011	16:08	-28	43.4	44.3	2.7	29.22	
12/22/2011	16:37	-7.0					

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	37405
<b>Flow Controller ID:</b>	FC00600
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	96.3%
<b>Final Helium Shroud:</b>	70.06%
<b>Tracer Test Passed:</b>	<input checked="" type="radio"/> Yes <input type="radio"/> No
<b>Notes:</b>	

**General Observations/Notes:**

12/22/11 @ 15:43 begin 200mL purge at 50mL/minute. End purge at 15:47
15:35 - CH4 = 0.2%, CO2 = 2.1%, O2 = 17.8%

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> LF-SGP-5(14.75-15.25)-SG/12222011/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> 5/8-inch Drill Bit
<b>Project:</b> Landfill LF1	<b>Sealant:</b> Cement Grout
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00005	<b>Miscellaneous Equipment:</b> PID, He Detector, Multigas Meter
<b>Samplers:</b> K. Nawrath	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 14.75 - 15.25	<b>Moisture Content of Sampling Zone:</b> Not Applicable
<b>Time and Date of Installation:</b> 12/14/2011	<b>Approximate Purge Volume:</b> 1 L

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
12/20/2011	10:00		40.2	60	1	29.28	
	10:23						
12/22/2011	16:09	-25	43.4	44.3	2.7	29.22	
12/22/2011	16:38	-8.0					

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	11827
<b>Flow Controller ID:</b>	FC00327
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	NA	
<b>Final Helium Shroud:</b>	NA	
<b>Tracer Test Passed:</b>	Yes	No
<b>Notes:</b>		

**General Observations/Notes:**

12/22/2011 @ 15:43 begin 1L purge at 50mL/minute. End purge at 15:52

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> LF-SGP-7A(8.1-13.1)-SG/12222011/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> 5/8-inch Drill Bit
<b>Project:</b> Landfill LF1	<b>Sealant:</b> Cement Grout/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25-inch OD; 0.17-inch ID Teflon
<b>Project #:</b> OH000294.2011.00005	<b>Miscellaneous Equipment:</b> PID, He Detector, Multigas Meter
<b>Samplers:</b> K. Nawrath	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 8.1 - 13.1 feet	<b>Moisture Content of Sampling Zone:</b> Not Applicable
<b>Time and Date of Installation:</b> 12/8/2011	<b>Approximate Purge Volume:</b> 200mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
12/19/2011	13:40						
	14:52						
12/22/2011	9:15	-28.5	46	76.5	2.1	29.33	
	9:49	-7					

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	① L      6 L
<b>Canister ID:</b>	8029
<b>Flow Controller ID:</b>	FC00478
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	93.9%
<b>Final Helium Shroud:</b>	71.2%
<b>Tracer Test Passed:</b>	① Yes      No
<b>Notes:</b>	Tracer Test passed at 0.0% He detected

**General Observations/Notes:**

12/22 - Note - 200 mL purged @ 50mL/min prior to sampling.
Dup-1 taken - LF-SGP-Dup-1/12222011/
14:00 - CH4 = 0.2%, CO2 = 1.9%, O2 = 17.6%

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> LF-SGP-Dup-1/12222011/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> 5/8-inch drill bit
<b>Project:</b> Landfill LF1	<b>Sealant:</b> Cement Grout/Bentonite
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00005	<b>Miscellaneous Equipment:</b> PID, He Detector, Multigas Meter
<b>Samplers:</b> K. Nawrath	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 8.1 - 13.1	<b>Moisture Content of Sampling Zone:</b> Not Applicable
<b>Time and Date of Installation:</b> 12/8/2011	<b>Approximate Purge Volume:</b> 200mL

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
12/22/2011	9:16	-28.25	46	76.5	2.1	29.33	
	9:51	-8.25					

(a) Record canister information at a minimum at the beginning and end of sampling

### SUMMA® Canister Information:

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	34639
<b>Flow Controller ID:</b>	FC00977
<b>Notes:</b>	

### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	NA	
<b>Final Helium Shroud:</b>	NA	
<b>Tracer Test Passed:</b>	Yes	No
<b>Notes:</b>		

### General Observations/Notes:

12/22 - Note - 200 mL purged @ 50mL/min prior to sampling.
Parent is LF-SGP-7A(8.1-13.1)-SG/12222011/

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> LF-SGP-7A(16.8-17.3)-SG/12222011/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> 5/8-inch Drill Bit
<b>Project:</b> Landfill LF1	<b>Sealant:</b> Cement Grout
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00005	<b>Miscellaneous Equipment:</b> PID, He Detector, Multigas Meter
<b>Samplers:</b> K. Nawrath	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 16.8 - 17.3	<b>Moisture Content of Sampling Zone:</b> Not Applicable
<b>Time and Date of Installation:</b> 12/8/2011	<b>Approximate Purge Volume:</b> 1 L

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
12/19/2011	14:54						
12/19/2011	15:19						
12/22/2011	9:17	-26.25	46.0	76.5	2.1	29.33	
12/22/2011	9:50	-5					

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	37338
<b>Flow Controller ID:</b>	FC00749
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	NA	
<b>Final Helium Shroud:</b>	NA	
<b>Tracer Test Passed:</b>	Yes	No
<b>Notes:</b>		

**General Observations/Notes:**

12/22/11 - 1L purged @ 50mL/min prior to sampling.

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> LF-SGP-13A(7.0-12.0)- SG/12222011/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> 5/8-inch Drill Bit
<b>Project:</b> Landfill LF1	<b>Sealant:</b> Cement Grout
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00005	<b>Miscellaneous Equipment:</b> PID, He Detector, Multigas Meter
<b>Samplers:</b> K. Nawrath	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 7.0 - 12.0	<b>Moisture Content of Sampling Zone:</b> Not Applicable
<b>Time and Date of Installation:</b> 12/13/2011	<b>Approximate Purge Volume:</b> 200mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
12/20/2011	8:10		39.4	62.7	1.3	29.29	
	9:19						
12/22/2011	14:31	-26.5	45.3	79.8	2.5	29.26	
12/22/2011	14:59	-5.5					

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	36442
<b>Flow Controller ID:</b>	FC00636
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	NA - Methane Detect 90.1% (12/22/2011)	
<b>Final Helium Shroud:</b>	NA - Methane Detect 57.2% (12/22/2011)	
<b>Tracer Test Passed:</b>	Yes	No
<b>Notes:</b>		

**General Observations/Notes:**

12/22/2011 - Purged 200mL @ 50mL/min
14:51 - Rechecked shroud @ 48% ; re-introduced helium to 98%
CH4 = 14.6 % , CO2 = 1.6%, O2 = 0.3%

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> LF-SGP-15A(6.0-11.0)-SG/12222011/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> 5/8-inch Drill Bit
<b>Project:</b> Landfill LF1	<b>Sealant:</b> Cement Grout
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00005	<b>Miscellaneous Equipment:</b> PID, He Detector, Multigas Meter
<b>Samplers:</b> K. Nawrath	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 6.0 - 11.0	<b>Moisture Content of Sampling Zone:</b> Not Applicable
<b>Time and Date of Installation:</b> 12/13/2011	<b>Approximate Purge Volume:</b> 200mL

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
12/19/2011	9:40		46.3	63	1.5	29.29	
	10:49						
12/22/2011	13:09	-27.5	46	74.6	2.5	29.29	
12/22/2011	13:41	-6.0					

(a) Record canister information at a minimum at the beginning and end of sampling

### SUMMA® Canister Information:

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	34146
<b>Flow Controller ID:</b>	FC00596
<b>Notes:</b>	

### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	Methane Detect 82.2% (12/22/2011)
<b>Final Helium Shroud:</b>	Methane Detect 70.1% (12/22/2011)
<b>Tracer Test Passed:</b>	<input checked="" type="radio"/> Yes <input type="radio"/> No
<b>Notes:</b>	Tracer Test Passed 3.0% He detected

### General Observations/Notes:

12/19/2011 - He = 38.1% @ 10:12 re-up to 96.0%
40.1% @ 10:35 re-up to 89%
12/22/2011 Start purge at 13:02 ; 13:20 recheck of shroud @ 63% ; re-introduce He to 88%
10:00 CH4 = 22.9%, CO2 = 0.0%, O2 = 7.1% ; 10:20 CH4 = 22.8%, O2 = 3.1%, CO2 = 0.0%

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> LF-SGP-19(12.71-17.71)-SG/12232011/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> 5/8-inch Drill Bit
<b>Project:</b> Landfill LF1	<b>Sealant:</b> Cement Grout
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00005	<b>Miscellaneous Equipment:</b> PID, He Detector, Multigas Meter
<b>Samplers:</b> K. Nawrath	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 12.71 - 17.71	<b>Moisture Content of Sampling Zone:</b> Not Applicable
<b>Time and Date of Installation:</b> 12/7/2011	<b>Approximate Purge Volume:</b> 200mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
12/20/2011	8:45						
	9:54						
12/23/2011	10:13	-30	36.0	94.8	4.6	29.54	
12/23/2011	10:45	-8.5					

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	37731
<b>Flow Controller ID:</b>	FC00181
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	95.4%
<b>Final Helium Shroud:</b>	79.1%
<b>Tracer Test Passed:</b>	<input checked="" type="radio"/> Yes <input type="radio"/> No
<b>Notes:</b>	Tracer Test Passed He detected at 0.0%

**General Observations/Notes:**

12/23/2011 at 10:02 purged 200mL at 50mL/min. End purge 10:06.
CH4 = 0.0%, CO2 = 2.3%, O2 = 5.4%

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> LF-SGP-19(19.58-20.08)-SG/12232011/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> 5/8-inch Drill Bit
<b>Project:</b> Landfill LF1	<b>Sealant:</b> Cement Grout
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00005	<b>Miscellaneous Equipment:</b> PID, He Detector, Multigas Meter
<b>Samplers:</b> K. Nawrath	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 19.58 - 20.08	<b>Moisture Content of Sampling Zone:</b> Not Applicable
<b>Time and Date of Installation:</b> 12/7/2011	<b>Approximate Purge Volume:</b> 1 L

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
12/20/2011	8:50						
12/20/2011	9:13						
12/23/2011	10:14	-26	36.0	94.8	4.6	29.54	
12/23/2011	10:47	-7					

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	1734
<b>Flow Controller ID:</b>	FC00964
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	NA	
<b>Final Helium Shroud:</b>	NA	
<b>Tracer Test Passed:</b>	Yes	No
<b>Notes:</b>		

**General Observations/Notes:**

12/23/2011 at 10:02 purged 1L at 50mL/minute. End purge at 10:10.

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> LF-SGP-29A(12.33-17.33)-SG/12232011/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> 5/8-inch Drill Bit
<b>Project:</b> Landfill LF1	<b>Sealant:</b> Cement Grout
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00005	<b>Miscellaneous Equipment:</b> PID, He Detector, Multigas Meter
<b>Samplers:</b> K. Nawrath	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 12.33 - 17.33	<b>Moisture Content of Sampling Zone:</b> Not Applicable
<b>Time and Date of Installation:</b> 12/7/2011	<b>Approximate Purge Volume:</b> 200mL

**Instrument Readings:**

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
12/20/2011	11:15						
	12:24						
12/23/2011	11:21	-27	35.8	91.1	5.3	29.54	NM
12/23/2011	11:51	-6.5					

(a) Record canister information at a minimum at the beginning and end of sampling

**SUMMA® Canister Information:**

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	3040
<b>Flow Controller ID:</b>	FC00312
<b>Notes:</b>	

**Tracer Test Information (if applicable):**

<b>Initial Helium Shroud:</b>	96.0%
<b>Final Helium Shroud:</b>	72.8%
<b>Tracer Test Passed:</b>	<input checked="" type="radio"/> Yes <input type="radio"/> No
<b>Notes:</b>	Tracer test passed He detected at 0.0%

**General Observations/Notes:**

12/23/2011 at 11:12 purged 200mL at 50mL/min. End purge at 11:16.
CH4 = 0.0%, CO2 = 4.4%, O2 = 9.8%

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> LF-SGP-29A(18.92-19.42)-SG/12232011/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> 5/8-inch Drill Bit
<b>Project:</b> Landfill LF1	<b>Sealant:</b> Cement Grout
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00005	<b>Miscellaneous Equipment:</b> PID, He Detector, Multigas Meter
<b>Samplers:</b> K. Nawrath	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 18.92 - 19.42	<b>Moisture Content of Sampling Zone:</b> Not Applicable
<b>Time and Date of Installation:</b> 12/7/2011	<b>Approximate Purge Volume:</b> 1 L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
12/20/2011	11:23						
	11:41						
12/23/2011	11:22	-27.5	35.8	91.1	5.3	29.54	NM
12/23/2011	11:35	-5.0					

(a) Record canister information at a minimum at the beginning and end of sampling

### SUMMA® Canister Information:

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	37707
<b>Flow Controller ID:</b>	FC00265
<b>Notes:</b>	

### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	NA
<b>Final Helium Shroud:</b>	NA
<b>Tracer Test Passed:</b>	Yes     No
<b>Notes:</b>	

### General Observations/Notes:

12/23/2011 at 11:12 purged 1L at 50mL/minute. End purge at 11:20.
12/23/2011 at 11:35. Summa pressure down to -5 in only 14 minutes. No leaks observed in the field. Possible regulator problems. See field notes for additional detail.

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> LF-SGP-35(7-12)-SG/12232011/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> 5/8-inch Drill Bit
<b>Project:</b> Landfill LF1	<b>Sealant:</b> Cement Grout
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00005	<b>Miscellaneous Equipment:</b> PID, He Detector, Multigas Meter
<b>Samplers:</b> K. Nawrath	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 7 - 12	<b>Moisture Content of Sampling Zone:</b> Not Applicable
<b>Time and Date of Installation:</b> 11/17/2011	<b>Approximate Purge Volume:</b> 200mL

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
12/20/2011	11:45						
	12:55						
12/23/2011	12:23	-26.5	36.3	93.6%	2.6	29.51	NM
12/23/2011	12:53	-7.0					

(a) Record canister information at a minimum at the beginning and end of sampling

### SUMMA® Canister Information:

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	34577
<b>Flow Controller ID:</b>	FC00106
<b>Notes:</b>	

### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	94.1%
<b>Final Helium Shroud:</b>	64.2%
<b>Tracer Test Passed:</b>	<input checked="" type="radio"/> Yes <input type="radio"/> No
<b>Notes:</b>	Tracer test passed He detected at 0.0%

### General Observations/Notes:

12/23/2011 at 12:14 begin purge of 200mL at 50mL/minute. 12:18 end purge.
CH4 = 0.1%, CO2 = 9.7, O2 = 5.4

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).



## Sub-slab/Soil-Gas Sample Collection Log

<b>Sample ID:</b> LF-SGP-35(14.92-15.42)-SG/12232011/	
<b>Client:</b> RACER Trust	<b>Boring Equipment:</b> 5/8-inch Drill Bit
<b>Project:</b> Landfill LF1	<b>Sealant:</b> Cement Grout
<b>Location:</b> Moraine, Ohio	<b>Tubing Information:</b> 0.25 inch OD; 0.17 inch ID Teflon
<b>Project #:</b> OH000294.2011.00005	<b>Miscellaneous Equipment:</b> PID, He Detector, Multigas Meter
<b>Samplers:</b> K. Nawrath	<b>Subcontractor:</b> None
	<b>Equipment:</b> SKC 220 Air Pumps, Defender 150
<b>Sampling Depth:</b> 14.92 - 15.42	<b>Moisture Content of Sampling Zone:</b> Not Applicable
<b>Time and Date of Installation:</b> 11/17/2011	<b>Approximate Purge Volume:</b> 1 L

### Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)
12/20/2011	12:20						
	13:05						
12/23/2011	12:24	-28.5	36.3	93.6	2.6	29.51	NM
12/23/2011	12:54	-7.5					

(a) Record canister information at a minimum at the beginning and end of sampling

### SUMMA® Canister Information:

<b>Size (circle one):</b>	<input checked="" type="radio"/> 1 L <input type="radio"/> 6 L
<b>Canister ID:</b>	34088
<b>Flow Controller ID:</b>	40673
<b>Notes:</b>	

### Tracer Test Information (if applicable):

<b>Initial Helium Shroud:</b>	NA
<b>Final Helium Shroud:</b>	NA
<b>Tracer Test Passed:</b>	Yes     No
<b>Notes:</b>	

### General Observations/Notes:

12/23/2011 at 12:14 begin purge of 1L at 50mL/minute. 12:22 end purge.

$V_1 + V_2 + V_3 = V_t$  where:  $V_1 = \pi r^2 h$  = open space volume of soil-gas screen;  $V_2 = \pi r^2 h$  = open space volume of sample tubing;  $V_3 = \pi r^2 h p$  = estimated open pore space for sand pack and dry bentonite seal;  $V_t$  = total volume;  $r$  = inner radius of soil-gas screen, borehole, or sample tubing;  $h$  = height of soil-gas screen or height (length) of tubing or height of sand pack and dry bentonite seal;  $p$  = porosity of sand pack and dry bentonite seal (40%).

ARCADIS

**Attachment E-4**

Geotechnical Laboratory Report

PTS File No: 42695  
 Client: ARCADIS

**PHYSICAL PROPERTIES DATA - PERMEABILITY TO AIR**

(METHODOLOGY: API RP40)

PROJECT NAME: RACER Trust - Moraine, Ohio  
 PROJECT NO: OH000294.2012.0005A

SAMPLE ID.	DEPTH, ft.	SAMPLE ORIENTATION (1)	ANALYSIS DATE	25 PSI CONFINING STRESS
				EFFECTIVE (2) PERMEABILITY TO AIR millidarcy
LF-36 (37-39)-G/09212012/	38.8	V	20121011	1570
LF-37 (24-26)-G/09212012/	25.65	V	20121011	0.44
LF-37 (28-30)-G/09212012/	29.75	V	20121011	3420

(1) Sample Orientation: H = horizontal; V = vertical; R = remold (2) Effective or Native = With as-received pore fluids in place. Air = Nitrogen gas.

**PARTICLE SIZE SUMMARY**  
(METHODOLOGY: ASTM D422/D4464M)

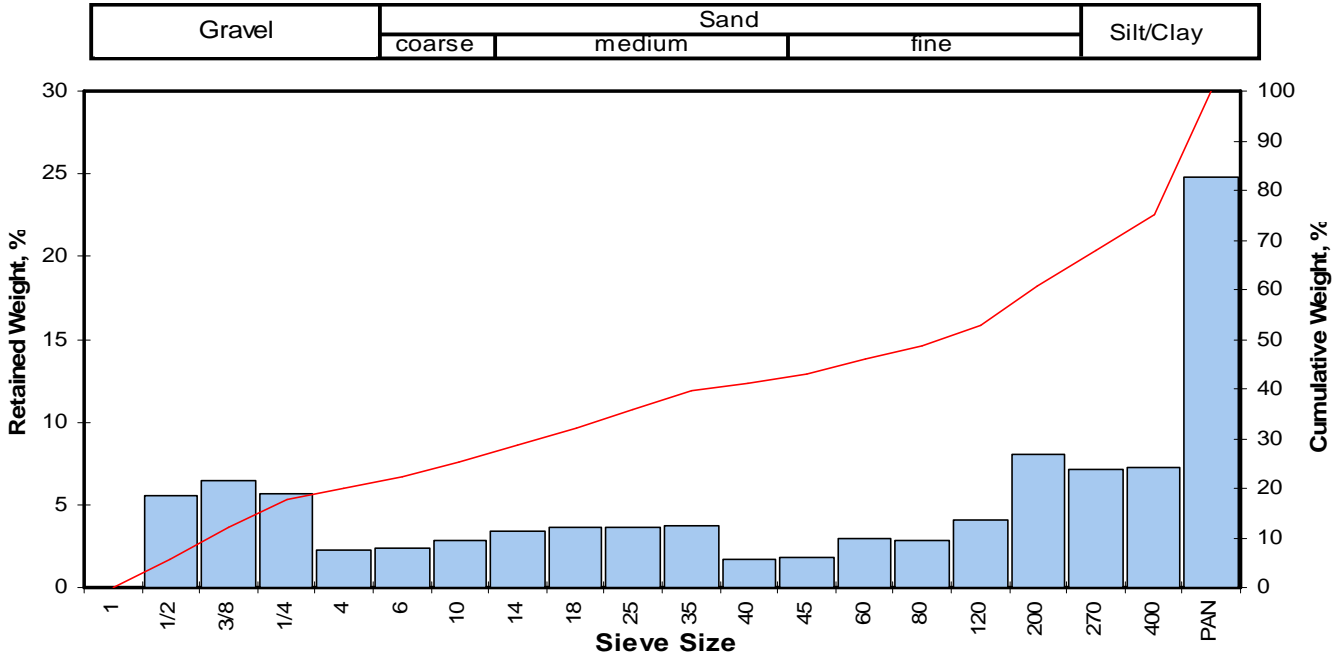
PROJECT NAME: RACER Trust - Moraine, Ohio  
PROJECT NO: OH000294.2012.0005A

Sample ID	Depth, ft.	Mean Grain Size Description (1)	Median Grain Size mm	Particle Size Distribution, wt. percent						Silt & Clay
				Gravel	Sand Size			Silt	Clay	
					Coarse	Medium	Fine			
LF-36 (8-10)-G/09202012/	8.45	Medium sand	0.159	20.01	5.16	15.99	19.72	(2)	(2)	39.12
LF-36 (11-13)-G/09212012/	12.85	Gravel	1.097	36.50	5.91	21.18	19.60	(2)	(2)	16.81
LF-36 (16-18)-G/09212012/	17.85	Silt	0.036	0.00	0.00	1.75	20.13	72.53	5.59	78.12
LF-37 (10-12)-G/09212012/	10.45	Medium sand	0.243	18.60	4.83	19.20	22.38	(2)	(2)	34.99
LF-37 (16-18)-G/09212012/	17.75	Silt	0.016	0.00	0.00	0.00	13.88	61.57	24.55	86.12

(1) Based on Mean from Trask  
(2) Mechanical sieve does not differentiate silt/clay fractions

