



5 August 2026

Mr. Muhammad Mereb
RMR and Compliance Coordinator
Ohio Department of Transportation
Office of Environmental Services
1980 West Broad Street, Mail Stop 4170
Columbus, Ohio 43223

Subject: Post Closure Plan Revisions
Ohio Department of Transportation, Former District 5 Headquarters, 115½ Maholm Street,
Newark, Ohio
ODOT Agreement# 42608, Task Order# 25-05-01
WSP Project# US0052709.0388.02.02
Ohio EPA ID# OHD981782816

Dear Mr. Mereb:

WSP USA Inc. (WSP) has enclosed revised pages from the October 2017 Post Closure Plan (PCP) for regulatory review and approval. The revised pages are identified below and provided in **Attachment A**. For reference, **Attachment B** includes a copy of the 2017 PCP with notes identifying the pages proposed for revision. The modifications in Attachment A are consistent with WSP's 23 April 2026 memorandum, and the requirements identified in Mr. Bulinski's 6 July 2026 email from Ohio EPA.

PCP MONITORING PROGRAM BACKGROUND

Groundwater contaminant migration is the primary fate and transport mechanism for the Project Area, and vapor intrusion is the primary risk pathway. Figure 1 (**Attachment C**) shows the Project Area, the associated environmental monitoring wells, sub-slab, and indoor air sampling locations. Groundwater within the Project Area is not used as a potable water source; however, it may serve as a mechanism for exposure to potential chemicals of concern through vapor intrusion. Because groundwater, soil gas, sub-slab, and indoor air conditions are interrelated, the semi-annual monitoring program provides data needed to evaluate potential environmental risks across these media.

ADDITION OF AN INDOOR AIR SAMPLING LOCATION AT 99 JAMES STREET

WSP proposed adding an indoor air sampling location at 99 James Street in its 23 April 2026 memorandum on file with Ohio EPA. The proposed location is in a newly renovated front office within the 99 James Street building, which is enclosed and separated from the warehouse. With this addition, the 99 James Street sampling locations will be identified as “Warehouse” for the existing paired sub-slab and indoor air location and “Office” for the proposed indoor air location. No sub-slab point is proposed for the office. Figure 1 identifies the sampling locations within the 99 James Street building.

CLASS I PERMIT MODIFICATION FOR INDOOR AIR LOCATION

For the proposed indoor air sampling location, WSP revised PCP page 8 and Sampling Analysis Plan (SAP) page 7, which is included as Appendix B to the PCP. These pages replace the corresponding original pages. WSP also revised PCP Figure 3 to show the additional indoor air sampling location at 99 James Street. The revised pages and figure are provided in **Attachment A**.

ELIMINATION OF NON-ESSENTIAL MONITORING WELLS

Consistent with the PCP, monitoring wells DMW-1 and DMW-8 are used solely to measure groundwater levels for evaluating the potentiometric surface across the Project Area. Both wells are on the 99 James Street property and are not perimeter monitoring points used to assess the broader potentiometric surface. Removing these monitoring points is expected to have minimal effect on potentiometric surface evaluations while reducing long-term well maintenance requirements.

CLASS II PERMIT MODIFICATION FOR MONITORING WELL ABANDONMENT

To support elimination of monitoring wells DMW-1 and DMW-8, WSP revised PCP page 14 to replace the corresponding original page. Table 1 was updated to remove DMW-1 and DMW-8, and PCP Figure 3 was revised to identify both wells as abandoned.

A new page will also be added to Appendix A of the Sampling Analysis Plan (SAP) to describe monitoring well sealing procedures. Appendix A contains the Field Standard Operating Procedures (FSOPs) applicable to the PCP. The added page will be used as a substitute for Section 200 – Groundwater, FSOP #204 (Monitoring Well Abandonment), which was not included in the original PCP on file with Ohio EPA. This insertion will be placed at the end of Section 200 – Groundwater. The revised pages, table, and figure are provided in **Attachment A**.

CLOSING

After Ohio EPA approves the Class II PCP modifications, WSP will schedule abandonment of monitoring wells DMW-1 and DMW-8. WSP anticipates completing the abandonment activities in mid-2027. The abandonment procedures will be described in a work plan submitted for regulatory

review and approval, and well sealing logs will be completed and filed in accordance with applicable regulations.

The additional indoor air sampling location will be implemented as a Class I modification during the 2026 Fall Sampling Event, and the results will be reported to Ohio EPA in accordance with the PCP.

Please contact us at (937) 859-3600 with any questions or comments.

Sincerely,

WSP USA Inc.

A handwritten signature in blue ink, appearing to read "Richard J Cherico".

Richard J Cherico
Senior Environmental Specialist

A handwritten signature in blue ink, appearing to read "D. Robert Ireson".

D. Robert Ireson
Assistant Vice President

Attachments.

ATTACHMENTS

ATTACHMENTS

ATTACHMENT A **PCP/SAP REVISIONS**

REVISED TABLE 1

REVISED FIGURE 3

PCP REVISED PAGES 8 & 14

SAP REVISED PAGE 7

SAP APPENDIX A INSERTION PAGE
(MONITORING WELL ABANDONMENT PROCEDURES)

Table 1 (Revised March 2023)
Post Closure Ground Water Monitoring Network
Former ODOT District 5 Headquarters
Newark, Ohio

Identification	Status	Well Diameter (inches)	Water Level	GW Sampling	Sampling Schedule	Monitoring Purpose
DMW-1	Existing	2	X		Semiannual	Downgradient of (Unit C) Water Level Only
DMW-4	Existing	2	X		Semiannual	Downgradient of (Unit C) Water Level Only
DMW-8	Existing	2	X		Semiannual	Downgradient of (Unit C) Water Level Only
MW-3R	Existing	2	X		Semiannual	Upgradient of (Unit C) Water Level Only
MW-21W	Existing	2	X		Semiannual	Downgradient of (Unit C) Water Level Only
MW-25	Existing	2	X		Semiannual	Downgradient of (Unit C) Water Level Only
MW-4R	Existing	2	X	X	Semiannual	POC Well Sidegradient of (Unit C)
MW-21E	Existing	2	X	X	Semiannual	POC Well Downgradient of (Unit C)
MW-24	Existing	2	X	X	Semiannual	POC Well Downgradient of (Unit C)
MW-6R	Existing	2	X	X	Semiannual	Containment Monitoring Well
MW-7R	Existing	2	X	X	Semiannual	Containment Monitoring Well
MW-9	Existing	4	X	X	Semiannual	Containment Monitoring Well
MW-10R	Existing	2	X	X	Semiannual	Containment Monitoring Well
MW-14	Existing	2	X	X	Semiannual	Containment Monitoring Well
MW-15	Existing	2	X	X	Semiannual	Containment Monitoring Well
MW-16	Existing	2	X	X	Semiannual	Containment Monitoring Well
MW-20	Existing	2	X	X	Semiannual	Containment Monitoring Well
MW-26	Existing	2	X	X	Semiannual	Containment Monitoring Well
DMW-3	Existing	2	X	X	Semiannual	Effectiveness Monitoring Well
DMW-5	Existing	2	X	X	Semiannual	Effectiveness Monitoring Well
DMW-7	Existing	2	X	X	Annual	Effectiveness Monitoring Well
DMW-9	Existing	2	X	X	Annual	Effectiveness Monitoring Well
MW-2	Existing	2	X	X	Semiannual	Effectiveness Monitoring Well
MW-8	Existing	4	X	X	Annual	Effectiveness Monitoring Well
MW-12	Existing	4	X	X	Semiannual	Effectiveness Monitoring Well
MW-17	Existing	2	X	X	Semiannual	Effectiveness Monitoring Well
MW-19	Existing	2	X	X	Semiannual	Effectiveness Monitoring Well
MW-21	Existing	2	X	X	Semiannual	Effectiveness Monitoring Well
MW-22	Existing	2	X	X	Annual	Effectiveness Monitoring Well
MW-23R	Existing	2	X	X	Semiannual	Effectiveness Monitoring Well
TMW-AR	Existing	2	X	X	Semiannual	Effectiveness Monitoring Well

Notes:

POC = Point of Compliance

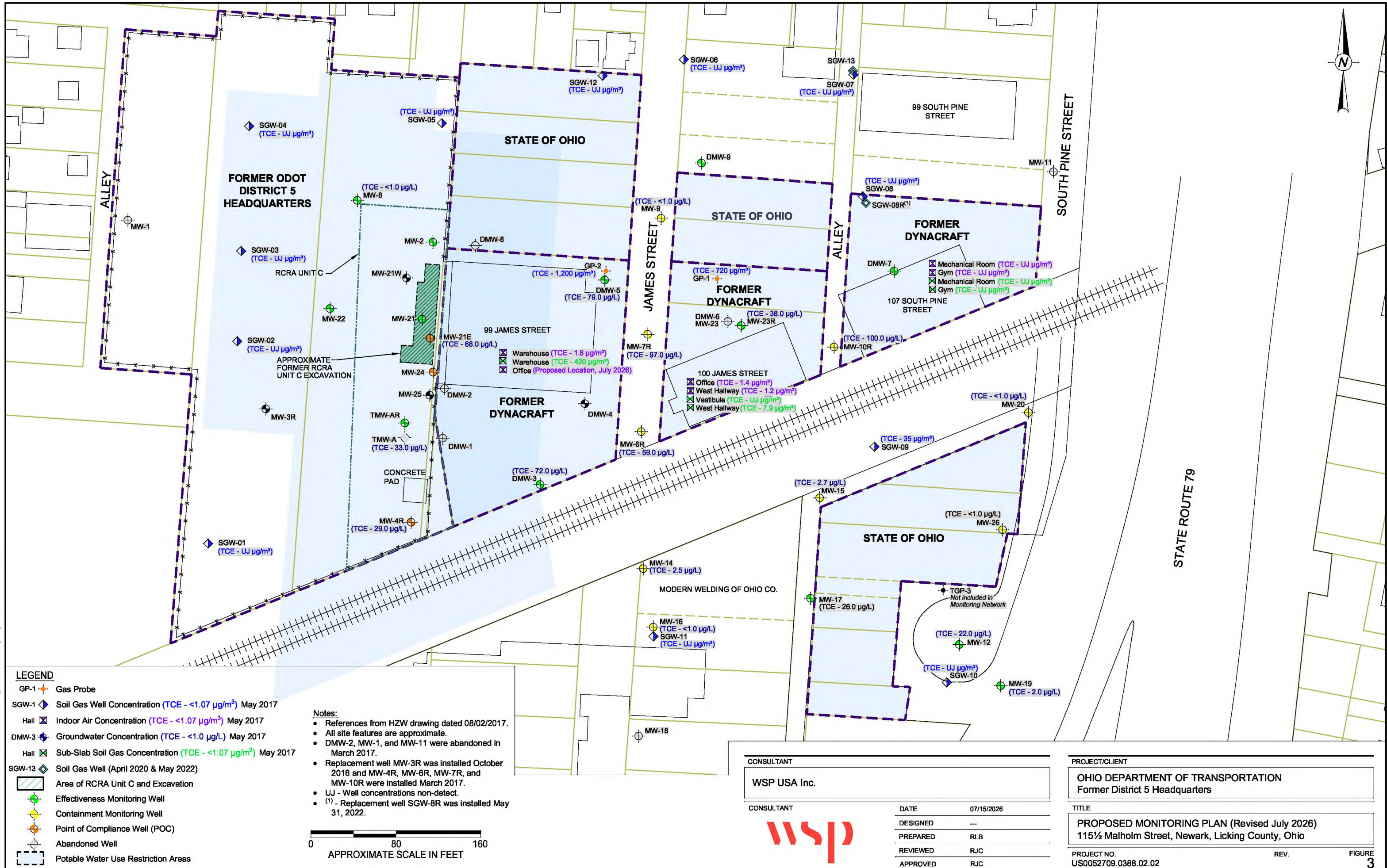
Monitoring Wells DMW-2, MW-1, and MW-11 were abandon in 2017.

Replacement Well MW-3R was installed in October 2016.

Replacement Wells MW-4R, MW-6R and MW-7R, and MW-10R installed in March 2017.

Replacement Well TMW-AR installed after Spring 2023 Semiannual Monitoring Event.

P:\DDOT\State-wide RMR Sites\Former District 5 HQs\Drawings\Dist 5 2025.dwg - Fig3 Mont Plan - Jul. 15, 2026



the indoor air within 99 James Street appear attributable to operations within that building including automobile and small engine repair and maintenance and do not appear associated with the Site. This is most noted in the disparity between soil gas and sub-slab benzene concentrations in and around 99 James Street and indoor air samples obtained from 99 James Street. In 2025, the 99 James Street property changed ownership, underwent renovations, and in 2026 now operates as light commercial/industrial activities with pallet racking and door distribution.

2.3 Soil Gas, Sub-Slab and Indoor Air Monitoring

To evaluate the ongoing risk associated with vapor intrusion, a soil gas, sub-slab and indoor air monitoring program has been established for the Site. A depiction of the monitoring sample locations is provided on **Figure 3**.

2.3.1 Soil Gas, Sub-Slab and Indoor Air Monitoring Locations

The various soil gas, sub-slab and indoor air monitoring locations are provided below. Each location will be sampled on a semi-annual basis.

Soil Gas Well Locations

The soil gas well network that will be sampled as part of the Post-Closure Plan activities is comprised of the fifteen (15) soil gas wells listed. **Figure 3** presents the locations of the soil gas wells in the Project Area.

SGW-01	SGW-02	SGW-03	SGW-04	SGW-05
SGW-06	SGW-07	SGW-08	SGW-09	SGW-10
SGW-11	SGW-12	SGW-13	GP-1	GP-2

Sub-Slab and Indoor Air Sampling Locations

- 99 James Street (Sub-Slab Soil Gas [99 James Street] and Indoor Air [99 James Street Warehouse and Office])
- 100 James Street (Sub-Slab Soil Gas [100 James Street Vestibule and West Hallway] and

Indoor Air [100 James Street Office and West Hallway]); and

2.4 Groundwater Monitoring

The Post-Closure Plan provides compliance and corrective action groundwater monitoring pursuant with applicable portions of 3745-54-90 through 3745-54-100. During closure, it was discerned that COC exceed GWPS at the POC. Since groundwater has been impacted by COC as well as the recalcitrant nature of the COC, detection monitoring during the Post-Closure Plan period is not anticipated. Therefore, the existing groundwater monitoring program is to be maintained.

Proposed containment standards or maximum GWPS will be used to demonstrate the extent of the groundwater plume. In addition, in order to continue to monitor the effectiveness of corrective action performed as a part of the facility closure during the post-closure period, groundwater effectiveness standards or “trigger” levels within the groundwater plume have been prepared. Again, the groundwater monitoring program is risk-based and is predicated on the fact that impacted groundwater is not used as drinking water within the plume or Project Area; consequently, it is protective of human health and environment.

2.3.1 Groundwater Monitoring Locations

Continued sampling of the existing groundwater monitoring network will be conducted as part of this Post-Closure Plan. The monitoring will occur on a semi-annual basis in conjunction with the soil gas, sub-slab soil gas, and indoor air monitoring. Specific groundwater sampling procedures, DQO methodologies and analyses for the various media are provided in the SAP included as **Appendix B** to this Post-Closure Plan. The specific wells to be part of the Post-Closure Plan monitoring are identified below. In addition, ~~six (6)~~ **four (4)** wells not listed below will also be utilized to collect static groundwater levels. **Table 1** provides a summary of the purpose for each monitoring well and the sampling schedule. A depiction of the monitoring well locations is provided on **Figure 3**.

- DMW-3
- DMW-5
- DMW-7
- DMW-9
- MW-2
- MW-4R
- MW-6R

well SGW-13, a soil gas sample from location SGW-07/SGW-13 will not be collected during that scheduled sampling event and notice will be made to the Ohio EPA. Notice to the Ohio EPA will be provided by phone or by email immediately after two unsuccessful attempts to sample any of the established soil gas wells due to high water levels.

2. If groundwater is encountered in any other soil gas well during purging, the purging process will cease and attempts to dewater the soil gas tubing using a peristaltic pump or equivalent technique will be performed for approximately 30 minutes.
 - a. A second attempt to sample the soil gas well will be made the following day. If groundwater precludes soil gas collection from a well on day two, a soil gas sample will not be collected during that scheduled sampling event and notice will be made to the Ohio EPA. Notice to the Ohio EPA will be provided by phone or by email immediately after two unsuccessful attempts to sample any of the established soil gas wells due to high water levels.
3. If the presence of groundwater precludes soil gas sampling from any soil gas well for consecutive sampling periods (i.e. back-to-back semi-annual events), the soil gas monitoring network will be re-evaluated to protect the receptors in that area.

The COCs in which soil gas (air) samples from the soil gas wells will be analyzed are the VOCs listed above in **Section 3.0, Proposed Sampling Approach**, and are identical to the VOCs being analyzed for groundwater samples. Analytical laboratory analysis for the COCs in soil gas (air) samples will be performed in accordance with U.S. EPA Methods TO-15 or 8260.

3.3 Sub-Slab Soil Gas and Indoor Air

Sub-slab soil gas and indoor air samples will be collected within the buildings located at 99 James Street, 100 James Street and 107 South Pine Street as part of Post-Closure Plan activities. In addition, one (1) ambient (exterior) air sample will be collected in conjunction with indoor air sampling. **Figure 3** presents the locations of 99 James Street, 100 James Street and 107 South Pine Street. Methodologies to perform sub-slab soil gas and indoor air sampling are presented in **Section 4.0, Field Methodologies and Procedures**. Information concerning the sub-slab soil gas and indoor air sample locations within the buildings at 99 James Street, 100 James Street and 107 South Pine Street is presented in the following table.

Location Address	Use of Location	Building Construction	Sub-Slab Soil Gas Sample Location(s)	Indoor Air Sample Location(s)
99 James Street	Commercial (Property Maintenance Contractor)	Slab, On-Grade	1) In Middle of Warehouse Along south wall of large	Large room 1) Warehouse and 2) Office
100 James Street	Commercial (Day Habilitation Services)	Slab, On-Grade	1) Northwest corner of vestibule and 2) West Hallway	1) East side office and 2) West Hallway
107 South Pine Street	Commercial (Day Habilitation Services)	Slab, On-Grade	1) Northwest corner of mechanical room and 2) Along north wall of gym	1) Mechanical room and 2) Gym

Monitoring Well Abandonment Procedures

**Replacement for SOP #204
(Not Included in EPA copy)**

Revised: July 2026

ATTACHMENTS

ATTACHMENT B

**2017 POST CLOSURE PLAN
(REVISED 2023)**

POST-CLOSURE PLAN

**FORMER OHIO DEPARTMENT OF TRANSPORTATION
DISTRICT 5 HEADQUARTERS FACILITY UNIT C
115 1/2 MAHOLM STREET
NEWARK, LICKING COUNTY, OHIO**

OCTOBER 2017

Prepared for:

Ohio Department of Transportation
Office of Environmental Services
1980 West Broad Street, Mail Stop #4170
Columbus, Ohio 43223

Prepared by:



HZW Environmental
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H17023-22

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DMW\KMR:dmw\kmr

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1.0 INTRODUCTION

On behalf of the Ohio Department of Transportation (ODOT) Office of Environmental Services, HZW Environmental Consultants, LLC (HZW) has prepared this Resource Conservation and Recovery Act (RCRA) Post-Closure Plan for the former test lab storage area (Unit C) of the ODOT District 5 Former Headquarters Facility located at 115½ Maholm Street in the City of Newark, Licking County, Ohio (herein referred to as the “Property” or the “Site”). The Site is listed as Ohio Environmental Protection Agency (EPA) Identification Number OHD981782816 and is owned and maintained by ODOT. **Figure 1** presents a Site Location Map.

Closure activities were completed at the Site in accordance with the Amended RCRA Closure Plan, Revision 6, prepared by Hull and dated April 2017 (hereinafter the Closure Plan). The objective of this Post-Closure Plan is to ensure continued protection of human health and the environment, since subsequent to closure the Property did not meet clean closure standards. This Post-Closure Plan is designed to meet the closure performance standards of Ohio Administrative Code (OAC) rules 3745-55-11 and 3745-66-11 and establishes the proposed groundwater, soil gas, sub-slab soil gas and indoor air monitoring programs for the Property in accordance with the technical components under rules 3745-55-18(B) of the OAC and the Ohio Environmental Protection Agency (EPA) Closure Plan Review Guidance dated October 2009.

The following subsections provide a general description of the Property and surrounding area. Specific details concerning the Property are contained in the Closure Plan (Hull, 2017).

1.1 Facility Representative

The contact information for the facility representative is as follows:

Mr. Timothy M. Hill, Administrator
Ohio Department of Transportation
1980 West Broad Street
Columbus, Ohio 43223
(614) 644-0377

1.2 Description of Facility

ODOT utilized the Property since the 1940s as the District 5 Headquarters before closing the facility in 1987. The Property was comprised of administrative offices, equipment storage, vehicle maintenance operations, testing facilities, and other areas in support of road construction and maintenance. The Property is irregular in shape and comprises approximately five (5) acres in size. Currently, the Property is a vacant grass lot. The buildings on the Property have been demolished since the facility closing in 1987, which included the main office building and garage, the traffic building, the test laboratory and several small storage buildings.

The Property is located within an area of mixed land use with commercial properties on the west, south and east, and vacant and occupied residential properties to the north, east, south and west. A property formerly owned by Dynacraft, Inc. (Dynacraft) is located directly east of the Property. West of the Property is a bulk petroleum storage facility and residential properties. The Property is bordered to the south by a railroad right-of-way owned by CSX Transportation, Inc. Systems with an industrial property occupied by the Modern Welding Company further south.

Several groundwater monitoring wells and permanent soil gas wells are located on these commercial (99 James Street, 100 James Street and 107 South Pine Street) and former residential properties as well as public rights-of-way located adjacent to and within the vicinity of the Property. Collectively, the Property, the commercial and residential properties and public rights-of-way in which groundwater monitoring wells and permanent soil gas wells are located are considered the “Project Area” for discussion purposes. Although the overall regional area is one of mixed use, the vast majority of the current Project Area is commercial/industrial (refer to **Figure 2**). **Figure 3** presents the proposed post-closure monitoring network in the Project Area.

ODOT and the Ohio EPA have developed and executed an Environmental Covenant pursuant to Ohio Revised Code Sections 5301.80 to 5301.92, which restricts the parcels of land owned by ODOT (inclusive of the Property) from being utilized for residential, commercial or industrial uses. In addition, several other activity use restrictions have been applied to the Property and other parcels of land owned by ODOT. The restrictions include not building an occupied structure to prevent

indoor air pathway completion; the prohibition of groundwater extraction and use with the exception of investigation, assessment, and remediation; the limitation of excavation activities occurring at depths greater than 18 inches below ground surface (bgs); and the limitation on the transfer of subsurface soils from the Site. A copy of the Environmental Covenant as recorded on the deed at the Licking County Recorder's Office is presented in **Appendix A**.

1.3 Description of Unit C

In 1986, an Ohio Environmental Protection Agency (EPA) Consent Order was signed by ODOT that required ODOT to submit a closure plan for five (5) hazardous waste storage units on the Property. Four (4) units have been approved for closure by the Ohio EPA: a waste storage area (Unit A), a traffic paint storage area (Unit B), a paint shop (Unit D), and a used motor oil storage area (Unit E). The remaining unit, Unit C, is currently undergoing closure.

Unit C is comprised of the former test laboratory building, the laboratory waste accumulation area building, and areas outside of the western walls of both buildings. Drummed test lab residues were accumulated at Unit C for 40 years, from 1947 to 1987. At the time of closure, the majority of the outside storage areas were paved with concrete or worn asphalt. The wastes associated with asphalt testing included 1,1,1-trichloroethane (1,1,1-TCA) and trichloroethene (TCE). The waste was classified as an F002 hazardous waste. A maximum inventory of approximately six (6) 55-gallon drums of waste was reportedly stored in the area. All drums were removed in 1987 when the facility closed.

In 1994, approximately 20,000 cubic yards of soil were removed from Unit C. Subsequent groundwater sampling identified concentrations of TCE and 1,1,1-TCA in groundwater. As a result, a groundwater extraction and treatment system was installed in 1996 to remediate groundwater. However, the groundwater extraction and treatment system proved to be ineffective, and in-situ groundwater remediation (persulfate injection) was conducted in September and October 2010 in an effort to reduce TCE concentrations.

1.4 Regional Geology and Hydrogeology

The Project Area is situated with the Appalachian Glaciated Plateau Province. Unconsolidated deposits in the area are associated with a buried valley system that has been filled with glacial outwash deposits up to 300 feet deep. These deposits consist mostly of moraine deposits composed of sand, gravel, gravel interbedded with sand lenses, and clay interbedded with discontinuous lenses of sand and gravel associated. Underlying these unconsolidated deposits is Mississippian-age shale, sandstone and limestone bedrock of the Waverly Formation. The Waverly Formation is approximately 700 feet thick and is underlain by the Ohio Shale (Sharp and Associates, Inc., 1996).

The principle water-bearing zone in the Newark area is the thick valley-fill glacial deposits of sand and gravel. Groundwater production from wells drilled into the sand and gravel deposits can yield more than 500 gallons of groundwater per minute. Typically, the commercially-developed wells are installed to depths between 150 to 260 feet. Within the groundwater aquifer, the closer to the recharge influence of the Licking River, the greater the potential groundwater yield. Well log records from the Ohio Department of Natural Resources (ODNR) indicate that several groundwater wells are installed for potable use throughout the Newark area; however, none of the wells are in close proximity to the Property (Kolmer, 1998).

1.5 Site-Specific Geology and Hydrogeology

Based on a review of soil boring logs from previous assessments and geotechnical borings from the expansion of State Route 79 (located approximately 650 feet east of the Property), the Project Area is situated on approximately five (5) to ten (10) feet of unconsolidated fill material underlain by approximately 20 feet of unconsolidated silty sand and fine sand with little to some gravel. A silty clay unit forms the aquitard unit beneath the sand and gravel deposits, separating it from coarser glacial outwash sands and gravels. It appears that the high clay content, stiff consistency and relative uniform thickness across the Project Area allows the clay layer to function as a confining unit for the upper saturated unit. Groundwater in the uppermost saturated unit was

encountered during assessment activities at approximately 15 bgs. Borings were completed to a maximum terminal depth of 30 feet bgs without encountering bedrock.