**Client:** ARCADIS  
**Project:** RACER Trust - Moraine, Ohio  
**Project No:** OH000294.2012.0005A

**PTS File No:** 42695  
**Sample ID:** LF-36 (8-10)-G/09202012/  
**Depth, ft:** 8.45



Opening		Phi of Screen	U.S. Sieve No.	Sample Weight grams	Incremental Weight, percent	Cumulative Weight, percent
Inches	Millimeters					
0.9844	25.002	-4.64	1	0.00	0.00	0.00
0.4922	12.501	-3.64	1/2	4.21	5.57	5.57
0.3740	9.500	-3.25	3/8	4.88	6.45	12.02
0.2500	6.351	-2.67	1/4	4.32	5.71	17.74
0.1873	4.757	-2.25	4	1.72	2.27	20.01
0.1324	3.364	-1.75	6	1.76	2.33	22.34
0.0787	2.000	-1.00	10	2.14	2.83	25.17
0.0557	1.414	-0.50	14	2.57	3.40	28.57
0.0394	1.000	0.00	18	2.70	3.57	32.14
0.0278	0.707	0.50	25	2.71	3.58	35.72
0.0197	0.500	1.00	35	2.84	3.76	39.48
0.0166	0.420	1.25	40	1.27	1.68	41.16
0.0139	0.354	1.50	45	1.35	1.79	42.94
0.0098	0.250	2.00	60	2.25	2.98	45.92
0.0070	0.177	2.50	80	2.13	2.82	48.74
0.0049	0.125	3.00	120	3.07	4.06	52.80
0.0029	0.074	3.75	200	6.11	8.08	60.88
0.0021	0.053	4.25	270	5.40	7.14	68.02
0.0015	0.037	4.75	400	5.45	7.21	75.23
			PAN	18.73	24.77	100.00

Cumulative Weight Percent greater than			
Weight percent	Phi Value	Particle Size	
		Inches	Millimeters
5	-3.75	0.5282	13.417
10	-3.37	0.4076	10.354
16	-2.84	0.2826	7.178
25	-1.04	0.0812	2.063
40	1.08	0.0187	0.474
50	2.66	0.0062	0.159
60	3.67	0.0031	0.079
75	4.73	0.0015	0.038
84	3.07	0.0047	0.119
90	1.92	0.0104	0.265
95	0.96	0.0203	0.515

Measure	Trask	Inman	Folk-Ward
Median, phi	2.66	2.66	2.66
Median, in.	0.0062	0.0062	0.0062
Median, mm	0.159	0.159	0.159
Mean, phi	-0.07	0.11	0.96
Mean, in.	0.0413	0.0364	0.0202
Mean, mm	1.050	0.925	0.514
Sorting	7.410	2.956	2.191
Skewness	1.754	-0.860	-1.291
Kurtosis	0.100	-0.204	0.334

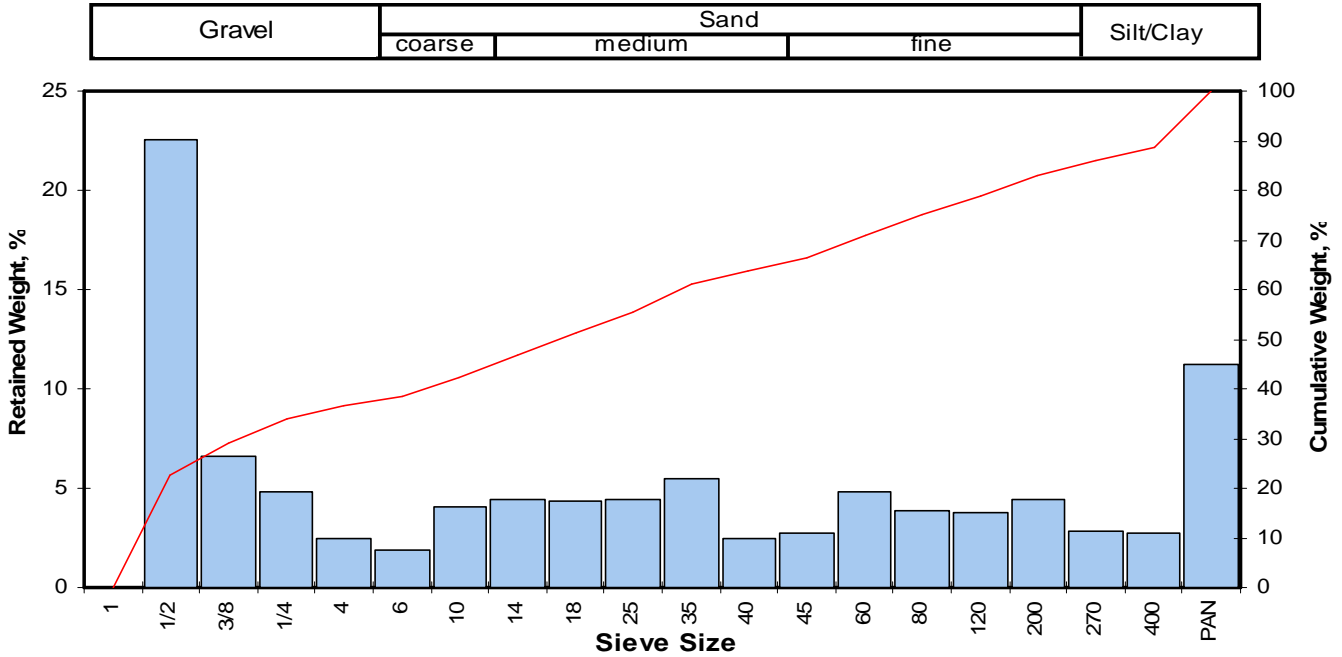
**Grain Size Description** Medium sand  
 (ASTM-USCS Scale) (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	20.01
Coarse Sand	10	5.16
Medium Sand	40	15.99
Fine Sand	200	19.72
Silt/Clay	<200	39.12
<b>TOTALS</b>	<b>Total</b>	<b>100</b>

**TOTALS** 75.61 100.00 100.00

**Client:** ARCADIS  
**Project:** RACER Trust - Moraine, Ohio  
**Project No:** OH000294.2012.0005A

**PTS File No:** 42695  
**Sample ID:** LF-36 (11-13)-G/09212012/  
**Depth, ft:** 12.85



Opening		Phi of Screen	U.S. Sieve No.	Sample Weight grams	Incremental Weight, percent	Cumulative Weight, percent
Inches	Millimeters					
0.9844	25.002	-4.64	1	0.00	0.00	0.00
0.4922	12.501	-3.64	1/2	32.43	22.58	22.58
0.3740	9.500	-3.25	3/8	9.52	6.63	29.20
0.2500	6.351	-2.67	1/4	6.91	4.81	34.01
0.1873	4.757	-2.25	4	3.57	2.49	36.50
0.1324	3.364	-1.75	6	2.70	1.88	38.38
0.0787	2.000	-1.00	10	5.79	4.03	42.41
0.0557	1.414	-0.50	14	6.31	4.39	46.80
0.0394	1.000	0.00	18	6.27	4.36	51.17
0.0278	0.707	0.50	25	6.43	4.48	55.64
0.0197	0.500	1.00	35	7.83	5.45	61.09
0.0166	0.420	1.25	40	3.58	2.49	63.59
0.0139	0.354	1.50	45	3.87	2.69	66.28
0.0098	0.250	2.00	60	6.93	4.82	71.10
0.0070	0.177	2.50	80	5.61	3.91	75.01
0.0049	0.125	3.00	120	5.43	3.78	78.79
0.0029	0.074	3.75	200	6.32	4.40	83.19
0.0021	0.053	4.25	270	4.04	2.81	86.00
0.0015	0.037	4.75	400	3.95	2.75	88.75
			PAN	16.16	11.25	100.00

Cumulative Weight Percent greater than			
Weight percent	Phi Value	Particle Size	
		Inches	Millimeters
5	-4.42	0.8443	21.444
10	-4.20	0.7241	18.393
16	-3.94	0.6023	15.298
25	-3.50	0.4452	11.307
40	-1.45	0.1074	2.729
50	-0.13	0.0432	1.097
60	0.90	0.0211	0.536
75	2.50	0.0070	0.177
84	3.89	0.0026	0.067
90	4.22	0.0021	0.054
95	2.11	0.0091	0.231

Measure	Trask	Inman	Folk-Ward
Median, phi	-0.13	-0.13	-0.13
Median, in.	0.0432	0.0432	0.0432
Median, mm	1.097	1.097	1.097
Mean, phi	-2.52	-0.02	-0.06
Mean, in.	0.2261	0.0399	0.0410
Mean, mm	5.742	1.014	1.041
Sorting	7.995	3.915	2.947
Skewness	1.289	0.029	-0.142
Kurtosis	0.303	-0.166	0.446

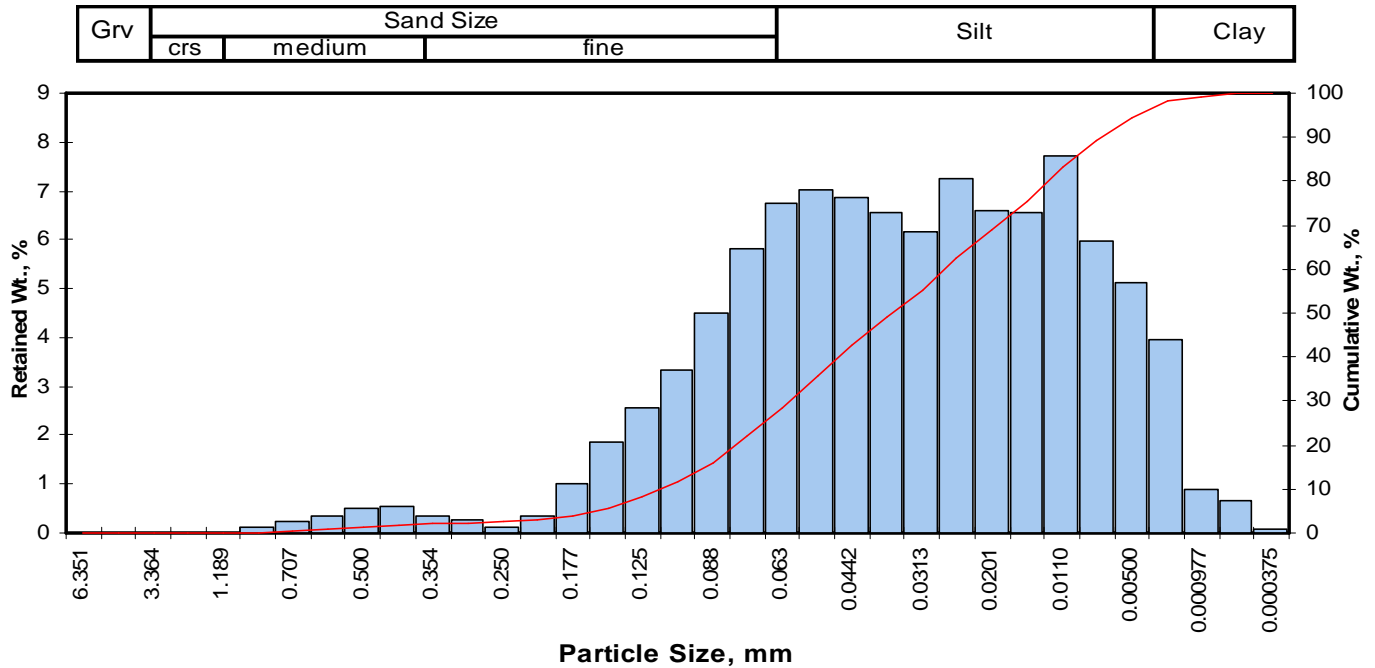
**Grain Size Description** (ASTM-USCS Scale) Gravel (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	36.50
Coarse Sand	10	5.91
Medium Sand	40	21.18
Fine Sand	200	19.60
Silt/Clay	<200	16.81
<b>Total</b>		<b>100</b>

**TOTALS** 143.65 100.00 100.00

Client: ARCADIS  
 Project: RACER Trust - Moraine, Ohio  
 Project No: OH000294.2012.0005A

PTS File No: 42695  
 Sample ID: LF-36 (16-18)-G/09212012/  
 Depth, ft: 17.85



Particle Size, mm

Opening		Phi of Screen	U.S. No.	Sample Weight, grams	Increment Weight, percent	Cumulative Weight, percent
Inches	Millimeters					
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.00	0.00	0.00
0.0331	0.841	0.25	20	0.11	0.11	0.11
0.0278	0.707	0.50	25	0.23	0.23	0.34
0.0234	0.595	0.75	30	0.34	0.34	0.68
0.0197	0.500	1.00	35	0.51	0.51	1.19
0.0166	0.420	1.25	40	0.56	0.56	1.75
0.0139	0.354	1.50	45	0.36	0.36	2.11
0.0117	0.297	1.75	50	0.26	0.26	2.37
0.0098	0.250	2.00	60	0.13	0.13	2.50
0.0083	0.210	2.25	70	0.35	0.35	2.85
0.0070	0.177	2.50	80	1.00	1.00	3.85
0.0059	0.149	2.75	100	1.86	1.86	5.71
0.0049	0.125	3.00	120	2.55	2.55	8.26
0.0041	0.105	3.25	140	3.32	3.32	11.58
0.0035	0.088	3.50	170	4.49	4.49	16.07
0.0029	0.074	3.75	200	5.81	5.81	21.88
0.0025	0.063	4.00	230	6.74	6.74	28.62
0.0021	0.053	4.25	270	7.01	7.01	35.63
0.00174	0.0442	4.50	325	6.88	6.88	42.51
0.00146	0.0372	4.75	400	6.54	6.54	49.05
0.00123	0.0313	5.00	450	6.16	6.16	55.21
0.000986	0.0250	5.32	500	7.26	7.26	62.47
0.000790	0.0201	5.64	635	6.58	6.58	69.05
0.000615	0.0156	6.00		6.55	6.55	75.59
0.000435	0.0110	6.50		7.73	7.73	83.32
0.000308	0.00781	7.00		5.98	5.98	89.30
0.000197	0.00500	7.65		5.11	5.11	94.41
0.000077	0.00195	9.00		3.96	3.96	98.37
0.000038	0.000977	10.00		0.90	0.90	99.27
0.000019	0.000488	11.00		0.65	0.65	99.92
0.000015	0.000375	11.38		0.08	0.08	100.00
<b>TOTALS</b>				<b>100.00</b>	<b>100.00</b>	<b>100.00</b>

Cumulative Weight Percent greater than			
Weight percent	Phi Value	Particle Size	
		Inches	Millimeters
5	2.65	0.0063	0.159
10	3.13	0.0045	0.114
16	3.50	0.0035	0.089
25	3.87	0.0027	0.069
40	4.41	0.0019	0.047
50	4.79	0.0014	0.036
60	5.21	0.0011	0.027
75	5.97	0.0006	0.016
84	6.56	0.0004	0.011
90	7.09	0.0003	0.007
95	7.85	0.0002	0.004

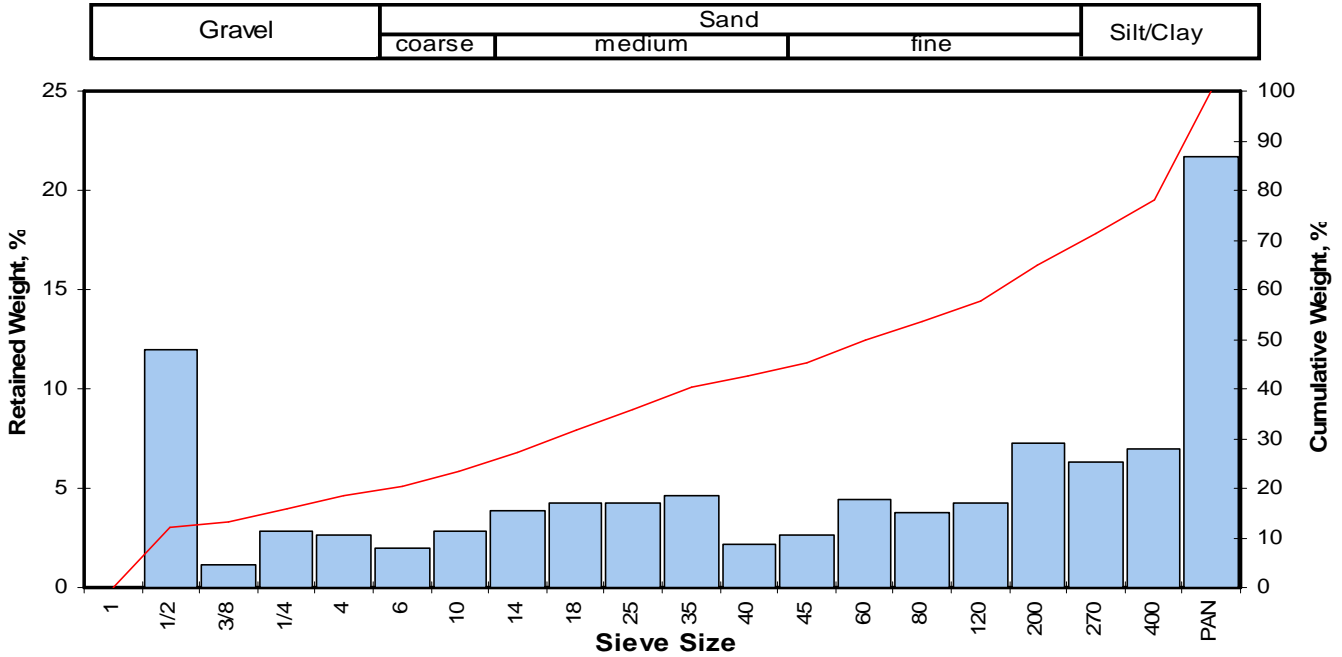
Measure	Trask	Inman	Folk-Ward
Median, phi	4.79	4.79	4.79
Median, in.	0.0014	0.0014	0.0014
Median, mm	0.036	0.036	0.036
Mean, phi	4.56	5.03	4.95
Mean, in.	0.0017	0.0012	0.0013
Mean, mm	0.042	0.031	0.032
Sorting	2.072	1.530	1.552
Skewness	0.915	0.155	0.167
Kurtosis	0.246	0.696	1.012

<b>Grain Size Description</b> (ASTM-USCS Scale)	Silt (based on Mean from Trask)
--	------------------------------------

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	1.75
Fine Sand	200	20.13
Silt	>0.005 mm	72.53
Clay	<0.005 mm	5.59
<b>Total</b>		<b>100</b>

**Client:** ARCADIS  
**Project:** RACER Trust - Moraine, Ohio  
**Project No:** OH000294.2012.0005A

**PTS File No:** 42695  
**Sample ID:** LF-37 (10-12)-G/09212012/  
**Depth, ft:** 10.45



Opening		Phi of Screen	U.S. Sieve No.	Sample Weight grams	Incremental Weight, percent	Cumulative Weight, percent
Inches	Millimeters					
0.9844	25.002	-4.64	1	0.00	0.00	0.00
0.4922	12.501	-3.64	1/2	10.27	12.01	12.01
0.3740	9.500	-3.25	3/8	0.99	1.16	13.16
0.2500	6.351	-2.67	1/4	2.42	2.83	15.99
0.1873	4.757	-2.25	4	2.23	2.61	18.60
0.1324	3.364	-1.75	6	1.68	1.96	20.57
0.0787	2.000	-1.00	10	2.45	2.86	23.43
0.0557	1.414	-0.50	14	3.28	3.83	27.27
0.0394	1.000	0.00	18	3.65	4.27	31.53
0.0278	0.707	0.50	25	3.65	4.27	35.80
0.0197	0.500	1.00	35	3.97	4.64	40.44
0.0166	0.420	1.25	40	1.87	2.19	42.63
0.0139	0.354	1.50	45	2.25	2.63	45.26
0.0098	0.250	2.00	60	3.77	4.41	49.67
0.0070	0.177	2.50	80	3.26	3.81	53.48
0.0049	0.125	3.00	120	3.63	4.24	57.72
0.0029	0.074	3.75	200	6.23	7.28	65.01
0.0021	0.053	4.25	270	5.37	6.28	71.28
0.0015	0.037	4.75	400	6.00	7.02	78.30
			PAN	18.56	21.70	100.00

Cumulative Weight Percent greater than			
Weight percent	Phi Value	Particle Size	
		Inches	Millimeters
5	-4.23	0.7376	18.734
10	-3.81	0.5526	14.037
16	-2.67	0.2499	6.347
25	-0.80	0.0683	1.735
40	0.95	0.0203	0.517
50	2.04	0.0095	0.243
60	3.23	0.0042	0.106
75	4.51	0.0017	0.044
84	3.50	0.0035	0.088
90	2.19	0.0086	0.219
95	1.09	0.0184	0.468

Measure	Trask	Inman	Folk-Ward
Median, phi	2.04	2.04	2.04
Median, in.	0.0095	0.0095	0.0095
Median, mm	0.243	0.243	0.243
Mean, phi	0.17	0.42	0.96
Mean, in.	0.0350	0.0295	0.0202
Mean, mm	0.890	0.748	0.514
Sorting	6.299	3.084	2.348
Skewness	1.136	-0.527	-0.942
Kurtosis	0.061	-0.137	0.411

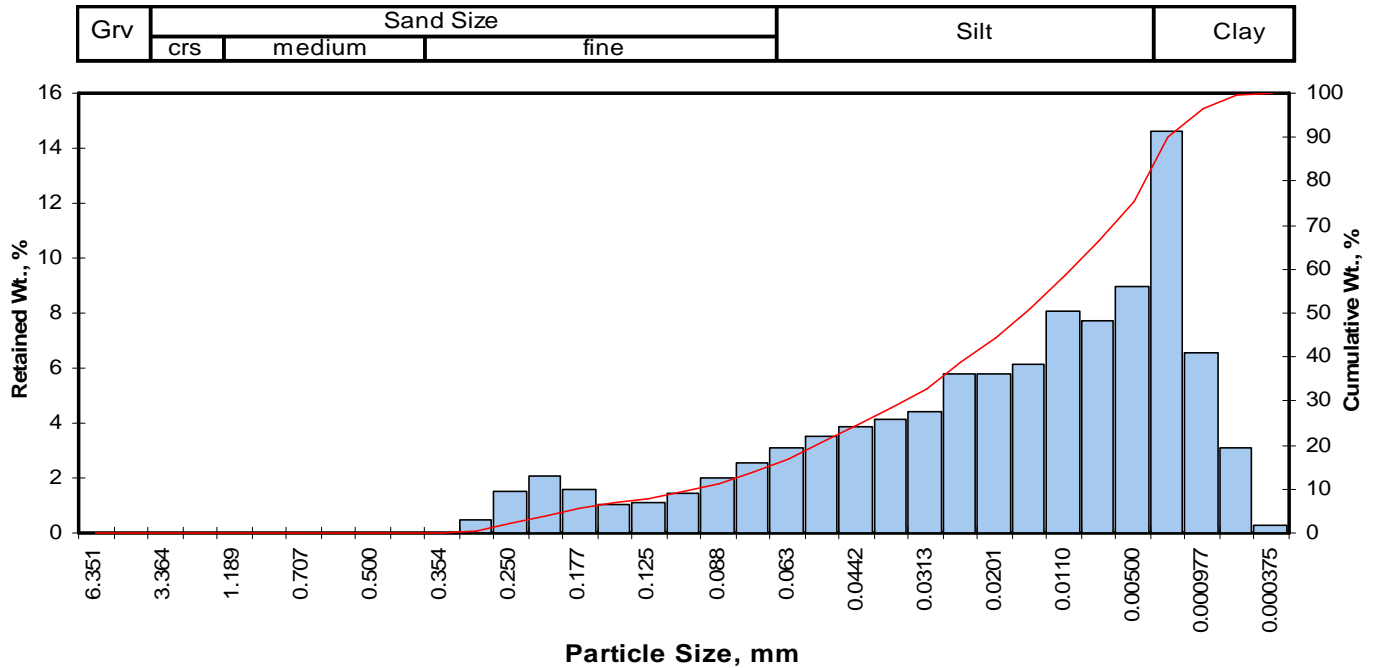
**Grain Size Description** Medium sand  
 (ASTM-USCS Scale) (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	18.60
Coarse Sand	10	4.83
Medium Sand	40	19.20
Fine Sand	200	22.38
Silt/Clay	<200	34.99
<b>TOTALS</b>	<b>Total</b>	<b>100</b>

**TOTALS** 85.53 100.00 100.00

Client: ARCADIS  
 Project: RACER Trust - Moraine, Ohio  
 Project No: OH000294.2012.0005A

PTS File No: 42695  
 Sample ID: LF-37 (16-18)-G/09212012/  
 Depth, ft: 17.75



Opening		Phi of Screen	U.S. No.	Sample Weight, grams	Increment Weight, percent	Cumulative Weight, percent
Inches	Millimeters					
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.00	0.00	0.00
0.0331	0.841	0.25	20	0.00	0.00	0.00
0.0278	0.707	0.50	25	0.00	0.00	0.00
0.0234	0.595	0.75	30	0.00	0.00	0.00
0.0197	0.500	1.00	35	0.00	0.00	0.00
0.0166	0.420	1.25	40	0.00	0.00	0.00
0.0139	0.354	1.50	45	0.02	0.01	0.01
0.0117	0.297	1.75	50	0.48	0.48	0.49
0.0098	0.250	2.00	60	1.53	1.53	2.02
0.0083	0.210	2.25	70	2.07	2.07	4.09
0.0070	0.177	2.50	80	1.60	1.60	5.69
0.0059	0.149	2.75	100	1.06	1.06	6.75
0.0049	0.125	3.00	120	1.10	1.10	7.85
0.0041	0.105	3.25	140	1.48	1.48	9.33
0.0035	0.088	3.50	170	1.98	1.98	11.31
0.0029	0.074	3.75	200	2.57	2.57	13.88
0.0025	0.063	4.00	230	3.11	3.11	16.99
0.0021	0.053	4.25	270	3.52	3.52	20.51
0.00174	0.0442	4.50	325	3.89	3.89	24.40
0.00146	0.0372	4.75	400	4.17	4.17	28.57
0.00123	0.0313	5.00	450	4.40	4.40	32.96
0.000986	0.0250	5.32	500	5.80	5.80	38.76
0.000790	0.0201	5.64	635	5.80	5.80	44.56
0.000615	0.0156	6.00		6.15	6.15	50.71
0.000435	0.0110	6.50		8.10	8.10	58.80
0.000308	0.00781	7.00		7.70	7.70	66.50
0.000197	0.00500	7.65		8.95	8.95	75.45
0.000077	0.00195	9.00		14.60	14.59	90.04
0.000038	0.000977	10.00		6.53	6.53	96.57
0.000019	0.000488	11.00		3.12	3.12	99.69
0.000015	0.000375	11.38		0.31	0.31	100.00
<b>TOTALS</b>				<b>100.00</b>	<b>100.00</b>	<b>100.00</b>

Cumulative Weight Percent greater than			
Weight percent	Phi Value	Particle Size	
		Inches	Millimeters
5	2.39	0.0075	0.191
10	3.33	0.0039	0.099
16	3.92	0.0026	0.066
25	4.54	0.0017	0.043
40	5.39	0.0009	0.024
50	5.96	0.0006	0.016
60	6.58	0.0004	0.010
75	7.61	0.0002	0.005
84	8.44	0.0001	0.003
90	9.00	0.0001	0.002
95	9.76	0.0000	0.001

Measure	Trask	Inman	Folk-Ward
Median, phi	5.96	5.96	5.96
Median, in.	0.0006	0.0006	0.0006
Median, mm	0.016	0.016	0.016
Mean, phi	5.37	6.18	6.11
Mean, in.	0.0009	0.0005	0.0006
Mean, mm	0.024	0.014	0.015
Sorting	2.904	2.259	2.246
Skewness	0.923	0.098	0.065
Kurtosis	0.195	0.631	0.981

**Grain Size Description** (ASTM-USCS Scale) Silt (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	0.00
Fine Sand	200	13.88
Silt	>0.005 mm	61.57
Clay	<0.005 mm	24.55
<b>Total</b>		<b>100</b>

PTS File No: 42695  
 Client: ARCADIS

**PHYSICAL PROPERTIES DATA - HYDRAULIC CONDUCTIVITY PACKAGE**

PROJECT NAME: RACER Trust - Moraine, Ohio  
 PROJECT NO: OH000294.2012.0005A

SAMPLE ID.	DEPTH, ft.	SAMPLE ORIENTATION (1)	MOISTURE CONTENT, % weight	METHODS: API RP 40 / ASTM D2216		API RP 40		API RP 40		API RP 40; EPA 9100	
				DENSITY		POROSITY, %Vb (2)		TOTAL PORE FLUID SATURATIONS (3), % Pv	25 PSI CONFINING STRESS		
				DRY BULK, g/cc	GRAIN, g/cc	TOTAL	AIR FILLED		EFFECTIVE (4,5) PERMEABILITY TO WATER, millidarcy	HYDRAULIC CONDUCTIVITY (4,5), cm/s	
LF-36 (37-39)-G/09212012/	38.8	V	7.4	1.94	2.75	29.2	14.8	49.5	28.3	2.84E-05	
LF-37 (24-26)-G/09212012/	25.65	V	21.2	1.56	2.63	40.5	7.3	81.9	1.59	1.60E-06	
LF-37 (28-30)-G/09212012/	29.75	V	8.7	1.92	2.71	29.3	12.7	56.8	562	5.65E-04	

(1) Sample Orientation: H = horizontal; V = vertical; R = remold (2) Total Porosity = no pore fluids in place; all interconnected pore channels; Air Filled = pore channels not occupied by pore fluids (3) Water = 0.9996 g/cc (4) Native State or Effective = With as-received pore fluids in place (5) Permeability to water and hydraulic conductivity measured at saturated conditions; Vb = Bulk Volume, cc; Pv = Pore Volume, cc; ND = Not Detected

PTS File No: 42695  
 Client: ARCADIS

**ORGANIC CARBON DATA - TOC (foc)**

(METHODOLOGY: WALKLEY-BLACK)

PROJECT NAME: RACER Trust - Moraine, Ohio  
 PROJECT NO: OH000294.2012.0005A

SAMPLE ID.	DEPTH, ft.	ANALYSIS DATE	ANALYSIS TIME	SAMPLE MATRIX	TOTAL ORGANIC CARBON, mg/kg
LF-36 (8-10)-G/09202012/	8.45	20121016	1315	SOIL	17800
LF-36 (11-13)-G/09212012/	12.85	20121016	1315	SOIL	12000
LF-36 (16-18)-G/09212012/	17.85	20121016	1315	SOIL	11900
LF-37 (10-12)-G/09212012/	10.5	20121016	1315	SOIL	>34000
LF-37 (16-18)-G/09212012/	17.75	20121016	1315	SOIL	32300

Blank	N/A	20121016	1315	BLANK	ND
SRM D079-542	N/A	20121016	1315	SRM	3420

Reporting Limit: 100

**QC DATA**

SRM ID/Lot No.	REC (%)	Control Limits	Certified Concentration mg/kg	QC Performance Acceptance Limits, mg/kg	
				Lower	Upper
SRM D079-542	101	75-125	3400	2550	4250

ND = Not Detected

FRACTION ORGANIC CARBON, g/g
------------------------------------

1.78E-02

1.20E-02

1.19E-02

>3.40E-02

3.23E-02

ND

3.42E-03

1.00E-04

PTS File No: 42695  
 Client: ARCADIS

### PHYSICAL PROPERTIES DATA - VAPOR TRANSPORT PACKAGE

PROJECT NAME: RACER Trust - Moraine, Ohio  
 PROJECT NO: OH000294.2012.0005A

SAMPLE ID.	DEPTH, ft.	SAMPLE ORIENTATION (1)	ANALYSIS DATE	METHODS: API RP40/ASTM D2216		API RP40		API RP40		API RP40		Mod. ASTM D425	API RP40
				MOISTURE CONTENT,		DENSITY		POROSITY (2)				TOTAL PORE FLUID (3) SATURATIONS, % Pv	
				% weight	cm <sup>3</sup> /cm <sup>3</sup>	DRY BULK, g/cm <sup>3</sup>	GRAIN, g/cm <sup>3</sup>	TOTAL, cm <sup>3</sup> /cm <sup>3</sup>	AIR FILLED, cm <sup>3</sup> /cm <sup>3</sup>	WATER FILLED, cm <sup>3</sup> /cm <sup>3</sup>	EFFECTIVE, cm <sup>3</sup> /cm <sup>3</sup>		
LF-36 (8-10)-G/09202012/	8.6	V	20121011	38.2	0.387	1.01	2.21	0.542	0.156	0.387	0.386	71.3	
LF-36 (11-13)-G/09212012/	12.9	V	20121011	22.2	0.317	1.43	2.95	0.516	0.198	0.317	0.315	61.5	
LF-36 (16-18)-G/09212012/	17.9	V	20121011	63.6	0.501	0.79	2.24	0.648	0.147	0.501	0.487	77.3	
LF-37 (10-12)-G/09212012/	10.65	V	20121011	37.7	0.446	1.18	2.41	0.509	0.062	0.446	0.255	87.7	
LF-37 (16-18)-G/09212012/	17.85	V	20121011	29.6	0.389	1.31	2.47	0.468	0.079	0.389	0.177	83.0	

(1) Sample Orientation: H = horizontal; V = vertical; R = remold

(2) Total Porosity = no pore fluids in place; all interconnected pore channels; Air Filled = pore channels not occupied by pore fluids, native sample; Effective = drainage porosity

PTS File No: 42695  
 Client: ARCADIS

**PHYSICAL PROPERTIES DATA - VAPOR TRANSPORT PACKAGE**

PROJECT NAME: RACER Trust - Moraine, Ohio  
 PROJECT NO: OH000294.2012.0005A

		METHODS: API RP40/ASTM D2216		API RP40		API RP40		API RP40		Mod. ASTM D425	API RP40	
								POROSITY (2)				TOTAL PORE FLUID (3) SATURATIONS, % Pv
SAMPLE ID.	DEPTH, ft.	SAMPLE ORIENTATION (1)	ANALYSIS DATE	MOISTURE CONTENT,		DENSITY		TOTAL, cm <sup>3</sup> /cm <sup>3</sup>	AIR FILLED, cm <sup>3</sup> /cm <sup>3</sup>	WATER FILLED, cm <sup>3</sup> /cm <sup>3</sup>	EFFECTIVE, cm <sup>3</sup> /cm <sup>3</sup>	
				% weight	cm <sup>3</sup> /cm <sup>3</sup>	DRY BULK, g/cm <sup>3</sup>	GRAIN, g/cm <sup>3</sup>					

(3) Water = 0.9996 g/cc; Pv = Pore Volume; ND = Not Detected

PTS File No: 42695  
 Client: ARCADIS

**PERMEABILITY DATA - VAPOR TRANSPORT PACKAGE**

PROJECT NAME: RACER Trust - Moraine, Ohio  
 PROJECT NO: OH000294.2012.0005A

METHODOLOGY: API RP40 25 PSI CONFINING PRESSURE API RP40 / EPA 9100 25 PSI CONFINING PRESSURE

SAMPLE ID.	DEPTH, ft.	SAMPLE ORIENTATION (1)	API RP40 25 PSI CONFINING PRESSURE		API RP40 / EPA 9100 25 PSI CONFINING PRESSURE	
			EFFECTIVE PERMEABILITY TO AIR (2), millidarcy	SPECIFIC PERMEABILITY TO AIR (3), millidarcy	SPECIFIC PERMEABILITY TO WATER (4), millidarcy	HYDRAULIC CONDUCTIVITY (4), cm/s
LF-36 (8-10)-G/09202012/	8.6	V	41.4	277	80.0	8.10E-05
LF-36 (11-13)-G/09212012/	12.9	V	105	454	71.3	7.19E-05
LF-36 (16-18)-G/09212012/	17.9	V	4.78	423	140	1.41E-04
LF-37 (10-12)-G/09212012/	10.65	V	0.09	80.2	16.2	1.63E-05
LF-37 (16-18)-G/09212012/	17.85	V	0.04	68.2	10.8	1.08E-05

(1) Sample Orientation: H = horizontal, V = vertical, R = remold  
 (2) Native State = As received with pore fluids in place  
 (3) Specific = without moisture  
 (4) Permeability to water and conductivity measured at saturated conditions  
 Air = Nitrogen gas.

## Laboratories

ASURE
INTRINSIC PERMEABILITY TO WATER (4), cm <sup>2</sup>

7.89E-10

7.04E-10

1.38E-09

1.60E-10

1.07E-10

PTS File No: 42695  
 Client: ARCADIS

### SOIL CLASSIFICATION DATA - VAPOR TRANSPORT PACKAGE

PROJECT NAME: RACER Trust - Moraine, Ohio  
 PROJECT NO: OH000294.2012.0005A

SAMPLE ID.	DEPTH, ft.	METHODS: ASTM D4318			ASTM D4318	ASTM D2487	USDA
		ATTERBERG LIMITS (1)			USCS / PLASTICITY	USCS	USDA/SCS (2)
		LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	CHART SYMBOL (Fines: <#40 Sieve)	CLASSIFICATION, Group Symbol: Name	SOIL TEXTURE SCHEME
LF-36 (8-10)-G/09202012/	8.5	4.7	N/A	NON-PLASTIC	NP	SM: Silty sand with gravel	Sandy loam
LF-36 (11-13)-G/09212012/	12.85	21.9	N/A	NON-PLASTIC	NP	SM: Silty sand with gravel	Loamy sand
LF-36 (16-18)-G/09212012/	17.85	51.1	N/A	NON-PLASTIC	NP	ML: Silt with sand	Silt loam
LF-37 (10-12)-G/09212012/	10.5	39.8	33.1	6.7	ML	SM: Silty sand with gravel	Sandy loam
LF-37 (16-18)-G/09212012/	17.95	34.1	25.9	8.2	ML	ML: Silt	Silt loam

USCS: Unified Soil Classification System  
 USDA: US Department of Agriculture  
 SCS: Soil Conservation Service

(1) Silt assumed as fine fraction for NON-PLASTIC (NP) samples. (2) Sand considered to be >No. 200 sieve for USDA SOIL TEXTURE SCHEME.

ID#: Gretech-A

**CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM**

42695  
Lab Work Order # Landfill LI/Gretech

Send Results to:	Contact & Company Name: <u>Joe Rumschlag / ARCADIS</u>		Telephone: <u>614-764-2310</u>		Preservative	<u>E</u>	<u>E</u>											
	Address: <u>284 Cramer Creek Ct.</u>		Fax: <u>614-764-1270</u>		Filtered (✓)													
	City	State	Zip	E-mail Address: <u>joe.rumschlag@arcadis-us.com</u>		# of Containers	<u>1</u>	<u>1</u>										
	<u>Dublin</u>	<u>OH</u>	<u>43017</u>			Container Information	<u>9</u>	<u>9</u>										
Project Name/Location (City, State): <u>RAPER TRUST / Moraine, OH</u>		Project #: <u>OH000294-2012-0005A</u>		<b>PARAMETER ANALYSIS &amp; METHOD</b> <u>Vapor Transport Package</u> <u>Hydraulic Cond. Package</u>														
Sampler's Printed Name: <u>Joseph Rumschlag</u>		Sampler's Signature: <u>[Signature]</u>																
<b>Sample ID</b>		<b>Collection</b>		<b>Type (✓)</b>		<b>Matrix</b>												
		Date	Time	Comp	Grab													
<u>LF-36 (8-10)-G/09202012/</u>		<u>9/20/12</u>	<u>1100</u>		<u>✓</u>	<u>SO</u>	<u>X</u>											
<u>LF-36 (11-13)-G/09212012/</u>		<u>9/21/12</u>	<u>1500</u>		<u>✓</u>	<u>SO</u>	<u>X</u>											
<u>LF-36 (16-18)-G/09212012/</u>		<u>9/21/12</u>	<u>1505</u>		<u>✓</u>	<u>So</u>	<u>X</u>											
<u>LF-36 (37-39)-G/09212012/</u>		<u>9/21/12</u>	<u>1520</u>		<u>✓</u>	<u>SO</u>	<u>X</u>	<u>JHR</u>										

- Keys**
- Preservation Key:**  
A. H<sub>2</sub>SO<sub>4</sub>  
B. HCL  
C. HNO<sub>3</sub>  
D. NaOH  
E. None  
F. Other: \_\_\_\_\_  
G. Other: \_\_\_\_\_  
H. Other: \_\_\_\_\_
- Container Information Key:**  
1. 40 ml Vial  
2. 1 L Amber  
3. 250 ml Plastic  
4. 500 ml Plastic  
5. Encore  
6. 2 oz. Glass  
7. 4 oz. Glass  
8. 8 oz. Glass  
9. Other: 2 1/2 Core  
10. Other: \_\_\_\_\_
- Matrix Key:**  
SO - Soil  
W - Water  
T - Tissue  
SE - Sediment  
SL - Sludge  
A - Air  
NL - NAPL/Oil  
SW - Sample Wipe  
Other: \_\_\_\_\_

**REMARKS**

Special Instructions/Comments: Lab PM: Rachel Spitz  Special QA/QC Instructions(-):

<b>Laboratory Information and Receipt</b>		<b>Relinquished By</b>		<b>Received By</b>		<b>Relinquished By</b>		<b>Laboratory Received By</b>	
Lab Name: <u>PTS Laboratories</u>	Cooler Custody Seal (✓) <input type="checkbox"/> Intact <input type="checkbox"/> Not Intact	Printed Name: <u>Joseph Rumschlag</u>	Printed Name: <u>Morgan Richards</u>	Printed Name:	Printed Name:	Printed Name:	Printed Name:	Printed Name:	Printed Name:
<input checked="" type="checkbox"/> Cooler packed with ice (✓)		Signature: <u>[Signature]</u>	Signature: <u>[Signature]</u>	Signature:	Signature:	Signature:	Signature:	Signature:	Signature:
Specify Turnaround Requirements: <u>Standard</u>	Sample Receipt:	Firm: <u>ARCADIS</u>	Firm/Courier: <u>PTS Laboratories</u>	Firm/Courier:	Firm/Courier:	Firm/Courier:	Firm/Courier:	Firm/Courier:	Firm/Courier:
Shipping Tracking #: <u>4564 4668 8733</u>	Condition/Cooler Temp: _____	Date/Time: <u>9/20/12 - 1800</u>	Date/Time: <u>9/27/12 - 1345</u>	Date/Time:	Date/Time:	Date/Time:	Date/Time:	Date/Time:	Date/Time:




ID#: Geotech-C

**CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM**

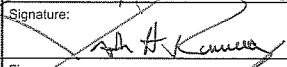
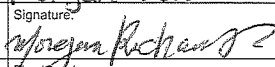
Page 1 of 1

42695  
Lab Work Order #  
Landfill 41/Geotech

Send Results to:	Contact & Company Name: <u>Joe Rumschlag / ARCADIS</u>		Telephone: <u>614-764-2310</u>		Preservative	<u>E</u>	<u>E</u>											
	Address: <u>284 Cramer Creek Ct.</u>		Fax: <u>614-764-1270</u>		Filtered (✓)													
	City: <u>Dublin</u>	State: <u>OH</u>	Zip: <u>43017</u>	E-mail Address: <u>Joe.Rumschlag@arcadis-us.com</u>		# of Containers	<u>1</u>	<u>1</u>										
	Project Name/Location (City, State): <u>RACER Trust / Mansura, OH</u>		Project #: <u>OH 000 2944 2012-0005A</u>		Container Information	<u>9</u>	<u>9</u>											
Sampler's Printed Name: <u>Joseph Rumschlag</u>		Sampler's Signature: 		<b>PARAMETER ANALYSIS &amp; METHOD</b>														
Sample ID		Collection		Type		Matrix		<u>vapor transport</u> <u>Package</u> <u>Hydraulic Cond.</u> <u>Package</u>										REMARKS
		Date	Time	Comp	Grab													
<u>LF-37(24-26)-6/09/2012/</u>		<u>9/21/12</u>	<u>1320</u>		<u>✓</u>	<u>SO</u>												
<u>LF-37(28-30)-6/09/2012/</u>		<u>9/21/12</u>	<u>1340</u>		<u>✓</u>	<u>SO</u>												

- Keys**
- Preservation Key:**  
 A. H<sub>2</sub>SO<sub>4</sub>  
 B. HCL  
 C. HNO<sub>3</sub>  
 D. NaOH  
 E. None  
 F. Other: \_\_\_\_\_  
 G. Other: \_\_\_\_\_  
 H. Other: \_\_\_\_\_
- Container Information Key:**  
 1. 40 ml Vial  
 2. 1 L Amber  
 3. 250 ml Plastic  
 4. 500 ml Plastic  
 5. Encore  
 6. 2 oz. Glass  
 7. 4 oz. Glass  
 8. 8 oz. Glass  
 9. Other: Soil Conc  
 10. Other: \_\_\_\_\_
- Matrix Key:**  
 SO - Soil  
 W - Water  
 T - Tissue  
 SE - Sediment  
 SL - Sludge  
 A - Air  
 NL - NAPL/Oil  
 SW - Sample Wipe  
 Other: \_\_\_\_\_