As indicated, the uppermost saturated unit is composed of unconsolidated silty to fine sand with varying percentages of gravel that underlies surficial fill material to a depth of approximately 25 to 30 feet. This saturated unit is fairly consistent across the Project Area. The potentiometric surface for the Project Area indicates groundwater flow in this unit is approximately east/southeast toward the State Route 79 right-of-way. Chemical analyses indicate that the groundwater in this saturated unit contains relatively high concentrations of iron and other dissolved solids relative to secondary drinking water standards.

Two aquifer pumping tests were conducted as part of previous assessments at monitoring wells MW-4 and MW-6 to determine the sustained flow for the purposes of initial design of the remedial groundwater treatment system. Groundwater from monitoring well MW-4 sustained a maximum flow rate of 3.5 gallons of groundwater per minute and monitoring well MW-6 sustained a maximum flow rate of 19.5 gallons of groundwater per minute. Hydraulic conductivity values were indicated to be approximately 10^{-3} to 10^{-2} centimeters per second (Sharp, 1996).

Given the available hydraulic conductivities, saturated thickness, and groundwater flow gradient for the upper saturated unit, Sharp calculated a groundwater flow velocity under non-pumping conditions to be between four (4) and five (5) feet per day across the Project Area. Under the optimum pumping conditions of the treatment unit, the groundwater flow velocity was calculated to increase to an average of eight (8) feet per day.

2.0 MONITORING PROGRAMS

The proposed monitoring program associated with this Post-Closure Plan consists of groundwater, soil gas, sub-slab soil gas, and indoor air sampling and analysis. Specific sampling procedures, data quality objectives (or DQOs), methodologies and analyses for the various media are provided in HZW's Sampling and Analysis Plan (or SAP) included as **Appendix B** to this Post-Closure

Plan. Well construction details for the soil gas and groundwater monitoring wells are included in **Appendix C**.

The Property has been in ongoing corrective action groundwater monitoring since groundwater protection standards (GWPS) pursuant to rule 3745-54-92 of the OAC have been exceeded at the point of compliance (POC) and beyond. The corrective action monitoring has included sampling soil gas, sub-slab soil gas and indoor air due to the potential risk of the chemicals or constituents of concern (COC). The GWPS exceedances have necessitated remedial activities that have included source removal, pump and treat and chemical injection to accelerate COC degradation. As a result of the Property's ongoing corrective action status, a series of Site-specific demonstrations were prepared by HZW on behalf of ODOT in a letter report dated January 29, 2016 entitled "*Proposed Demonstrations in Support of the Unit C Closure/Post-Closure Plans for the Former ODOT District 5 Headquarters at 115 ½ Maholm Street, Newark, Licking County, Ohio*" and supplied to the Ohio EPA.

The demonstrations were designed to set up a monitoring program and risk-based evaluation for the Property as the primary components of the Post-Closure Plan. The monitoring program was designed to be protective of human health and the environment in accordance with rules 3745-55-11 of the OAC. Upon Ohio EPA's review of the letter report, a comment letter was issued by the Ohio EPA dated March 16, 2016.

On May 5, 2016, representatives from ODOT, HZW and Hull met with Ohio EPA personnel to discuss the proposed post-closure monitoring demonstrations. At the conclusion of the meeting, it was generally agreed upon that the monitoring and demonstrations were acceptable to comply with OAC rules 3745-54-75 and 54-90 through 54-100. Moreover, it was concurred that although COC concentrations are stabilizing or degrading, the Property would remain in compliance/corrective action monitoring for some time since residual COC concentrations are unlikely to fall below GWPS for detection monitoring during the post-closure period.

2.1 Components of the Monitoring Program

Groundwater contaminant migration is the primary fate and transport mechanism, and vapor intrusion is the primary risk pathway at the Site. Although groundwater is not used in the Project Area, it serves as the mechanism for COC exposure (i.e., vapor intrusion) in the Project Area. The existing network of wells suggests that the COC concentrations are generally stabilizing and/or degrading and are protective of human health and the environment under the Site-specific exposure scenario. Currently, the appropriate monitoring responses are occurring and additional active remediation would provide no further COC concentration reduction or risk benefit. From a Property risk perspective, these media monitoring programs are highly interrelated (i.e., groundwater, soil gas, sub-slab, indoor air, etc.). The following sections present the COC to be monitored and discuss the details of the various media monitoring programs.

2.2 Property COC

Volatile organic compounds (VOCs) are the primary contaminant at the Property and in the Project Area. The specific Property VOCs are consistent to all monitoring programs detailed in this Post-Closure Plan and are listed below.

- 1,1,1-TCA;
- 1,1-dichloroethane (1,1-DCA);
- 1,2-dichloroethane (1,2-DCA);
- carbon tetrachloride;
- cis-1,2-dichloroethene (cis-1,2-DCE);
- methylene chloride;
- tetrachloroethene (PCE);
- trans-1,2-dichloroethene (trans-1,2-DCE);
- TCE;
- 1,1-dichloroethene (1,1-DCE);
- chlorobenzene;
- vinyl chloride;
- benzene; and
- toluene.

Although benzene and toluene remain COC, please note that as documented in quarterly sampling events since 2013, the presence of the petroleum hydrocarbons, specifically benzene and toluene, in

the indoor air within 99 James Street appear attributable to operations within that building including automobile and small engine repair and maintenance and do not appear associated with the Site. This is most noted in the disparity between soil gas and sub-slab benzene concentrations in and around 99 James Street and indoor air samples obtained from 99 James Street.

2.3 Soil Gas, Sub-Slab and Indoor Air Monitoring

To evaluate the ongoing risk associated with vapor intrusion, a soil gas, sub-slab and indoor air monitoring program has been established for the Site. A depiction of the monitoring sample locations is provided on **Figure 3**.

2.3.1 Soil Gas, Sub-Slab and Indoor Air Monitoring Locations

The various soil gas, sub-slab and indoor air monitoring locations are provided below. Each location will be sampled on a semi-annual basis.

Soil Gas Well Locations

The soil gas well network that will be sampled as part of the Post-Closure Plan activities is comprised of the fifteen (15) soil gas wells listed. **Figure 3** presents the locations of the soil gas wells in the Project Area.

SGW-01	SGW-02	SGW-03	SGW-04	SGW-05
SGW-06	SGW-07	SGW-08	SGW-09	SGW-10
SGW-11	SGW-12	SGW-13	GP-1	GP-2

Sub-Slab and Indoor Air Sampling Locations

- 99 James Street (Sub-Slab Soil Gas [99 James Street] and Indoor Air [99 James Street])
- 100 James Street (Sub-Slab Soil Gas [100 James Street Vestibule and West Hallway] and Indoor Air [100 James Street Office and West Hallway]); and

- 107 S. Pine Street (Sub-Slab Soil Gas [107 South Pine Street Mechanical Room and Gym] and Indoor Air [107 South Pine Street Mechanical Room and Gym]).

As noted above, specific sampling procedures, DQO methodologies and analyses for the various media are provided in the SAP included as **Appendix B** of this Post-Closure Plan.

2.3.2 Soil Gas, Sub-Slab Soil Gas and Indoor Air Trigger or Containment Levels

Compliance monitoring and corrective action monitoring for soil gas, sub-slab, and indoor air will provide both containment and effectiveness aspects pursuant to OAC 3745-54-99 and 100. Containment monitoring will consist of select “trigger or containment levels” such that additional corrective action or response may be necessary. The ongoing monitoring is also designed to monitor the appropriate effectiveness of previous corrective actions. The soil gas, sub-slab and indoor air sample identifications are provided in Section 2.3.1 above and are depicted on **Figure 3**.

In order to establish a monitoring program that more adequately reflects the compliance, corrective action, and Post-Closure Plan process and provides a means to further assess and evaluate data on a Site-wide basis as well outline specific steps of any additional remedial action (if necessary), the U.S. EPA’s Vapor Intrusion Screening Level (VISL) Calculator will be used. This approach is in line with U.S. EPA’s Office of Solid Waste and Emergency Response, Technical Guide: *“Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air”* dated June 2015 (OSWER Publication 9200.2-154). The U.S. EPA prefers this frontline screening methodology. Moreover, per the Ohio EPA’s website on August 26, 2015, the RCRA program is recommending the VISL Calculator approach in screening risk for vapor intrusion. Therefore, statistical manipulation of soil gas, sub-slab and indoor air data to generate containment values, etc. is not proposed.

The VISL Calculator is a spreadsheet tool that (1) lists chemicals considered to be volatile and known to pose a potential cancer risk or non-cancer hazard through the inhalation pathway; (2) provides generally recommended screening-level concentrations for groundwater, soil gas (exterior to buildings and sub-slab) and indoor air for default target risk levels and exposure scenarios; and

(3) allows calculation of site-specific screening levels based on user-defined target risk levels and exposure scenarios.

The VISLs are calculated using the recommended approaches in existing guidance and are based on current understanding of the vapor intrusion pathway. Target indoor air concentrations are calculated according to the guidance provided in Risk Assessment Guidance for Superfund (RAGS) Part F (EPA 2009), which does not support the route-to-route extrapolations that were used in the now outdated screening tables in the EPA's November 2002 draft vapor intrusion guidance (EPA 2002). The screening levels for groundwater and soil gas (either sub-slab gas or soil gas collected exterior to buildings) are calculated from the target indoor air concentrations using empirically-based conservative "generic" attenuation factors that reflect generally reasonable worst-case conditions as described in the U.S. EPA's vapor intrusion guidance (EPA 2015).

The default generic VISLs are based on default exposure parameters and factors that represent Reasonable Maximum Exposure (RME) conditions for long-term/chronic exposures. Site-specific criteria that can be input to the calculator include exposure scenario (either residential or commercial), target risk for carcinogens, target hazard quotient for non-carcinogens and average in situ groundwater temperature. The VISL Calculator incorporates the latest toxicity values in the Regional Screening Levels (RSL) tables (EPA, "Regional Screening Levels") and is updated as new versions of the RSL tables are released.

The VISL Calculator was used to calculate soil gas, sub-slab and indoor air containment or "trigger level" concentrations for both residential and commercial/industrial land use for the Site-specific COC. The RSLs utilized included a Hazard Quotient 1.0 (HQ=1) and a cancer risk of 1.0×10^{-5} . Calculator input parameters were model defaults and/or standard defaults to the Ohio EPA's "Sample Collection and Evaluation of Vapor Intrusion to Indoor Air", dated May 2010 for residential and commercial/industrial land use. The only specific change made to the standard calculator defaults was the soil and groundwater temperature of 11 degrees Celsius per Ohio EPA guidance.

Appendix D presents the VISL Calculator results as well as a summary table of the proposed trigger level or containment soil gas, sub-slab and indoor air concentrations for both residential and non-residential (commercial/industrial) land use for all Site COC identified in Section 2.2 above. *Please note that the VISL calculator also provides a groundwater contaminant concentration above which a potential vapor intrusion risk may exist. Further discussion regarding VISL groundwater “trigger levels” is provided in Section 2.4.3 below.*

TCE is the primary Site risk driver at this time. As presented in **Appendix D**, the calculated TCE residential land use trigger level for soil gas (or sub-slab) is 70 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$), and the TCE trigger level under a commercial/industrial land use scenario is $290 \mu\text{g}/\text{m}^3$. The indoor air trigger level for TCE under a residential scenario is $2.1 \mu\text{g}/\text{m}^3$ and is $8.8 \mu\text{g}/\text{m}^3$ for a commercial/industrial land use scenario.

The Project Area (i.e., the properties owned by ODOT as well as the properties located at 99 James Street, 100 James Street and 107 South Pine Street) are considered commercial/industrial properties and, thus, the appropriate trigger levels for indoor air and sub-slab soil gas are those for a commercial/industrial land use scenario. The commercial/industrial land use scenario for these properties was recently verified through the site managers/occupants. The verification included specific details regarding receptor frequency and duration (refer to **Appendix E**). The environmental setting and trigger levels will be reviewed periodically to evaluate whether any changes have occurred in factors such as land use, receptors, exposure parameters or toxicity values.

2.3.3 Multiple COC Exposures in Soil Gas, Sub-Slab Soil Gas and Indoor Air

According to the proposed plan herein, the exceedance of the calculated levels in **Appendix D** will serve as a “trigger” for additional response (e.g., further corrective action or remedial action). To evaluate the potential exposure to multiple chemicals within the indoor air samples, a multiple chemical adjustment (MCA) will be performed for both carcinogenic and non-carcinogenic compounds in soil gas, sub-slab gas, and indoor air. The MCA will be the sum of the maximum detected COC concentration divided by the constituent target level (i.e., $\text{conc}_x/\text{target level}_x$ +

conc./target level,...). A resultant summation less than or equal to 1.0 for both carcinogenic and non-carcinogenic effects will indicate an acceptable risk level. In accordance with the U.S. EPA RAGS (Part A) protocol, one (1) significant figure will be utilized in the MCA.

Please note that only an exceedance of an indoor air MCA would result in further corrective or response action (see **Section 2.3.4**). Exceedance of a MCA for soil gas and/or sub-slab soil gas does not necessarily indicate a receptor is placed in an unacceptable risk level. The monitoring for soil gas and sub-slab soil gas are only used as indicators to suggest that further evaluation of the pathway and subsequent exposure are necessary. For instance, 99 James and 100 James Street reveal nearby soil gas (i.e., GP-1 and GP-2) and sub-slab soil gas concentrations exceeding COC MCA levels; however, indoor air sampling results quantify acceptable risk levels for the site receptors.

2.3.4 Soil Gas, Sub-Slab and Indoor Air Trigger Level Exceedance Response

If the trigger/containment level for a particular indoor air, soil gas, or sub-slab soil gas sample is exceeded (or the MCA at a particular sample location is exceeded), the proposed response actions as part of this Post-Closure Plan may include, but will not be limited to, the following:

- Notifying the Ohio EPA by telephone (1-800-282-9378 in Ohio or 1-800-224-0946 outside Ohio) when an **indoor air analytical result exceeds a trigger level**. Currently, the applicable trigger level for the properties located at 99 James Street, 100 James Street and 107 South Pine Street is 8.8 µg/m³ as calculated by VISL. Each of these properties is considered commercial/industrial land use and land use was recently verified.
- Re-sampling of the indoor air location within five (5) business days of receiving the final laboratory analytical result and initial evaluation of the data. For TCE, re-sampling of the indoor air location will occur when a TCE concentration has been detected at 75 percent of its trigger level (6.6 µg/m³). Given that TCE is the primary risk driver, response action levels and times will correspond to the Ohio EPA's August 2016 Guidance Document entitled *Recommendations Regarding Response Action Levels and Timeframes for Common Contaminants of Concern at Vapor Intrusion Sites in Ohio*.
- Potential re-sampling of soil gas and sub-slab soil gas locations if data suggest trigger levels are exceeded and indoor air sampling is not currently being conducted or adequately evaluating potential risk.

- Potential installation of additional soil gas wells, as necessary, if soil gas or a sub-slab gas trigger level exceedance is confirmed and no appropriate indoor air sampling is being conducted.
- Implementation of a mitigation technique such as HVAC control, installation of a sub-slab vapor depressurization system, installation of a vapor barrier system, etc. if an exceedance of an indoor air trigger level is confirmed.
- Written notification to the appropriate property owner if an indoor air trigger level is confirmed.

As mentioned in Section 2.3.2, the trigger levels for sub-slab soil gas and indoor air samples collected in the Project Area are considered to meet the exposure assumptions for a commercial/industrial land use scenario. The trigger levels for soil gas samples will be applied based on the proximity of the data to the applicable adjacent land use. Residential land use appears focused to the north and west of the Site while commercial/industrial land use appears focused to the south and east of the Site (see **Figure 2** and **Figure 3**). All appropriate response actions will be completed in coordination with the Ohio EPA.

A review of more recent indoor air, soil gas, sub-slab, and groundwater data reveals that appropriate monitoring is occurring based on the distribution of COC and the ongoing monitoring data. The indoor air, soil gas and sub-slab sampling data appear to demonstrate a stabilized/degrading source and based on the quantity of data from circa 2013 through 2016 account for spatial and seasonal distribution. Currently, where existing soil gas concentrations exceed trigger levels (i.e., GP-1 and GP-2), an appropriate sub-slab and indoor air sampling regime is established (i.e., 99 James Street, 100 James Street, and 107 Pine Street).

Similarly, where existing COC groundwater concentrations exceed the proposed groundwater trigger levels, a network of soil gas wells is present to monitor the risk for potential vapor intrusion. **Figure 3** depicts recent TCE data spatially for indoor air, soil gas, sub-slab soil gas and groundwater. Further discussion regarding groundwater is presented in **Section 2.4** below.

2.4 Groundwater Monitoring

The Post-Closure Plan provides compliance and corrective action groundwater monitoring pursuant with applicable portions of 3745-54-90 through 3745-54-100. During closure, it was discerned that COC exceed GWPS at the POC. Since groundwater has been impacted by COC as well as the recalcitrant nature of the COC, detection monitoring during the Post-Closure Plan period is not anticipated. Therefore, the existing groundwater monitoring program is to be maintained.

Proposed containment standards or maximum GWPS will be used to demonstrate the extent of the groundwater plume. In addition, in order to continue to monitor the effectiveness of corrective action performed as a part of the facility closure during the post-closure period, groundwater effectiveness standards or “trigger” levels within the groundwater plume have been prepared. Again, the groundwater monitoring program is risk-based and is predicated on the fact that impacted groundwater is not used as drinking water within the plume or Project Area; consequently, it is protective of human health and environment.

2.3.1 Groundwater Monitoring Locations

Continued sampling of the existing groundwater monitoring network will be conducted as part of this Post-Closure Plan. The monitoring will occur on a semi-annual basis in conjunction with the soil gas, sub-slab soil gas, and indoor air monitoring. Specific groundwater sampling procedures, DQO methodologies and analyses for the various media are provided in the SAP included as **Appendix B** to this Post-Closure Plan. The specific wells to be part of the Post-Closure Plan monitoring are identified below. In addition, six (6) wells not listed below will also be utilized to collect static groundwater levels. **Table 1** provides a summary of the purpose for each monitoring well and the sampling schedule. A depiction of the monitoring well locations is provided on **Figure 3**.

- DMW-3
- DMW-5
- DMW-7
- DMW-9
- MW-2
- MW-4R
- MW-6R

- MW-7R
- MW-8
- MW-9
- MW-10R
- MW-12
- MW-14
- MW-15
- MW-16
- MW-17
- MW-19
- MW-20
- MW-21
- MW-21E
- MW-22
- MW-23R
- MW-24
- MW-26
- TMW-AR

Of the monitoring wells identified above, six (6) wells including MW-21E, MW-24, DMW-7, DMW-9, MW-2, and MW-22 will be part of the post-closure monitoring network that were not part of the monitoring program as part of the post injection remediation that occurred in September and October 2010 (Hull, 2017). The aforementioned wells have not been sampled since circa 2010. The wells will be redeveloped prior to sampling in accordance with the SAP (refer to **Appendix B**).

Wells MW-4R, MW-21E, and MW-24 represent POC wells or wells immediately downgradient of Unit C (see **Table 1**). Please note that well MW-4R is more lateral or side gradient than a true POC well. Monitoring wells TMW-AR, DMW-3, DMW-5, DMW-7, DMW-9, MW-2, MW-8, MW-12, MW-17, MW-19, MW-21, MW-22, and MW-23R are considered “effectiveness” wells that will monitor conditions associated with former corrective actions. Wells MW-6R, MW-7R, MW-9, MW-10R, MW-14, MW-15, MW-16, MW-20, and MW-26 are considered containment wells. The containment group of wells will ensure GWPS are met at the plume boundary.

2.4.2 Maximum Groundwater Protection Standards and Containment

While it is the ultimate goal of the Post-Closure Plan to meet the GWPS throughout the Project Area, it is currently imperative that GWPS are met to demonstrate the extent of the groundwater plume. Therefore, for the Site, groundwater containment or determination standards are the GWPS maximum concentrations as presented in rule 3745-54-94 of the OAC. *Please note that no GWPS maximum concentration is provided in rule 3745-54-94 of the OAC for 1,1-DCA. As such, the value for 1,1-DCA presented below is the United States EPA Residential Tapwater Regional Screening Level, which is 28 micrograms per liter (µg/L) using a carcinogenic risk level of 1E-05.*

•	1,1,1-TCA	200 micrograms per liter (or µg/L)
•	1,1-DCA	28 µg/L
•	1,2-DCA	5 µg/L
•	carbon tetrachloride	5 µg/L
•	cis-1,2-DCE	70 µg/L
•	methylene chloride	5 µg/L
•	PCE	5 µg/L
•	trans-1,2-DCE	100 µg/L
•	TCE	5 µg/L
•	1,1-DCE	7 µg/L
•	chlorobenzene	100 µg/L
•	vinyl chloride	2 µg/L
•	benzene	5 µg/L
•	toluene	1,000 µg/L

If a GWPS standard is exceeded at a downgradient containment well, the extent of the groundwater plume may be considered undefined. Accordingly, the extent of the groundwater plume will need to be re-determined, if possible based upon physical and/or geologic conditions. Some typical response actions to re-determine the extent of the groundwater plume are discussed in **Section 2.4.4** below.

2.4.3 Groundwater Corrective Action and Effectiveness Wells and Standards

The groundwater effectiveness standards are the groundwater trigger levels generated for each COC by the VISL Calculator (see **Appendix D**). The groundwater trigger level is an indoor air vapor intrusion level due to the absence of potable wells and the readily available municipal

drinking water source in the Project Area. The trigger levels have been generated for both residential and commercial land uses. For TCE, again the primary Site risk driver, the trigger levels for groundwater are 11 µg/L, and 44 µg/L, for residential and commercial land uses, respectively.

Examining recently detected TCE concentrations in groundwater from the May 2017 groundwater sampling event (see **Figure 3**) to the TCE trigger concentration for commercial/industrial land use of 44 µg/L (refer **Appendix D**) indicates that each of the effectiveness wells DMW-3, DMW-5 and MW-21 exceed the threshold. The comparison was limited to the commercial/industrial groundwater target level concentrations because the groundwater plume is limited to properties zoned commercial/industrial or controlled by ODOT (see **Figure 2** and **Appendix A**).

As with the soil gas concentrations, groundwater data reveals that appropriate monitoring is occurring based on the distribution of COC and the ongoing monitoring data. Currently, where existing groundwater concentrations (as well as soil gas concentrations) exceed trigger levels (e.g., DMW-3 and MW-21), an appropriate sub-slab soil gas and indoor air sampling regime is established (i.e., 99 James Street, 100 James Street, and 107 Pine Street). Hence, this closely-integrated monitoring will continue as part of the Post-Closure Plan process.

The sampled media data appear to demonstrate a stabilized/degrading source based on the quantity of data from circa 2013 through May of 2017. The collected data account for spatial and seasonal distribution. Recent groundwater monitoring results from May 2017 indicated first time detections of COC, including TCE, within monitoring wells MW-4R, MW-6R, MW-7R and MW-10R. Each of these wells serves as a replacement well for a much larger diameter well that was a part of the pump and treat system and used in the monitoring network. It is suspected that these detections are a result of the lower water volume inflow due to the reduced diameter and/or the fresh disturbance of a small, former, soil smear zone. Nevertheless, the groundwater monitoring network indicates that the COC plume is contained.

2.4.4 Groundwater Trigger Level Exceedance Response

Groundwater trigger levels exist for both COC containment and effectiveness. The containment levels are the maximum GWPS concentrations pursuant to rule 3745-54-94 of the OAC. The effectiveness standards are those trigger levels calculated by the VISL model for groundwater. As such, the response requirements are different. Each is discussed in separate subsections below.

2.4.4.1 *Response Requirements for Exceedance of GWPS*

If the containment level as identified in **Section 2.4.2** for a particular groundwater COC has been exceeded, the proposed additional response as part of this Post-Closure Plan may include, but will not be limited to, the following:

- Re-sampling of the location within five (5) business days of receiving the final laboratory analytical results and initial evaluation of the data.
- If the exceedance is confirmed, a re-evaluation of the potential groundwater receptors in vicinity. Potential installation of an additional well or wells downgradient of the appropriate containment well where the exceedance occurred.
- Written notification to the appropriate property owner if GWPS are exceeded and confirmed further off-Site where COC migration has occurred.
- Groundwater mitigation as necessary.

All appropriate response actions will be completed in coordination with the Ohio EPA.

2.4.4.2 *Response Requirements for Exceedance of Effectiveness Standards*

In essence, Site effectiveness standards in groundwater have been exceeded. To date, appropriate response actions have been implemented in some form of vapor intrusion pathway assessment and sampling. The measures are anticipated to continue. If groundwater effectiveness trigger levels are exceeded elsewhere, response measures will be taken to protect human health and the environment. These measures may include, but will not be limited to, the following:

- Re-sampling of the location within (5) business days of receiving final laboratory analytical results and initial evaluation of the data.
- Evaluation of potential additional Site indoor air vapor intrusion pathways and receptors associated with the groundwater trigger level exceedance.
- Potential installation of additional soil gas wells, sub-slab sample points, and indoor air sampling locations.
- Written notification to the appropriate property owner if an indoor air trigger level is confirmed.
- Groundwater and/or vapor mitigation as necessary.

2.5 Installation of Additional Monitoring Points

The installation of any additional soil gas wells, sub-slab vapor points and/or groundwater monitoring wells will be conducted in accordance with the SAP included in **Appendix B**.

3.0 REPORTING

For each calendar year, a corrective action effectiveness report that details the results of the two semi-annual events, will be completed and submitted to the Ohio EPA. In accordance with rule 3745-54-100(G) of the OAC, corrective action effectiveness reports will contain the necessary information (e.g., continued plume stability evaluations, demonstrations that workers in commercial/industrial structures remain protected, etc.) to demonstrate that the corrective action remains effective and appropriate.

Each corrective action effectiveness report will be prepared summarizing the soil gas, sub-slab, indoor air, and groundwater results from the semi-annual monitoring events. This report will serve as status reporting to the regulatory agency. The reports will be prepared and submitted within 90 days of receipt of the final laboratory results. These reports will, at a minimum, include a discussion of sampling event field activities and observations, a summary table of historical and present analytical data, and appropriate summary maps charting groundwater concentrations of COC. All data necessary for Ohio EPA to conduct a Tier I data evaluation will be submitted with each report.

Additional reporting requirements and schedule for the corrective action effectiveness reports are listed in Section 6 of the SAP (refer to **Appendix B**).

As specified in rule 3745-50-58 of the OAC, an annual monitoring report will be submitted to the Director by March 1st of each year, on the form provided by the Director per OAC 3745-65-94(A)(2). Groundwater monitoring data submitted in electronic format will follow the general format specified in "Supplementary Annual Report for Final Standards Ground Water Monitoring Information Form and Instructions" (rules 3745-54-90 through -54-100 of the OAC). Similarly, all data necessary for Ohio EPA to conduct a Tier I data evaluation will be submitted with each report. The annual monitoring reports will include the results of the groundwater quality assessment program, which includes, but is not limited to, the calculated (or measured) rate of migration of the Site COCs in the sampled environmental media (i.e., groundwater, soil gas, sub-slab soil gas and indoor air). In accordance with OAC 3745-54-100(G), the annual report will contain corrective action effectiveness reporting that will include the necessary information (e.g., continued plume stability evaluations, demonstrations that workers in commercial/industrial buildings remain protected, etc.) to demonstrate that the corrective action remains effective and appropriate and protective of human health and the environment. In addition, the annual report will include a brief summary of the review of the environmental setting (e.g., land use) of the Project Area and the trigger levels.

As part of the annual reporting to the Ohio EPA, it will be demonstrated that groundwater is not used within the determined extent of the plume (i.e., that the groundwater ingestion pathway is incomplete), through an annual groundwater use determination. The demonstration will include a (i) physical inspection for potable wells of the impacted properties as well as all properties within 300 feet of the impacted properties; (ii) an ODNR online water well files will be reviewed for all properties within 1,500 feet of the groundwater plume to determine if any new potable use wells have been installed; and (iii) a review of the Ohio EPA's files regarding the former Dynacraft property's operation and maintenance (O&M) inspection reports. The Dynacraft property O&M inspection reports document that groundwater wells (for potable purposes or otherwise with the exception for investigation, monitoring, or remediation of the groundwater, or for temporary dewatering during construction activities, or during the installation and/or maintenance of subsurface utilities) have not been installed on the property.

At this time, statistical analysis of groundwater data is not anticipated since the detected VOCs are not naturally occurring and are not present at typical “background concentrations”. Site VOC trigger levels have been established for the impacted environmental media that are protective of human health and the environment. Changes in VOC concentration at select wells may be monitored by time-concentration plots. Review of data in this manner may prove to be more beneficial since linear trends in concentration may be more readily observable than statistical analysis.

4.0 MAINTENANCE AND INSPECTIONS

Inspection and maintenance of all post-closure systems will be conducted concurrently with all sampling activities. The inspection program and maintenance activities will be recorded in a dedicated field book and/or on standard field forms and will become part of the Site record. During each of the groundwater, soil gas, sub-slab and indoor air sampling activities, the Site will be inspected for damage due to use, abuse, wear, vandalism, or weathering. Regular maintenance, and, if necessary, repair activities will be completed. For the groundwater and soil vapor monitoring system, the inspection program consists of checking each monitoring well or vapor sampling port for:

- Damaged protective casing;
- Damaged well casings;
- Missing or damaged well covers, caps, or locks;
- Presence of foreign objects in wells or sampling port areas;
- Heaving of wells;
- Damaged concrete pads;
- Subsidence of wells;
- Silting of wells;
- Damaged sampling ferrules; and
- Other signs of unauthorized use, tampering, or deterioration.

If damage to any of these items is noted during these semi-annual inspections, the damaged items will be immediately repaired, or as soon as practicable if the utilization of a subcontractor is required to repair the item(s). In addition, the Ohio EPA will be notified upon

discovery of damaged items. All damage and repair or maintenance actions will be noted in a field logbook and/or on standard field forms and noted in the annual report to the Ohio EPA.

5.0 PUBLIC INFORMATION

Groundwater underlying the Site shall not be extracted or used for any purpose, potable or otherwise, except for investigation, monitoring, or remediation of the groundwater, or for temporary dewatering during construction activities, or during the installation and/or maintenance of subsurface utilities. If groundwater is encountered, dermal personal protection from contact with the groundwater must be donned by all workers. Groundwater generated as a result of dewatering activities will be properly disposed in accordance with all local, state, and federal requirements.

When any excavation is planned at the Site, the contractor shall contact ODOT and its contracted consultant to evaluate the current conditions of groundwater in the vicinity of the excavation, and to evaluate the necessity for developing a respiratory protection standard to be followed during construction activities. If deemed necessary, the respiratory protection standard shall specify monitoring procedures, and appropriate respiratory protection measures to be followed should monitoring indicate that a screening level is exceeded.

Intrusive work involving excavation, utility installation or decommissioning, or other subsurface disturbance that may generate either contaminated soils or groundwater will be conducted under strict worker protection protocols and proper waste disposal procedures will be conducted in accordance with all local, state, and federal requirements. Any excavation or other activities specifically within Unit C will necessitate adherence to rule 3745-27-13 of the OAC.

As identified in Section 1.2., above, land use has been restricted from residential, commercial and industrial land uses. ODOT and the Ohio EPA have developed and executed an Environmental Covenant pursuant to Ohio Revised Code Sections 5301.80 to 5301.92 (refer to **Appendix A**). Other activity use restrictions include not building an occupied structure to prevent indoor air pathway

completion; the prohibition of groundwater extraction and use with the exception of investigation, assessment, and remediation; the limitation of excavation activities occurring at depths greater than 18 inches bgs; and the limitation on the transfer of subsurface soils from the Site. The Environmental Covenant is recorded on the deed at the Licking County Recorder's Office.

6.0 AMENDMENTS OF POST-CLOSURE PLAN

It is anticipated that ODOT will continue the post-closure compliance/corrective action monitoring phase for a minimum of 30 years. Any change to sampling locations, sampling frequency, sampling program (e.g., return to detection monitoring, etc.) or analytical parameters will be implemented in accordance with OAC 3745-50-51, 3745-54-18 and/or 3745-54-100, as appropriate. Any Post-Closure Plan changes will be amended per rules 3745-54-100(H) or OAC 3745-54-18(D) of the OAC, as necessary.

7.0 SCHEDULE AND FINANCIAL ASSURANCE

The initiation of this Post-Closure Plan and its associated activities shall commence upon Ohio EPA approval. It is anticipated that the sampling program will be implemented during March and September to allow for seasonally variability associated with data collection. The number of sampling locations and/or frequency of sampling may be reduced in the future provided that analytical data remains stable and will be subject to the provisions of rules 3745-50-51 and 3745-54-18 of the OAC. ODOT is a public entity, and as such, there is no financial assurance necessary.

8.0 COMPLETION OF POST-CLOSURE CARE AND CERTIFICATION

As noted above, it is anticipated that ODOT will continue the post-closure compliance and/or corrective action monitoring phase for a minimum of 30 years. In the unlikely event that post-closure care is to cease, no later than 60 days after completion of the established post-closure care period for Unit C, ODOT will submit to the Director, by registered mail, a certification that the post-closure care period for Unit C was performed in accordance with the specifications in the approved Post-Closure Plan and any amendments. The certification will be signed and completed by ODOT

and a qualified professional engineer and certified in accordance with rule OAC 3745-55-20 of the OAC. The exact wording found in rule 3745-50-42(D) of the OAC will be included in the statements of the owner/operator and the independent registered professional engineer. Because Ohio EPA may choose to extend the post-closure time period under rule 3745-55-17(A)(2)(b) of the OAC, ODOT may wish to meet with Ohio EPA staff before beginning the post-closure certification process to ensure that Ohio EPA does not find cause to extend the period.

9.0 REFERENCES

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Sharp and Associates, Inc., *Area C Amended RCRA Closure Plan Area C Closure*, January 1997.

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U.S. EPA's Office of Solid Waste and Emergency Response *Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources*, OSWER Publication 9200.2-154, June 2015.

U.S. EPA's *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A)*, December 1989.

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TABLE

Table 1 (Revised March 2023)
Post Closure Ground Water Monitoring Network
Former ODOT District 5 Headquarters
Newark, Ohio

Identification	Status	Well Diameter (inches)	Water Level	GW Sampling	Sampling Schedule	Monitoring Purpose
DMW-1	Existing	2	X		Semiannual	Downgradient of (Unit C) Water Level Only
DMW-4	Existing	2	X		Semiannual	Downgradient of (Unit C) Water Level Only
DMW-8	Existing	2	X		Semiannual	Downgradient of (Unit C) Water Level Only
MW-3R	Existing	2	X		Semiannual	Upgradient of (Unit C) Water Level Only
MW-21W	Existing	2	X		Semiannual	Downgradient of (Unit C) Water Level Only
MW-25	Existing	2	X		Semiannual	Downgradient of (Unit C) Water Level Only
MW-4R	Existing	2	X	X	Semiannual	POC Well Sidegradient of (Unit C)
MW-21E	Existing	2	X	X	Semiannual	POC Well Downgradient of (Unit C)
MW-24	Existing	2	X	X	Semiannual	POC Well Downgradient of (Unit C)
MW-6R	Existing	2	X	X	Semiannual	Containment Monitoring Well
MW-7R	Existing	2	X	X	Semiannual	Containment Monitoring Well
MW-9	Existing	4	X	X	Semiannual	Containment Monitoring Well
MW-10R	Existing	2	X	X	Semiannual	Containment Monitoring Well
MW-14	Existing	2	X	X	Semiannual	Containment Monitoring Well
MW-15	Existing	2	X	X	Semiannual	Containment Monitoring Well
MW-16	Existing	2	X	X	Semiannual	Containment Monitoring Well
MW-20	Existing	2	X	X	Semiannual	Containment Monitoring Well
MW-26	Existing	2	X	X	Semiannual	Containment Monitoring Well
DMW-3	Existing	2	X	X	Semiannual	Effectiveness Monitoring Well
DMW-5	Existing	2	X	X	Semiannual	Effectiveness Monitoring Well
DMW-7	Existing	2	X	X	Annual	Effectiveness Monitoring Well
DMW-9	Existing	2	X	X	Annual	Effectiveness Monitoring Well
MW-2	Existing	2	X	X	Semiannual	Effectiveness Monitoring Well
MW-8	Existing	4	X	X	Annual	Effectiveness Monitoring Well
MW-12	Existing	4	X	X	Semiannual	Effectiveness Monitoring Well
MW-17	Existing	2	X	X	Semiannual	Effectiveness Monitoring Well
MW-19	Existing	2	X	X	Semiannual	Effectiveness Monitoring Well
MW-21	Existing	2	X	X	Semiannual	Effectiveness Monitoring Well
MW-22	Existing	2	X	X	Annual	Effectiveness Monitoring Well
MW-23R	Existing	2	X	X	Semiannual	Effectiveness Monitoring Well
TMW-AR	Existing	2	X	X	Semiannual	Effectiveness Monitoring Well

Notes:

POC = Point of Compliance

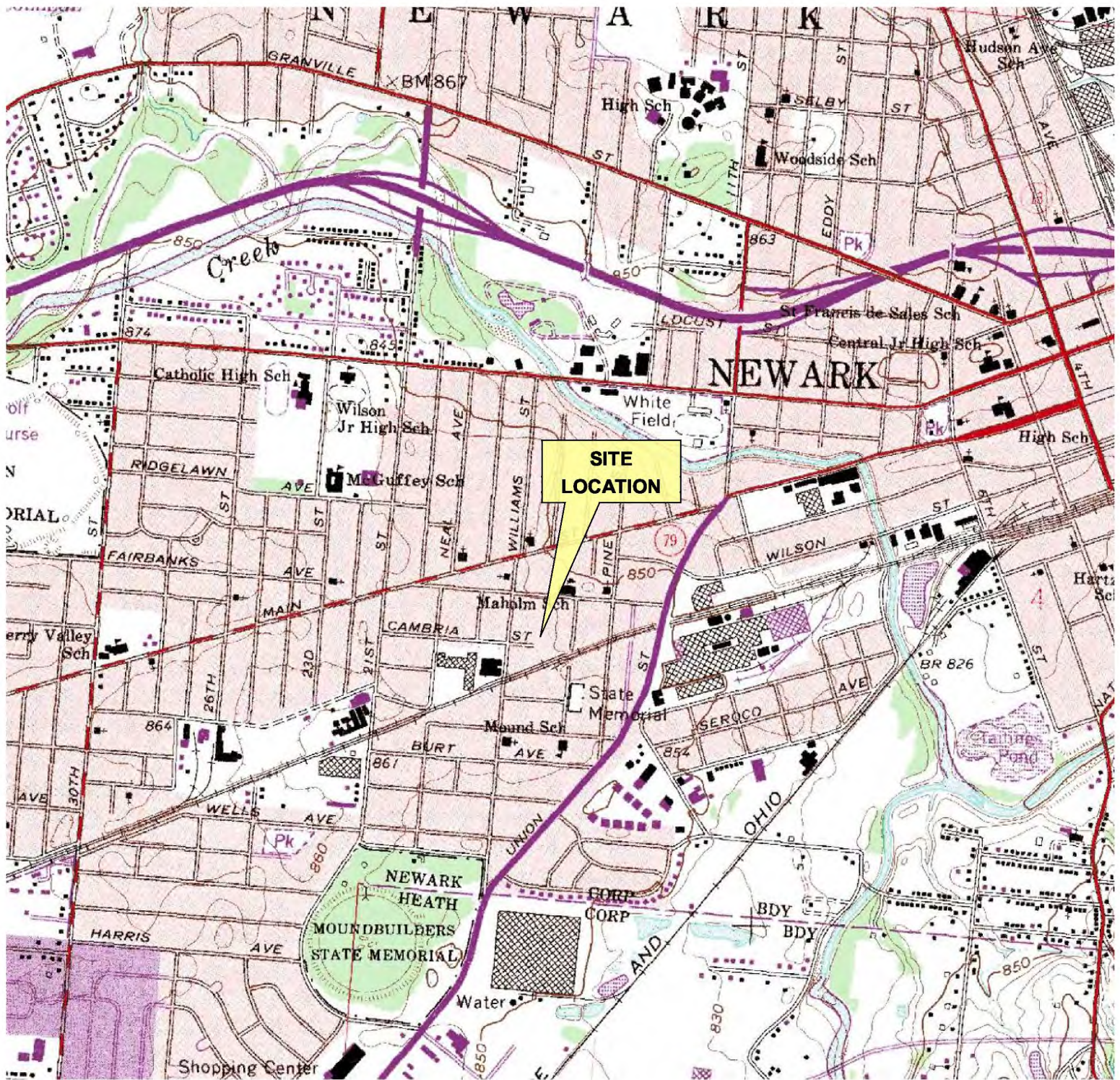
Monitoring Wells DMW-2, MW-1, and MW-11 were abandon in 2017.

Replacement Well MW-3R was installed in October 2016.

Replacement Wells MW-4R, MW-6R and MW-7R, and MW-10R installed in March 2017.

Replacement Well TMW-AR installed after Spring 2023 Semiannual Monitoring Event.

FIGURES



REFERENCE: USGS 7.5-Minute Topographic Map, Newark, Ohio

DATED: 1984

Latitude: 40.049994 °N / Longitude: -82.423974° w

SCALE: 0 1,500 feet

**FIGURE 1
SITE LOCATION MAP
115 1/2 MAHOLM STREET
NEWARK, OHIO 43055**

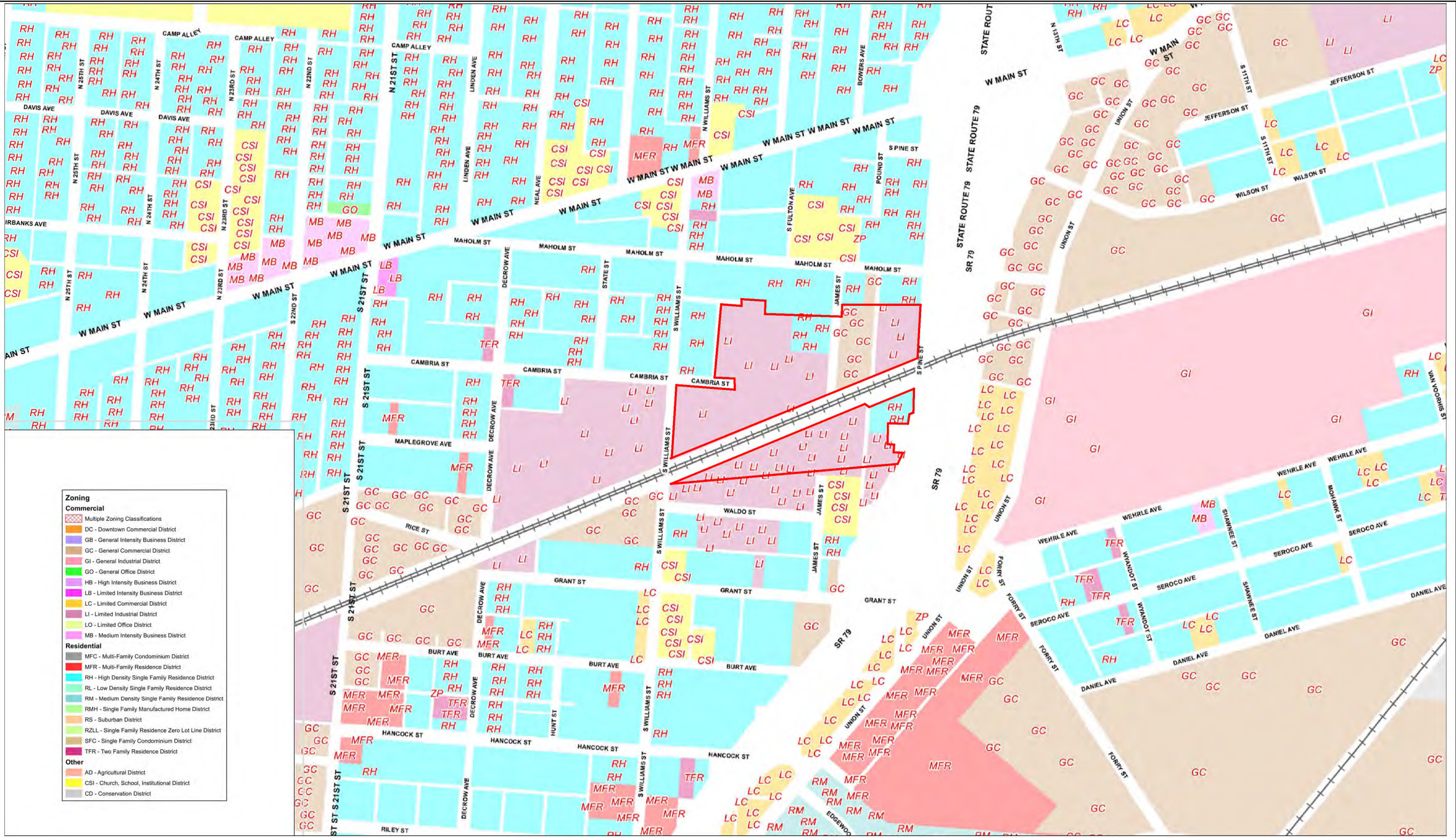
**PREPARED FOR
ODOT**



6105 Heisley Road, Mentor, OH 44060
440-357-1260 - Fax 440-357-1510

DRAWN BY:	CK
APPROVED BY:	KMR
PROJECT NO.	H15006-20

FIGURE 1 SITE LOCATE



LEGEND

General Location of ODOT Project Area

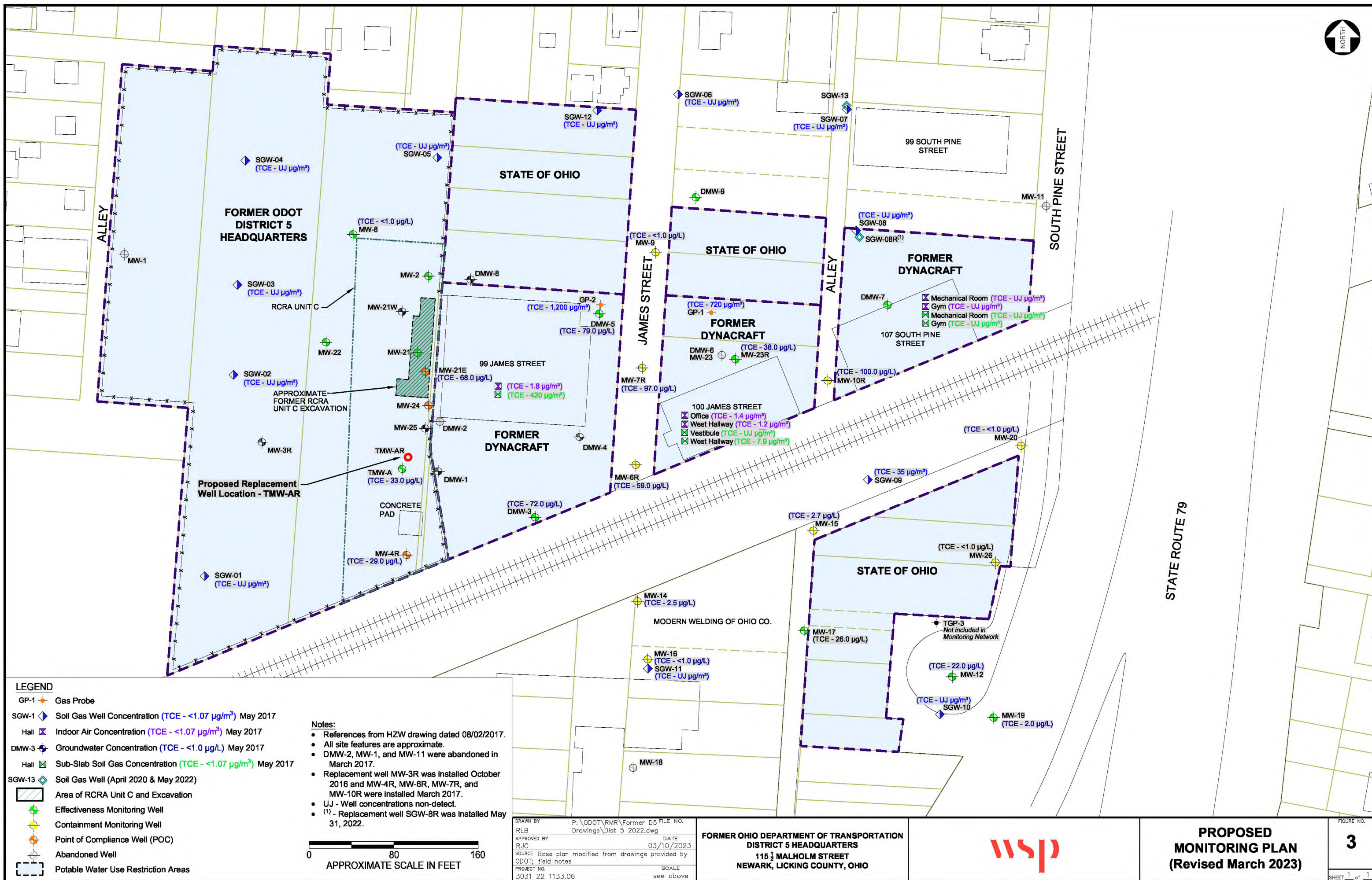
REFERENCES: 1) City of Newark, Ohio Zoning

NORTH

DRAWN	CK 01/26/2016
PROJECT NO.	H15006-32
DRAWING NUMBER	FIG2 ZONING MAP

FIGURE 2
LAND USAGE AND ZONING MAP
FORMER ODOT DISTRICT 5 HEADQUARTERS
NEWARK, LICKING COUNTY, OHIO

PREPARED FOR
ODOT



APPENDIX A

ENVIRONMENTAL COVENANT



201709260020528
 Pgs:13 \$116.00 T20170023510
 9/26/2017 10:54 AM MEPP0 BOX 306
 Bryan A. Long Licking County Recorder

TO BE RECORDED IN **DEED RECORDS**,
 PURSUANT TO ORC 317.08(A)

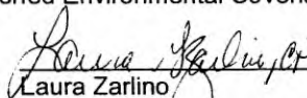
AFFIDAVIT

STATE OF OHIO)

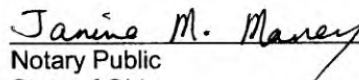
COUNTY OF FRANKLIN)

ss:

Before me, the subscriber, a Notary Public in and for the State of Ohio, personally appeared Tonya R. Lassiter, who, being duly sworn according to law, deposes and says that: (i) she is employed as a records management officer in the Legal Office of the Ohio Environmental Protection Agency ("Ohio EPA") and, as such, is authorized to sign this Affidavit on behalf of Ohio EPA; and (ii) the attached document is a true and correct copy of the Environmental Covenant issued by the Director, and entered in the Ohio EPA Director's Journal on September 1, 2017, regarding property known as ODOT D5 Headquarters, located at 115 1/2 Maholm Street in Newark, Licking County, Ohio and further described in the attached Environmental Covenant.


 Laura Zarlino
 Paralegal
 Ohio EPA Legal Office

Sworn to and subscribed before me, a Notary Public in and for the State of Ohio, this 1st day of September, 2017.


 Janine M. Maney
 Notary Public
 State of Ohio

Permanent Commission
No expiration, R.C. 147.03

This instrument prepared by:

Sarah M. Miles, Attorney
 Ohio EPA Legal Office
 P.O. Box 1049
 Columbus, Ohio 43216-1049

Ohio EPA SEP 1 '17
 Entered Directors Journal



JANINE M. MANEY
 ATTORNEY AT LAW
 NOTARY PUBLIC
 STATE OF OHIO
 My Comm. Has No
 Expiration Date
 Section 147.03 R. C.

I certify this to be a true and accurate copy of the
official documents as filed in the records of the Ohio
Environmental Protection Agency.

By:  Date: 9-1-17

Ohio EPA SEP 1 '17
Entered Directors Journal

**To be recorded with Deed
Records - ORC § 317.08**

ENVIRONMENTAL COVENANT

This Environmental Covenant is entered into by The State of Ohio, Department of Transportation ("ODOT" or "Owner") and the Ohio Environmental Protection Agency ("Ohio EPA") pursuant to Ohio Revised Code ("ORC") §§ 5301.80 to 5301.92 for the purpose of subjecting the Property described in section 2 herein ("the Property") to the activity and use limitations set forth herein.