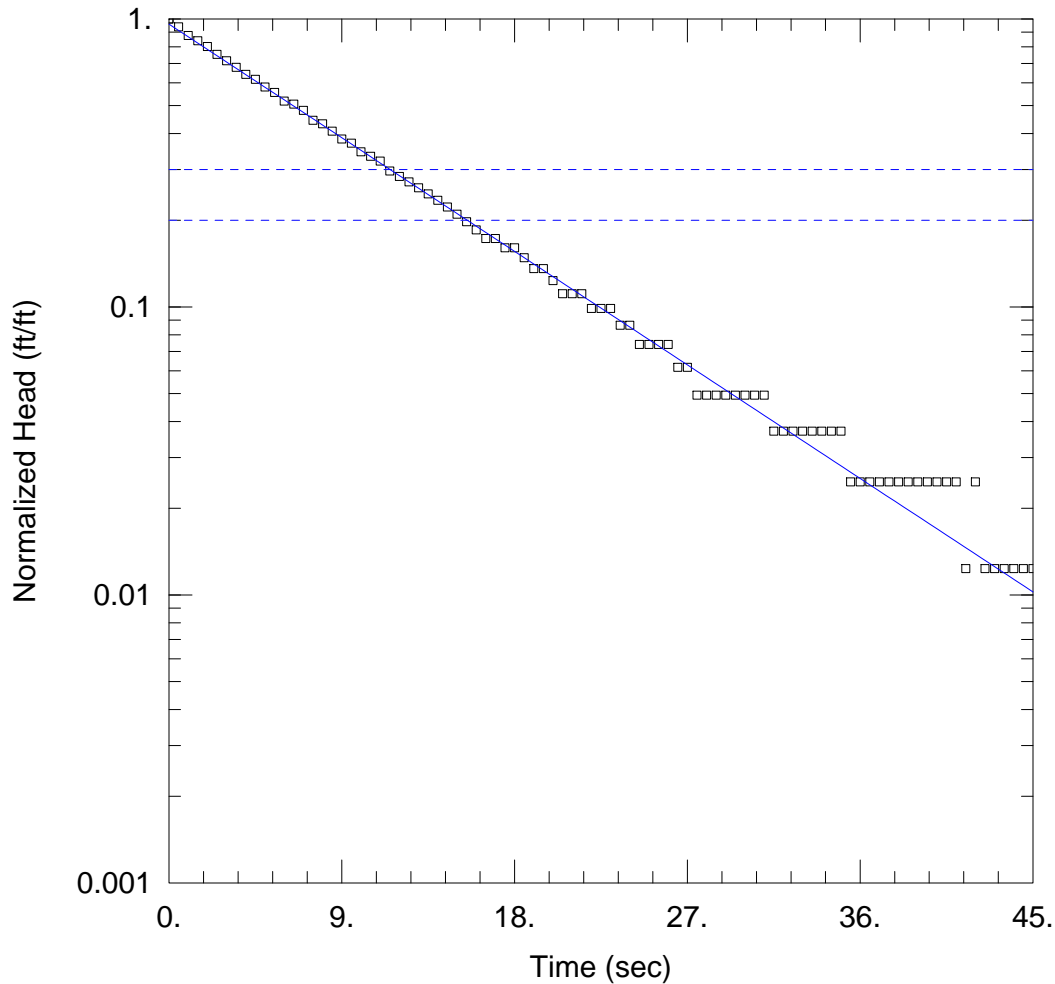
Special Instructions/Comments: \_\_\_\_\_  Special QA/QC Instructions(✓): \_\_\_\_\_

Laboratory Information and Receipt		Relinquished By		Received By		Relinquished By		Laboratory Received By	
Lab Name: <u>PTS Laboratories</u>	Cooler Custody Seal (✓) <input type="checkbox"/> Intact <input type="checkbox"/> Not Intact	Printed Name: <u>Joseph Rumschlag</u>	Signature: 	Printed Name: <u>Morgan Richards</u>	Signature: 	Printed Name:	Signature:	Printed Name:	Signature:
<input checked="" type="checkbox"/> Cooler packed with ice (✓)		Firm: <u>ARCADIS</u>	Date/Time: <u>9-26-12 / 1800</u>	Firm/Courier: <u>PTS Laboratories</u>	Date/Time: <u>9/27/12 1345</u>	Firm:	Date/Time:	Firm:	Date/Time:
Specify Turnaround Requirements: <u>Standard</u>	Sample Receipt:								
Shipping Tracking #: <u>451446688722</u>	Condition/Cooler Temp: _____								

ARCADIS

**Attachment E-5**

Pneumatic Slug Test Analysis  
Reports



TEST 1

Data Set: C:\...\LF-36 (36-41)\_B&R\_UC\_TEST 1.aqt

Date: 12/14/12

Time: 09:07:02

PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-36 (36-41)

Test Date: 9/20/2012

AQUIFER DATA

Saturated Thickness: 13.47 ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (LF-36 (36-41))

Initial Displacement: 0.81 ft

Static Water Column Height: 13.47 ft

Total Well Penetration Depth: 13.47 ft

Screen Length: 5. ft

Casing Radius: 0.19 ft

Well Radius: 0.0833 ft

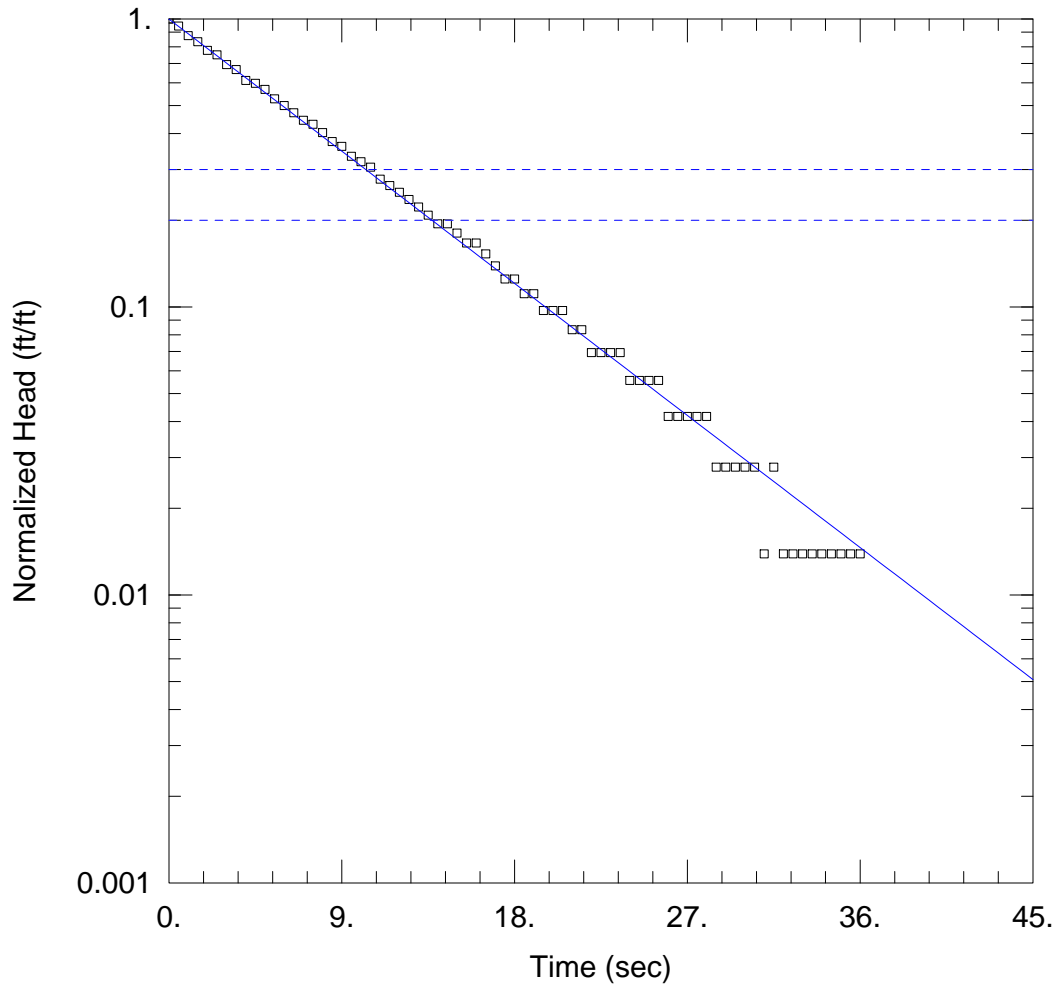
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

K = 118.2 ft/day

y0 = 0.7768 ft



TEST 2

Data Set: C:\...\LF-36 (36-41)\_B&R\_UC\_TEST 2.aqt

Date: 12/14/12

Time: 09:07:48

PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-36 (36-41)

Test Date: 9/20/2012

AQUIFER DATA

Saturated Thickness: 13.47 ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (LF-36 (36-41))

Initial Displacement: 0.72 ft

Static Water Column Height: 13.47 ft

Total Well Penetration Depth: 13.47 ft

Screen Length: 5. ft

Casing Radius: 0.19 ft

Well Radius: 0.0833 ft

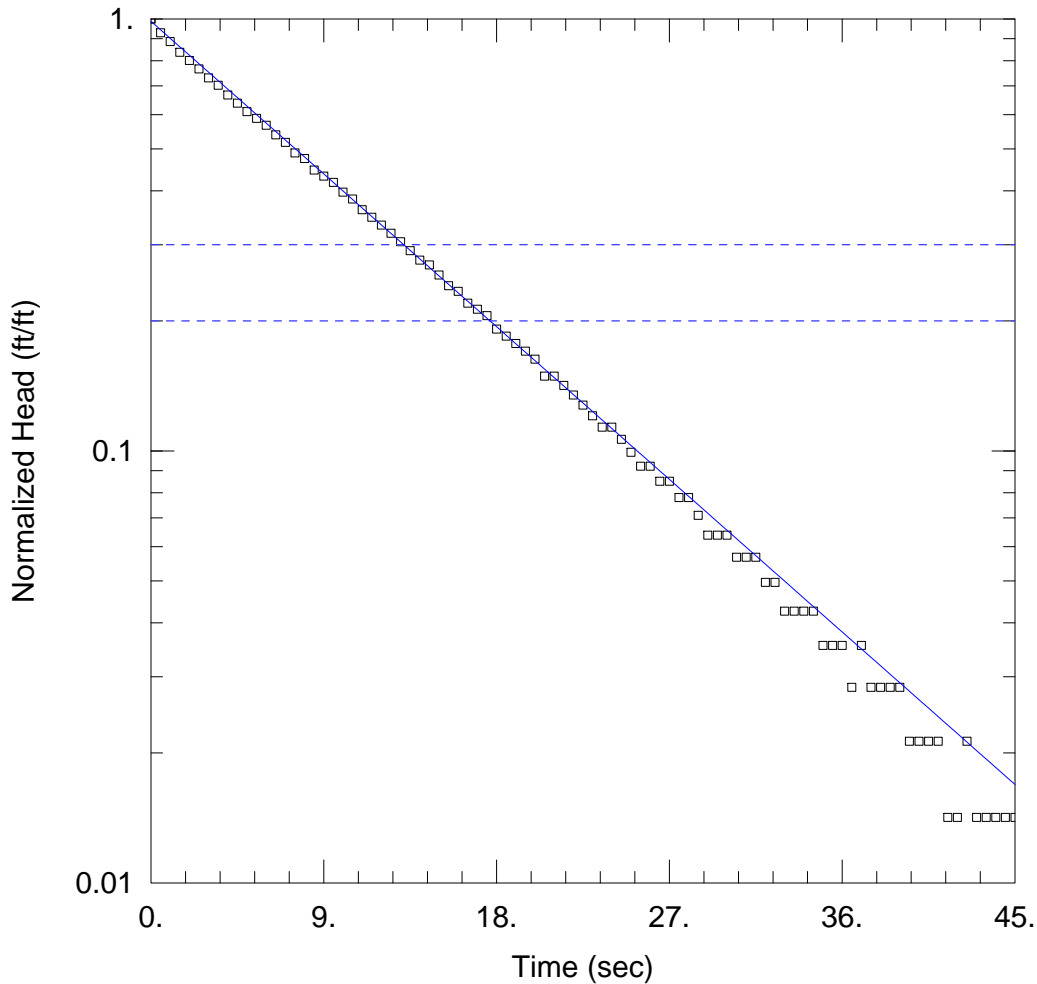
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bower-Rice

K = 137.5 ft/day

y0 = 0.719 ft



### TEST 3

Data Set: C:\...\LF-36 (36-41)\_B&R\_UC\_TEST 3.aqt

Date: 12/14/12

Time: 09:08:17

### PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-36 (36-41)

Test Date: 9/20/2012

### AQUIFER DATA

Saturated Thickness: 13.47 ft

Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (LF-36 (36-41))

Initial Displacement: 1.41 ft

Static Water Column Height: 13.47 ft

Total Well Penetration Depth: 13.47 ft

Screen Length: 5. ft

Casing Radius: 0.19 ft

Well Radius: 0.0833 ft

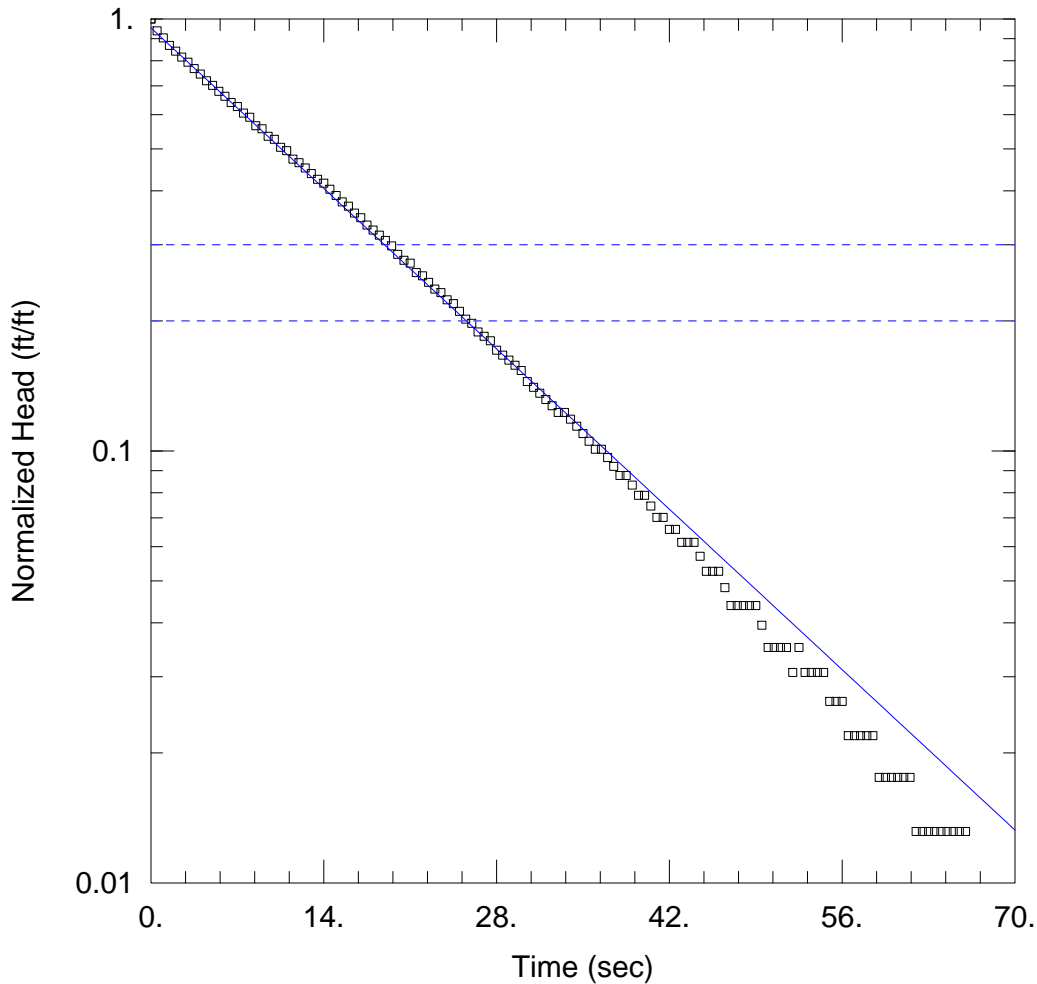
### SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

K = 106. ft/day

y0 = 1.392 ft



### TEST 4

Data Set: C:\...\LF-36 (36-41)\_B&R\_UC\_TEST 4.aqt

Date: 12/14/12

Time: 09:08:29

### PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-36 (36-41)

Test Date: 9/20/2012

### AQUIFER DATA

Saturated Thickness: 13.47 ft

Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (LF-36 (36-41))

Initial Displacement: 2.28 ft

Static Water Column Height: 13.47 ft

Total Well Penetration Depth: 13.47 ft

Screen Length: 5. ft

Casing Radius: 0.19 ft

Well Radius: 0.0833 ft

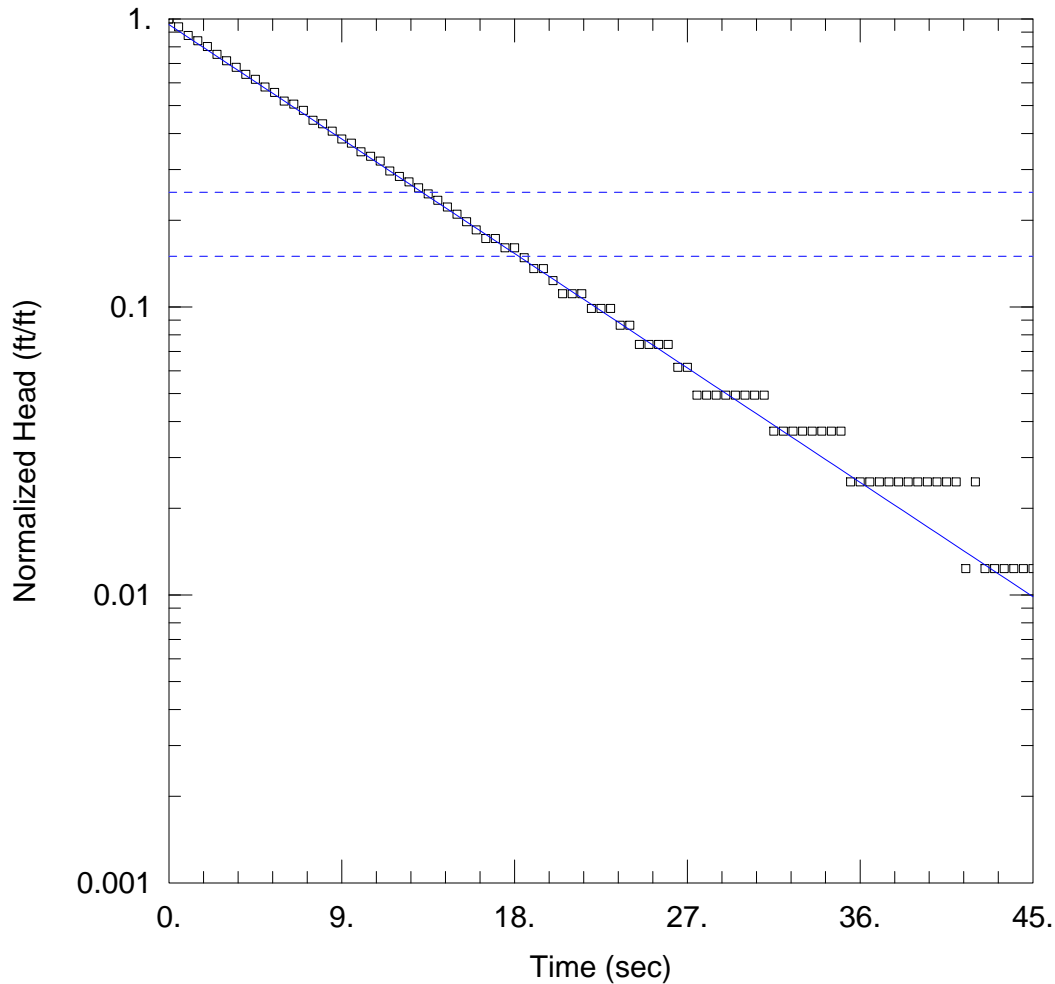
### SOLUTION

Aquifer Model: Unconfined

Solution Method: Bower-Rice

K = 71.6 ft/day

y0 = 2.174 ft



TEST 1

Data Set: C:\...\LF-36 (36-41)\_Hv\_UC\_TEST 1.aqt

Date: 12/14/12

Time: 09:08:42

PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-36 (36-41)

Test Date: 9/20/2012

AQUIFER DATA

Saturated Thickness: 13.47 ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (LF-36 (36-41))

Initial Displacement: 0.81 ft

Static Water Column Height: 13.47 ft

Total Well Penetration Depth: 13.47 ft

Screen Length: 5. ft

Casing Radius: 0.19 ft

Well Radius: 0.0833 ft

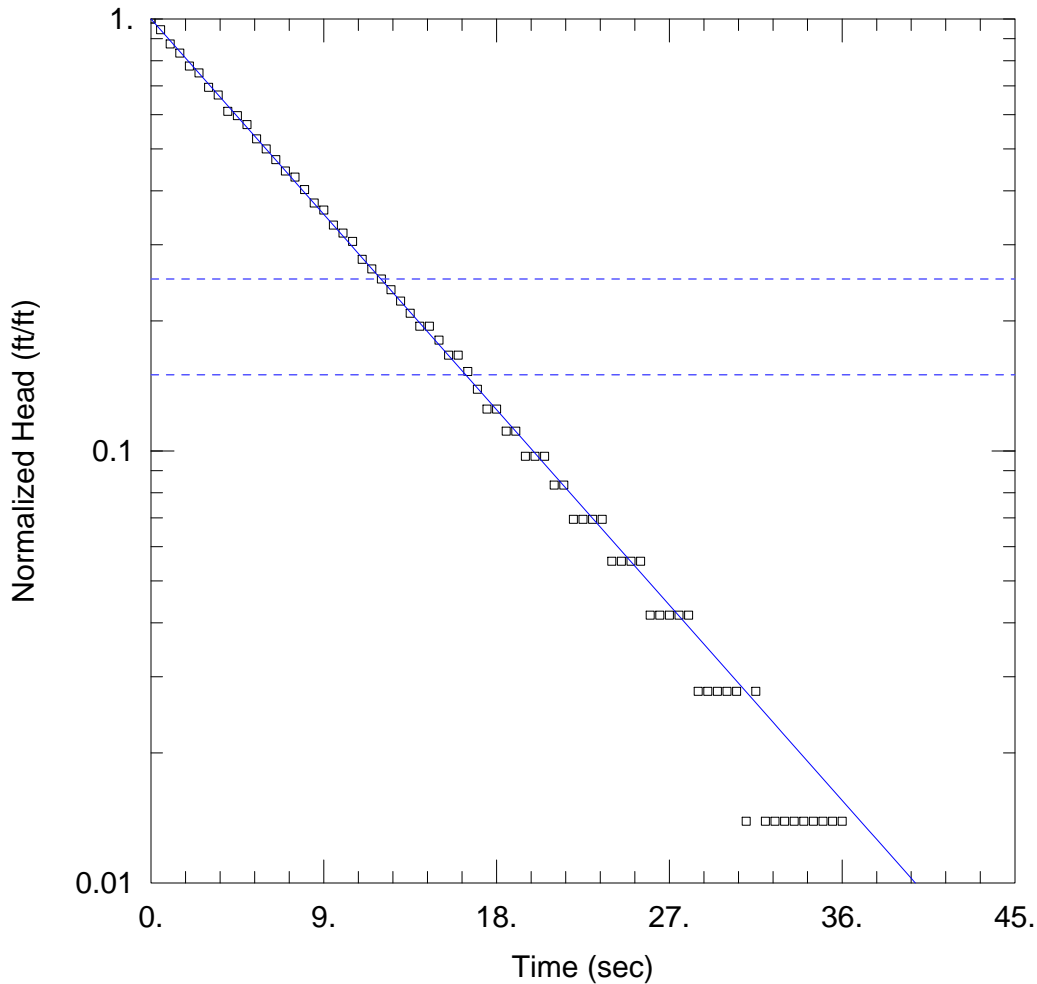
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