Whereas, this Environmental Covenant concerns an area known as the ODOT Former District 5 Headquarters. The area known as the ODOT Former D5 Headquarters is Parcel #054-186854-00.000 and Parcel #054-186860-00.000 as recorded in Instrument Number 201406250011575) and being a part of Exhibit A, 4.124 Acres. Additionally, ODOT is the Owner of additional certain real property located in the City of Newark, Licking County, Ohio 43055 (Parcel #054-223590-00.000, 054-223938-00.000, 054-228720-00.000, 054-229584-00.000, 054-226560-00.000, 054-217932-00.000, 054-217944-00.000, 054-221784-00.000, 054-230238-00.000, 054-221154-00.000, 054-220626-00.000 and 054-228810-00.000 as recorded in Instrument Number 201406250011575) and being a part of Exhibit A, 4.124 Acres, all of Exhibit B, 0.271 Acre and all of Exhibit C, 0.751 Acre. Said Exhibit A, Exhibit B and Exhibit C are the legal description reference on the Affidavit of Survey of Robert C. Canter as recorded in Instrument Number 201406250011575, Licking County Official Records. Collectively, these Parcel numbers are known as the "Property", and;

Whereas, Owner asserts the implementation of appropriate use restrictions on land and ground water use on the Property is in furtherance of protecting human health and the environment.

Now therefore, Owner and Ohio EPA agree to the following:

1. Environmental Covenant. This instrument is an environmental covenant developed and executed pursuant to ORC §§ 5301.80 to 5301.92.
2. Property. This Environmental Covenant concerns the Property as described above and attached as Exhibit A.
3. Owner. The State of Ohio, Department of Transportation ("Owner") is the owner of the Property. Owner is located at 1980 West Broad Street, Columbus, Ohio 43223.

4. Holders. Pursuant to ORC § 5301.81, the holder of this Environmental Covenant ("Holder") is the Owner, whose address is listed above
5. Activity and Use Limitations. As part of the closure plan of waste management units on the Property, Owner hereby imposes and agrees to comply with the following activity and use limitations:
 - A. Limitation Prohibiting Construction of Occupied Structures. The construction, placement or use of occupied structures on the Property is forbidden unless Owner or Transferee contacts and obtains permission from the Ohio EPA.
 - B. The Property shall not be used for residential, commercial or industrial land uses.

The term "residential land use" shall include, but not be limited to, the following:

- (i) Single and multi-family dwelling and rental units;
- (ii) Day care centers and preschools;
- (iii) Correctional facilities;
- (iv) Transient or other residential facilities; and
- (v) Production of food-chain products by agricultural means for animal or human consumption.

The term "commercial land use", shall include, but not be limited to warehouses, retail gasoline stations, retail establishments, professional offices, office buildings, hotels and motels, religious facilities, restaurants and other food and beverage services, entertainment facilities, hospitals and clinic, and parking facilities.

The term "industrial land use", shall include manufacturing, processing operations and office and warehouse use, including but not limited to production, storage and parking/driveway use.

- C. Limitation Prohibiting Ground Water Extraction and Use. Groundwater underlying the Property shall not be extracted or used for any purpose, potable or otherwise, except for investigation, monitoring and remediation of groundwater or in conjunction with construction or excavation activities or maintenance of subsurface utilities.
- D. Limitation on Excavation Activities. For any and all excavation activities occurring more than 18 inches below the surface, notice must be provided

to the owner and Ohio EPA. A health and safety plan must be submitted to Ohio EPA for approval.

- E. Limitation on Transfer of Materials. No subsurface soils shall be transferred from the Property.

If any event or action by or on behalf of a person who owns an interest in or holds an encumbrance on the Property constitutes a breach of the activity and use limitations, Owner or Transferee shall notify Ohio EPA within thirty (30) days of becoming aware of the event or action, and shall remedy the breach of the activity and use limitations within sixty (60) days of becoming aware of the event or action, or such other time frame as may be agreed to by the Owner or Transferee and Ohio EPA.

6. Running with the Land. This Environmental Covenant shall be binding upon the Owner and all assigns and successors in interest, including any Transferee, and shall run with the land, pursuant to ORC § 5301.85, subject to amendment or termination as set forth herein. The term "Transferee," as used in this Environmental Covenant, shall mean any future owner of any interest in the Property or any portion thereof, including, but not limited to, owners of an interest in fee simple, mortgagees, easement holders, and/or lessees.
7. Compliance Enforcement. Compliance with this Environmental Covenant may be enforced pursuant to ORC § 5301.91. Failure to timely enforce compliance with this Environmental Covenant or the activity and use limitations contained herein by any party shall not bar subsequent enforcement by such party and shall not be deemed a waiver of the party's right to take action to enforce any non-compliance. Nothing in this Environmental Covenant shall restrict the Director of Ohio EPA from exercising any authority under applicable law.
8. Rights of Access. Owner hereby grants to Ohio EPA, its agents, contractors, and employees the right of access to the Property for implementation or enforcement of this Environmental Covenant.
9. Compliance Reporting. Owner or Transferee, if applicable, shall annually submit to Ohio EPA written documentation verifying that the activity and use limitations set forth herein remain in place and are being complied with. Documentation shall be due to Ohio EPA Central Office on June 1st of each year beginning the year after the effective date of this Environmental Covenant, unless otherwise directed by Ohio EPA.

10. Notice upon Conveyance. Each instrument hereafter conveying any interest in the Property or any portion of the Property shall contain a notice of the activity and use limitations set forth in this Environmental Covenant, and provide the recorded location of this Environmental Covenant. The notice shall be substantially in the following form:

THE INTEREST CONVEYED HEREBY IS SUBJECT TO AN ENVIRONMENTAL COVENANT, DATED _____, 20____, RECORDED IN THE DEED OR OFFICIAL RECORDS OF THE LICKING COUNTY RECORDER ON _____, 20____, IN [DOCUMENT _____, or BOOK _____, PAGE _____]. THE ENVIRONMENTAL COVENANT CONTAINS THE FOLLOWING ACTIVITY AND USE LIMITATIONS:

- A. Limitation Prohibiting Construction of Occupied Structures. The construction, placement or use of occupied structures on the Property is forbidden unless Owner or Transferee contacts and obtains permission from the Ohio EPA.
- B. The Property shall not be used for residential, commercial, or industrial land uses, as defined in OAC 3745-300-08(C)(2)(a), OAC 3745-300-08(C)(2)(b), and OAC 3745-300-08(C)(2)(c), respectively.
- C. Limitation Prohibiting Ground Water Extraction and Use. Groundwater underlying the Property shall not be extracted or used for any purpose, potable or otherwise, except for investigation, monitoring and remediation of groundwater or in conjunction with construction or excavation activities or maintenance of subsurface utilities.
- D. Limitation on Excavation Activities. For any and all excavation activities occurring more than 18 inches below the surface, notice must be provided to the owner and Ohio EPA. A health and safety plan must be submitted to Ohio EPA for approval.
- E. Limitation on Transfer of Materials. No subsurface soils shall be transferred from the Property.

Owner or Transferee, if applicable, shall notify Ohio EPA within ten (10) days after each conveyance of an interest in the Property or any portion thereof. The notice shall include the name, address, and telephone number of the Transferee, a copy of the deed or other documentation evidencing the conveyance, and a survey map that shows the boundaries of the property being transferred.

11. Representations and Warranties. Owner hereby represents and warrants to the other signatories hereto:
 - A. that the Owner is the sole owner of the Property;
 - B. that the Owner holds fee simple title to the Property and that the Owner conducted a current title search that shows that the Property is not subject to any interests or encumbrances that conflict with the activity and use limitations set forth in this Environmental Covenant;
 - C. that the Owner has the power and authority to enter into this Environmental Covenant, to grant the rights and interests herein provided and to carry out all obligations hereunder;
 - D. that the Owner has identified all other persons that own an interest in or hold an encumbrance on the Property, and, if applicable, notified such persons of the Owner's intention to enter into this Environmental Covenant; and
 - E. that this Environmental Covenant will not materially violate or contravene or constitute a material default under any other agreement, document or instrument to which Owner is a party or by which Owner may be bound or affected.
12. Amendment or Termination. This Environmental Covenant may be amended or terminated by consent of all of the following: the Owner or a Transferee, the Holder, and the Ohio EPA, pursuant to ORC § 5301.90 and other applicable law. The term, "Amendment," as used in this Environmental Covenant, shall mean any changes to the Environmental Covenant, including the activity and use limitations set forth herein, or the elimination of one or more activity and use limitations when there is at least one limitation remaining. The term, "Termination," as used in this Environmental Covenant, shall mean the elimination of all activity and use limitations set forth herein and all other obligations under this Environmental Covenant.

This Environmental Covenant may be amended or terminated only by a written instrument duly executed by the Director of Ohio EPA and the Owner or Transferee and the Holder of the Property or portion thereof, as applicable. Within thirty (30) days of signature by all requisite parties on any amendment or termination of this Environmental Covenant, the Owner or Transferee shall file such instrument for recording with the Licking County Recorder's Office, and shall provide a true file and date-stamped copy of the recorded instrument to Ohio EPA.

13. Severability. If any provision of this Environmental Covenant is found to be unenforceable in any respect, the validity, legality, and enforceability of the remaining provisions shall not in any way be affected or impaired.
14. Governing Law. This Environmental Covenant shall be governed by and interpreted in accordance with the laws of the State of Ohio.
15. Recordation. Within thirty (30) days after the date of the final required signature upon this Environmental Covenant, Owner shall file this Environmental Covenant for recording, in the same manner as a deed to the Property, with the Licking County Recorder's Office.
16. Effective Date. The effective date of this Environmental Covenant shall be the date upon which the fully executed Environmental Covenant has been recorded as a deed record for the Property with the Licking County Recorder.
17. Distribution of Environmental Covenant. The Owner shall distribute a file- and date-stamped copy of the recorded Environmental Covenant to the Ohio EPA.
18. Notice. Unless otherwise notified in writing by or on behalf of the current owner or Ohio EPA, any document or communication required by this Environmental Covenant shall be submitted to:

Ohio EPA – Central Office
 Lazarus Government Center
 Division of Environmental Response and Revitalization
 P.O. Box 1049
 Columbus, Ohio 43216-1049
 Attn: DERR Records Management Officer

Or, send electronically to: records@epa.state.oh.us

And

Ohio EPA – Central District Office
 P.O. Box 1049
 Columbus, Ohio 43216-1049
 Attn: Site Coordinator for ODOT Former District 5 Headquarters

Any notice to Holder shall be sent to:

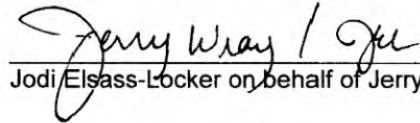
Ohio Department of Transportation
Office of Environmental Services
1980 West Broad Street
Columbus, OH 43223
Attn: Legal Counsel

[Remainder of page left intentionally blank]

The undersigned representative of Owner represents and certifies that he is authorized to execute this Environmental Covenant.

IT IS SO AGREED:

OWNER AND HOLDER: The State of Ohio, Department of Transportation



Jodi Elsass-Locker on behalf of Jerry Wray, Director

State of Ohio)
) ss:
County of Franklin)

Before me, a notary public, in and for said county and state, personally appeared Jodi Elsass-Locker on behalf of Jerry Wray, a duly authorized representative of the Owner and Holder, who acknowledged to me the execution of the foregoing instrument on behalf of the Owner and Holder.

IN TESTIMONY WHEREOF, I have subscribed my name and affixed my official seal this 30th day of June, 2017.



Notary Public

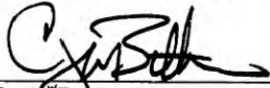


Steven Ross Irvine, Attorney At Law
NOTARY PUBLIC - STATE OF OHIO
My commission has no expiration date
Sec. 147.03 R.C.

This instrument was prepared by:

Steven Ross Irvine
Assistant Legal Counsel, Ohio Department of Transportation
1980 West Broad Street
Columbus, OH 43223
Mail Stop# 4170

OHIO ENVIRONMENTAL PROTECTION AGENCY



Craig Butler, Director

State of Ohio)
) ss:
 County of Franklin)

Before me, a notary public, in and for said county and state, personally appeared Craig Butler, the Director of Ohio EPA, who acknowledged to me the execution of the foregoing instrument on behalf of Ohio EPA.

IN TESTIMONY WHEREOF, I have subscribed my name and affixed my official seal this 1st day of SEPTEMBER, 2017.

Notary Public




This instrument was prepared by:

Steven Ross Irvine
 Assistant Legal Counsel, Ohio Department of Transportation
 1980 West Broad Street
 Columbus, OH 43223
 Mail Stop# 4170

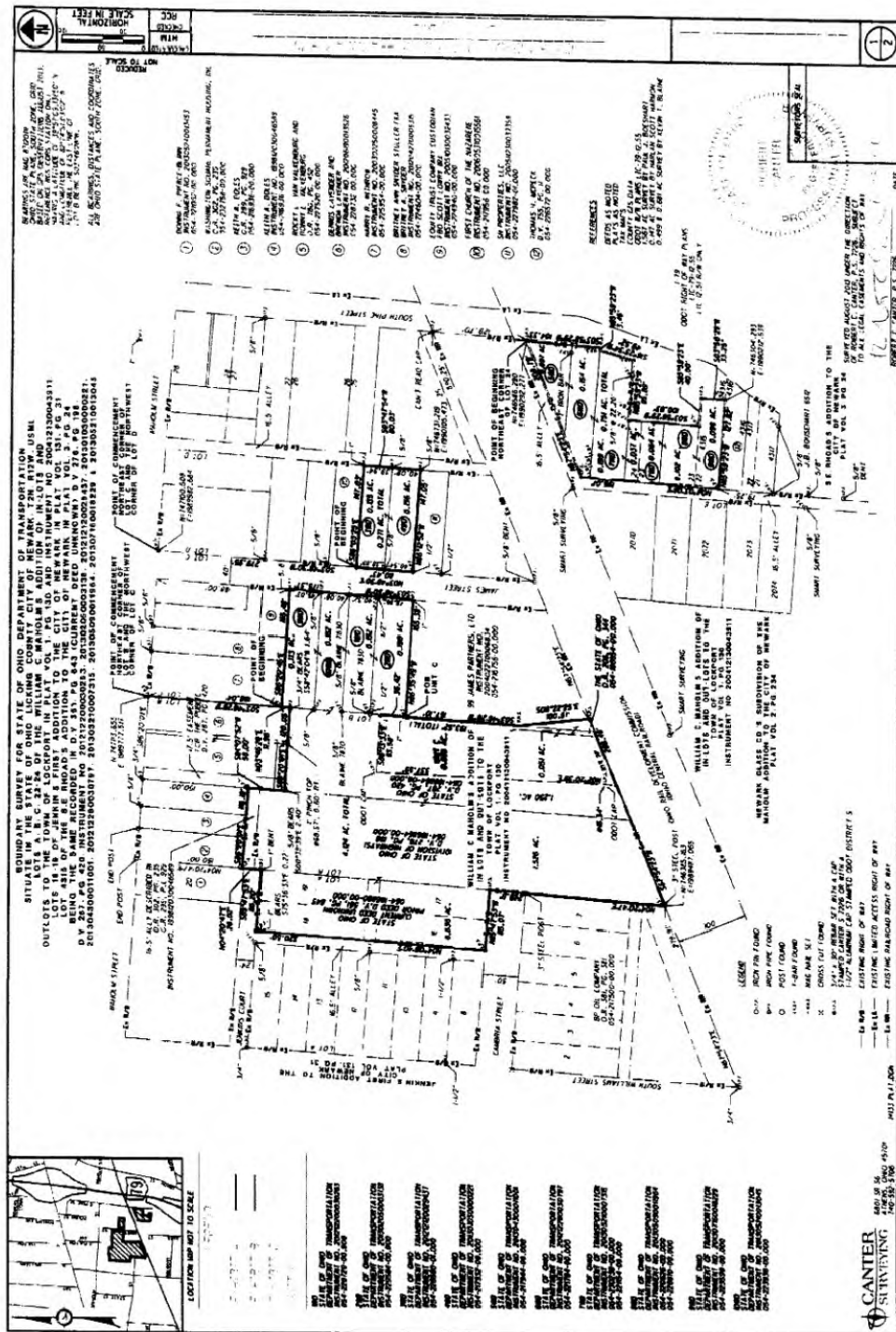
Sarah M. Miles
 Staff Attorney, Ohio EPA
 50 West Town St., Suite 700
 Columbus, Ohio 43216-1049

CHARMA DIANE CASTEEL
 NOTARY PUBLIC
 STATE OF OHIO
 MY COMMISSION EXPIRES

May 10, 2019

EXHIBITS A, B & C
LEGAL PROPERTY
DESCRPITIONS

1. Subject's Name: [Redacted] 2. Date of Birth: [Redacted] 3. Sex: [Redacted] 4. Race: [Redacted] 5. Height: [Redacted] 6. Weight: [Redacted] 7. Eye Color: [Redacted] 8. Hair Color: [Redacted] 9. Hair Style: [Redacted] 10. Facial Features: [Redacted] 11. Scars/Tattoos: [Redacted] 12. Other: [Redacted]	13. Date of Arrest: [Redacted] 14. Location of Arrest: [Redacted] 15. Agency: [Redacted] 16. Officer: [Redacted] 17. Charge: [Redacted] 18. Bond: [Redacted] 19. Court: [Redacted] 20. Judge: [Redacted] 21. Trial Date: [Redacted] 22. Verdict: [Redacted] 23. Sentence: [Redacted] 24. Prison Number: [Redacted] 25. Release Date: [Redacted]	26. Current Address: [Redacted] 27. Previous Addresses: [Redacted] 28. Employment History: [Redacted] 29. Education: [Redacted] 30. Military Service: [Redacted] 31. Criminal History: [Redacted] 32. Mental Health: [Redacted] 33. Substance Use: [Redacted] 34. Other: [Redacted]	35. Family Members: [Redacted] 36. Friends: [Redacted] 37. Associates: [Redacted] 38. Other: [Redacted]	39. Notes: [Redacted] 40. Signatures: [Redacted] 41. Date: [Redacted] 42. Time: [Redacted]
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APPENDIX B

SAMPLING AND ANALYSIS PLAN

SAMPLING AND ANALYSIS PLAN

**FORMER OHIO DEPARTMENT OF TRANSPORTATION
DISTRICT 5 HEADQUARTERS FACILITY UNIT C
115 1/2 HAHOLM STREET
NEWARK, LICKING COUNTY, OHIO**

OCTOBER 2017

Prepared for:

Ohio Department of Transportation
Office of Environmental Services
1980 West Broad Street, Mail Stop #4170
Columbus, Ohio 43223

Prepared by:



HZW Environmental
Consultants

**6105 Heisley Road ♦ Mentor, Ohio 44060
440-357-1260 ♦ Fax 440-357-1510**

H17023-22

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FIGURES

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Figure 2 – Land Usage and Zoning Map

Figure 3 – Monitoring Well, Soil Gas Well, Sub-Slab Soil Gas & Indoor Air Sample Locations Map

APPENDICES

Appendix A – HZW’s Field Standard Operating Procedures

Appendix B – HZW’s Field Forms

DMW\KMR:dmw\kmr

I:\2017\HI7023-22\Post-Closure Plan Documents\Final Post-Closure Plan\ODOT D5 HQ SAP September 2017.Docx



1.0 INTRODUCTION

On behalf of the Ohio Department of Transportation's (ODOT's) Office of Environmental Services, HZW Environmental Consultants, LLC (HZW) has prepared this Sampling and Analysis Plan (SAP) for the former test lab storage area (Unit C) of the ODOT District 5 Former Headquarters Facility located at 115½ Maholm Street in the City of Newark, Licking County, Ohio (herein referred to as the "Property" or the "Site"). **Figure 1** presents a Site location map. The Site is listed as Ohio Environmental Protection Agency (EPA) Identification Number OHD981782816 and is owned and maintained by ODOT. This SAP was prepared in support of the proposed groundwater, soil gas, sub-slab soil gas and indoor air monitoring program for the Post-Closure Plan implementation.

1.1 Description of Facility

ODOT utilized the Property since the 1940s as the District 5 Headquarters before closing the facility in 1987. The Property was comprised of administrative offices, equipment storage, vehicle maintenance operations, testing facilities, and other areas in support of road construction and maintenance. The Property is irregular in shape and is approximately five (5) acres in size. Currently, the Property is a vacant grass lot with the exception of a decommissioned remedial system building, which was previously used for groundwater and soil vapor extraction to remove chlorinated organic compounds from the soil and groundwater. The buildings on the Property have been demolished since the facility closing in 1987, which included the main office building and garage, the traffic building, the test laboratory and several small storage buildings.

The Property is located within an area of mixed land use with commercial properties on the west, south and east, and vacant and occupied residential properties to the north, east, south and west (refer to **Figure 2**). A property formerly owned by Dynacraft, Inc. (Dynacraft) is located directly east of the Property. West of the Property is a bulk petroleum storage facility and residential properties. The Property is bordered to the south by a railroad right-of-way owned by CSX Transportation, Inc. Systems with an industrial property occupied by the Modern Welding Company further south.

Several groundwater monitoring wells and permanent soil gas wells are located on these commercial (99 James Street, 100 James Street and 107 South Pine Street) and former residential properties as well as public rights-of-way located adjacent to and within the vicinity of the Property. Collectively, the Property, the commercial and residential properties and public rights-of-way in which groundwater monitoring wells and permanent soil gas wells are located are considered the "Project Area" for discussion purposes.

1.2 Description of Unit C

In 1986, an Ohio Environmental Protection Agency (EPA) Consent Order was signed by ODOT that required ODOT to submit a closure plan for five (5) hazardous waste storage units on the Property. Four (4) units have been approved for closure by the Ohio EPA: a waste storage area (Unit A), a traffic paint storage area (Unit B), a paint shop (Unit D), and a used motor oil storage area (Unit E). The remaining unit, Unit C, is currently undergoing closure.

Unit C is comprised of the former test laboratory building, the laboratory waste accumulation area building, and areas outside of the western walls of both buildings. Drummed test lab residues were accumulated at Unit C for 40 years, from 1947 to 1987. At the time of closure, the majority of the outside storage areas were paved with concrete or worn asphalt. The wastes associated with asphalt testing included 1,1,1-trichloroethane (1,1,1-TCA) and trichloroethene (TCE). The waste was classified as an F002 hazardous waste. A maximum inventory of approximately six (6) 55-gallon drums of waste was reportedly stored in the area. All drums were removed in 1987 when the facility closed.

In 1994, approximately 20,000 cubic yards of soil were removed from Unit C. Subsequent groundwater sampling identified concentrations of TCE and 1,1,1-TCA in groundwater. As a result, a groundwater extraction and treatment system was installed in 1996 to remediate groundwater. However, the groundwater extraction and treatment system was determined to not be performing effectively. As a result, *in-situ* groundwater remediation (persulfate injection) was conducted in September and October 2010 in an effort to reduce TCE concentrations.

2.0 DATA QUALITY OBJECTIVES

The data quality objective (DQO) process is a strategic planning approach that is designed to ensure that the type, quantity and quality of environmental data used in decision making processes are appropriate for the intended application. The DQO process is an iterative process requiring re-evaluation of objectives as the investigation proceeds. DQOs provide a systematic procedure for defining criteria that a data collection design should satisfy, including when to collect samples, sampling locations, the number of samples to collect and tolerable levels of decision error. Based on the outputs of the DQO process, a specific SAP is developed, and may require revision as data are evaluated. The purpose of this SAP is to outline the groundwater, soil gas, sub-slab soil gas and indoor air monitoring program for the Post-Closure Plan implementation. More specifically, this SAP focuses on monitoring the groundwater plume beneath the Project Area and evaluating risk for complete and potentially complete exposure pathways. The DQOs for this SAP are presented below.

- ◆ Obtain accurate static groundwater levels from monitoring wells within the Project Area to monitor groundwater flow.
- ◆ Perform groundwater, soil gas, sub-slab soil gas and indoor air sampling activities using methodologies outlined in **Section 4.0** of this SAP as well as the Field Standard Operating Procedures (FSOP) presented in **Appendix A** in order to obtain samples of environmental media that are accurate and representative.
- ◆ Obtain analytical data of a quality that is sufficient to permit an evaluation of groundwater, soil gas, sub-slab soil gas and indoor air conditions. Groundwater and soil gas analytical data will be utilized to evaluate groundwater plume conditions beneath the Project Area (e.g., stability, attenuation and/or migration). Sub-slab soil gas and indoor air analytical data will be utilized to evaluate risk to receptors within the buildings at 99 James Street, 100 James Street and 107 South Pine Street. Further discussion of the proposed sampling approach is presented in **Section 3.0**, below.
- ◆ Analytical data will include quantified and qualified concentrations. The analytical laboratory will report analytical data that is identified below the practical quantitation limit but above the method detection limit as “estimated” concentrations for a particular analyte.
- ◆ Identify analytical data that are outside acceptance criteria (i.e., data out of laboratory control, or has interference from matrix effects), which may not satisfy DQOs.
- ◆ Provide all data and documentation necessary for the Ohio EPA to conduct a Tier 1 Data Validation.
- ◆ Evaluate analytical data from groundwater, soil gas, sub-slab soil gas and indoor air sampling events in accordance with **Section 2.0** of the Post-Closure Plan dated August 2017. Further discussion of data evaluation is presented in **Section 5.0** of this SAP.

- ◆ If necessary, perform verification sampling within 30 days of receipt of analytical laboratory data should analytical data from sampling events indicate an exceedance of a standard or criteria.
- ◆ Based on the evaluation of analytical data from groundwater, soil gas, sub-slab soil gas and indoor air sampling, determine if additional sampling points (i.e., groundwater monitoring wells, soil gas wells, sub-slab soil gas sample points or indoor air sample locations) are necessary to monitor the groundwater plume and exposure pathways or if a remedy should be implemented such as a sub-slab vapor mitigation system or engineered vapor barrier within the buildings located at 99 James Street, 100 James Street or 107 South Pine Street. Should additional sampling points require installation, the sampling points will be installed in accordance with the methodologies outlined in **Section 4.0** of this SAP as well as the Field Standard Operating Procedures presented in **Appendix A**.