K = 151.8 ft/day

y0 = 0.7737 ft



### TEST 2

Data Set: C:\...\LF-36 (36-41)\_Hv\_UC\_TEST 2.aqt

Date: 12/14/12

Time: 09:08:56

### PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-36 (36-41)

Test Date: 9/20/2012

### AQUIFER DATA

Saturated Thickness: 13.47 ft

Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (LF-36 (36-41))

Initial Displacement: 0.72 ft

Static Water Column Height: 13.47 ft

Total Well Penetration Depth: 13.47 ft

Screen Length: 5. ft

Casing Radius: 0.19 ft

Well Radius: 0.0833 ft

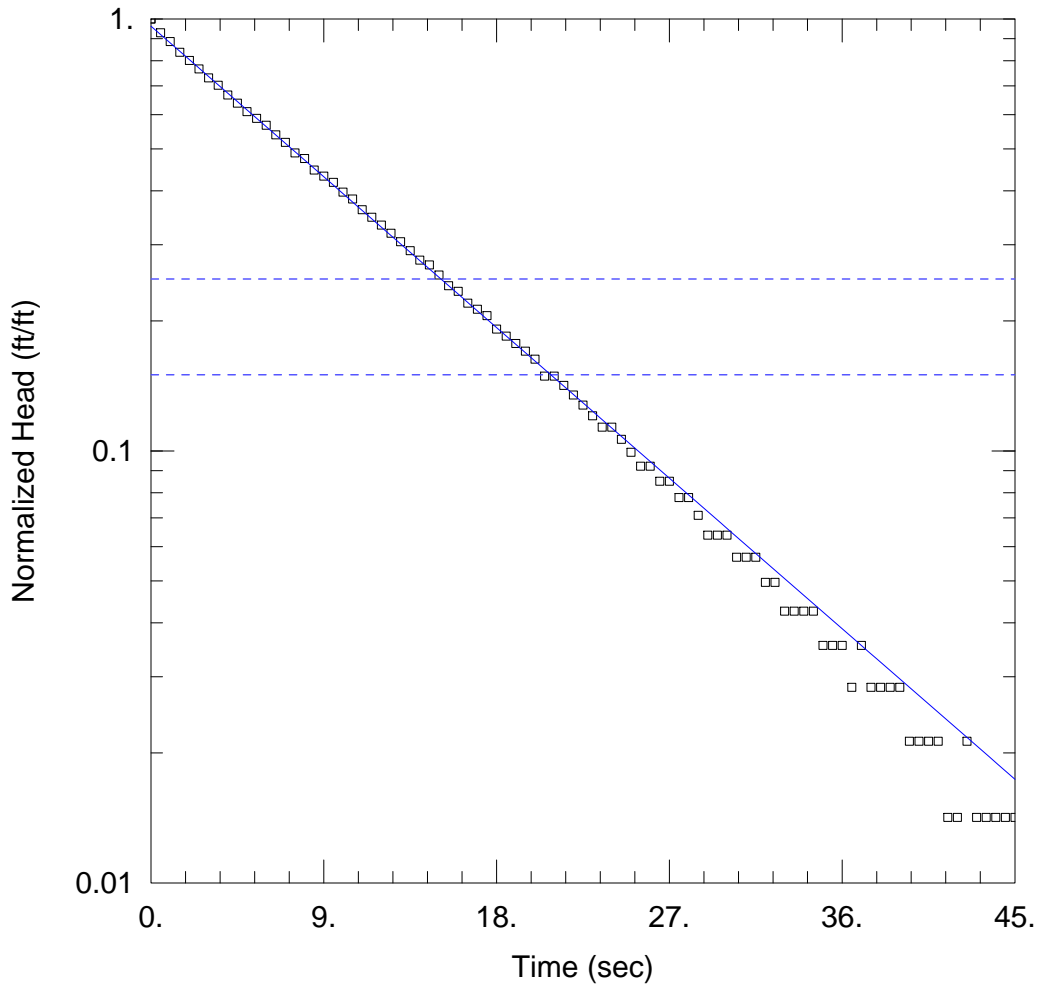
### SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

K = 172.7 ft/day

y0 = 0.7197 ft



### TEST 3

Data Set: C:\...\LF-36 (36-41)\_Hv\_UC\_TEST 3.aqt

Date: 12/14/12

Time: 09:09:09

### PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-36 (36-41)

Test Date: 9/20/2012

### AQUIFER DATA

Saturated Thickness: 13.47 ft

Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (LF-36 (36-41))

Initial Displacement: 1.41 ft

Static Water Column Height: 13.47 ft

Total Well Penetration Depth: 13.47 ft

Screen Length: 5. ft

Casing Radius: 0.19 ft

Well Radius: 0.0833 ft

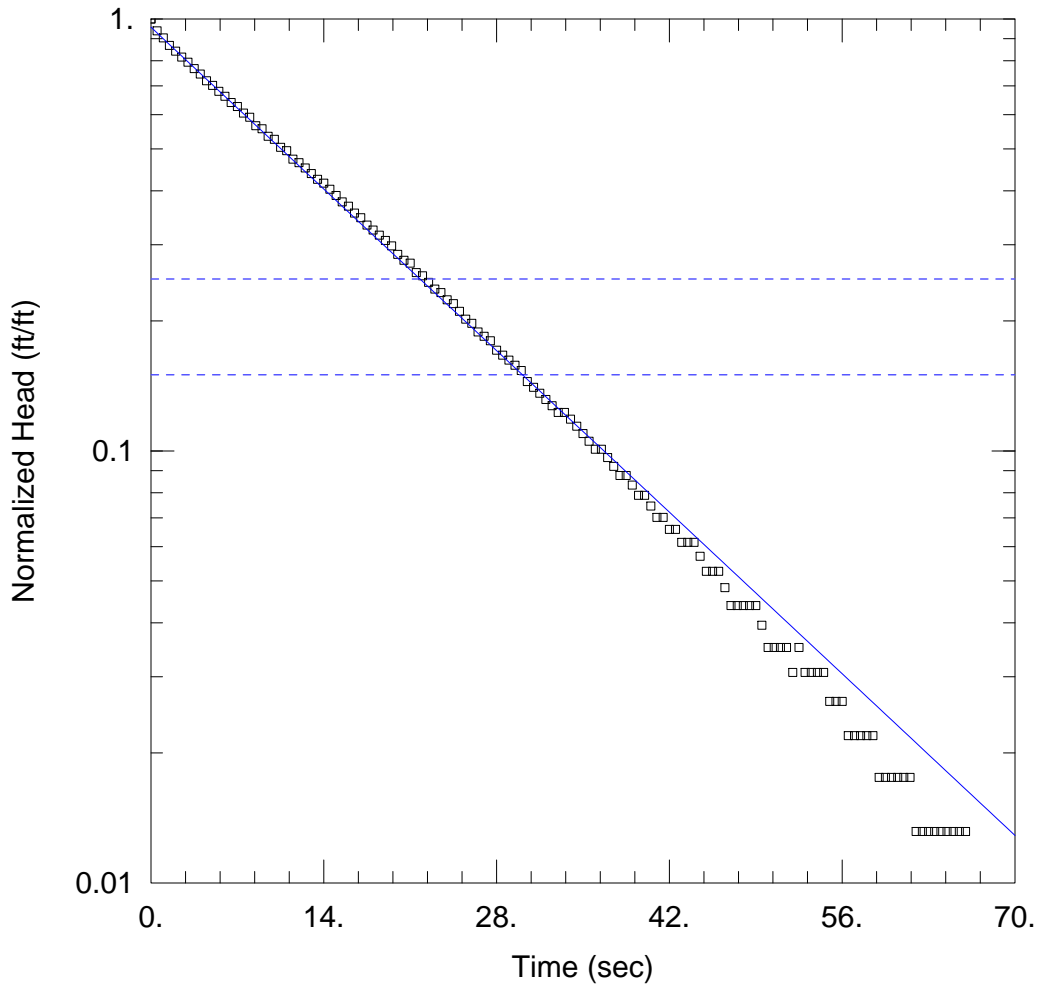
### SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

K = 133.2 ft/day

y0 = 1.356 ft



TEST 4

Data Set: C:\...\LF-36 (36-41)\_Hv\_UC\_TEST 4.aqt

Date: 12/14/12

Time: 09:09:22

PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-36 (36-41)

Test Date: 9/20/2012

AQUIFER DATA

Saturated Thickness: 13.47 ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (LF-36 (36-41))

Initial Displacement: 2.28 ft

Static Water Column Height: 13.47 ft

Total Well Penetration Depth: 13.47 ft

Screen Length: 5. ft

Casing Radius: 0.19 ft

Well Radius: 0.0833 ft

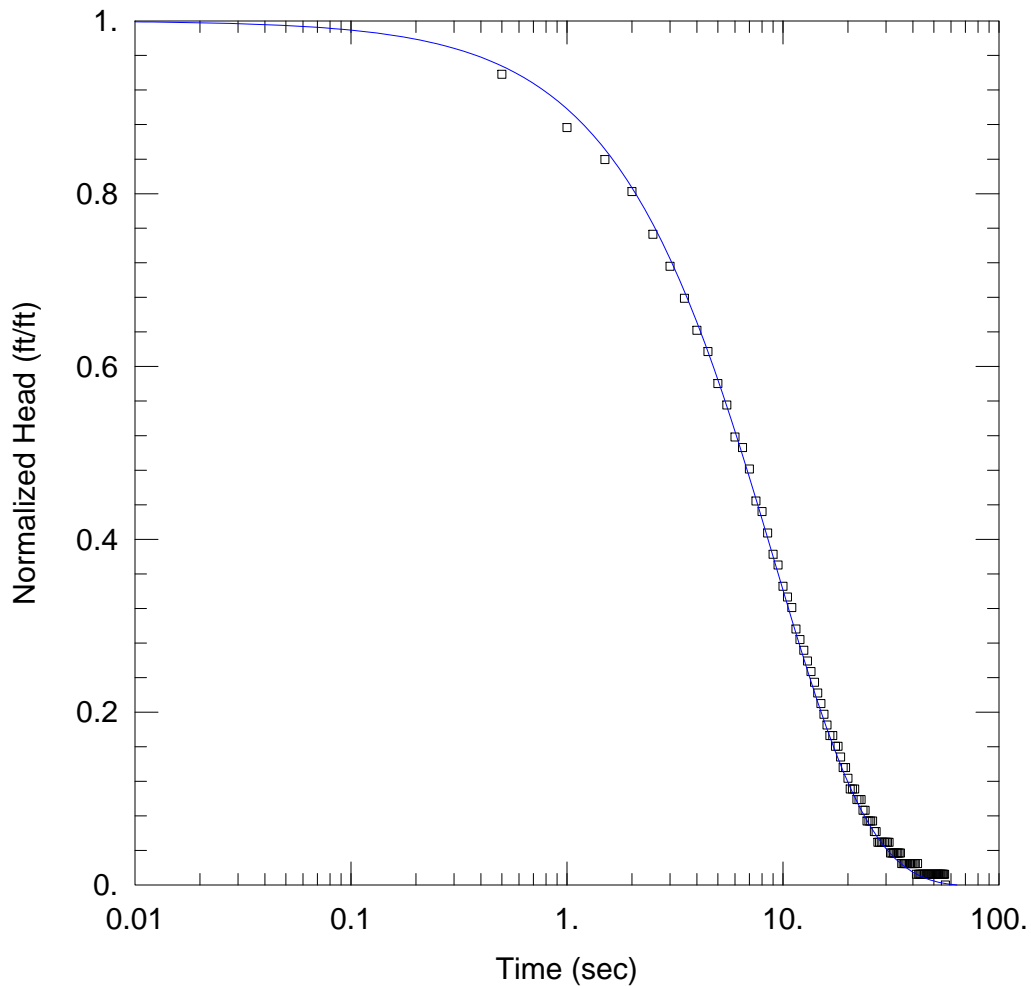
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

K = 91.9 ft/day

y0 = 2.181 ft



TEST 1

Data Set: C:\...\LF-36 (36-41)\_KGS\_UC\_TEST 1.aqt

Date: 12/14/12

Time: 09:09:40

PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-36 (36-41)

Test Date: 9/20/2012

AQUIFER DATA

Saturated Thickness: 13.47 ft

WELL DATA (LF-36 (36-41))

Initial Displacement: 0.81 ft

Static Water Column Height: 13.47 ft

Total Well Penetration Depth: 13.47 ft

Screen Length: 5. ft

Casing Radius: 0.19 ft

Well Radius: 0.0833 ft

SOLUTION

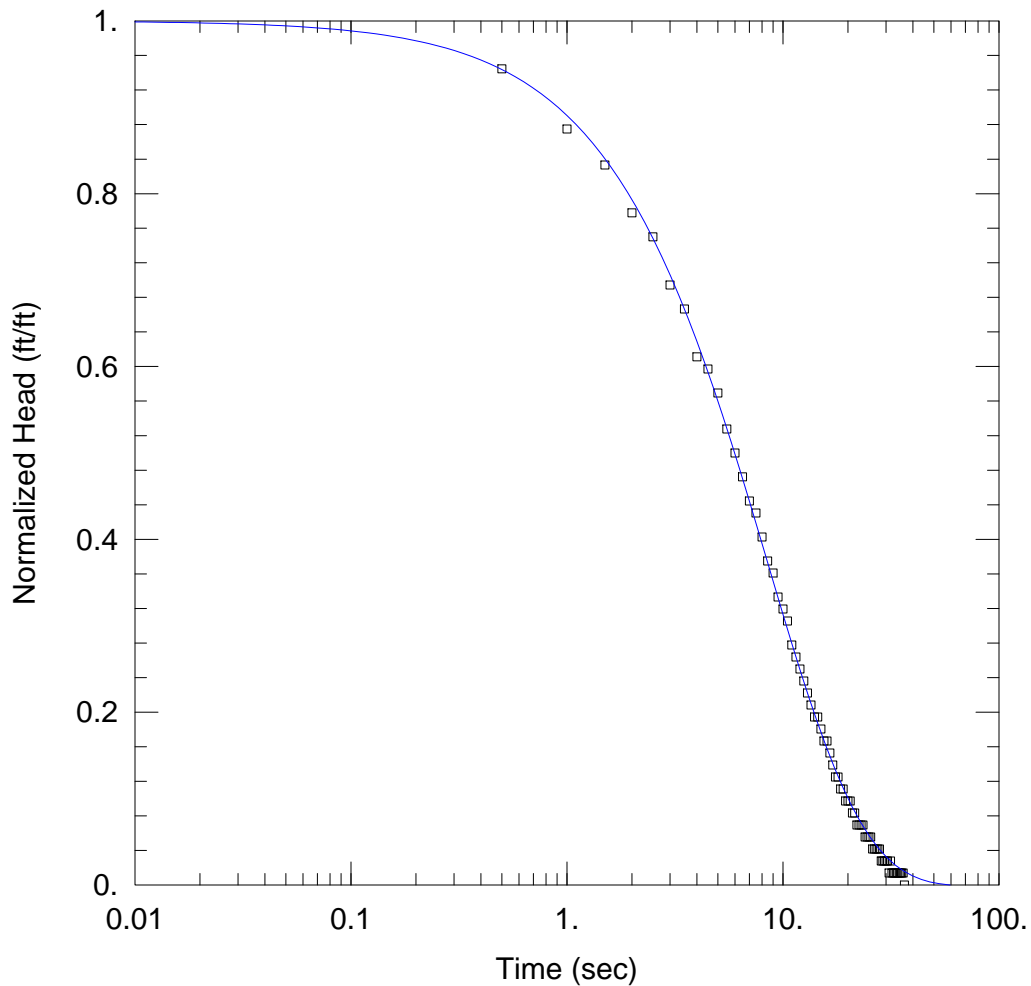
Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 141.6 ft/day

Ss = 1.397E-8 ft<sup>-1</sup>

Kz/Kr = 1.



TEST 2

Data Set: C:\...\LF-36 (36-41)\_KGS\_UC\_TEST 2.aqt

Date: 12/14/12

Time: 09:09:51

PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-36 (36-41)

Test Date: 9/20/2012

AQUIFER DATA

Saturated Thickness: 13.47 ft

WELL DATA (LF-36 (36-41))

Initial Displacement: 0.72 ft

Total Well Penetration Depth: 13.47 ft

Casing Radius: 0.19 ft

Static Water Column Height: 13.47 ft

Screen Length: 5. ft

Well Radius: 0.0833 ft

SOLUTION

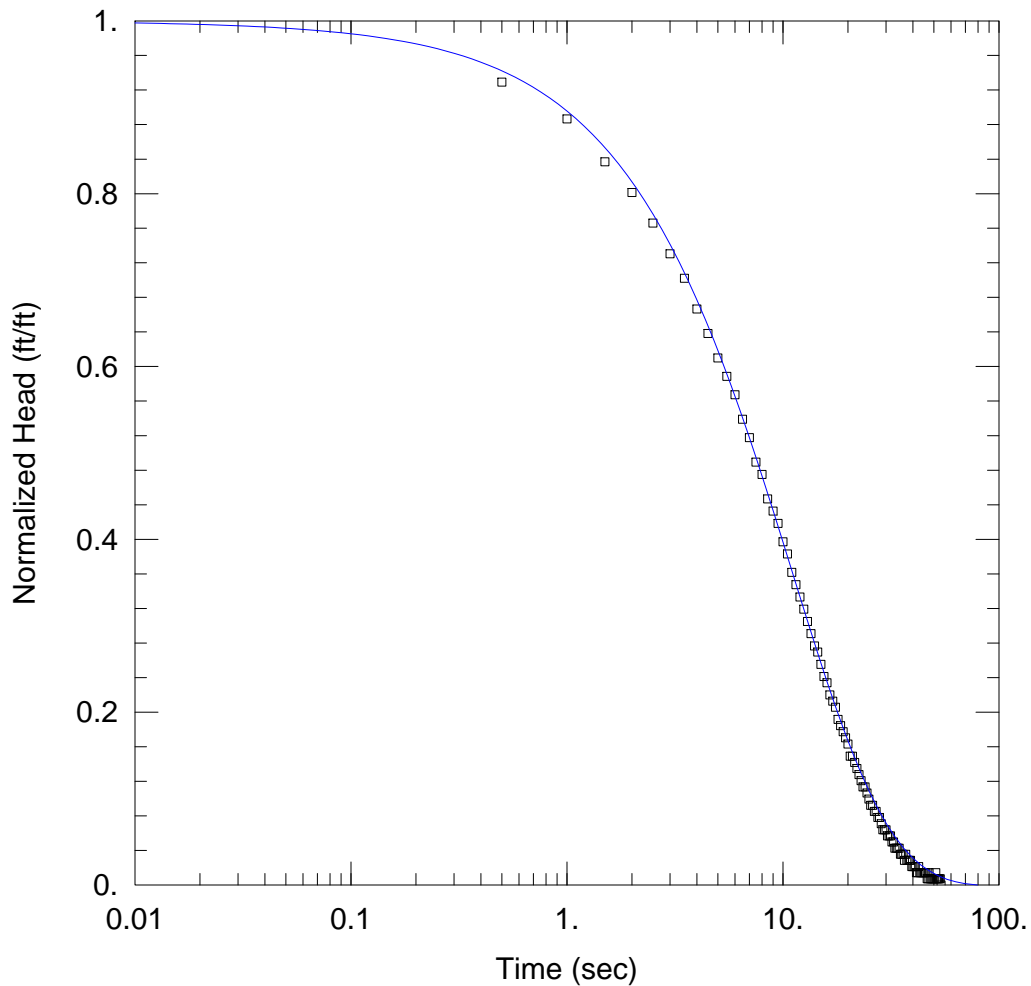
Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 153. ft/day

Kz/Kr = 1.

Ss = 1.39E-8 ft<sup>-1</sup>



TEST 3

Data Set: C:\...\LF-36 (36-41)\_KGS\_UC\_TEST 3.aqt

Date: 12/14/12

Time: 09:10:12

PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-36 (36-41)

Test Date: 9/20/2012

AQUIFER DATA

Saturated Thickness: 13.47 ft

WELL DATA (LF-36 (36-41))

Initial Displacement: 1.41 ft

Static Water Column Height: 13.47 ft

Total Well Penetration Depth: 13.47 ft

Screen Length: 5. ft

Casing Radius: 0.19 ft

Well Radius: 0.0833 ft

SOLUTION

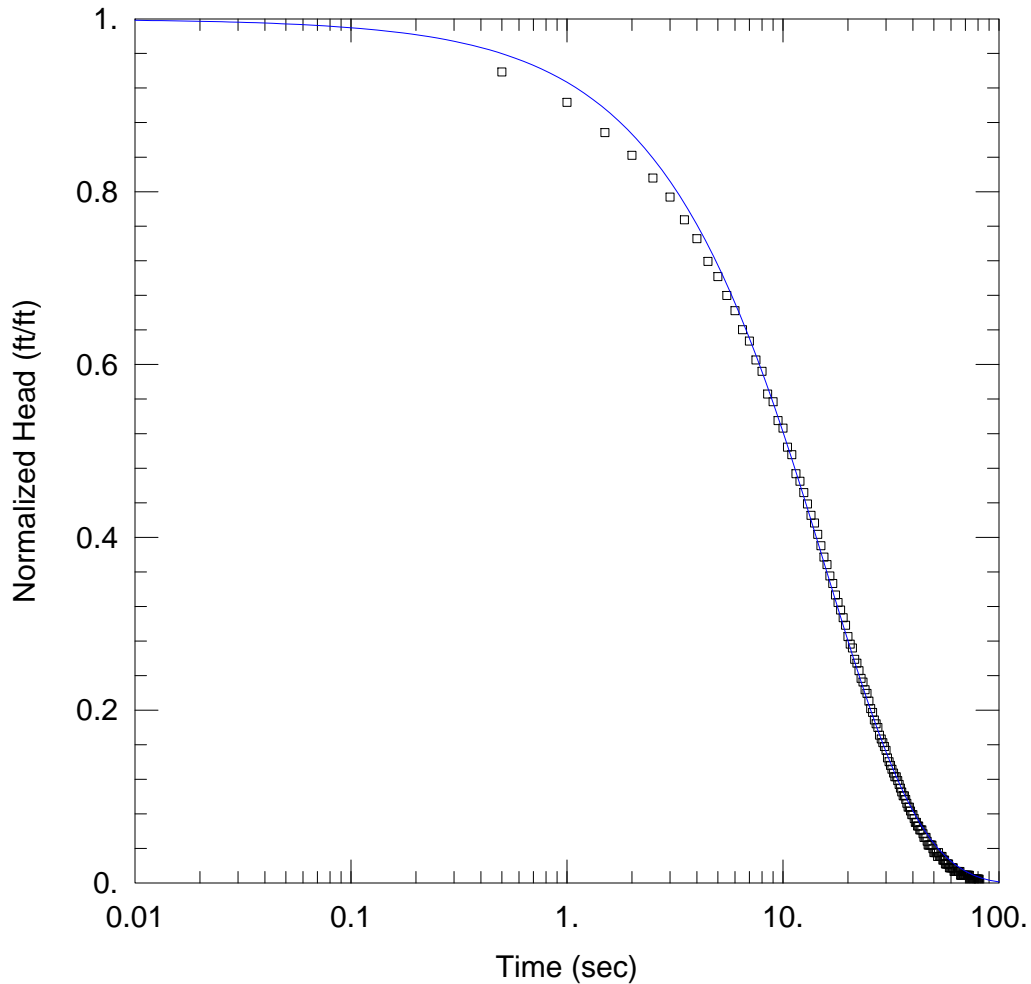
Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 120.1 ft/day

Ss = 0.0001 ft<sup>-1</sup>

Kz/Kr = 1.



#### TEST 4

Data Set: C:\...\LF-36 (36-41)\_KGS\_UC\_TEST 4.aqt

Date: 12/14/12

Time: 09:10:24

#### PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-36 (36-41)

Test Date: 9/20/2012

#### AQUIFER DATA

Saturated Thickness: 13.47 ft

#### WELL DATA (LF-36 (36-41))

Initial Displacement: 2.28 ft

Static Water Column Height: 13.47 ft

Total Well Penetration Depth: 13.47 ft

Screen Length: 5. ft

Casing Radius: 0.19 ft

Well Radius: 0.0833 ft

#### SOLUTION

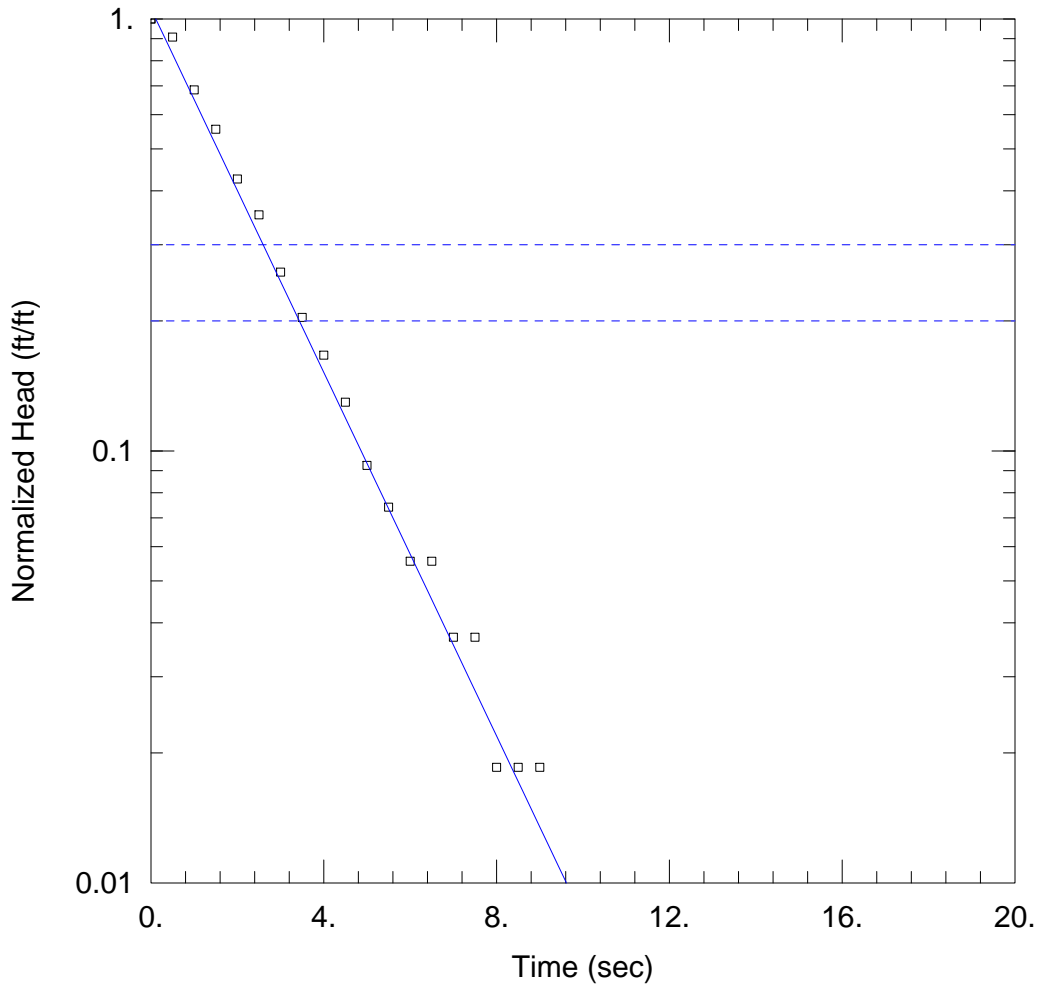
Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 84.1 ft/day

Ss = 5.99E-5 ft<sup>-1</sup>

Kz/Kr = 1.



TEST 1

Data Set: C:\...\LF-37 (28-33)\_B&R\_UC\_TEST 1.aqt

Date: 12/14/12

Time: 09:10:46

PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-37 (28-33)

Test Date: 9/21/2012

AQUIFER DATA

Saturated Thickness: 13. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (LF-37 (28-33))

Initial Displacement: 0.54 ft

Static Water Column Height: 13. ft

Total Well Penetration Depth: 13. ft

Screen Length: 5. ft

Casing Radius: 0.19 ft

Well Radius: 0.0833 ft

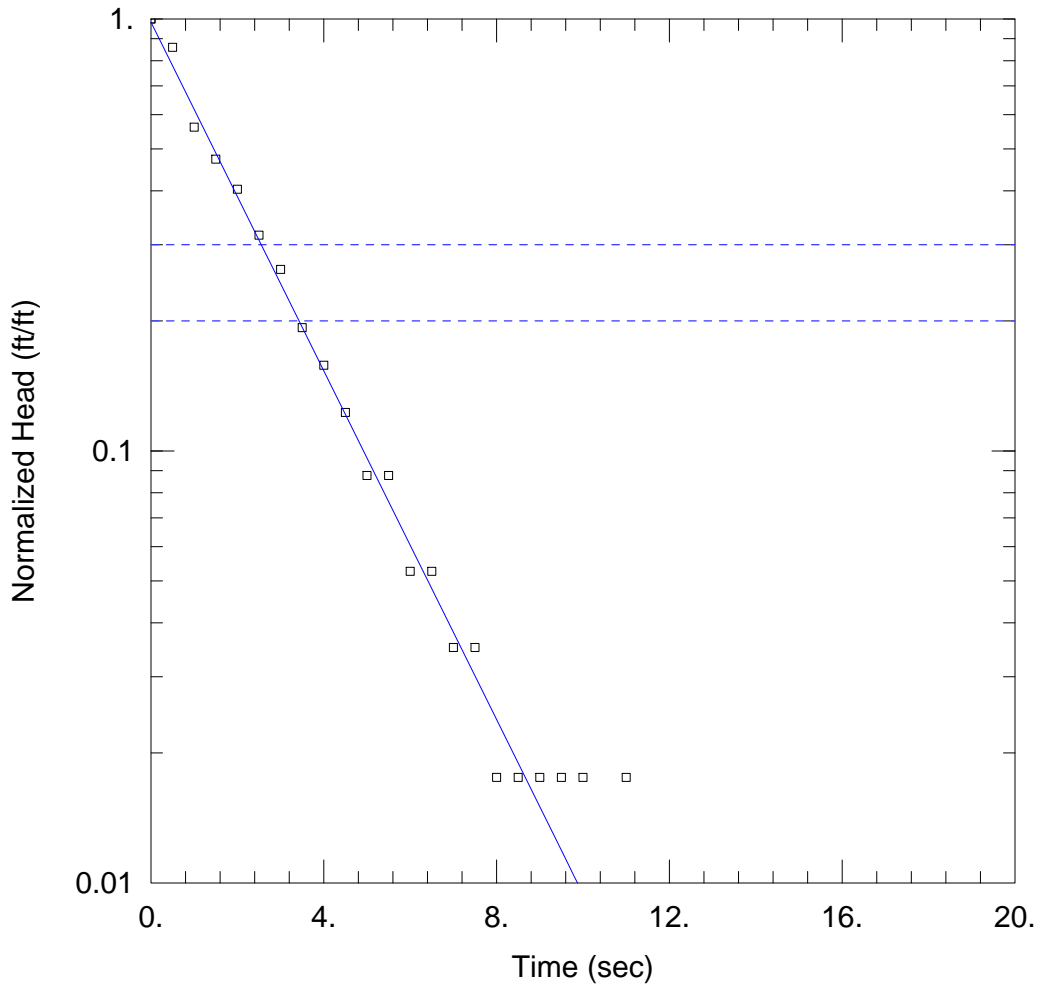
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

K = 564.7 ft/day

y0 = 0.57 ft



TEST 2

Data Set: C:\...\LF-37 (28-33)\_B&R\_UC\_TEST 2.aqt

Date: 12/14/12

Time: 09:11:02

PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-37 (28-33)

Test Date: 9/21/2012

AQUIFER DATA

Saturated Thickness: 13. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (LF-37 (28-33))

Initial Displacement: 0.57 ft

Static Water Column Height: 13. ft

Total Well Penetration Depth: 13. ft

Screen Length: 5. ft

Casing Radius: 0.19 ft

Well Radius: 0.0833 ft

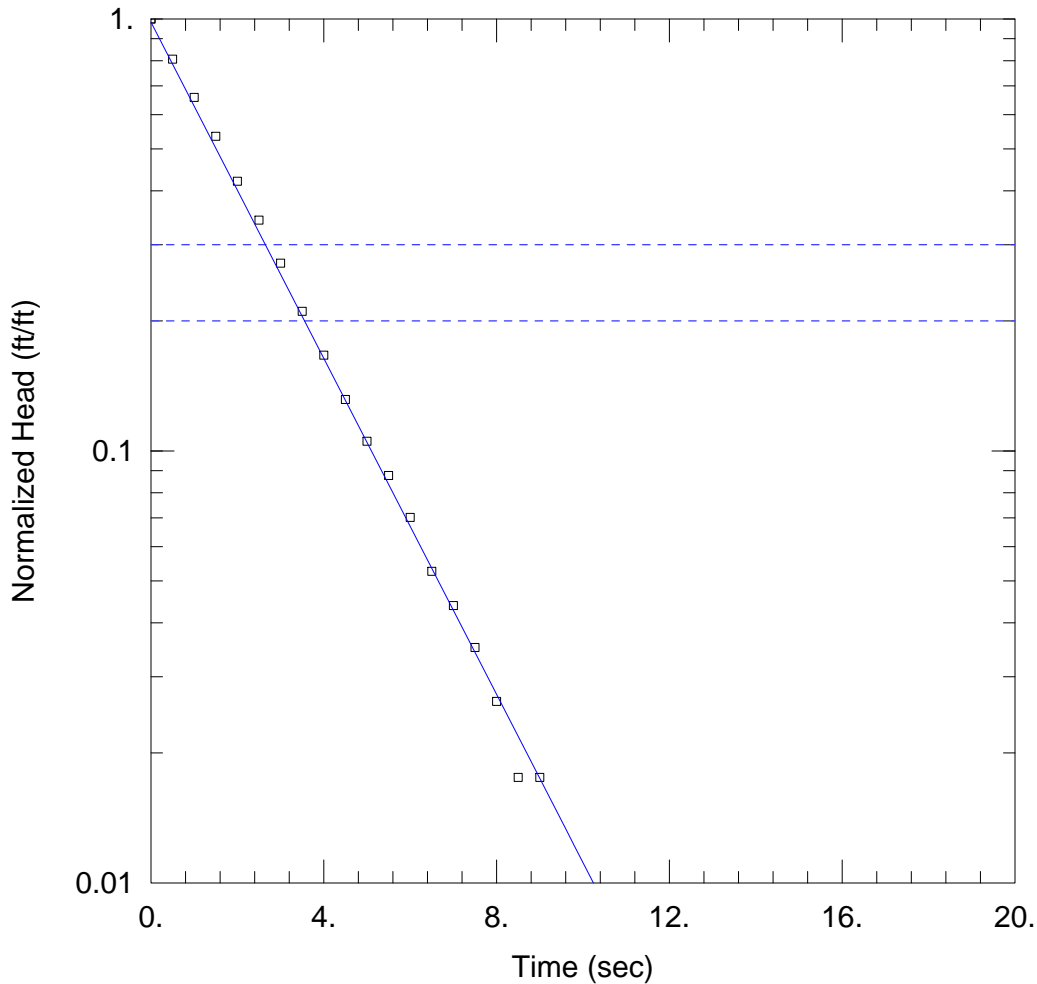
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

K = 541.4 ft/day

y0 = 0.56 ft



TEST 3

Data Set: C:\...\LF-37 (28-33)\_B&R\_UC\_TEST 3.aqt

Date: 12/14/12

Time: 09:11:15

PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-37 (28-33)

Test Date: 9/21/2012

AQUIFER DATA

Saturated Thickness: 13. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (LF-37 (28-33))

Initial Displacement: 1.14 ft

Static Water Column Height: 13. ft

Total Well Penetration Depth: 13. ft

Screen Length: 5. ft

Casing Radius: 0.19 ft

Well Radius: 0.0833 ft

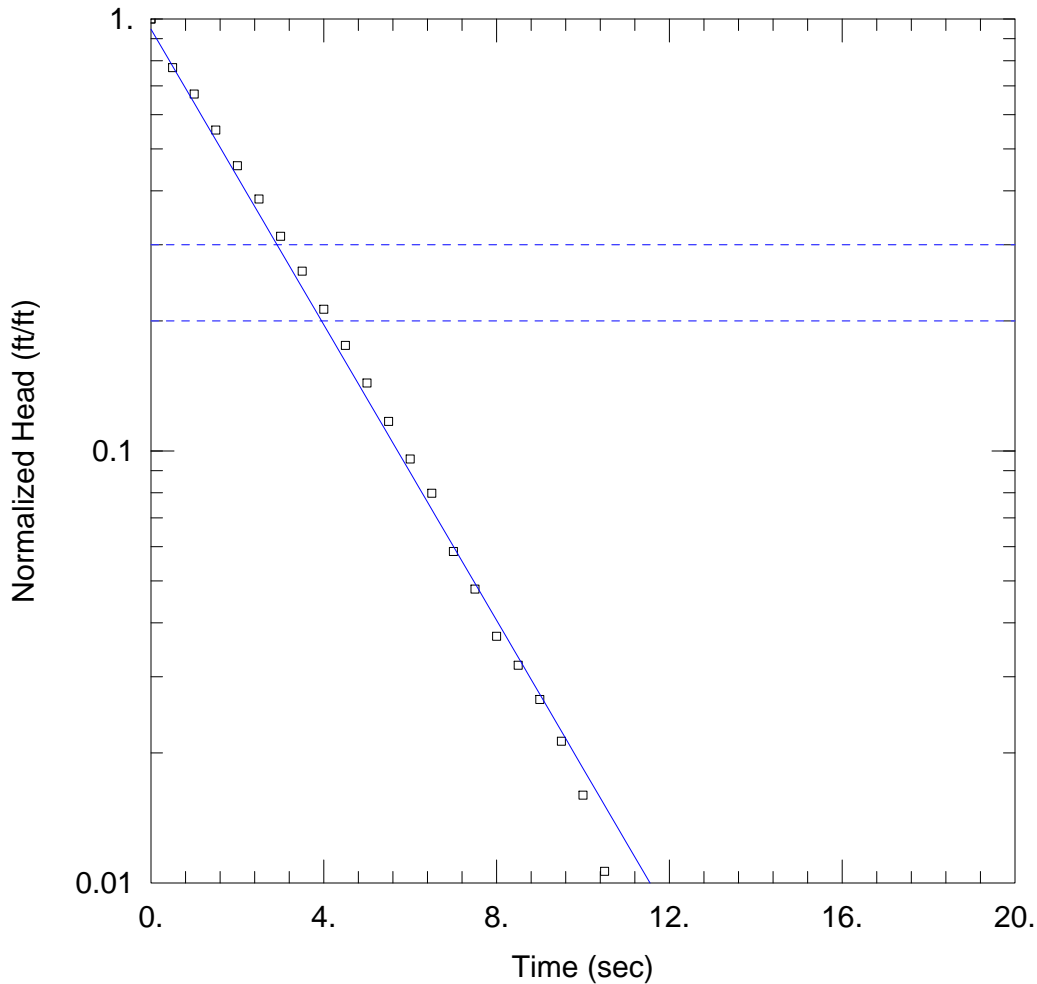
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

K = 521.9 ft/day

y0 = 1.12 ft



### TEST 4

Data Set: C:\...\LF-37 (28-33)\_B&R\_UC\_TEST 4.aqt

Date: 12/14/12

Time: 09:11:25

### PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-37 (28-33)

Test Date: 9/21/2012

### AQUIFER DATA

Saturated Thickness: 13. ft

Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (LF-37 (28-33))

Initial Displacement: 1.88 ft

Static Water Column Height: 13. ft

Total Well Penetration Depth: 13. ft

Screen Length: 5. ft

Casing Radius: 0.19 ft

Well Radius: 0.0833 ft

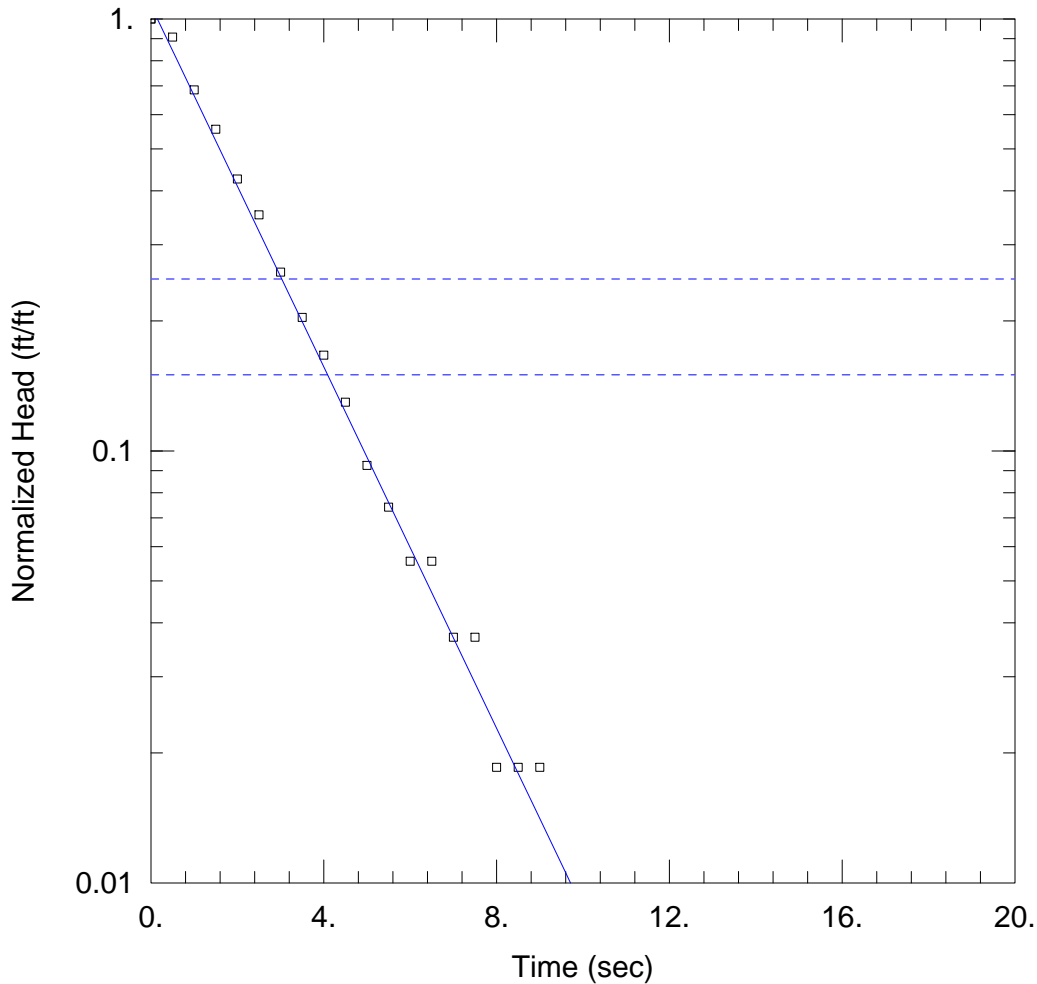
### SOLUTION

Aquifer Model: Unconfined

Solution Method: Bower-Rice

K = 459. ft/day

y0 = 1.78 ft



TEST 1

Data Set: C:\...\LF-37 (28-33)\_Hv\_UC\_TEST 1.aqt

Date: 12/14/12

Time: 09:11:36

PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-37 (28-33)

Test Date: 9/21/2012

AQUIFER DATA

Saturated Thickness: 13. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (LF-37 (28-33))