3.0 PROPOSED SAMPLING APPROACH

The proposed sampling approach for collection of groundwater, soil gas, sub-slab soil gas and indoor air samples within the Project Area is presented below in accordance with the Post-Closure Plan dated October 2017. The chemicals of concern (COCs) for all media analysis are the volatile organic compounds (VOCs) presented within the Post-Closure Plan and listed below.

- 1,1,1-TCA
- 1,1-Dichloroethane (1,1-DCA)
- 1,1-Dichloroethene (1,1-DCE)
- 1,2-DCA
- Benzene
- Carbon tetrachloride
- Chlorobenzene
- cis-1,2-DCE
- trans-1,2-DCE
- Methylene chloride
- Tetrachloroethene (PCE)
- Toluene
- TCE
- Vinyl chloride

3.1 Groundwater Monitoring Wells

The groundwater monitoring well network that will be sampled as part of Post-Closure Plan activities is comprised of the twenty-five (25) monitoring wells listed below. Table 1 within the Post-Closure Plan dated October 2017 provides a summary of the purpose of each monitoring well and sampling schedule. **Figure 3** depicts the locations of the monitoring wells within the Project Area. Methodologies to perform groundwater sampling are presented in **Section 4.0, Field Methodologies and Procedures**.

MW-4R	MW-9	MW-20	DMW-9	MW-19
MW-21E	MW-10R	MW-26	MW-2	MW-21
MW-24	MW-14	DMW-3	MW-8	MW-22
MW-6R	MW-15	DMW-5	MW-12	MW-23R
MW-7R	MW-16	DMW-7	MW-17	TMW-AR

The COCs in which groundwater samples from the twenty-five (25) monitoring wells will be analyzed are the VOCs referenced above in **Section 3.0, Proposed Sampling Approach**. Analytical laboratory analysis for the COCs in groundwater samples will be performed in accordance with United States Environmental Protection Agency (U.S. EPA) SW846 Method 8260.

3.2 Soil Gas Wells

The soil gas well network that will be sampled as part of the Post-Closure Plan activities is comprised of the fifteen (15) soil gas wells listed below. **Figure 3** presents the locations of the soil gas wells in the Project Area. Methodologies to perform soil gas sampling are presented in **Section 4.0, Field Methodologies and Procedures**.

SGW-01	SGW-02	SGW-03	SGW-04	SGW-05
SGW-06	SGW-07	SGW-08	SGW-09	SGW-10
SGW-11	SGW-12	SGW-13	GP-1	GP-2

Prior to April 2020, twelve (12) soil gas wells, SGW-01 through SGW-12, were installed around the perimeter of the groundwater plume while two (2) soil gas wells (i.e., GP-1 and GP-2) were installed within the vicinity of the highest concentrations of TCE historically detected in groundwater. On 16 April 2020, a new soil gas well (labeled as SGW-13) was installed approximately 2.5 feet north of well SGW-07 at a shallower depth (6-7 feet bgs) to serve as an alternative sampling well to SGW-07, upon the presence of shallow groundwater. Historically, groundwater has interfered with soil gas sample collection from soil gas well SGW-07, most recently in October 2019. The location of soil gas well SGW-13 is presented on **Figure 3**. A copy of the well completion log that presents soil core descriptions and well installation construction for well SGW-13 is presented in **Appendix C** of the Post-Closure Plan.

When shallow groundwater interferes with soil gas sample collection, the following procedures will be performed:

1. If groundwater is encountered in soil gas well SGW-07 during purging, the purging process will cease and attempts to dewater the soil gas tubing using a peristaltic pump or equivalent technique will be performed for approximately 30 minutes. A second attempt to sample soil gas well SGW-07 will be made the following day. If groundwater interferes with soil gas collection from SGW-07 on day two, soil gas well SGW-13 will serve as an alternate sampling location to SGW-07.
 - a. If groundwater is encountered in soil gas well SGW-13 during purging, the purging process will cease and attempts to dewater the soil gas tubing using a peristaltic pump or equivalent technique will be performed for approximately 30 minutes. If the well can be purged of groundwater, a second attempt to sample the soil gas well will be made the following day. If groundwater precludes soil gas collection from

well SGW-13, a soil gas sample from location SGW-07/SGW-13 will not be collected during that scheduled sampling event and notice will be made to the Ohio EPA.

2. If groundwater is encountered in any other soil gas well during purging, the purging process will cease and attempts to dewater the soil gas tubing using a peristaltic pump or equivalent technique will be performed for approximately 30 minutes.
 - a. A second attempt to sample the soil gas well will be made the following day. If groundwater precludes soil gas collection from a well on day two, a soil gas sample will not be collected during that scheduled sampling event and notice will be made to the Ohio EPA.
3. If the presence of groundwater precludes soil gas sampling from any soil gas well for consecutive sampling periods (i.e. back-to-back semi-annual events), the soil gas monitoring network will be re-evaluated to protect the receptors in that area.

The COCs in which soil gas (air) samples from the soil gas wells will be analyzed are the VOCs listed above in **Section 3.0, Proposed Sampling Approach**, and are identical to the VOCs being analyzed for groundwater samples. Analytical laboratory analysis for the COCs in soil gas (air) samples will be performed in accordance with U.S. EPA Methods TO-15 or 8260.

3.3 Sub-Slab Soil Gas and Indoor Air

Sub-slab soil gas and indoor air samples will be collected within the buildings located at 99 James Street, 100 James Street and 107 South Pine Street as part of Post-Closure Plan activities. In addition, one (1) ambient (exterior) air sample will be collected in conjunction with indoor air sampling. **Figure 3** presents the locations of 99 James Street, 100 James Street and 107 South Pine Street. Methodologies to perform sub-slab soil gas and indoor air sampling are presented in **Section 4.0, Field Methodologies and Procedures**. Information concerning the sub-slab soil gas and indoor air sample locations within the buildings at 99 James Street, 100 James Street and 107 South Pine Street is presented in the following table.

Location Address	Use of Location	Building Construction	Sub-Slab Soil Gas Sample Location(s)	Indoor Air Sample Location(s)
99 James Street	Commercial (Property Maintenance Contractor)	Slab, On-Grade	Along south wall of large room	Large room
100 James Street	Commercial (Day Habilitation Services)	Slab, On-Grade	1) Northwest corner of vestibule and 2) West Hallway	1) East side office and 2) West Hallway
107 South Pine Street	Commercial (Day Habilitation Services)	Slab, On-Grade	1) Northwest corner of mechanical room and 2) Along north wall of gym	1) Mechanical room and 2) Gym

The COCs in which sub-slab soil gas (air) and indoor air samples from 99 James Street, 100 James Street and 107 South Pine Street will be analyzed are the VOCs listed below and are identical to the VOCs being analyzed for groundwater samples and soil gas samples from the soil gas wells. Analytical laboratory analysis for the COCs in sub-slab soil gas (air) and indoor air samples will be performed in accordance with U.S. EPA Methods TO-15 or 8260.

- ◆ 1,1,1-TCA
- ◆ 1,1-DCA
- ◆ 1,1-DCE
- ◆ 1,2-DCA
- ◆ Benzene
- ◆ Carbon tetrachloride
- ◆ Chlorobenzene
- ◆ cis-1,2-DCE
- ◆ trans-1,2-DCE
- ◆ Methylene chloride
- ◆ PCE
- ◆ Toluene
- ◆ TCE
- ◆ Vinyl chloride



4.0 FIELD METHODOLOGIES AND PROCEDURES

The field methodologies and procedures for collection of groundwater, soil gas, sub-slab soil gas and indoor air samples at the Project Area are presented and described in the following subsections. In addition, field methodologies and procedures for installing additional sampling points (i.e., groundwater monitoring wells, soil gas wells, sub-slab soil gas sample points and indoor air sample locations) are presented in each subsection in the event additional sampling points are necessary to install. Field activities will be conducted in general conformance with this SAP, HZW's Field Standard Operating Procedures presented in **Appendix A**, the Ohio EPA's *Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring* (updated periodically) and the Ohio EPA's *Sample Collection and Evaluation of Vapor Intrusion to Indoor Air* Guidance Document (May 2010 and subsequent updates).

4.1 Groundwater Sampling Methodologies and Procedures

Groundwater samples will be collected from the twenty-five (25) monitoring wells referenced in **Section 3.1** using low-flow purging and sampling techniques. In order to collect representative groundwater samples from monitoring wells, the monitoring wells must be adequately purged prior to sampling and no earlier than 24 hours after well development (for new monitoring wells). Purging will require the removal of water necessary to meet the stabilization criteria. A low-flow sampler and dedicated polyethylene tubing will be used in the purging and sampling of each monitoring well.

HZW's Field Standard Operating Procedures in **Appendix A** that are applicable to groundwater sampling are listed below. Certain activities presented in separate subsections (such as monitoring well inspection or groundwater elevation measurement) are included as part of HZW's FSOP #203 – Groundwater Sampling Standard Operating Procedure.

- ◆ FSOP #203 – Groundwater Sampling Standard Operating Procedure
- ◆ FSOP #005 – Equipment Calibration Standard Operating Procedure
- ◆ FSOP #006 – Field Equipment Decontamination Standard Operating Procedure
- ◆ FSOP #007 – Investigation-Derived Waste Standard Operating Procedure

4.1.1 Monitoring Well Inspection

At the time of each groundwater sampling event, the monitoring wells should be inspected prior to initiating groundwater sampling activities. Monitoring well inspection activities will include the following:

1. Visually inspect the protective cover or flushmount for any damage and record any damage to the well.
2. Identify and record any unusual conditions such as standing water around the protective cover or flushmount that could contribute to surface contamination.

3. The lid of the protective cover or flushmount should be carefully opened to observe if any insects or standing water are present within the protective cover or flushmount. Chemical sprays should not be used to kill insects and standing water should be evacuated from the protective cover or flushmount interior.
4. Evaluate if any unusual odors are emanating from the monitoring well. Additional field measurements using a multi-gas meter or photoionization detector may be required if the unusual odors are present.

4.1.2 Groundwater Elevation Measurement

Groundwater level measurements will be obtained from all the monitoring wells in the Project Area on the same calendar day or, in unusual circumstances, within a 24-hour period. The groundwater level measurements will be obtained using an electronic water level indicator or an interface probe. Once the friction cap is removed from the well, the groundwater levels will be allowed to equilibrate prior to collecting groundwater measurements. Procedures for obtaining groundwater level measurements are presented below.

1. Prior to using the electronic water level indicator or interface probe, the instrument should be cleaned in accordance with established decontamination procedures.
2. Identify the location on the monitoring well in which groundwater levels have been measured during previous sampling events. If the well is newly-installed, a measuring point should be designated on the well.
3. Slowly lower the water level indicator or interface probe into the well until the electrode comes in contact with the groundwater and/or non-aqueous phase liquid surface.
4. Record the measurement(s) on the indicator or probe tape to the nearest one-hundredth of a foot (0.01 foot).
5. Once the water level indicator or interface probe is removed from the well, the indicator or probe should be cleaned in accordance with established decontamination procedures prior to using the indicator or probe is used in the next well.

4.1.3 Groundwater Purging and Sampling Equipment

Groundwater purging and sampling activities will be completed using low-flow purging and sampling techniques. Specifically, low-flow purging and sampling techniques will be conducted with a bladder pump and an in-line multi-parameter water quality meter equipped with a flow-through cell. A description of the low-flow purging and sampling equipment is presented below.

Bladder Pump: A portable bladder pump and controller (such as the QED Sample Pro[®] portable micropurge pump and micropurge MP15 backpack unit or an equivalent pump/unit acceptable to the Ohio EPA) will be utilized. The bladder pump uses either compressed gas

(carbon dioxide) or an oil-less compressor and an electrical source for operating the pump. A typical bladder pump is constructed of stainless steel with a disposable polyethylene bladder inside the pump housing. On a typical bladder pump, groundwater enters the inlet in the upper head section of the pump and flows down into the bladder. Groundwater is forced out of the bladder by the compressed gas or air. A bladder pump typically has check valves with stainless steel seats and check balls at the groundwater inlet and outlet. After use at a monitoring well, the pump housing will be decontaminated and the polyethylene bladder replaced. Although reference is made to QED products, an equivalent bladder pump constructed of similar inert materials may be utilized for low-flow purging and sampling activities. As indicated above, polyethylene tubing will be utilized in sampling activities and non-reactive polypropylene string will be connected to the bladder pump housing in order to raise and lower the pump. The tubing and string will be replaced between sampling monitoring wells.

Multi-Parameter Water Quality Meter: A multi-parameter water quality meter (such as a Horiba U-50 series meter or an equivalent acceptable to the Ohio EPA) equipped with a flow-through cell will be utilized to monitor field stabilization parameters. Selection of the water quality meter will be based upon availability from a commercial environmental rental supply company and a review/evaluation of field indicator parameter readings from sampling events. The water quality meters are calibrated by the commercial environmental rental supply company with field calibration completed each day of use. Field calibration will be recorded at the start of each day. A copy of HZW's Field Calibration Form is presented in **Appendix B**.

4.1.4 Groundwater Purging and Sampling Procedures

Groundwater purging and sampling activities will be conducted in general conformance with HZW's FSOP #203 – Groundwater Sampling Standard Operating Procedures presented in **Appendix A**. Low-flow purging and sampling procedures involve slowly lowering the bladder pump, tubing and non-reactive polypropylene string attached to the bladder pump housing into the well. The bladder pump will be set at the center of the well screen or the center of the water column. A short period of time (e.g., 10-15 minutes) will elapse to allow groundwater levels to equilibrate with the introduction of the pump into the well. After the short period of time, an electronic water level indicator will be lowered into the monitoring well to measure the static groundwater level. The static groundwater level indicator will remain in the monitoring well the duration of purging and sampling activities.

Purging activities will be initiated with the bladder pump set at the lowest pumping rate. Static groundwater levels will be monitored and pumping rate adjusted accordingly until little or no drawdown is occurring or drawdown has stabilized. Field indicator parameters will be collected and the static groundwater level monitored every five (5) minutes once drawdown has stabilized. The field indicator parameters and static groundwater levels will be recorded on the field sampling sheets, which are presented in **Appendix B**.

In accordance with Chapter 10 of the Ohio EPA's *Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring*, it is recommended that specific conductivity and two (2) other parameters be selected for well stabilization criteria. Given that VOCs are the only COC for groundwater, certain stabilization criteria such as turbidity provide limited benefit in the Site monitoring and analysis program (i.e., VOC data are not biased by turbidity). Empirical monitoring well sampling data from the Project Area reveal no correlation between turbidity levels and concentrations of VOC in groundwater (refer to groundwater summary data within HZW's Post-Injection Monitoring Summary Reports since circa 2011). Moreover, ongoing technical research indicates no correlation between turbidity levels and VOC concentrations (GWMR, 1997). Therefore, the principal Site indicators suggesting well stabilization will be specific conductance, pH, and oxidation-reduction potential (ORP). Temperature will be monitored for stabilization due to its importance in data interpretation with VOCs. Based on the method of sampling (i.e., bladder pump) fairly consistent temperatures are anticipated throughout the purging and sampling process at each well location.

Specifically, the Site field indicator parameters will be considered stabilized when three (3) consecutive readings within five (5) minutes from each other meet the stabilization criteria from the select parameters listed below as presented in Chapter 10 of the Ohio EPA's *Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring*.

- ◆ Specific Conductivity ($\pm 3\%$)
- ◆ pH (± 0.2 Standard Unit)
- ◆ Oxidation-Reduction Potential (± 20 millivolts)
- ◆ Temperature ($\pm 0.5^\circ$ Celsius)

The indicator parameters turbidity and dissolved oxygen (DO) will also be monitored to suggest potential groundwater changes during purging. Attempts will be made to stabilize turbidity to 10 NTUs or less and DO levels within 10% or ± 0.2 milligrams per liter prior to sampling. However, they will not be utilized as the principal or primary indicator parameters for the Site.

Upon determination of field indicator parameters being stabilized, a groundwater sample will be collected from the monitoring well. Please note that if the principal Site indicator parameters have not stabilized within an hour of purging, a sample will be collected and considered representative given the conditions. Groundwater will be transferred directly from the bladder pump tubing to clean, preserved (as necessary), laboratory-supplied containers and placed in an iced sample cooler for preservation in the field.

In the event that the recharge rate of a well was less than the lowest achievable pumping rate and the well was dewatered during purging, a groundwater sample will be collected as soon as the groundwater level has recovered sufficiently to collect a sample, even if the principal Site field indicator parameters have not stabilized.

4.1.5 Groundwater Sample Handling

All groundwater samples collected during a sampling event will be placed in an iced cooler in the field with appropriate chain-of-custody documentation. The sample containers will be wrapped in protective packaging (e.g., bubble wrap) for transport. A sufficient amount of ice will be maintained in all field coolers and any melted ice (i.e., water) drained from the cooler, if necessary. If samples are not transported to the analytical laboratory directly from the field, the groundwater samples will be temporarily stored in a sample refrigerator maintained at a temperature of approximately 4° Celsius. All groundwater sample containers will be wrapped in protective packaging during transport to the analytical laboratory and a sufficient amount of ice present to maintain a temperature of approximately 4° Celsius.

4.1.6 Quality Control Samples

Field quality control (QC) samples will be collected during the sampling events in general conformance with U.S. EPA publication SW-846. QC samples will be collected in such a way that ensures clear association between the environmental samples and the relevant QC sample. Definitions, sampling requirements and frequency of collection of the field QC samples are described below.

Equipment Blanks: Water (typically Type II Reagent Grade Water, or, at a minimum distilled water) is poured into or pumped through the sample device after decontamination, transferred to the sample bottle, then transported to the laboratory for analysis. Equipment blanks are a type of U.S. EPA field blank. One equipment rinseate blank will be collected each day groundwater sampling activities is performed. The equipment rinseate blanks will be analyzed for the COCs for which the groundwater samples will be analyzed.

Trip Blanks: A sample volatile 40 milliliter vial filled by the analytical laboratory with Type II Reagent-Grade Water that is transported with the sample media to the Project Area, handled as a sample and returned to the analytical laboratory for analysis. One trip blank will be provided for each cooler containing volatile organic compound (VOC) samples sent to the analytical laboratory and will be analyzed for VOCs only.

Field Duplicate Samples: A second water sample collected independently at the same location as the original sample during sampling activities. The total number of field duplicates for each analysis will be one per ten or fewer aqueous samples per exposure area per analytical method. The analytical laboratory will not be able to relate the field duplicates to the associated field samples. One complete sample set will be identified with a coded or false identifier. Both the false and the true identifiers will be recorded in the field notebook. These coded field duplicates are used to assess the representativeness of the sampling procedure.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Samples: A single sample divided into three (3) equal parts for analysis. An aliquot of the matrix is spiked with a known

concentration of all compounds of interest. The MS/MSD are subjected to the entire analytical procedure in order to indicate both accuracy and precision of the method for the matrix by measuring the percent recovery and the relative percent difference of the two spiked samples. These samples are used to assess matrix interference effects on the method, as well as to evaluate instrument performance. The MS/MSDs do not control the analytical process. MS/MSDs are analyzed for every 20 environmental samples of each matrix and each analysis per exposure area.

4.1.7 Field Decontamination

All non-disposable equipment will be decontaminated between sampling monitoring wells. The non-disposable equipment that is anticipated to be decontaminated consists of the electronic water level indicator, the flow through cell for the water quality meter and the bladder pump. The Teflon®-line polyethylene tubing and polypropylene string connected to the bladder pump and the polyethylene bladder in the pump housing will be replaced between monitoring wells.

Decontamination procedures will consist of using a Liqui-Nox® cleaning solution and triple-rinsing the equipment with distilled water. All decontamination waters generated as part of the decontamination procedures will be combined with the purge waters generated during a sampling event.

4.1.8 Investigation-Derived Waste

All purge and decontamination waters generated during a sampling event will be placed in DOT-approved 55-gallon drums, labeled, and placed on the former ODOT District 5 Headquarters property pending proper disposal. At the completion of groundwater sampling activities for a sampling event, a composite water sample will be collected from the 55-gallon drums containing purge and decontamination water. The composite water sample will be analyzed for VOCs by U.S. EPA SW-846 Method 8260. Based on the results of laboratory analysis, the purge and decontamination waters are either discharged to the City of Newark sanitary sewer during the subsequent quarterly sampling event or disposed of as hazardous waste prior to the drums being at the former ODOT District 5 Headquarters property for 90 days.

4.2 Soil Gas Sampling Methodologies and Procedures

Soil gas samples will be collected from the thirteen (13) soil gas wells referenced in **Section 3.2**. Representative soil gas samples will be collected from each soil gas well following adequate purging activities. Soil gas samples will not be collected from soil gas wells if a rainfall event greater than one-half inch occurred within 24 hours of the anticipated start of sampling activities.

HZW's Field Standard Operating Procedures in **Appendix A** that are applicable to soil gas sampling are listed below.

- ◆ FSOP #301 – Soil Gas Sampling Standard Operating Procedure
- ◆ FSOP #005 – Equipment Calibration Standard Operating Procedure

4.2.1 Soil Gas Well Inspection

At the time of each soil gas sampling event, the soil gas wells should be inspected prior to initiating soil gas sampling activities. Soil gas well inspection activities will include the following:

1. Visually inspect the protective cover or flushmount for any damage and record any damage to the well.
2. Identify and record any unusual conditions such as standing water around or in the protective cover or flushmount that could contribute to contamination or limit collection of a soil gas sample.
3. The lid of the protective cover or flushmount should be carefully opened to observe if any insects are present within the protective cover or flushmount. Chemical sprays should not be used to kill insects.

The condition of the soil gas well may warrant further evaluation (e.g., perform a leak test) or installation of a new soil gas well.

4.2.2 Soil Gas Well Purging Equipment

Soil gas well purging activities will be performed prior to collecting a soil gas sample from each well. A soil gas well will be purged of stagnant air (i.e., air present in the sand pack around the vapor implant and in the soil gas well tubing) using either a multi-gas meter (such as a RAE® Systems Multi-RAE meter or an equivalent with an acceptable flow rate) or a dedicated, plastic 60 milliliter syringe.

If a multi-gas meter is selected to purge the soil gas wells, the multi-gas meter must have a manufacturer-documented flow rate of approximately 200 milliliters per minute (the recommended sample collection flow rate in the Ohio EPA's *Sample Collection and Evaluation of Vapor Intrusion to Indoor Air* Guidance Document dated May 2010). The advantages in using a multi-gas meter are 1) the purging rate is automatic and relatively consistent and 2) certain indicator parameters such as oxygen levels, lower explosive limit measurements and bulk organic vapor concentrations can be monitored during purging activities. Selection of a specific multi-gas meter will be based upon availability from a commercial environmental rental supply company and a review of the manufacturer-documented flow rates for the meter. The multi-gas meter is calibrated by the commercial environmental rental supply company with field calibration completed each day of use. Field calibration of a multi-gas meter will be recorded in the field notes.

The use of a dedicated, plastic 60 milliliter syringe will require manual operation of the syringe. When purging with a syringe, the syringe plunger should be withdrawn at a slow and consistent rate such as not to purge air from the soil gas well in excess of 200 milliliters per minute.

4.2.3 Soil Gas Well Purging and Sampling Procedures

The purging of a soil gas well will be completed according to its documented well construction. With the construction details, the approximate volume of air to be purged from each soil gas well can be calculated using the Soil Gas/Indoor Air Sampling Data Form presented in **Appendix B**. The procedures for purging and sampling a soil gas well are described below.

1. Check to make sure the valve on the Summa canister is and remains closed.
2. Connect the sample train (200 milliliter per minute flow regulator and vacuum gauge) to either a one (1) or six (6) Liter, batch-certified clean Summa canister. Do not overtighten the connection fittings.
3. On the sample end of the sample train, attach a short length of Teflon[®] tubing. Insert a plastic 60 milliliter syringe into the open end of the Teflon[®] tubing and perform a “shut-in” test on the sample train and Summa canister to ensure that no leaks are occurring at the connections. If a vacuum cannot be held on the sample train, check all fittings and repeat the “shut-in” test until a vacuum can be maintained or replace the sample train and/or Summa canister with a replacement.
4. Remove the cap or plug that seals the tubing in the soil gas well and insert a dedicated 3-way stopcock into the soil gas well tubing. Short lengths of Teflon[®] tubing will be attached to the other stopcock ports to allow purging and sampling.
5. Once the “shut-in” test is complete, attach the Summa canister and sample train to the end of the Teflon[®] tubing on the remaining available port of the 3-way stopcock.
6. At one end of the Teflon[®] tubing attach to an available port on the 3-way stopcock, the multi-gas meter or plastic, 60 milliliter syringe. If any flexible tubing is necessary to make connections, very short lengths (generally one inch or less) of Tygon[®] tubing should be used. The use of the multi-gas meter allows the soil gas well to be purged continuously, while the plastic syringe must be removed after withdrawing 60 milliliters of air. Once the plastic syringe is filled, the stopcock should be turned to close off the tubing from the soil gas well to the syringe. The syringe can then be removed and the syringe plunger depressed to push the air out of the syringe. Then, the plastic syringe can be reattached to the Teflon[®] tubing on the port of the 3-way stopcock, open the tubing from the soil gas well to the syringe and continue purging activities with the syringe.
7. Once the soil gas well has been purged, a soil gas sample will be collected. The soil gas sample will be collected in a one (1) or six (6) Liter, batch-certified clean, stainless steel Summa canister equipped with a dedicated sample train consisting of a flow controller regulated at 200 milliliters per minute and a vacuum gauge. The Summa canister will

- have an attached tag identifying the soil gas sample as well as places to indicate sample collection start and end times and sample collection start and end vacuum readings.
8. Open the valve on the Summa canister to begin collecting the soil gas sample and continue until the vacuum is between -2 and -5 mmHg. Upon reaching a vacuum of -2 to -5 mmHg, close the valve on the Summa canister.
 9. Disconnect the sample train and replace the ferrule nut on the Summa canister.
 10. Check that all the required information is recorded on the Summa canister tag and in the Soil Gas/Indoor Air Sampling Data Forms.