Initial Displacement: 0.54 ft

Static Water Column Height: 13. ft

Total Well Penetration Depth: 13. ft

Screen Length: 5. ft

Casing Radius: 0.19 ft

Well Radius: 0.0833 ft

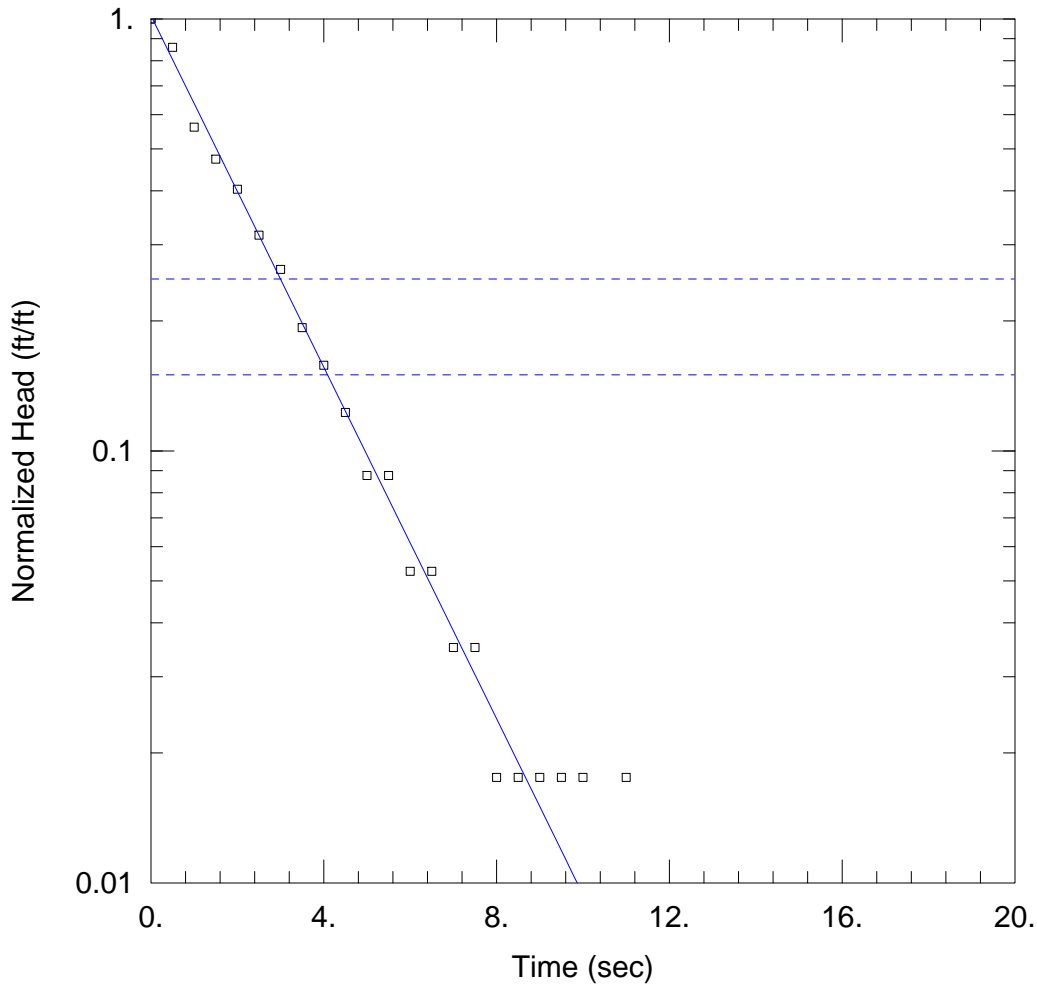
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

K = 719.1 ft/day

y0 = 0.58 ft



TEST 2

Data Set: C:\...\LF-37 (28-33)\_Hv\_UC\_TEST 2.aqt

Date: 12/14/12

Time: 09:11:49

PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-37 (28-33)

Test Date: 9/21/2012

AQUIFER DATA

Saturated Thickness: 13. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (LF-37 (28-33))

Initial Displacement: 0.57 ft

Static Water Column Height: 13. ft

Total Well Penetration Depth: 13. ft

Screen Length: 5. ft

Casing Radius: 0.19 ft

Well Radius: 0.0833 ft

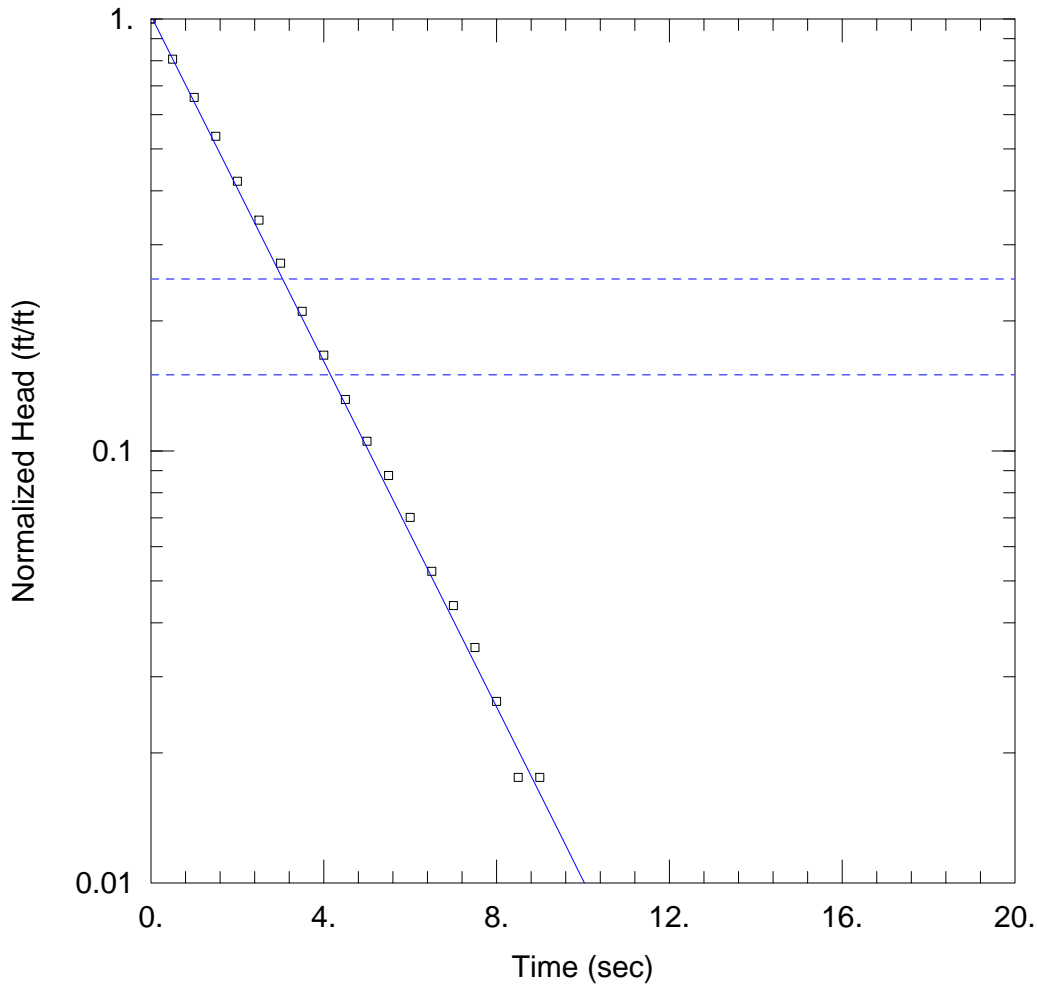
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

K = 699.5 ft/day

y0 = 0.58 ft



TEST 3

Data Set: C:\...\LF-37 (28-33)\_Hv\_UC\_TEST 3.aqt

Date: 12/14/12

Time: 09:12:00

PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-37 (28-33)

Test Date: 9/21/2012

AQUIFER DATA

Saturated Thickness: 13. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (LF-37 (28-33))

Initial Displacement: 1.14 ft

Static Water Column Height: 13. ft

Total Well Penetration Depth: 13. ft

Screen Length: 5. ft

Casing Radius: 0.19 ft

Well Radius: 0.0833 ft

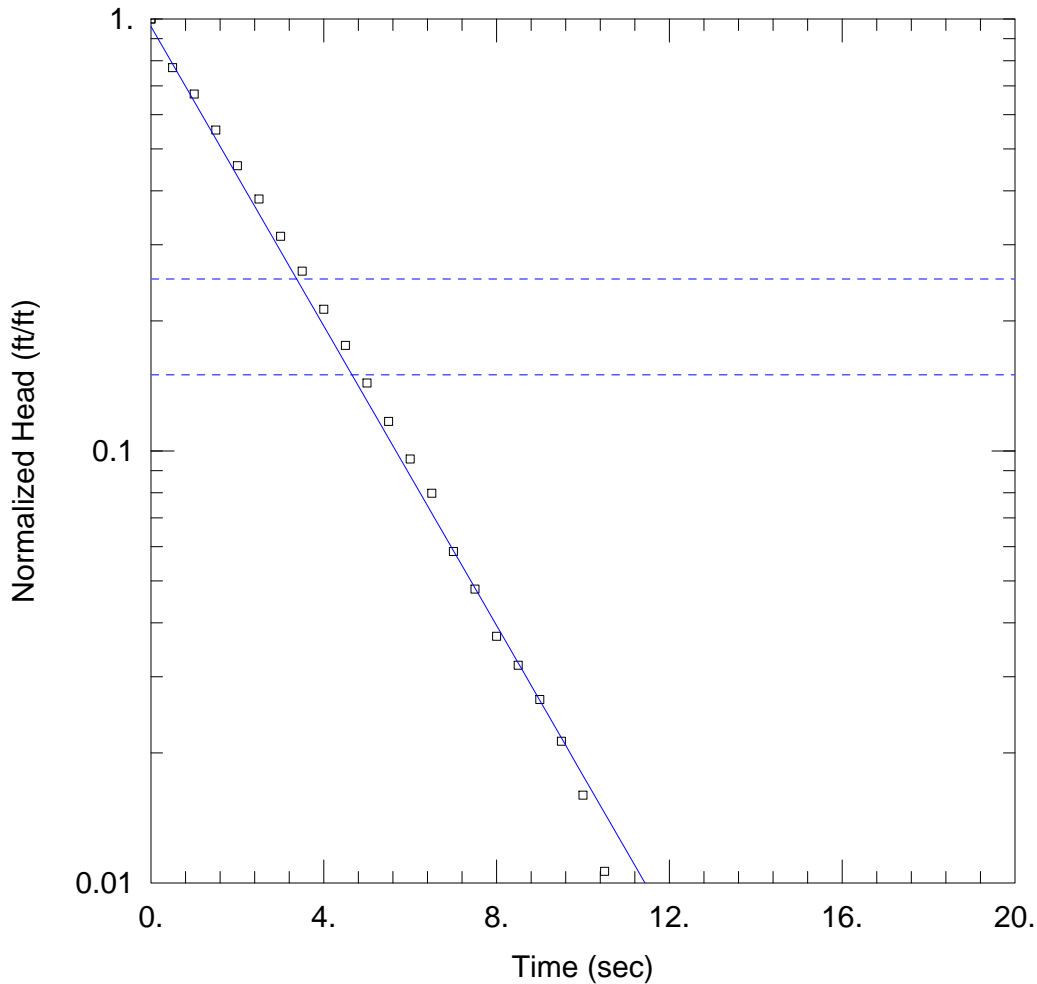
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

K = 687.9 ft/day

y0 = 1.16 ft



TEST 4

Data Set: C:\...\LF-37 (28-33)\_Hv\_UC\_TEST 4.aqt

Date: 12/14/12

Time: 09:12:13

PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-37 (28-33)

Test Date: 9/21/2012

AQUIFER DATA

Saturated Thickness: 13. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (LF-37 (28-33))

Initial Displacement: 1.88 ft

Static Water Column Height: 13. ft

Total Well Penetration Depth: 13. ft

Screen Length: 5. ft

Casing Radius: 0.19 ft

Well Radius: 0.0833 ft

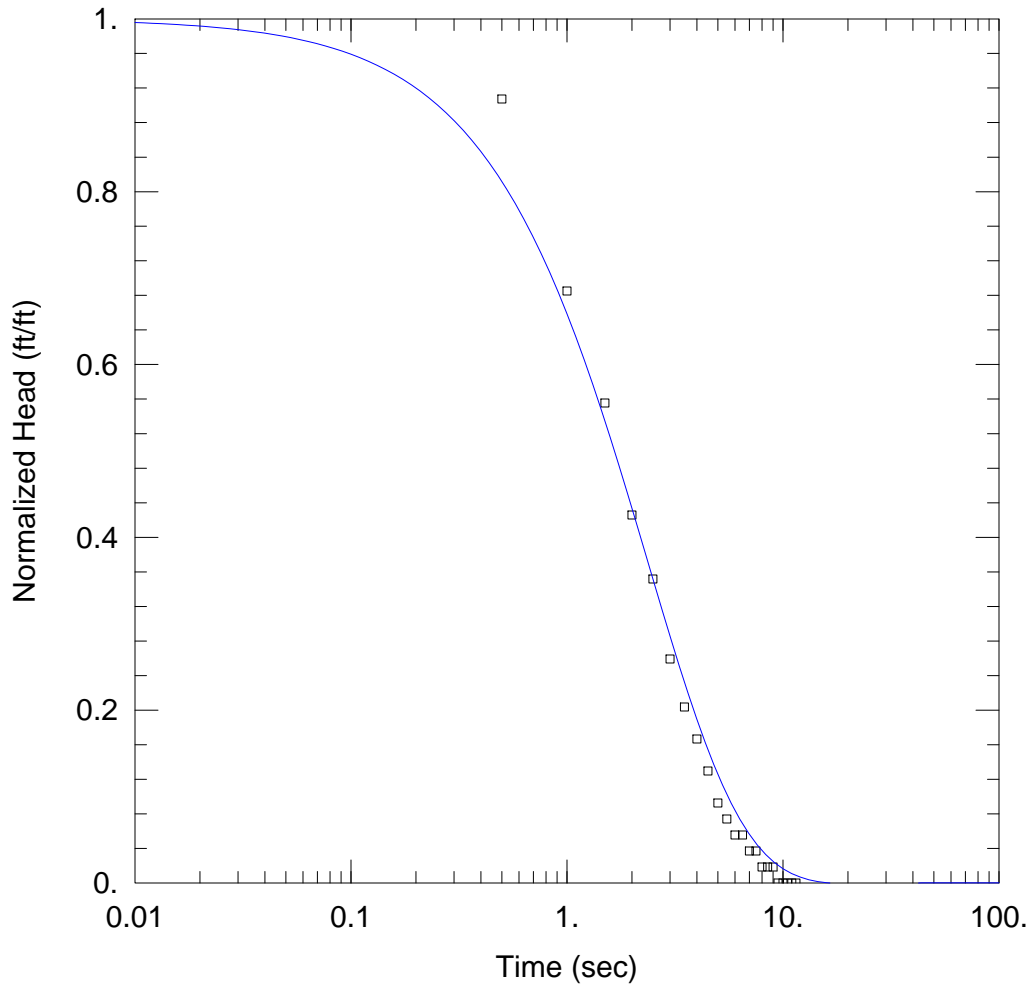
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

K = 596. ft/day

y0 = 1.805 ft



TEST 1

Data Set: C:\...\LF-37 (28-33)\_KGS\_UC\_TEST 1.aqt

Date: 12/14/12

Time: 09:12:29

PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-37 (28-33)

Test Date: 9/21/2012

AQUIFER DATA

Saturated Thickness: 13. ft

WELL DATA (LF-37 (28-33))

Initial Displacement: 0.54 ft

Static Water Column Height: 13. ft

Total Well Penetration Depth: 13. ft

Screen Length: 5. ft

Casing Radius: 0.19 ft

Well Radius: 0.0833 ft

SOLUTION

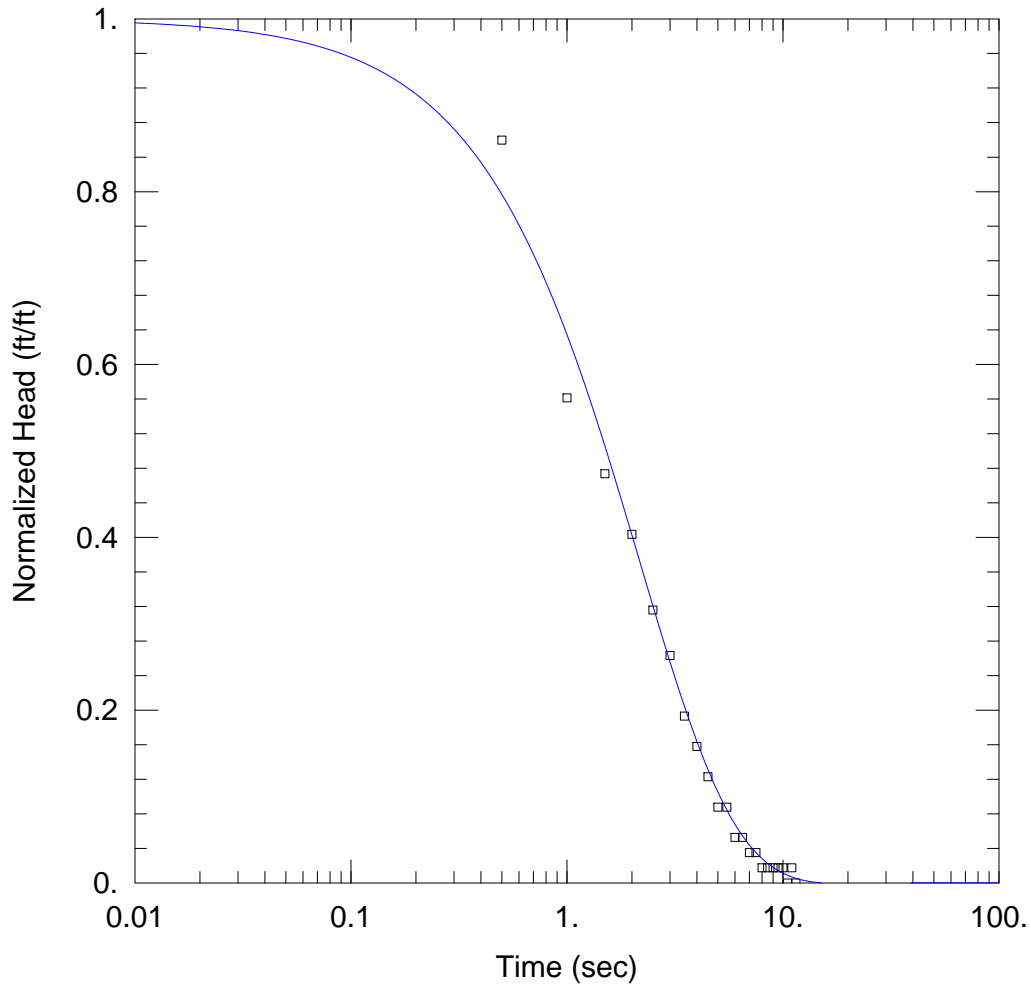
Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 549.4 ft/day

Ss = 9.09E-12 ft<sup>-1</sup>

Kz/Kr = 1.



TEST 2

Data Set: C:\...\LF-37 (28-33)\_KGS\_UC\_TEST 2.aqt

Date: 12/14/12

Time: 09:12:40

PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-37 (28-33)

Test Date: 9/21/2012

AQUIFER DATA

Saturated Thickness: 13. ft

WELL DATA (LF-37 (28-33))

Initial Displacement: 0.57 ft

Total Well Penetration Depth: 13. ft

Casing Radius: 0.19 ft

Static Water Column Height: 13. ft

Screen Length: 5. ft

Well Radius: 0.0833 ft

SOLUTION

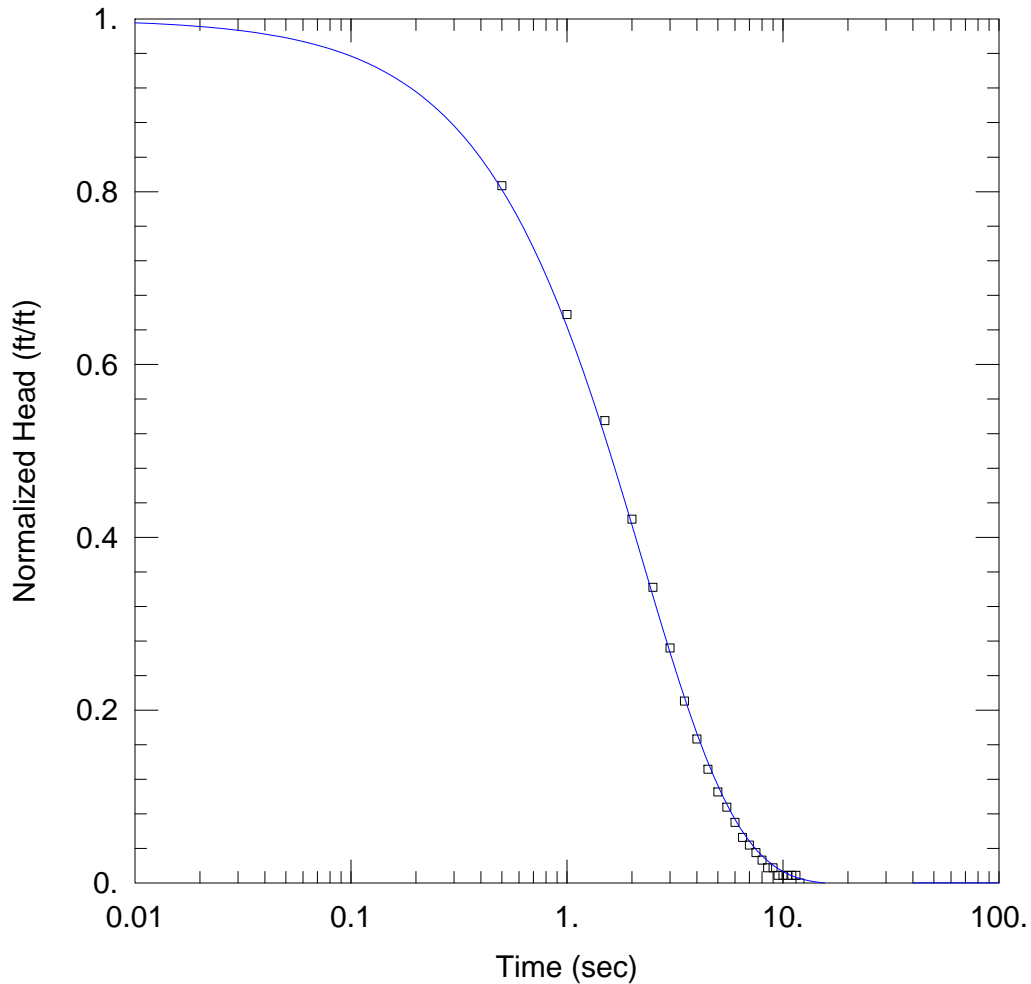
Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 598.3 ft/day

Kz/Kr = 1.

Ss = 1.68E-7 ft<sup>-1</sup>



TEST 3

Data Set: C:\...\LF-37 (28-33)\_KGS\_UC\_TEST 3.aqt

Date: 12/14/12

Time: 09:12:53

PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-37 (28-33)

Test Date: 9/21/2012

AQUIFER DATA

Saturated Thickness: 13. ft

WELL DATA (LF-37 (28-33))

Initial Displacement: 1.14 ft

Total Well Penetration Depth: 13. ft

Casing Radius: 0.19 ft

Static Water Column Height: 13. ft

Screen Length: 5. ft

Well Radius: 0.0833 ft

SOLUTION

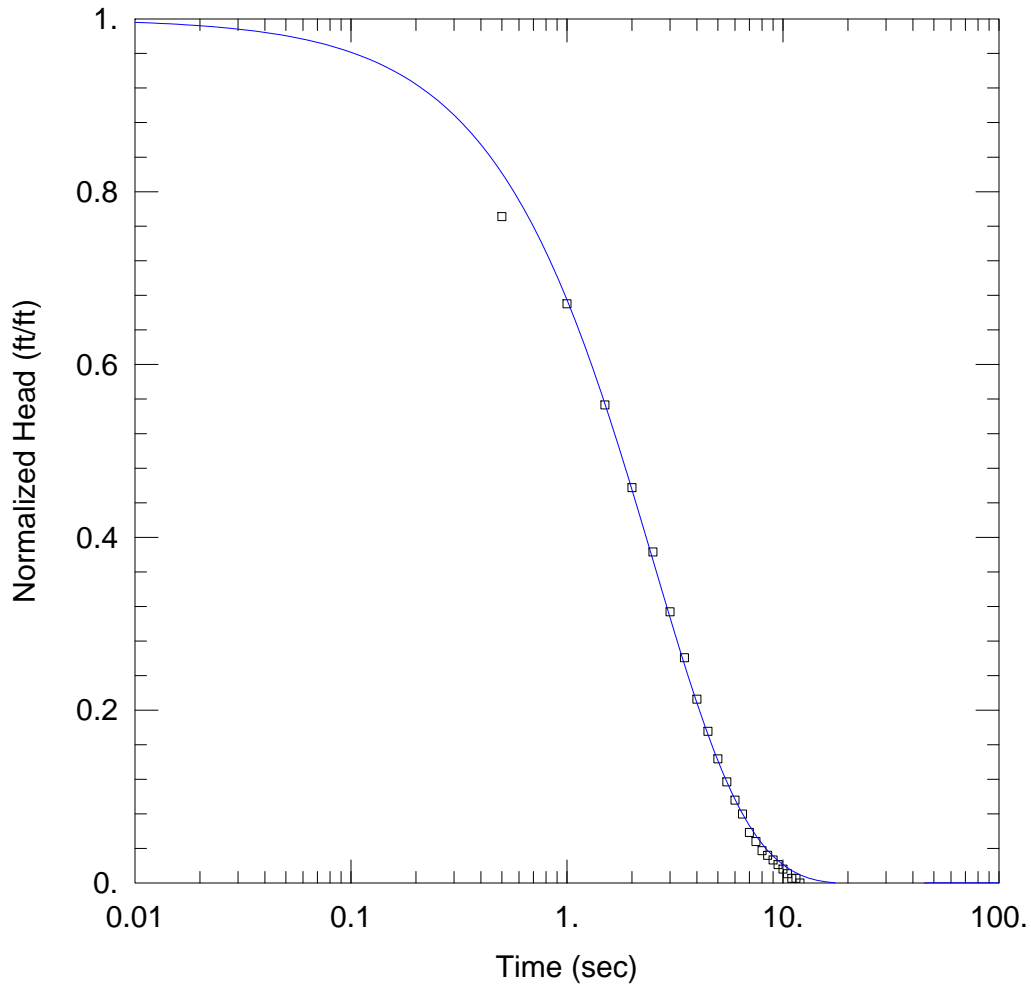
Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 579.6 ft/day

Kz/Kr = 1.

Ss = 1.68E-7 ft<sup>-1</sup>



### TEST 4

Data Set: C:\...\LF-37 (28-33)\_KGS\_UC\_TEST 4.aqt

Date: 12/14/12

Time: 09:13:04

### PROJECT INFORMATION

Company: ARCADIS

Client: RACER

Project: OH000294.2012

Location: Moraine, Ohio

Test Well: LF-37 (28-33)

Test Date: 9/21/2012

### AQUIFER DATA

Saturated Thickness: 13. ft

### WELL DATA (LF-37 (28-33))

Initial Displacement: 1.88 ft

Total Well Penetration Depth: 13. ft

Casing Radius: 0.19 ft

Static Water Column Height: 13. ft

Screen Length: 5. ft

Well Radius: 0.0833 ft

### SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 517.5 ft/day

Kz/Kr = 1.

Ss = 1.68E-7 ft<sup>-1</sup>

ARCADIS

**Attachment E-6**

Supporting Documentation for the  
Leaching Potential Calculations

## Introduction

Leaching potential calculations were completed to determine the potential of site-specific volatile organic compounds (VOCs) from waste in Landfill L1, located at the Revitalizing Auto Communities Environmental Response Trust (RACER Trust) Moraine Facilities (Site) in Moraine, Ohio, to impact groundwater. Data from borings through the waste and a vadose zone model were used to estimate the contribution to groundwater of each of several VOCs.

## Model Objective

The objective of the leaching potential calculations was to determine if site-specific VOCs in Landfill L1 waste could leach to the transmissive part of the saturated zone. Toward this end, concentrations of VOCs were computed at the bottom of the modeled saturated zone over time.

## Model Scenario

The scenario that was modeled was that of the typical flux of each VOC in the unsaturated (“vadose”) zone under the footprint of Landfill L1 over time. In this model scenario, water from precipitation infiltrates the upper layer of fill in the landfill and percolates downward through the soil and waste. As it moves, it comes in contact with waste. Constituents of the waste can leach downward toward the saturated zone and contribute to groundwater. The volatile constituents can also move upwards and downwards by diffusion in the gas phase. At all times during model analysis, equilibrium is being maintained and adjusted between the four phases present: the soil pore water (water phase), the organic waste (oil phase), the solid fraction (soil phase), and the soil vapor (air phase). As percolation, advection, and phase partitioning are taking place, degradation is also occurring. The constituent is attenuating, and the organic part of the waste is also breaking down.

The available data was used to estimate conditions in 1973 when the landfill closed. The model then computed the concentration of each VOC for each year from 1973 to 2013. The concentration of each constituent at the base of the vadose zone will increase, reach a peak value, and then decline. If the decline had not begun by 2013, then the modeling period was extended to 2273, and concentrations were computed for each decade, for years ending in “3” to simplify the analysis.

## Method

The method used to estimate the leach potential was a vadose zone computer model to compute the concentration of each VOC at the base of the vadose zone. The horizontal groundwater flow and the vertical percolation of vadose zone pore water were compared to determine a dilution factor. This allowed the estimation of groundwater concentration of each constituent under the landfill over time.

The model selected for the leaching computations was Vadose zone Interactive Processes (VIP). This model was the successor to the Regulatory and Investigative Treatment Zone (RITZ) model developed in 1985 by the Robert S. Kerr Environmental Research Laboratory of the United States Environmental Protection Agency (U.S. EPA) (Short 1985; Nofziger et al. 1988). The RITZ model was created to simulate hazardous waste land treatment units. The model was to be expanded to take into account more advanced land treatment scenarios and to allow for its use outside of the land farming context. The planned model was referred to as RITZE (RITZ-Enhanced). Ultimately, this model was developed and completed in 1987 outside of the U.S. EPA at Utah State University and renamed VIP (Stevens, et al. 1989a). The VIP model has been tested and evaluated by the U.S. EPA against other models in its genre (Nofziger et al. 1994), and it has been tested for sensitivity (Stevens, et al. 1989b). In spite of its age, VIP was considered suitable for this application because it can handle the partitioning of organic chemicals from a waste phase, and it can handle the transport mechanisms that were relevant to this Site, advection and dispersion.

More recent models take advantage of the augmentation in computer power that has been made available since 1989. These models allow for three dimensions, the complicated mathematical representation of the motion of nonaqueous phases, a more accurate handling of soil saturation as a function of depth, and can incorporate groundwater flow. However, these enhancements were not considered necessary to meet the objectives of this modeling task. To obtain an average downward flux of VOCs, a one-dimensional model is sufficient. The nonaqueous phase is not mobile at Landfill L1. The task at hand and the properties of the soils did not justify the level of detail required to model the van Genuchten curves. The groundwater component of this investigation was also one simple question, impartation of VOCs to the transmissive zone, and not concentrations at specific wells and times. Thus, a sophisticated treatment was not deemed necessary to meet the model objectives. VIP was considered adequate and appropriate for this task.

VIP uses a form of the finite difference method of computation. Thus the one-dimensional domain is divided into grid blocks. In these calculations, a 0.1 meter grid block size was used.

### **Chemical Constituents**

The following chemical constituents were considered: benzene, toluene, ethylbenzene, total xylenes (“xylene”), tetrachloroethene (PCE), and trichloroethene (TCE). Data from degradation products were considered, but were not run in the model. These degradation products included cis-1,2-dichloroethene (cis-1,2-DCE) and vinyl chloride.

### **Data Inputs**

In order to carry out the VIP modeling, several categories of data inputs were required: geotechnical data, metrological data, analytical data, chemical properties, and knowledge of the history of the unit. These categories of inputs are discussed below.

#### **Geotechnical Data**

The stratigraphic setting was chosen such that there was 1.4 meters (4.6 feet [ft.]) of sandy fill underlain by a silty fill. The interface of the two zones was taken as the average of its location in borings LF-10 and LF-18, and rounded to the nearest tenth of a meter. The water table was taken to be 7.7 meters (25.3 ft.) below land surface (bls). This value was chosen by averaging the depth to water from four nearby monitoring wells: 4S, GM-2, GM-6, and GM-32.

Petrophysical samples were collected from two borings, LF-36 and LF-37, and sent to PTS Laboratories, Inc. (PTS) in Santa Fe Springs, California. The rate of downward advective movement of water in the unsaturated zone in a one-dimensional model is controlled by the least permeable layer. Therefore, the properties of the samples collected 16 to 18 ft. bls were used to represent the flow in the model. Both of these samples were determined by sieve analysis to be silt loam using the United States Department of Agriculture (USDA) soil texture scheme. The more conservative values from LF-37 were selected for use in the VIP model. The soil texture parameter that controlled unsaturated flow was 5.30, the average value for silt loam (Clapp and Hornberger 1978). The total porosity in the LF-37 sample was 46.8 percent (%). The air-filled porosity was measured to be 7.9 %. The saturated hydraulic conductivity was reported by PTS to be  $1.08 \times 10^{-5}$  centimeters per second (cm/sec). The soil density was 1.31 grams per cubic centimeter ( $\text{g}/\text{cm}^3$ ).

Boring logs were used to determine the initial location of the oily waste phase. Although waste is observed throughout the landfill, the most impacted material is the white clay/sludge fill. Using boring logs, this material was placed in the model in an interval 4.3 meters to 6.1 meters (14 ft. to 20 ft.) bls. The waste was assumed to contain 10 % immobile non-aqueous phase material by 1973 (date landfill was closed). This material was assumed to have a density of  $0.8 \text{ g/cm}^3$ . The rate of decay of the non-aqueous phase material was set equal to  $1.0 \times 10^{-4} \text{ day}^{-1}$ .

#### Meteorological Data

Seasonal temperature fluctuations tend to damp out with depth. It has been documented that the temperature difference from summer to winter can be greatly diminished just 10 ft. bls (Fluker 1958). Because the biodegradation rates at depths of 14 ft. and lower were most important, it was considered adequate to run the model at a single temperature. The average temperature in Dayton, Ohio was 52.0 degrees Fahrenheit (11.1 degrees Celsius) between 1934 and 2011 (NOAA 2012). Average annual precipitation was 37.68 inches per year (in./yr) from 1919 to 2011 (NOAA 2012). According to the groundwater modeling, the recharge rate at this site is 15 in./yr. This value was initially used in the VIP model.

#### Analytical Data

Analytical data from numerous borings were considered in trying to determine the concentrations of the VOCs. To be conservative, the initial concentrations were taken from a sample collected in 2012 from boring LF-37 within the white clay/sludge material. In this sample, toluene was detected at 230,000  $\mu\text{g/kg}$ , ethylbenzene was detected at 95,000  $\mu\text{g/kg}$ , xylene was detected at 420,000  $\mu\text{g/kg}$ , and TCE was detected at 100,000  $\mu\text{g/kg}$ . These detections were J-flagged by the laboratory, indicating that the concentrations were estimated, but for the purpose of these model calculations, they were assumed to be quantitative. Benzene was not detected. It is believed to be present but masked by the high detection limits necessitated by the high concentrations of other VOCs. The detection limit of benzene was 147,000  $\mu\text{g/kg}$ . Because this was a reporting limit and not a method detection limit, the benzene concentration was estimated to be approximately one third as much, 50,000  $\mu\text{g/kg}$ . The value selected for benzene was very conservative because the highest benzene concentration detected in waste or soil at the landfill was 100  $\mu\text{g/kg}$  at LF-37 (24-26 ft. bls) in the waste and 0.67J  $\mu\text{g/kg}$  at LF-37 (28-30 ft. bls) in native soil. PCE was not detected in the sample, so it was also assigned a concentration of 50,000  $\mu\text{g/kg}$ . This arbitrary value was very conservative, because the highest PCE concentration detected in waste or soil at Landfill L1 was 840  $\mu\text{g/kg}$  at LF-37 (10-12 ft. bls) in the waste and 896  $\mu\text{g/kg}$  in LF-18 (20-22 ft. bls) in native soil. Because

biodegradation does not take place in oily waste, the concentrations of all of the constituents in the waste measured in 2012 were assumed to be similar to those in 1973, and these were used as initial conditions in the model.

#### Chemical Properties

VIP model inputs include certain properties of the chemicals themselves. These inputs include partition coefficients, degradation rates, and the diffusivity of the constituent in the air phase. Some of these values are based upon more basic parameters, such as vapor pressure, molecular weight, and aqueous solubility. The sources of these chemical values are discussed in this section.

One of the strengths of the VIP model is its ability to account for equilibrium partition of chemicals between phases. The partitioning between the non-aqueous phase and soil pore water is governed by an “oil-water partition coefficient”. For the purposes of this calculation, it was assumed that the octanol-water partition coefficient would approximate the partitioning properties of the organic phase of the waste in the white clay/sludge. Octanol water partition coefficients were taken from Hansch et al. (1995).

Air-water partition coefficients ( $K_{aw}$ ) were computed from Henry’s law as follows:

$$K_{aw} = \frac{MV(T)}{SRT}$$

In this relation,  $M$  is the molecular weight of the constituent in grams per mole,  $V(T)$  is the vapor pressure in atmospheres,  $S$  is the aqueous solubility in grams per cubic meter,  $R$  is the ideal gas constant in cubic meter-atmospheres per mole degree Kelvin, and  $T$  is temperature in degrees Kelvin. The molecular weights were obtained from Reid et al. (1987). The vapor pressures were calculated as a function of temperature using the Wagner Equation and the chemical-specific constants found in Reid et al. (1987). Use of the Wagner Equation allowed the use of more accurate vapor pressure values and thus the computation of partition coefficients that were site-specific. The aqueous solubility for the BTEX constituents were taken from Thibodeaux (1979), and the solubility of the chlorinated constituents came from Schwille (1988).

The soil water partition coefficients were computed by multiplying the organic carbon partition coefficients ( $K_{oc}$ ) by the fraction organic carbon. The fraction organic carbon

was measured by PTS. The value for the soil sample collected 16 to 18 ft. bls from LF-37 was 0.0323 grams per gram (g/g). The  $K_{oc}$  values were obtained from U.S. EPA (2007).

The air dispersion coefficients  $D_a$  were obtained from Thibodeaux (1979). The reference values in the literature  $D_{ref}$  were corrected for local temperature using the following relation:

$$D_a = D_{ref} \left( \frac{T}{T_{ref}} \right)^{1.5}$$

In the above relation,  $T_{ref}$  is the reference temperature for the literature diffusivity. The diffusivity values were then further corrected for the fact that the diffusion was taking place in a porous medium, not open air, by multiplying by the Millington and Quirk (1961) factor  $C$ :

$$C = \frac{\phi_a^{10/3}}{\phi^2}$$

In this relation,  $\phi$  is the total porosity and  $\phi_a$  is the air filled porosity. As stated above, these porosity values came from the analysis of the sample from LF-37 by PTS.

The biodegradation rates used in the model were obtained from several sources. The benzene value came from ERT (1984). The rates for toluene, ethylbenzene, and xylene came from U.S. EPA (1987). The values for PCE and TCE came from Wood, et al. (1985). The biodegradation rates were entered at one tenth their literature values in the lower zone, 1.4 meters in depth or deeper. These lower values were chosen to simulate anaerobic conditions.

#### Site History

The most important parameter from the history of this site is the year Landfill L1 closed, 1973. This parameter helps to relate the time in the model to actual time.

### Unsaturated Zone Model Results

The preliminary VIP runs indicated that the recharge rate was too high. VIP will stop running if any grid block becomes saturated. This error flag indicates that in three dimensions, vadose zone water reaches the silty zone and flows laterally around it. Field observations of perched water tables in the landfill corroborate the existence of lower flow zones in the landfill. In a one-dimensional model, the flow of the entire column is limited by that in the slowest zone. Thus, the recharge rate was reduced to 4 in./yr. Even this rate is probably higher than the actual flow under the low-permeability clay/sludge. However, the 4 in./yr was considered conservative.

Retarded advection velocities were found to be less than one in./yr. Such slow movement would restrict the motion of all of the constituents. It was found that dispersion in the vapor phase was the main mode of downward transport. This mechanism is inefficient. Wherever waste was deposited in the lower part of the unsaturated zone, VOCs will be able to reach groundwater. But the average flux will be much lower. In particular, the most impacted material, the white clay/sludge, does not interface with the saturated zone and is not close to it, except in a small part of the area of Landfill L1.

The VIP model gave the concentration in each phase in each 0.1-meter grid block for every year. In this section, the concentration in pore water is presented for the lowest grid block, 7.6 to 7.7 meters bls. This is the grid block at the interface between the unsaturated zone and the saturated zone.

Benzene concentrations increased pore water in the lowest grid block from 1973 until 1996 when the peak value was reached, 0.005  $\mu\text{g/L}$ . This concentration was less than the analytical detection limit of commercial laboratories. By the end of the simulation in 2013, only 1.3 % of the original benzene mass was remaining in the model domain. The model results may explain the lack of benzene detections in groundwater by Landfill L1.

Results for the other BTEX constituents were similar. Toluene is predicted to reach its maximum concentration at the bottom of the vadose zone in 2014 at 0.02  $\mu\text{g/L}$ . This concentration was less than the analytical detection limit of commercial laboratories. Ethylbenzene and xylene do not reach their maximum concentrations before 2021, when the model was stopped, but the future years were not simulated because more than one third of the respective mass was exhausted. Attenuation restricts the fraction of these VOCs that can reach the groundwater.

The chlorinated VOCs were different. Their biodegradation rates were very slow, enabling these constituents to survive until they would reach the groundwater. The advection rates were almost at a standstill, a fraction of an in./yr. Vapor diffusion was the main transport mechanism under the low-permeability clay/sludge. For this reason, the model predicted that it would take many years for these constituents to reach their maximum concentration in the lower vadose zone. PCE reached its maximum concentration in the simulation in the year 2203. This concentration was 197  $\mu\text{g/L}$ . PCE first reached a concentration of 5.0  $\mu\text{g/L}$  in 2013 in the model. TCE reached its maximum concentration in the model in 2233 at a concentration of 495  $\mu\text{g/L}$ . TCE first reached 5.0  $\mu\text{g/L}$  in 2003 in the model.

### Groundwater Concentrations

In interpreting the model results, it should be remembered that the VOC concentrations in pore water in the lower unsaturated zone are different from what one would see in the sandy transmissive part of the saturated zone. If one were to neglect the low permeability part of the saturated zone and assume that the VOCs in the lower vadose zone could skip into the transmissive saturated zone (a very conservative scenario), then one can compute the concentration of the VOCs in the groundwater. This conservative scenario was applied to the model results for PCE and TCE. The BTEX constituents have higher rates of degradation, and did not reach the saturated zone at significant concentrations.

The concentrations of PCE and TCE in groundwater can be obtained by comparing the vertical and horizontal flow. The volume flux of groundwater into the saturated zone can be computed by multiplying the recharge rate by the area of the landfill. If Landfill L1 has an area of 7.8 acres and a recharge rate of 4 in./yr (a very conservative assumption since there is a layer with a saturated hydraulic conductivity of  $1.08 \times 10^{-5}$  cm/sec) then the vertical volumetric flux of water is 310 cubic ft. per day ( $\text{ft.}^3/\text{day}$ ). Using Darcy's law, the horizontal volumetric flux was computed for the flow of groundwater in native sand and gravel. Using the mobile porosity of 8 %, the groundwater velocity was estimated to be 2 ft./day. The thickness of the transmissive zone is 25 ft., and the transverse width of the landfill is 600 ft. Thus the flux is 25 ft. x 600 ft. x 2 ft. = 30,000  $\text{ft.}^3/\text{day}$ . The ratio between the vertical flux (310) and the horizontal flux (30,000) is approximately 100. Thus, in this conservative scenario, the maximum concentration of PCE under the landfill will be approximately 2  $\mu\text{g/L}$  at the beginning of the 23<sup>rd</sup> century; the TCE concentration will be just under the 5  $\mu\text{g/L}$  standard 30 years later.

## Conclusions

The leaching model and the groundwater flow rates at the Site provide rationale as to why the concentrations of the VOCs are low in the monitoring wells downgradient of Landfill L1 when they are high in some of the waste or soil samples from within the landfill. Advective flow is hindered by the low-permeability clay and sludge within the landfill. Transport is limited to vapor diffusion. This method is too slow to deliver BTEX constituents before they can degrade. The chlorinated VOCs will take so long to reach the saturated zone that it will take centuries to reach 1.0 µg/L in groundwater given dilution, even if the VOCs could skip over the low-permeability layer in the upper saturated zone. Detectable VOCs in monitoring wells downgradient of the landfill are likely to originate from sources upgradient of this landfill.

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