4.2.4 Soil Gas Sample Handling

Soil gas samples are collected in stainless steel Summa canisters with appropriate chain-of-custody documentation. Once a soil gas sample is collected, the Summa canister is returned to the box with protective packaging material in which it was shipped by the analytical laboratory for return transport to the analytical laboratory. Soil gas samples will be transported to the analytical laboratory by overnight courier under chain-of-custody documentation. Attempts will be made to keep the Summa canisters from being exposed to extreme temperatures (hot, cold) and direct sunlight.

4.2.5 Quality Control Samples

The QC samples that will be collected as part of soil gas well sampling activities will consist of a field duplicate sample. One (1) field duplicate soil gas sample will be collected from a soil gas well during each sampling event.

4.3 Sub-Slab Soil Gas Sampling Methodologies and Procedures

Sub-slab soil gas samples will be collected from sample points in 99 James Street, 100 James Street and 107 South Pine Street at the locations identified in **Section 3.3**. HZW's Field Standard Operating Procedures in **Appendix A** that are applicable to sub-slab soil gas sampling are FSOP #301 – Soil Gas Sampling Standard Operating Procedures.

4.3.1 Sub-Slab Soil Gas Sample Point Inspection

At the time of each sub-slab soil gas sampling event, the sub-slab soil gas sample point should be inspected prior to initiating sub-slab soil gas sampling activities. Inspection of the sub-slab soil gas sample points will include, but is not limited to, observing the following:

- ◆ If the plastic floor cover cap is damaged;
- ◆ If the cap on the stainless steel barb is missing;
- ◆ If any damage has occurred to the sample point such as the steel barb being bent or the silicone sleeve around the steel barb appears to be deteriorating;

- ◆ If a noticeable amount of dirt or debris is accumulating around the sample point;
- ◆ If water is present on the floor near or over the sample point; and
- ◆ If a chemical was spilled or is stored in the vicinity of the sample point.

The condition of the sub-slab soil gas sample point may warrant further evaluation (e.g., perform a leak test) or installation of a new sub-slab soil gas sample point.

4.3.2 Sub-Slab Soil Gas Sampling Procedures

Sub-slab soil gas samples will be collected in one (1) or six (6) Liter, batch-certified clean, stainless steel Summa canisters equipped with dedicated sample trains consisting of flow controllers regulated at 200 milliliters per minute and vacuum gauges. The Summa canisters will have an attached tag identifying the sub-slab soil gas sample as well as places to indicate sample collection start and end times and sample collection start and end vacuum readings. The procedures for collecting sub-slab soil gas samples are presented below.

1. Assemble the Summa canister and sample train. Make sure the valve on the Summa canister remains closed.
2. Attach a short length of Teflon[®] tubing to the sample end of the sample train. Insert a plastic, 60 milliliter syringe into the open end of the Teflon[®] tubing and perform a “shut-in” test on the sample train and Summa canister to ensure that no leaks are occurring at the connections. If a vacuum cannot be held on the sample train, check all fittings and repeat the “shut-in” test until a vacuum can be maintained.
3. Once the “shut-in” test is complete, attach a 3-way stopcock to the Teflon[®] tubing on the end of the sample train. Use a second length of Teflon[®] tubing from the sub-slab soil gas sample point to the 3-way stopcock. The length of tubing should be as short as possible. If any flexible tubing is necessary to make connections, very short lengths (generally one inch or less) of Tygon[®] tubing should be used.
4. Insert a dedicated, plastic, 60 milliliter syringe into the remaining available port on the 3-way stopcock connected with a small length of Teflon tubing. Turn the 3-way stopcock to purge the volume of ambient air in the tubing from the sub-slab soil gas sample point to the 3-way stopcock.
5. Once the tubing is purged, turn the 3-way stopcock for the soil gas sample to be collected by the Summa canister. Open the valve on the Summa canister to begin collecting the sub-slab soil gas sample and continue until the vacuum is between -2 and -5 mmHg. Upon reaching a vacuum of -2 to -5 mmHg, close the valve on the Summa canister.
6. Disconnect the sample train and replace the ferrule nut on the Summa canister.
7. Check that all the required information is recorded on the Summa canister tag and in the Soil Gas/Indoor Air Sampling Data Forms.

4.3.3 Sub-Slab Soil Gas Sample Handling

Sub-slab soil gas samples are collected in stainless steel Summa canisters with appropriate chain-of-custody documentation. Once a sub-slab soil gas sample is collected, the Summa canister is returned to the box with protective packaging material in which it was shipped by the analytical laboratory for return transport to the analytical laboratory. Sub-slab soil gas samples will be transported to the analytical laboratory by overnight courier under chain-of-custody documentation. Attempts will be made to keep the Summa canisters from being exposed to extreme temperatures (hot, cold) and direct sunlight.

4.3.4 Quality Control Samples

The QC samples that will be collected as part of sub-slab soil gas sampling activities will consist of a field duplicate sample. One (1) field duplicate sub-slab soil gas sample will be collected during each sampling event.

4.4 Indoor Air Sampling Methodologies and Procedures

Indoor air samples will be collected from locations within the buildings located at 99 James Street, 100 James Street and 107 South Pine Street as identified in **Section 3.3**. HZW's Field Standard Operating Procedures in **Appendix A** that are applicable to indoor air sampling are SOP #401 – Indoor and Ambient Air Sampling Standard Operating Procedures.

4.4.1 Pre-Sampling Activities

Prior to initiating indoor air sample collection activities, a brief building inspection will be conducted. Inspection activities will identify and inventory all chemicals stored or used in the building and any other potential sources of volatile compounds in the building. An initial building survey will be completed and updated as necessary during sampling events. In addition, interviews with personnel may be conducted to assist in identifying, reducing or eliminating the impact of building occupant activities. Information obtained during the buildings inspection and interviews will be recorded on HZW's Soil Gas/Indoor Building Survey Form, a copy of which is presented in **Appendix B**.

4.4.2 Indoor Air Sampling Procedures

Indoor air samples will be collected in six (6) Liter, batch-certified clean, stainless steel Summa canisters equipped with dedicated sample trains consisting of appropriate flow controllers (i.e., 8-hour flow controllers for commercial/industrial properties or 24-hour flow controllers for residential properties) and vacuum gauges. The Summa canisters will have an attached tag identifying the indoor air sample as well as places to indicate sample collection start and end times and sample collection start and end vacuum readings. The procedures for collecting indoor air samples are presented below.

1. Assemble the Summa canister and sample train. Make sure the valve on the Summa canister remains closed.
2. Attach a short length of Teflon® tubing to the sample end of the sample train. Insert a plastic, 60 milliliter syringe into the open end of the Teflon® tubing and perform a “shut-in” test on the sample train and Summa canister to ensure that no leaks are occurring at the connections. If a vacuum cannot be held on the sample train, check all fittings and repeat the “shut-in” test until a vacuum can be maintained.
3. Once the “shut-in” test is complete, remove the Teflon tubing from the end of the sample train and open the Summa canister valve to begin sample collection. Record the sample collection start time and the initial pressure of the canister.
4. Return to the sample location approximately 30 minutes prior to sample collection termination. Stop sample collection at the appropriate time by closing the valve on the Summa canister. Record the sample end time and final vacuum reading, which should be between -2 and -5 mmHg.
5. Disconnect the sample train and replace the ferrule nut on the Summa canister.
6. Check that all the required information is recorded on the Summa canister tag and in the Soil Gas/Indoor Air Sampling Data Forms.

4.4.3 Indoor Air Sample Handling

Indoor air samples are collected in stainless steel Summa canisters with appropriate chain-of-custody documentation. Once an indoor air sample is collected, the Summa canister is returned to the box with protective packaging material in which it was shipped by the analytical laboratory for return transport to the analytical laboratory. Indoor air samples will be transported to the analytical laboratory by overnight courier under chain-of-custody documentation. Attempts will be made to keep the Summa canisters from being exposed to extreme temperatures (hot, cold) and direct sunlight.

4.4.4 Quality Control Samples

The QC samples that will be collected as part of indoor air sampling activities will consist of a field duplicate sample and an ambient (exterior) air sample. One (1) field duplicate indoor air sample and one (1) ambient air sample will be collected during each sampling event. The ambient air sample location will be in an area of unobstructed airflow way from features that may influence the ability to collect a representative sample.

4.5 Installation of Additional Sampling Points

The findings of groundwater, soil gas, sub-slab soil gas and indoor air monitoring activities may identify the need to install additional sampling points (i.e., groundwater monitoring wells, soil

gas wells, sub-slab soil gas sample points and indoor air sample locations) as part of the Post-Closure Plan. The methodologies for installing additional sampling points are presented in the subsections below.

4.5.1 Groundwater Monitoring Wells

Permanent groundwater monitoring wells will be installed using either a hydraulic direct-push drilling unit (such as a Geoprobe® or equivalent) equipped with hollow-stem augers or a conventional drilling rig. Any permanent groundwater monitoring well installed by HZW will be installed using a Geoprobe® drilling unit, and any permanent groundwater monitoring well installed by a drilling sub-contractor will be installed using either a hydraulic direct-push drilling unit or a conventional drilling rig. In general, the use of a hydraulic direct-push drilling unit will be limited to permanent monitoring wells installed at shallower depths (i.e., maximum of 20 to 25 feet below ground surface), whereas a conventional drilling rig will be used to install permanent monitoring wells at depths greater than 20 to 25 feet below ground surface.

Any replacement or newly installed monitoring well will be continuously logged by a qualified field geologist or environmental scientist and subsurface soil samples may be collected. When a hydraulic direct-push drilling unit is utilized to install a monitoring well, subsurface soils will be collected continuously using direct-push dual-tube drilling and sampling techniques *prior to* installing the monitoring well. (The methodology to install soil borings using direct-push dual-tube drilling and sampling techniques is presented in HZW's FSOP #101 – Soil Boring Installation Standard Operating Procedures in **Appendix A**) However, when a conventional drilling rig is utilized to install a monitoring well, subsurface soils will be collected continuously with a two-foot long, two-inch diameter split-spoon sampler *at the time* of monitoring well installation. The use of the split-spoon sampler will be in accordance with the Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils (ASTM D 1586) procedure with a blow count recorded every six (6) inches. Soil samples, if collected during monitoring well installation, will be collected and field screened in conformance with HZW's FSOP #102 – Soil Sampling Standard Operating Procedure and HZW's FSOP #103 – Soil Sample Field Screening Standard Operating Procedure in **Appendix A**.

Monitoring well casings will consist of two- (2-) inch inside diameter, Schedule 40, polyvinyl chloride (PVC) riser pipe with flush, threaded joints. The well screen will consist of a ten- (10-) foot long, two- (2-) inch inside diameter 0.01-inch machine slotted PVC screen. Since groundwater is confined to the silty sand and distinct sand and gravel units approximately 15 to 30 feet below ground surface, each well will be constructed such that the screen extends across the lower portion of the water-producing zone. The actual depth of the screen will be determined during well installation. The sand pack will consist of washed, medium sand that will be placed around the annular space around the well screen and extend two (2) feet above the well screen.

A bentonite seal with a minimum thickness of two (2) feet will be placed above the top of the sand pack. The remaining annular space for the monitoring well will be filled with either a bentonite slurry or bentonite chips to a depth of one (1) foot below ground surface. The monitoring well will be completed as a flushmount or with an above-grade protective cover. In general, monitoring wells installed in paved areas will be completed as flushmounts, while monitoring

wells installed in grass areas will be completed with above-grade protective covers. The flushmount cover or above-grade protective cover will be set above the monitoring well with concrete in the remaining annular space in the monitoring well.

The procedures to install permanent monitoring wells are presented below and in HZW's FSOP #201 – Monitoring Well Installation Standard Operating Procedure in **Appendix A** for two-inch monitoring wells.

1. The boring will be advanced to the targeted depth using 4.25-inch inside diameter hollow-stem augers.
2. At terminal depth, the center plug or inner cutting head will be removed to verify the borehole depth using a weighted tape measure.
3. Approximately one (1) foot of washed, medium sand will be placed at the bottom of the borehole.
4. The two- (2-) inch PVC well screen and riser pipe will be assembled and inserted into the borehole through the hollow-stem augers. A PVC end cap will be threaded to the bottom of the well screen.
5. Washed, medium sand will be slowly poured in the annular space around the well screen. A weighted tape measure and probe rods will be lowered into the borehole to prevent bridging of the sand. The sand pack will extend approximately two (2) feet above the well screen and the top of the sand pack measured with a weighted tape measure.

The rate of removal of the auger flights from the borehole will follow the rate that the sand pack fills the borehole. Augers will remain in the borehole (at a minimum) at approximately the same elevation as the top of the sand pack.

6. Following placement of the sand pack, bentonite chips will be poured in the annular space above the sand pack creating a bentonite seal. The bentonite seal will extend a minimum of two (2) feet above the sand pack and will be hydrated with distilled water after placement of every one (1) foot of bentonite chips. In the event that groundwater is observed above the top of the sand pack, a bentonite slurry will be used as the presence of groundwater may prevent proper placement and sealing of the bentonite chips. The bentonite slurry will be pumped through a side discharge tremie pipe.

The rate of removal of the auger flights from the borehole will follow the rate that the bentonite chips/bentonite slurry fills the borehole. Augers will remain in the borehole (at a minimum) at approximately the same elevation as the top of the sand pack.

7. The remaining annular space in the monitoring well will be filled with either a bentonite slurry (mixed in a ratio of 20-23 gallons of potable water to 50 pounds of

- bentonite) or bentonite chips that are hydrated with distilled water every foot. If a bentonite slurry is used, the slurry will be pumped into the borehole through a side discharge tremie pipe. The bentonite slurry or bentonite chips will be added continuously to the annular space as the auger flights are retracted at the rate the bentonite slurry or bentonite chips fills the borehole. The bentonite slurry or bentonite chips will fill the borehole to approximately one (1) to two (2) feet below ground surface.
8. The monitoring well will be completed with a flushmount cover or with an above-grade protective cover. The remaining annular space in the borehole will be filled with concrete with the cover (either flushmount or above-grade protective) placed in the concrete. The concrete pad around the flushmount cover or above-grade protective cover will slope away from the cover.
 9. The top of the riser pipe will be marked or notched to identify the measuring point for obtaining static water levels. An expansion (friction) cap will be placed in the top of the riser pipe for a water-tight seal.
 10. If an above-grade protective cover is used, the cover will be secured with a lock. A drain hole may be installed above the ground surface in the protective cover if a drain hole has not been pre-drilled.
 11. The monitoring well will be permanently labeled with the well identification.

Following monitoring well installation, the newly-installed monitoring well will be developed. The newly-installed monitoring well will need to cure a minimum of 24 to 48 hours after installation before performing well development activities. Monitoring well developed is performed to a) removed fluids that may have been introduced during well installation activities, b) remove fine sediment from the vicinity of the well screen, and c) ensure good hydraulic interconnection between the sand filter pack and the adjacent geologic materials in which the well screen is installed. Monitoring wells will generally be developed by surging and purging techniques or purging with an inertial lift pump. Certain considerations must be accounted for when performing well development activities such as excessive or vigorous surging can permanently damage a well or surging a well installed in silt or clay may introduce more fine sediment into the well.

The procedures to develop monitoring wells are presented below and in HZW's FSOP #202 – Monitoring Well Development Standard Operating Procedure in **Appendix A**. Well development activities will be documented in HZW's Monitoring Well Field Data Sheets.

1. Obtain depth to groundwater and total depth measurements from each monitoring well using an electronic water level indicator or interface probe. The indicator or probe should be decontaminated prior to use and between each monitoring well. Measurements should be taken from the marked or notched location on the well riser pipe and all readings recorded to the nearest one-hundredth of a foot.

2. Well development will proceed by removing an equivalent volume of fluid as the volume of drilling fluids used during well construction followed by a removal of five (5) successive well volumes of water from the well. Well development procedures for surging and pumping and purging with an inertial lift pump are presented below.

Surging and Pumping

- a. Start at the bottom of the well screen and gradually work upwards in 2 to 3 foot intervals to the top of the well, surging slowly with a surge block, a pump equipped with a surge block or the pump.
- b. Surge for one (1) minute and then pump the well to remove at least one (1) well volume of sediment-laden water.
- c. Repeat this process and continue to pump the well at a sustainable rate.

Inertial Lift Pump

- a. If using an inertial lift pump with a surge block attachment, start at the bottom of the well screen and gradually work upwards in 2 to 3 foot intervals to the top of the well, surging slowly.
 - b. Surge for one (1) minute then purge the well to remove at least one (1) well volume of sediment-laden water.
 - c. Repeat this process and continue to purge the well at a sustainable rate. The pump foot valve should be within two (2) inches of the bottom of the well during purging to remove sediment.
 - d. If using an inertial lift pump without a surge block attachment, purge the well at a sustainable rate. The pump foot valve should be within two (2) inches of the bottom of the well during purging to remove sediment.
3. After each well volume is removed, measure field water quality parameters to evaluate if the parameters meet stabilization criteria. At a minimum the field water quality parameters that will be monitored include specific conductance, pH, and ORP. Temperature will also be utilized as a fourth stabilization and/or data management criterion. The indicator parameters turbidity and DO will be monitored; however, they will not be utilized as well stabilization parameters for the Site.

Field indicator parameters will be considered stabilized when three (3) consecutive readings meet the stabilization criteria presented in **Section 4.1.4** above.

4. If stabilization criteria are not met, a low-flow pump will be used to develop the well.

- a. Well development will continue by low-flow pumping at a rate less than one (1) Liter per minute. Field water quality parameters will be measured after each well volume is removed. A maximum of ten (10) well volumes will be removed. If a well is purged dry during well development, the well will continue to be developed upon sufficient recharge.
- b. If field water quality parameters have not stabilized using low-flow pumping, the purge rates, filter pack size and screen size will be checked to determine if these are appropriate. Turbidity readings will be plotted against well volumes to assess if any trends are present.
- c. If the turbidity versus well volume plots indicate a trend of successively lower turbidity measurements over the last three (3) well volumes removed, well development will cease for 24 hours and a second series of development cycles will be conducted during low-flow pumping for a maximum of three (3) well volumes.
- d. If field water quality parameters have not stabilized after a second series of development cycles, no further well development will occur and groundwater sampling can proceed.

4.5.2 Soil Gas Wells

Soil gas wells will be installed using a hydraulic direct-push drilling unit. As part any new or replacement soil gas well installation, subsurface soils will be collected continuously using direct-push dual-tube drilling and sampling techniques *prior to* installing the soil gas well in order to record the subsurface lithology and confirm that groundwater will not be encountered at the targeted soil gas well depth. All lithological descriptions will be completed a qualified geologist or environmental scientist. The methodology to install soil borings using direct-push dual-tube drilling and sampling techniques is presented in HZW's FSOP #101 – Soil Boring Installation Standard Operating Procedures in **Appendix A**.

The soil gas wells will be installed to depths between eight (8) and twelve (12) feet below ground surface as the other soil gas wells in the Project Area are installed to these depths. Each soil gas well will be constructed of six- (6-) inch stainless steel vapor implants and Teflon® tubing. A sand pack, consisting of washed, medium sand, will be placed three (3) to four (4) inches below the vapor implant, around the vapor implant and three (3) to four (4) inches above the vapor implant. Two (2) inches of dry, granular bentonite will be placed above the sand pack with additional granular bentonite hydrated with distilled water placed in the remaining annular space of the soil gas well. The purpose of placing two (2) inches of dry, granular bentonite on top of the sand pack is to limit the introduction of water into the sand pack and vapor implant. At approximately one (1) foot below ground surface, a two- (2-) inch inside diameter PVC pipe will be placed in the bentonite and extend to a few inches below ground surface. The PVC pipe will enclose and protect the Teflon® tubing. The remaining annular space will be filled with concrete and a flushmount cover secured over the soil gas well.

The procedures to install soil gas wells are presented below and in HZW's FSOP #301 – Soil Gas Sampling Standard Operating Procedure in **Appendix A**.

1. Using direct-push dual-tube drilling and sampling techniques, install a soil boring to soil gas well terminal depth. Soil samples will be collected to record the subsurface lithology and to confirm that groundwater will not be encountered at the targeted soil gas well depth.
2. Upon reaching soil gas well terminal depth, remove the inner rods from the dual-tube drilling and sampling system.
3. Attach a six (6) inch stainless steel vapor implant to appropriately-sized Teflon® tubing.
4. Begin slowly retracting the outer probe rods of the dual-tube drilling and sampling system and slowly pour three (3) to four (4) inches of washed, medium sand in the bottom of the borehole. A weighted tape measure will be used to verify placement of the sand and prevent bridging of the sand.
5. Lower the stainless steel vapor implant and Teflon® tubing into the borehole to the top of the sand. Attach a 3-way stopcock to the top end of the Teflon® tubing.
6. Slowly pour washed, medium sand in the annular space around and approximately three (3) to four (4) inches above the vapor implant as the probe rods continue to be retracted. A weighted tape measure will be used to monitor placement and depth of the sand around the vapor implant. In addition, the weighted tape measure, or, if necessary, probe rods will be lowered into the borehole to prevent bridging of sand.
7. At the top of the sand pack, slowly pour two (2) inches of dry, granular bentonite into the annular space. Continue retracting the probe rods and slowly pouring granular bentonite into the borehole. Begin hydrating the granular bentonite by delivering water in small amounts using a plastic 60 milliliter syringe and polyethylene tubing placed down the borehole.
8. Continue adding bentonite and hydrating until approximately one (1) foot below ground surface. At approximately one (1) foot below ground surface, place a piece of two (2) inch PVC pipe around the Teflon® tubing connected to the vapor implant. The PVC pipe should extend to a few inches below ground surface.
9. Place a flushmount manhole cover over the PVC pipe and Teflon® tubing. Concrete will be placed in the remaining annular space to secure the flushmount manhole cover. The ground surface concrete pad around the flushmount manhole cover will slope away from the manhole cover.
10. The soil gas well will be permanently labeled with the well identification.

11. As part of the first soil gas sampling activities, perform leak testing. Place a shroud over the soil gas well and fill the shroud with lab-grade helium. The helium percentages in the shroud will be measured using a field helium detector and will be compared to the helium percentages in the soil gas sample as determined by the analytical laboratory. In the event that the leak test indicates a soil gas well is not sufficiently sealed, either repairs to the soil gas well will be made or the soil gas well may be re-installed.

4.5.3 Sub-Slab Soil Gas Sampling Points

The sub-slab soil gas sampling points will be constructed of stainless steel or brass materials. While HZW will utilize Vapor Pins[®] for sub-slab soil gas sampling points other equivalent materials are available to construct sub-slab soil gas sampling points that can be used in place of Vapor Pins[®]. Since HZW will utilize Vapor Pins[®], the procedures to install Vapor Pins[®] are presented below and in HZW's FSOP #301 – Soil Gas Sampling Standard Operating Procedure in **Appendix A**.

1. Identify any and all underground utilities, cracks in the concrete floor and any other potential preferential pathways in relation to proposed sub-slab soil gas sampling points.
2. Drill a 1.5-inch diameter hole in the concrete floor to an approximate depth of 1.75 inches. Concrete dust generated from drilling should be evacuated using a wet-dry vacuum equipped with the appropriate filter.
3. Within the 1.5-inch diameter hole, drill a 5/8-inch diameter hole through the concrete floor slab and approximately three (3) to four (4) inches below the floor slab. Thoroughly clean out the 5/8-inch diameter hole with a bottle brush. A wet/dry vacuum equipped with the appropriate filter can be used to evacuate the concrete dust removed by the bottle brush; however, the wet/dry vacuum should not be placed directly over the drilled hole.
4. Attach a new silicone sleeve to a stainless steel Vapor Pin[®] and place the lower end of the Vapor Pin[®] assembly into the drilled hole.
5. Using the Vapor Pin[®] installation/extraction tool, tap the Vapor Pin[®] into the concrete floor slab. Ensure that the Vapor Pin[®] remains vertical and the installation/extraction tool remains in-line/parallel to the Vapor Pin[®] to avoid damage to the barb fitting on the Vapor Pin[®] and for a secure fit in the drilled hole.
6. Tap the Vapor Pin[®] into the concrete floor slab until a slight bulge appears between the concrete floor slab and the Vapor Pin[®]. Check that the Vapor Pin[®] was installed correctly. If not, replace the silicone sleeve and re-install the Vapor Pin[®].
7. Place the cap on the barb fitting of the Vapor Pin[®] and install a flushmount cover over the Vapor Pin[®] in the 1.5-inch diameter hole.

8. As part of the first sub-slab soil gas sampling activities, perform leak testing. Place a shroud over the Vapor Pin[®] and fill the shroud with lab-grade helium. The helium percentages in the shroud will be measured using a field helium detector and will be compared to the helium percentages in the sub-slab soil gas sample as determined by the analytical laboratory.

In the event that the leak test indicates a Vapor Pin[®] is not sufficiently sealed and needs to be re-installed, a mechanical leak test will be conducted on the Vapor Pin[®] at the time of re-installation. The mechanical leak test will be conducted by placing a two- (2-) inch inside diameter PVC coupling with VOC-free plumber's putty around the Vapor Pin[®]. Distilled water will be poured into the PVC coupling and the water level monitored. If the water level drops noticeably, the Vapor Pin[®] will be removed and re-installed at least one (1) foot from the original location.

4.5.4 Indoor Air Sample Locations

In identifying potential indoor air sampling locations, an inspection of a building and potential locations and interviews will be conducted. HZW's FSOP #401 – Indoor and Ambient Air Sampling Standard Operating Procedure in **Appendix A** describes pre-sampling activities related to indoor air sampling locations inclusive of a Soil Gas/Indoor Air Building Survey Form. The inspection of a building and potential locations and interviews will be conducted to document uses of and operations within the building; conduct an inventory and identify all chemicals used and stored in the building; identify any other potential sources of volatile compounds in the building; building features (such as the heating, ventilation and air conditioning system); and potential for sample equipment to be moved or tampered with by occupants and/or visitors to the building.

Indoor air samples will be collected in six (6) Liter, batch-certified clean, stainless steel Summa canisters equipped with dedicated sample trains consisting of 24-hour flow controllers and vacuum gauges. Sampling locations will generally be placed at a representative height, such as the breathing zone, approximately four (4) to six (6) feet above floor surface and/or in the lowest indoor areas or in areas that are likely to capture the highest indoor air concentrations.

5.0 DATA EVALUATION

Analytical data for groundwater, soil gas, sub-slab soil gas and indoor air samples collected in the Project Area as part of Post-Closure Plan activities will be evaluated in accordance with **Section 2.0** of the approved Post-Closure Plan and any subsequent amendments. As noted in the Post-Closure Plan, containment and effectiveness standards or “trigger levels” have been derived for soil gas, sub-slab soil gas, indoor air and groundwater. The trigger levels will be used to initiate a schedule for confirmation sampling, notification, remedial action, reporting and post-closure plan modification in accordance with Ohio Administrative Code (OAC) 3745-54-100 if an exceedance of a standard occurs.

6.0 PROJECT SCHEDULE AND REPORTING

6.1 Project Schedule

Groundwater, soil gas, sub-slab soil gas and indoor air samples will be collected on a semi-annual basis as part of Post-Closure Plan (PCP) activities. The number of sampling locations and/or frequency of sampling may be reduced in the future provided that analytical data remain stable and will be subject to the provisions in OAC 3745-50-51 and 3745-54-18. It is anticipated that the sampling program will be implemented during April (i.e., Spring) and October (i.e., Fall) to allow for seasonal variability associated with data collection.

6.2 Project Reporting

As part of PCP activities, corrective action effectiveness reports and supplementary annual monitoring reports will be prepared. Further discussion of these reports is presented below.

Corrective Action Effectiveness Reports (CAERs): For each calendar year, a CAER that summarizes groundwater, soil gas, sub-slab soil gas and indoor air analytical results for the two semi-annual events, will be prepared and submitted to the Ohio EPA within 90 days of receipt of the Fall (i.e., October Event) analytical laboratory reports. The CAERs will, at a minimum, include a discussion of field sampling activities and observations, summary data tables for the current sampling event as well as previous sampling events as applicable and supporting mapping. Each analytical laboratory report will contain all data necessary for the Ohio EPA to conduct a Tier 1 data validation.

In addition to the above reporting, on a semi-annual basis, an evaluation of chemicals in indoor air compared to chemicals in sub-slab vapors (refer to Section 2.3 of PCP) with multiple chemical adjustments (MCAs) will be prepared and submitted to the Ohio EPA within 10 business days of receipt of the subject analytical laboratory reports.

Supplementary Annual Monitoring Reports: In accordance with OAC 3745-50-58(L)(4), annual monitoring reports will be submitted to the Director of the Ohio EPA by March 1 of each year on the form provided by the Ohio EPA in accordance with OAC 3745-65-94(A)(2). Groundwater monitoring data submitted in electronic format will follow the most current format specified in the Supplementary Annual Report for Final Standards Ground Water Monitoring Information (OAC 3745-54-90 through -54-100) Form and Instructions. Each analytical laboratory report will contain all data necessary for the Ohio EPA to conduct a Tier 1 data validation. The annual monitoring reports will include the results of the groundwater quality assessment program, which includes, but is not limited to, the calculated (or measured) rate of migration of the Site COCs in the sampled environmental media (i.e., groundwater, soil gas, sub-slab soil gas and indoor air). In accordance with OAC 3745-54-100(G), the annual report will contain corrective action effectiveness reporting that will include the necessary information (e.g., continued plume stability evaluations, demonstrations that workers in commercial/industrial buildings remain protected, etc.) to demonstrate that the corrective action remains effective and appropriate and protective of human health and the environment.

7.0 REFERENCES

In preparing this SAP, HZW referenced several technical documents and publications, which are presented below.

Hull & Associates, Inc., *Amended RCRA Closure Plan, Ohio Department of Transportation District 5 Former Headquarters Facility Unit C, Revision 6*, April 2017.

J.R. Kolmer & Associates, *Phase II Environmental Assessment – Dynacraft Golf Products, Inc.*, July 23, 1998.

Paul, C.J. and Puls, R.W., Winter 1997, Impact of Turbidity on TCE and Degradation Products in Ground Water, *Ground Water Monitoring and Remediation*, 128-133.

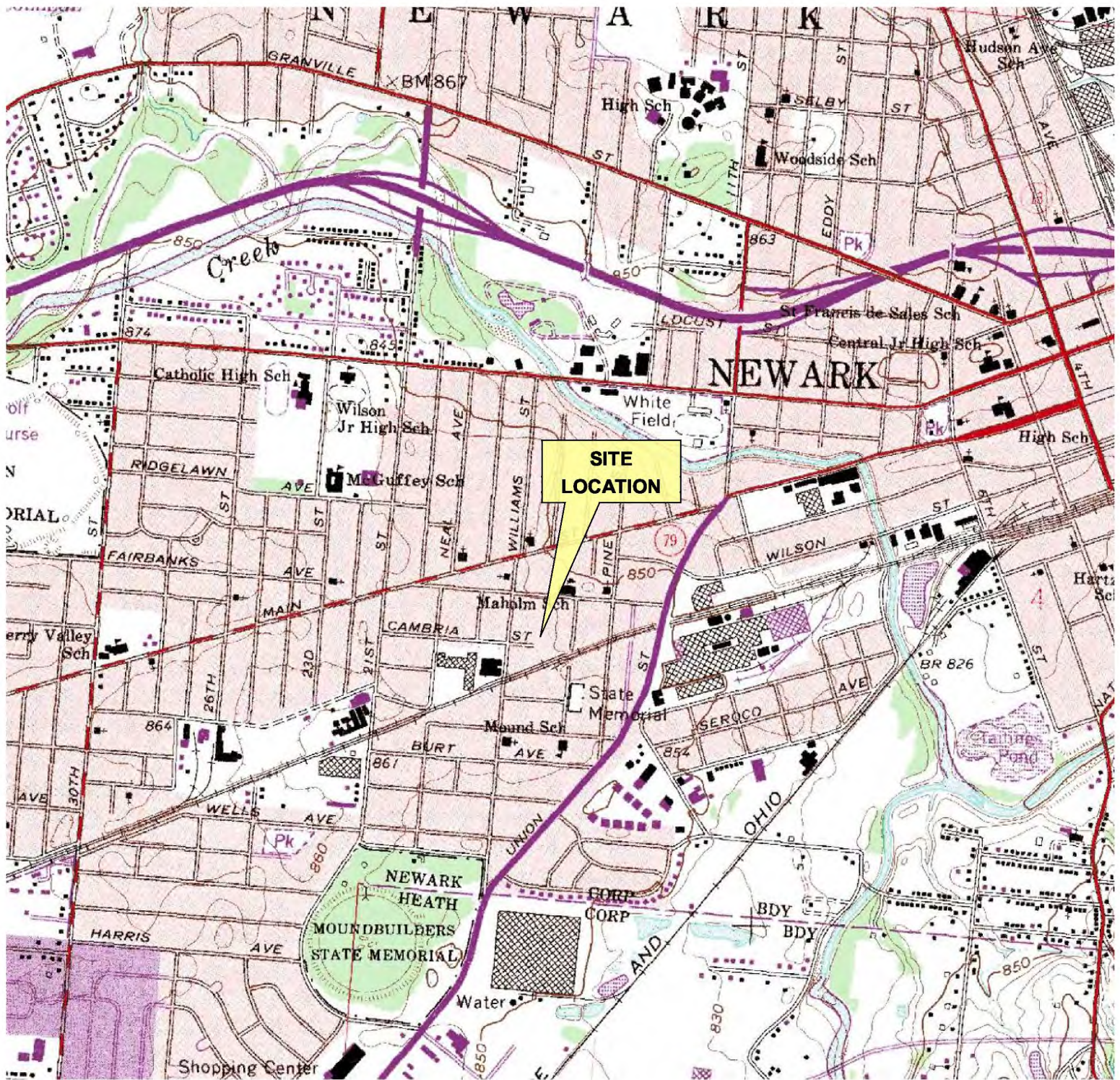
Sharp and Associates, Inc., *Area C Amended RCRA Closure Plan Area C Closure*, January 1997.

Sharp and Associates, Inc., *Certification of Closure Area C Closure*, January 13, 1997.

U.S. EPA's Office of Solid Waste and Emergency Response *Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources*, OSWER Publication 9200.2-154, June 2015.



FIGURES



REFERENCE: USGS 7.5-Minute Topographic Map, Newark, Ohio

DATED: 1984

Latitude: 40.049994 °N / Longitude: -82.423974° W

SCALE: 1" = 1,500 feet

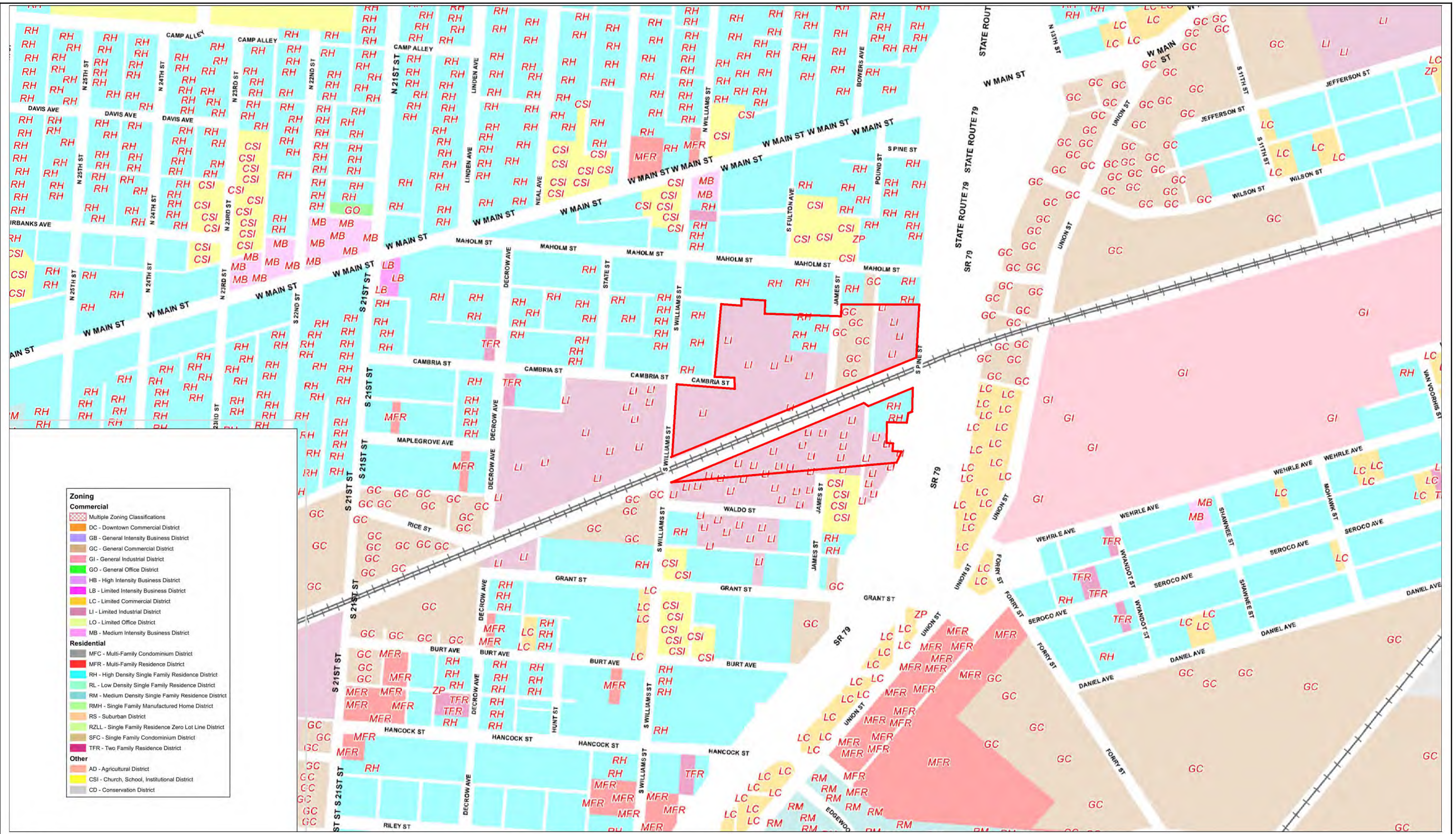


6105 Heisley Road, Mentor, OH 44060
440-357-1260 - Fax 440-357-1510

**FIGURE 1
SITE LOCATION MAP
115 1/2 MAHOLM STREET
NEWARK, OHIO 43055**

**PREPARED FOR
ODOT**

DRAWN BY:	CK
APPROVED BY:	KMR
PROJECT NO.	H15006-20
FIGURE 1 SITE LOCATE	



Zoning	
Commercial	
	Multiple Zoning Classifications
	DC - Downtown Commercial District
	GB - General Intensity Business District
	GC - General Commercial District
	GI - General Industrial District
	GO - General Office District
	HB - High Intensity Business District
	LB - Limited Intensity Business District
	LC - Limited Commercial District
	LI - Limited Industrial District
	LO - Limited Office District
	MB - Medium Intensity Business District
Residential	
	MFC - Multi-Family Condominium District
	MFR - Multi-Family Residence District
	RH - High Density Single Family Residence District
	RL - Low Density Single Family Residence District
	RM - Medium Density Single Family Residence District
	RMH - Single Family Manufactured Home District
	RS - Suburban District
	RZLL - Single Family Residence Zero Lot Line District
	SFC - Single Family Condominium District
	TFR - Two Family Residence District
Other	
	AD - Agricultural District
	CSI - Church, School, Institutional District
	CD - Conservation District

LEGEND

General Location of ODOT Project Area

REFERENCES: 1) City of Newark, Ohio Zoning

NORTH

DRAWN CK 01/26/2016

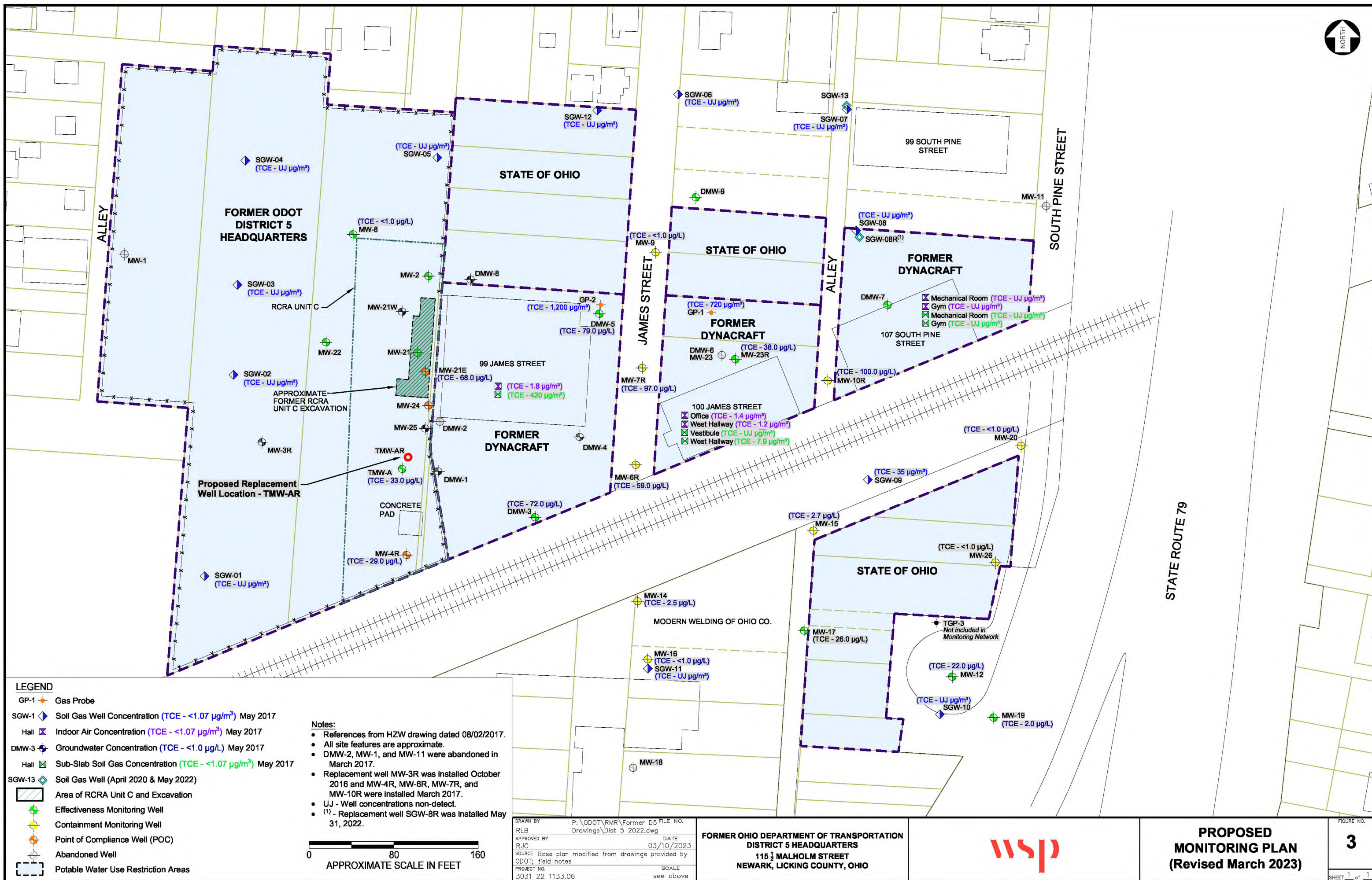
PROJECT NO. H15006-32

DRAWING NUMBER FIG2 ZONING MAP

HZW Environmental Consultants

FIGURE 2
LAND USAGE AND ZONING MAP
FORMER ODOT DISTRICT 5 HEADQUARTERS
NEWARK, LICKING COUNTY, OHIO

PREPARED FOR
ODOT



APPENDIX A

HZW's FIELD STANDARD OPERATING PROCEDURES

Field Standard Operating Procedures

Index to FSOPs



November 2007
Revision 3.3 July 2017

INDEX OF FIELD STANDARD OPERATING PROCEDURES

Section 000 – General Field-Related Activities

- FSOP #001 – Utility Clearance
- FSOP #002 – Field Documentation
- FSOP #003 – Sample Identification Nomenclature
- FSOP #004 – Sample Chain-of-Custody and Sample Handling
- FSOP #005 – Field Equipment Calibration
- FSOP #006 – Field Equipment Decontamination
- FSOP #007 – Investigation-Derived Waste
- FSOP #008 – Global Positioning System Unit Use
- FSOP #009 – Differential Surveying

Section 100 – Soil

- FSOP #101 – Soil Boring Installation
- FSOP #102 – Soil Sampling
- FSOP #103 – Soil Sample Field Screening

Section 200 – Groundwater

- FSOP #201 – Monitoring Well Installation
- FSOP #202 – Monitoring Well Development
- FSOP #203 – Groundwater Sampling
- FSOP #204 – Monitoring Well Abandonment

Section 300 – Soil Gas

- FSOP #301 – Soil Gas Sampling
- FSOP #302 – Permanent Soil Gas Well Abandonment

Section 400 – Indoor and Ambient Air

- FSOP #401 – Indoor and Ambient Air Sampling

Section 500 – Surface Water

- FSOP #501 – Surface Water Sampling

Section 600 – Sediment

- FSOP #601 – Sediment Sampling

Section 700 – Asbestos

- FSOP #701 – Asbestos Sampling

INDEX OF FIELD STANDARD OPERATING PROCEDURES (CONTINUED)

Section 800 – Lead-Based Paint

FSOP #801 – Lead Paint Testing/Sampling

Section 900 – Explosive Gas (Landfills)

FSOP #901 – Explosive Gas Monitoring

FSOP #902 – Permanent Explosive Gas Monitoring Station Installation

FSOP #903 – Permanent Explosive Gas Monitoring Station Abandonment

Field Standard Operating Procedures

#005 – Field Equipment Calibration



HZW Environmental
Consultants

November 2007
Revision 3.2 June 2017

REVISION HISTORY

Below is a summary of the revisions to this Standard Operating Procedure.

Date	Revisions
October 2010	Field Equipment Calibration SOP developed
June 2015	Extensive revisions and reformatting of Field Equipment Calibration SOP performed
December 2016	Revisions to font, added new company logo
June 2017	Added calibration of GEM 2000/2000 Plus meter

I:\Geology Group\SOPs\Revised SOPs - December 2016\FSOP 005 - Field Equipment Calibration FSOP.doc

FSOP #005 – FIELD EQUIPMENT CALIBRATION STANDARD OPERATING PROCEDURES**1.0 PURPOSE AND APPLICABILITY**

This SOP has been prepared for use by HzW personnel only. The purpose of this SOP is to provide procedures to calibrate equipment that is owned or routinely/frequently utilized by HzW field personnel.

2.0 HEALTH AND SAFETY

Property health and safety precautions must be observed during equipment calibration activities. Specific attention must be given to the use of compressed gas cylinders and a radiation source (XRF detector). The site-specific Health and Safety Plan (HASP) or HzW's general HASP provides guidelines on health and safety precautions. Field personnel should rely on the site-specific or general HASP to evaluate field conditions at a site such as potential chemical hazards, what is the appropriate personal protective equipment and site monitoring activities.

3.0 DEFINITIONS

Calibration: Adjusting an instrument to a specific standard in order for the instrument to obtain readings with accuracy and precision.

4.0 EQUIPMENT AND MATERIALS

The equipment and materials required to calibrate each field instrument owned or routinely/frequently utilized by field personnel is specific to the field instrument. Below is a listing of the equipment and materials necessary to calibrate each field instrument and is instrument-specific.

4.1 MiniRAE 2000 Photoionization Detector

- MiniRAE 2000 Photoionization Detector
- Isobutylene Compressed Gas Cylinder (100 ppm)
- Tedlar Bag(s)
- Calibration Gas Cylinder Adapter with Gauge
- Probe Filters
- Batteries and AC Power Supply
- Field Notebook

4.2 MicroFID Flame Ionization Detector

- MicroFID Flame Ionization Detector
- Methane Compressed Gas Cylinder (100 ppm)
- Tedlar Bag(s)
- Calibration Gas Cylinder Adapter with Gauge
- Hydrogen Gas
- Field Notebook

4.3 Multi-RAE Gas Meter

- Multi-RAE Gas Meter
- Isobutylene Compressed Gas Cylinder (100 ppm)
- Multi-Gas Compressed Gas Cylinder (CO = 50 ppm; H₂S = 10 ppm; CH₄ = 2.5%; and O₂ = 18%)
- Tedlar Bag(s)
- Calibration Gas Cylinder Adapter with Gauge
- Probe Filters
- Batteries and AC Power Supply
- Field Notebook

4.4 Landtec GEM 2000/2000 Plus Meter

- Landtec GEM 2000/2000 Plus Meter
- Compressed Calibration Gas Cylinder (CH₄ = 50.0%; CO₂ = 35.0%) – **GEM 2000 and GEM 2000 Plus**
- Compressed Calibration Gas Cylinder (O₂ = 4.0%)
- Compressed Calibration Gas Cylinder (CO = 50 ppm and H₂S = 25 ppm) – **GEM 2000 Plus only**
- Calibration Gas Cylinder Adapter with Gauge
- Field Notebook

4.5 Horiba U-50 Series Water Quality Meters

- Horiba U-50 Series Water Quality Meter
- Calibration Solution (pH 4 Standard Solution)
- Distilled Water
- Field Notebook

4.6 Oakton PC 10 pH/Conductivity/Temperature Meter

- Oakton PC 10 pH/Conductivity/Temperature Meter
- pH Buffer Solutions (4.01, 7.00, 10.00)
- Conductivity Buffer Solution (1,413 µS)
- Distilled Water
- Clean, Laboratory-Supplied Glass Containers

- Field Notebook

4.7 Hanna HI991301 Water Quality Meter

- Hanna HI991301 pH/Conductivity/Temperature Meter
- pH Buffer Solutions (4.01, 7.00, 10.00)
- Conductivity Buffer Solution (1,413 μ S)
- Distilled Water
- Clean, Laboratory-Supplied Glass Containers
- Field Notebook

4.8 LaMotte 2020 and 2020E Turbidimeter

- LaMotte 2020 and 2020E Turbidimeter
- Calibration Solutions (1.0 NTU and 10.0 NTU)
- Distilled Water
- Paper Towels
- Field Notebook

4.9 Niton 300 XL X-Ray Fluorescence Detector

- Niton 300 XL X-Ray Fluorescence Detector
- Calibration/Standard Sample Cards
- Field Notebook

5.0 PROCEDURES

The calibration procedures for each field instrument owned or routinely/frequently used by field personnel are presented below. Calibration should be conducted at the beginning of each day or use and documented in project field notes as well as the master equipment calibration log. If a field instrument is being used continuously for a time period greater than four (4) hours, it may be necessary to check the calibration after four (4) hours of use.

5.1 Mini-RAE 2000 Photoionization Detector

- A. Turn on the MiniRAE 2000 and wait for the "Ready.." message.
- B. Press and hold down the [MODE] and [N/-] keys simultaneously for three (3) seconds to enter the Programming Menu.
- C. Once the first menu item, "Calibrate/Select Gas?" is displayed, release the [MODE] and [N/-] keys simultaneously.
- D. Choose "Calibrate/Select Gas?" from the Programming Menu by pressing the [Y/+] key.

- E. The first sub-menu displays “Fresh air Cal?” (i.e., zero gas)
- F. Choose “Fresh air Cal?” by pressing the [Y/+] key.
- G. The meter will display “zero in progress” followed by “wait..” and a countdown timer.
- H. After a 15 second pause, the meter will display “zeroed...reading = X.X ppm...”.
- I. Press any key to return to the “Fresh air Cal?” sub-menu.
- J. The meter will continue to scroll through the sub-menu to “Span Cal?”
- K. Connect the meter to a 100 ppm isobutylene span gas or a Tedlar™ bag containing the span gas.
- L. Press the [Y/+] key at “Span Cal?” sub-menu. The meter will display the gas name and corresponding gas value.
- M. The meter will then display “Apply gas now!”.
- N. Turn on the valve for the span gas.
- O. The meter will display “wait...30” with a countdown timer showing the number of second remaining while the meter performs the calibration.
- P. The meter will display the calibrated value when the countdown timer reaches 0.
- Q. When the meter is finished calibrating, it will display “Span Cal Done! Turn Off Gas.” Turn off the flow of gas and disconnect the span gas from the meter.

The MiniRAE 2000 PID is considered calibrated once the fresh air value is equal to 0.0 ppm and the span gas value is equal to 100 ppm. The MiniRAE PID will be calibrated once a day unless conditions warrant additional calibration. Once calibrated the PID will be used to conduct headspace analysis of duplicate soil samples that have been allowed to equilibrate and may be used for soil gas surveys.

5.2 MicroFID Flame Ionization Detector

- A. Prior to turning on the meter, check the internal hydrogen gas gauge to ensure that the internal hydrogen cylinder is full.
- B. If the internal hydrogen cylinder needs filling, follow steps 1 through 15; however, if the internal hydrogen cylinder is full, proceed to step C.
 - 1. Connect the refill adapter for the meter to the tank of hydrogen.

2. Tighten the refill adapter to the tank with a wrench being cautious not to overtighten.
 3. While holding the flexible hose of the refill adapter, open the hydrogen tank and ensure there are no leaks.
 4. Turn off the FID.
 5. On the refill adapter, open the 3-way valve and purge the flexible hose of any impurities.
 6. Close the 3-way valve on the adapter.
 7. Locate the knurled collar on the front side of the FID.
 8. Hold the knurled collar and slide it towards the FID exposing a port.
 9. Insert the fitting on the end of the flexible hose of the refill adapter into the exposed port. The fitting will “click” when properly seated.
 10. Release the knurled collar allowing it to return to its original position.
 11. On the refill adapter, open the 3-way valve.
 12. Fill the internal hydrogen cylinder until full (1,600–1,800 psig) as indicated on the gauge.
 13. Once the internal hydrogen cylinder is full, close the 3-way valve on the refill adapter.
 14. Close the valve on the tank of hydrogen (the source).
 15. Relieve the gas pressure in the flexible hose and disconnect the flexible hose fitting by pulling the knurled collar away from the FID.
- C. Turn on the FID meter.
- D. Press the “CAL” key and select the desired Cal Memory.
- E. Enter the desired response factor and press the “ENTER” key.
- F. Select Low Range (0.5 to 2,000 ppm) or High Range (10 and 50,000 ppm) and press the “ENTER” key.
- G. Connect the zero air gas Tedlar™ bag containing zero air to the FID.

- H. Open the bag and press the “ENTER” key.
- I. Following calibration to zero air, the FID will ask for the span gas concentration.
- J. Enter the known span gas concentration (typically, 100 ppm methane) and connect the span gas Tedlar™ bag to the FID.
- K. Open the bag and press the “ENTER” key. The FID will set its sensitivity.
- L. When calibrated and ready for use, the FID’s display will return to normal.
- M. Press the “ALARM” key and enter the alarm level for the selected Cal Memory.

The MicroFID is considered calibrated once the zero air value is equal to 0.0 ppm and the span gas value is equal to 100 ppm. The MicroFID will be calibrated once a day unless conditions warrant additional calibration. Once calibrated the FID may be used to conduct headspace analysis of duplicate soil samples that have been allowed to equilibrate and may be utilized as part of soil gas surveys.

5.3 Multi-RAE Gas Meter

Since the Multi-RAE gas meter is a multi-gas meter, several sensors require calibration. The calibration procedures presented below are for multi-sensor calibrations. If a single-sensor calibration is required, consult the instrument manual. Calibration procedures for fresh air, multi-sensor span gas and multi-sensor bump calibrations are presented below.

Fresh Air Calibration

A fresh air calibration should be performed in outside ambient air with little to no wind.

- A. At the Calibration Menu, select “Fresh Air”. Press [Y/+] once to enter the fresh air calibration sub-menu.
- B. Press [Y/+] to start fresh air calibration.
- C. A countdown screen will appear. The fresh air calibration can be aborted at any time during the countdown by pressing [N/-].
- D. At the completion of the countdown, the display will show if the fresh air calibration passed or failed for each sensor followed by the sensor’s fresh air readings.

Multi-Sensor Span Gas Calibration

- A. At the Calibration Menu, select “Multi Sensor Span”.

- B. Install the calibration adapter and connect it to a source of calibration gas.
- C. Start the flow of calibration gas.
- D. Press [Y/+] to start calibrating or wait for the calibration to start automatically.
- E. A countdown screen will appear. The calibration can be aborted at any time during the countdown by pressing [N/-].
- F. At the completion of the countdown, the display will show if the multi-sensor span gas calibration passed or failed for each sensor followed by the sensor's readings.

Multi-Sensor Bump Calibration

- A. At the Calibration Menu, select "Multi Sensor Bump".
- B. Install the calibration adapter and connect it to a source of calibration gas.
- C. Start the flow of calibration gas.
- D. Press [Y/+] to start calibrating or wait for calibration to start automatically.
- E. A countdown screen will appear. The calibration can be aborted at any time during the countdown by pressing [N/-].
- F. At the completion of the countdown, the display will show if the multi-sensor span gas calibration passed or failed for each sensor followed by the sensor's readings.
- G. If a sensor requires a different calibration gas, the instrument will display a prompt. Change the calibration gas and, when ready, start the bump test by pressing [Y/+].
- H. If one or more sensors fails a bump test, be sure to calibrate those sensors. If the sensors pass, the bump test is complete and press Exit to return to the main menu.

5.4 Landtec GEM 2000/2000 Plus Meter

The Landtec GEM 2000/2000 Plus meter can be used for a number of applications, but are typically utilized for explosive gas monitoring at landfills or other locations where explosive gases are a concern. Calibration of the Landtec GEM 2000/2000 Plus meter is performed at the beginning of each use or after obtaining a methane reading greater than or equal to five (5) percent.

The Landtec GEM 2000/2000 Plus meter can operate in a Gas Analyzer (GA) mode or a Gas Extraction Monitor (GEM) mode. The GA mode is used for monitoring points such as punch bars or methane monitoring stations at landfills, while the GEM mode is used for monitoring extraction systems in which a vacuum is present. Typically, the GEM 2000/2000 Plus meter will be operated in the GA mode; however, calibration procedures for both modes are presented below. Calibration procedures are identical for both modes with slight differences in functions and zeroing sensors specific to a mode.

Determining Mode of Operation and Initial Start-Up (GA and GEM modes)

- A. After start-up and allowing the meter to perform a self-test, press the ENTER button (a 90 degree arrow pointing down and to the left).
- B. The meter may be configured to be in either the GA mode or GEM mode. Check with the project manager on the correct mode to use the meter. To quickly check which mode of operation the meter is in, once the self-test is complete, review the bottom of the screen on the meter. If “5 Measure Flow” is present, the meter is in the GEM mode. Conversely, if the screen displays the barometric pressure and the relative pressure upon completion of the self-test, the meter is in GA mode. Perform the following steps to change the meter to GA mode if the meter is in GEM mode or if the meter is in GA mode, to change to GEM mode.
 1. Press “1” to select “Menu”.
 2. A menu will display in the center of the screen. Use the down arrow button to highlight “MODE OF OPERATION” and press the ENTER button to select.
 3. A sub-menu will display in the center of the screen. For GA mode, scroll using the arrow buttons to highlight “LANDFILL GAS ANALYZER”, and for GEM mode scroll to highlight “GAS EXTRACTION MONITOR”.
- B. The screen on the meter will display readings on the left and a menu at the bottom. Press “1” to select “Menu”.
- C. A menu will display in the center of the screen. Use the down arrow button to highlight “FIELD CALIBRATION” and press the ENTER button to select.
- D. The screen will display “CHECK CALIBRATION” at the top with a menu at the bottom.
- E. Press the PUMP button (picture of a fan) and allow the unit to warm up for a few minutes.
- F. Verify that the numbers in the S (span target) row match the concentrations on the calibration gas cylinders. Should the numbers need to be adjusted, press “3” to select “Edit target concentrations”, enter the correct concentration and press

ENTER after each gas concentration has been entered. This procedure will likely need to be completed for calibration of the oxygen sensor.

Span Gas Calibration (GA and GEM Modes)

The calibration gas cylinder (methane, carbon dioxide and nitrogen mix) must be connected prior to initiating span gas calibration.

A. CH₄ (methane) Span

1. Press the ENTER button to select "Calibration Menu".
2. A menu will display in the center of the screen. Use the down arrow button to highlight "SPAN CHANNEL(S)" and press the ENTER button to select.
3. A sub-menu will display to the right. Use the up and down buttons to select "SPAN CH₄ @ 50.0%" and press the ENTER button. The screen will read "Calibration complete" and the CH₄ sensor is calibrated.

B. CO₂ (carbon dioxide) Span

1. Press the ENTER button to select "Calibration Menu".
2. A menu will display in the center of the screen. Use the down arrow button to highlight "SPAN CHANNEL(S)" and press the ENTER button to select.
3. A sub-menu will display to the right. Use the up and down buttons to select "SPAN CO₂ @ 35.0%" and press the ENTER button. The screen will read "Calibration complete" and the CO₂ sensor is calibrated.

C. CO (carbon monoxide) and H₂S (hydrogen sulfide) Spans (GEM 2000 Plus only**)**

1. Turn off and disconnect the calibration gas cylinder (methane, carbon dioxide and nitrogen mix).
2. Connect a flow regulator to the compressed calibration gas cylinder (carbon monoxide and hydrogen sulfide mix) and attach a short piece of tubing with a plastic quick connect fitting to the regulator.
3. Connect the plastic quick connect fitting to the upper port on the right side of the meter and turn the knob on the regulator to begin the gas flow.

4. Observe the readings in the “R” row and wait until the readings stabilize. Once the readings have stabilized, press the ENTER button to select “Calibration Menu”.
5. A menu will display in the center of the screen. Use the down arrow button to highlight “SPAN CHANNEL(S)” and press the ENTER button to select.
6. A sub-menu will display to the right. Use the up and down buttons to select “SPAN CO @ 0050 ppm” and press the ENTER button. The screen will read “Calibration complete” and the CO sensor is calibrated.
7. Press the ENTER button to select “Calibration Menu”.
8. A menu will display in the center of the screen. Use the down arrow button to highlight “SPAN CHANNEL(S)” and press the ENTER button to select.
9. A sub-menu will display to the right. Use the up and down buttons to select “SPAN H₂S @ 0025 ppm” and press the ENTER button. The screen will read “Calibration complete” and the H₂S sensor is calibrated.

D. O₂ (oxygen) Span

1. Turn off and disconnect the calibration gas cylinder (methane, carbon dioxide and nitrogen mix or carbon monoxide and hydrogen sulfide mix).
2. Press the PUMP button and observe the O₂ readings.
3. Once the O₂ readings have stabilized, connect the calibration gas cylinder of 4.0% oxygen.
4. Press the ENTER button to select “Calibration Menu”.
5. A menu will display in the center of the screen. Use the down arrow button to highlight “SPAN CHANNEL(S)” and press the ENTER button to select.
6. A sub-menu will display to the right. Use the up and down buttons to select “SPAN O₂ @ 4.0%” and press the ENTER button. The screen will read “Calibration complete” and the O₂ sensor is calibrated.

Transducer Zeroing (GA Mode Only)

The relative pressure transducer should be zeroed after every reading in a permanent methane monitoring station. It is critical during calibration and use of the meter that the pump not be on to obtain accurate and representative relative pressure readings.

- A. Once calibration is complete, press the PUMP button (picture of a fan) and allow the meter to purge for a minimum of 60 seconds. After 60 seconds, turn the pump off by pressing the PUMP button.
- B. Once purging is complete, press “1” to select “Menu”.
- C. A menu will display in the center of the screen. The “ZERO TRANSDUCERS” field should be highlighted when the menu is displayed. If not, scroll to ZERO TRANSDUCERS using the up and down arrow buttons.
- D. Press the ENTER button to select ZERO TRANSDUCERS.
- E. The screen on the meter should display “ZERO RELATIVE PRESSURE TRANSDUCER” and show relative pressure readings in a box near the center or bottom of the screen.
- F. Allow the relative pressure numbers to stabilize and then press the ENTER button to zero the transducer(s). A box will display on the screen indicated “Transducer zeroed” once the transducer is zeroed.
- G. Press “1” to “Exit” into the main reading screen on the meter.

Sensor Zeroing (GEM Mode Only)

Sensor zeroing should be performed after every reading.

- A. Press the ENTER button to select “Calibration Menu”.
- B. Use the down arrow button to highlight “ZERO CHANNEL(S)” and press the ENTER button to select.
- C. A sub-menu will appear to the right. Use the up and down arrow buttons to select “ZERO CH4” and press ENTER. The CH4 sensor is zeroed.
- D. For the GEM 2000 Plus meter, the hydrogen (H2), carbon monoxide (CO) and hydrogen sulfide (H2S) sensors must also be zeroed.
 1. Press the ENTER button to select “Calibration Menu”.
 2. Use the down arrow button to highlight “ZERO CHANNEL(S)” and press the ENTER button to select.

3. A sub-menu will appear to the right. Use the up and down arrow buttons to select "ZERO H2" and press the ENTER button. The screen will read "User zero complete" and the H2 sensor is zeroed.
 4. Press the ENTER button to select "Calibration Menu".
 5. Use the down arrow button to highlight "ZERO CHANNEL(S)" and press the ENTER button to select.
 6. A sub-menu will appear to the right. Use the up and down arrow buttons to select "ZERO CO" and press the ENTER button. The screen will read "User zero complete" and the CO sensor is zeroed.
 7. Press the ENTER button to select "Calibration Menu".
 8. Use the down arrow button to highlight "ZERO CHANNEL(S)" and press the ENTER button to select.
 9. A sub-menu will appear to the right. Use the up and down arrow buttons to select "ZERO H2S" and press the ENTER button. The screen will read "User zero complete" and the H2S sensor is zeroed.
- E. Connect a flow regulator to the compressed calibration gas cylinder (methane, carbon dioxide and nitrogen mix) and attach a short piece of tubing with a plastic quick connect fitting to the regulator.
- F. Connect the plastic quick connect fitting to the upper port on the right side of the meter and turn the knob on the regulator to begin the gas flow.
- G. Observe the readings in the "R" row and wait until the readings stabilize. Once the readings have stabilized, press the ENTER button to select "Calibration Menu".
- H. A sub-menu will appear to the right. Use the up and down arrow buttons to select "ZERO O2" and press the ENTER button. The screen will read "User zero complete" and the O2 sensor is zeroed.

5.5 Horiba U-50 Series Water Quality Meter

The Horiba U-50 Series water quality meters have the option of calibrating the meter automatically or manually. The calibration procedures below are for automatic calibration. If manual calibration is preferred or necessary, consult the user's manual for the meter.

In performing the automatic calibration, the water quality parameters of pH, conductivity and turbidity are automatically calibrated in the pH 4 standard solution, and dissolved oxygen and water depth are calibrated in air.

Calibration Considerations

- A. Wait at least 20 minutes after turning the meter power on before calibrating the dissolved oxygen sensor.
- B. Use about 200 milliliters of standard solution in the calibration cup.
- C. Calibration values are:

Parameter	Value
pH	4.01
Conductivity	0.449 S/m (or, 4.49 mS/m)
Turbidity	0 NTU
Dissolved Oxygen	8.92 mg/L
Water Depth	0 m

- D. Air temperature changes can cause instability during calibration. Ensure that the ambient air temperature is the same temperature as the calibration solution to accurately calibrate the meter.
- E. Do not hold the probe while performing auto calibration. Body temperature can elevate the internal temperature sensor measurement creating a dissolved oxygen calibration error.

Meter Calibration

- A. Remove the sensor guard and rinse the sensor probe two or three times in distilled water.
- B. Remove the transparent calibration cup and fill the cup to the line with pH 4 standard solution.
- C. Press the CAL key on the control unit to set the calibration mode.
- D. Press the down (▼) to move the cursor to “Auto Calibration”, then press the ENTER key.
- E. Immerse the sensor probe in the transparent calibration cup. Check that the pH sensor, ORP sensor, reference electrode, conductivity sensor, turbidity sensor and temperature sensor are submerged in the pH 4 standard solution and check that there are no air bubbles on the sensor.

- F. With the sensor probe still in the transparent calibration cup, place the transparent calibration cup into the black calibration cup.
- G. When all the sensor values have stabilized, press the ENTER key to start calibration. Do not remove the sensor probe from the calibration solution.
- H. Calibration is finished when the message “Cal complete. MEAS to measure.” appears. Press the MEAS key to set the measurement screen, then start measurement.

5.6 Oakton PC 10 pH/Conductivity/Temperature Meter

pH Calibration

- A. Turn on the pH/Conductivity/Temperature meter.
- B. Prepare the following pH buffer solutions: 4.01, 7.00 and 10.00.
- C. Press the “MODE” key to select the pH mode.
- D. Rinse the probe with distilled or deionized water.
- E. Dip the probe into the 7.00 calibration buffer. The probe must be completely immersed in the buffer and the probe should be stirred gently to create a homogeneous sample.
- F. Press the “CAL/MEAS” key. The display will show a primary measured reading, while a secondary reading below the primary one will indicate the pH buffer.
- G. Wait for the measured pH value to stabilize. The “READY” indicator will display when stabilized.
- H. After the reading has stabilized, press the “ENTER” key to confirm calibration. A confirming indicator, “CON”, will flash and disappear. The meter is now calibrated to the buffer solution.
- I. Rinse the probe in distilled water.
- J. The meter will automatically scroll to the next buffer calibration solution option (4.01 or 10.00).
- K. Dip the probe into either the 4.01 or 10.00 calibration buffer and repeat steps E through I for each buffer solution.

Conductivity Calibration

- A. Prepare the conductivity buffer solution of 1,413 microSiemens (µS).

- B. Press the “MODE” key to select the conductivity mode.
- C. Rinse the probe with distilled water.
- D. Dip the probe into the 1,413 μS calibration buffer.
- E. Press the “CAL/MEAS” key. The display will show a primary reading which is a measure of the conductivity and a secondary reading of the temperature.
- F. Press the arrow keys ($\blacktriangledown$ or $\blacktriangle$) to scroll to the value of the conductivity standard.
- G. Press the “ENTER” key to confirm calibration. The “CON” indicator appears briefly and the meter will automatically switch back to the measurement mode.
- H. Calibration with other conductivity buffer solutions can be completed by repeating steps D through G.

When obtaining measurements with the Oakton PC10 pH/conductivity/temperature meter, submerge and slowly stir the meter in the groundwater sample until the reading stabilizes, but for not more than thirty (30) seconds. Upon completion of measurements, triple-rinse the meter with distilled water prior to conducting additional measurements.

5.7 Hanna HI991301 Water Quality Meter

pH Calibration

- A. While in pH measurement mode, press and hold the MODE button until “CAL” is displayed on the lower LCD.
- B. Release the button. The LCD will display “pH 7.01 USE”.
- C. Place the probe in a pH 7.01 buffer solution. The meter will recognize the buffer value, then display “pH 4.01 USE”.
- D. Place the probe in the 4.01 buffer solution. When the second buffer is recognized, the LCD will display “OK” for one (1) second and the meter will return to normal measurement mode.

Conductivity (EC) Calibration

- A. While in the EC measurement mode, press and hold the MODE button until “CAL” is displayed on the lower LCD.
- B. Release the button and immerse the probe in the EC buffer solution (“ μS 1413 USE”).

- C. Once the calibration has been automatically performed, the LCD will display “OK” for one (1) second and return to normal measurement mode.

5.8 LaMotte 2020 and 2020E Turbidimeter

A nephelometer/turbidimeter is used in comparing the turbidity of liquids by viewing light through them and determining how much light is eliminated.

Calibration

The turbidimeter has been pre-calibrated in the range of 0 to 1,100 Nephelometric Turbidity Units (NTU) with AMCO™ primary standards manufactured by Advanced Polymer Systems, Inc. Turbidimeters will be calibrated once per week according to the manufacturer's specifications unless conditions warrant additional calibration.

- A. Turn on the turbidimeter by pressing the “READ” key.
- B. Prepare turbidity tubes with calibration standards of 1.00 NTU and 10.0 NTU.
- C. Wipe the turbidity tube with a clean, lint-free cloth. Hold the top and bottom of the turbidity tube between the index finger and thumb.
- D. Open the lid of the turbidimeter and insert the turbidity tubes containing calibration solutions into the chamber. When inserting the turbidity tube, the indexing arrow mark on the turbidity tube should align with the indexing arrow mark on the turbidimeter.
- E. Close the lid of the turbidimeter and press the “READ” key. If the displayed value is the same as the calibration standard, proceed to steps 1 through 3.
 - 1. Press the “CAL” key for five (5) seconds until “CAL” is displayed.
 - 2. Release the “CAL” key and the display on the turbidimeter will flash.
 - 3. Adjust the measured reading to the standard value by scrolling through the arrow buttons (▲ or ▼).
- F. Once displaying the standard value, press the “CAL” button to confirm calibration.
- G. Follow steps C through F for calibration with additional standards.

Measurements

- A. Collect a representative sample or use a portion of the sample that is collected for pH, temperature, or conductivity analysis, and pour off enough to fill the turbidity tube to the fill line and replace the cap on the tube.
- B. Wipe off excess water and any streaks with a soft, lint-free cloth (lens paper).
- C. Press “READ” key and the instrument will turn on. Place the meter on a flat, sturdy surface. Do not hold the instrument while making measurements.
- D. Insert the turbidity tube in the instrument so the indexing arrow on the turbidity tube aligns with the indexing arrow on the turbidimeter. Close the lid.
- E. Press the “READ” key and the turbidity measurement will be displayed within five (5) seconds.
- F. Rinse the turbidity tube with distilled water.
- G. Repeat steps A through F for the next samples. If the sample is higher than 1,100 NTU, it must be diluted and re-tested.

Turbidity measurements are reported in nephelometric turbidity units (NTUs). It is important to note that if the turbidity measurements are for NPDES reporting purposes, all values above 40 NTU must be diluted with turbidity free water and calculated by multiplying by a dilution factor.

5.9 Niton 300 XL X-Ray Fluorescence Detector

The Niton 300 XL X-Ray Fluorescence Detector should be calibrated prior to and after performing lead-based paint testing.

- A. Touch the light pen across the bar code template to display the bar code screen.
- B. Swipe the “Calibrate” bar code.
- C. Place the Niton standard sample card with the colored side up.
- D. Take a reading of the orange 1.02 mg/cm² strip. The Niton 300 XL X-Ray Fluorescence Detector should display a value between 0.9 and 1.1 mg/cm².
- E. Repeat Step D two more times. If the detector indicates readings between 0.9 and 1.1 mg/cm², it is ready to begin taking readings.

6.0 DOCUMENTATION

Calibration activities will be documented in project field notes each time a calibration is performed. In addition, calibration activities should be recorded in the master equipment calibration log book.

7.0 ADDITIONAL INFORMATION

Field equipment requires routine cleaning and calibration by manufacturer-trained technicians. The field equipment will be cleaned and calibrated by manufacturer-trained technicians in accordance with the manufacturer's recommendations. If a manufacturer does not provide scheduled cleaning and calibration intervals, the field equipment will be cleaned and calibrated by manufacturer-trained technicians every six (6) months.

Field Standard Operating Procedures

#006 – Field Equipment Decontamination



November 2007
Revision 3.1 December 2016

REVISION HISTORY

Below is a summary of the revisions to this Standard Operating Procedure.

Date	Revisions
October 2010	Field Equipment Decontamination SOP developed
June 2011	Slight modifications to Field Equipment Decontamination SOP, but not recorded
June 2015	Extensive revisions and reformatting of Field Equipment Decontamination SOP performed
December 2016	Revisions to font, added new company logo

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FSOP #006 – FIELD EQUIPMENT DECONTAMINATION STANDARD OPERATING PROCEDURES**1.0 PURPOSE AND APPLICABILITY**

This SOP has been prepared for use by HzW personnel only. The purpose of this SOP is to provide general procedures to decontaminate reusable field equipment. In certain instances, project- or site-specific decontamination procedures will be required and are outside the purpose of this SOP. The project- or site-specific decontamination procedures will be presented in the applicable closure, post-closure or field sampling and analysis plans.

Effective decontamination procedures are implemented to minimize the potential for cross-contamination and to minimize the potential for off-site contaminant migration (i.e., the transfer of contaminants to areas outside the exclusion zone or project site, usually via improperly decontaminated equipment).

2.0 HEALTH AND SAFETY

Property health and safety precautions must be observed during monitoring well installation activities. The site-specific Health and Safety Plan (HASP) or HzW's general HASP provides guidelines on health and safety precautions. Field personnel should rely on the site-specific or general HASP to evaluate field conditions at a site such as potential chemical hazards, what is the appropriate personal protective equipment and site monitoring activities.

3.0 DEFINITIONS

The following terminology is applicable to field equipment decontamination.

Decontamination: The process of neutralization, washing, rinsing, and removing contamination from exposed surfaces of equipment to minimize the potential for contaminant migration.

Cross-contamination: The transfer of contaminants from their known or suspected location into a non-contaminated location.

4.0 EQUIPMENT AND MATERIALS

The equipment and materials required to perform decontamination procedures is presented below. Given the general nature of the decontamination procedures and the various field activities that the decontamination procedures could encompass,

not all the equipment and materials below will be necessary to perform decontamination of reusable equipment with every project.

- Liquid-Nox Detergent
- Distilled Water
- Potable Water (for use in Power Washer)
- Polyethylene Sheeting (6-mil thickness)
- Decontamination Pad
- Nitrile Gloves
- DOT-Approved 55-Gallon Drums and Drum Labels for Decontamination Water
- Five (5) Gallon Buckets
- Brushes
- Sorbent Pads (in the event free-phase non-aqueous phase liquid is encountered)
- Appropriate Personal Protective Equipment (Coveralls, Safety Glasses, Face Shields)

5.0 PROCEDURES

The generalized sequence of routine decontamination procedures for sampling equipment consists of a detergent wash (i.e. Liqui-Nox[®] detergent), followed by a triple rinsing with distilled water. If muddy conditions prevail, it is recommended that the equipment be rinsed with tap water into a separate tub prior to the detergent wash. Heavy equipment, such as drill rigs and drilling equipment, is normally power-washed or steam-cleaned.

5.1 General Decontamination

General decontamination procedures pertain to decontaminating smaller field equipment such as that used for soil or groundwater sampling activities.

- A. Place a minimum four (4) foot by four (4) foot piece of 6-mil polyethylene sheeting on the ground surface. The ground surface should be level and free of any large stones, sticks or other debris that could puncture or rip the sheeting.
- B. Remove all gross materials/debris/contamination from the field equipment.
- C. If equipment is muddy, scrub and rinse with distilled water in a separate container prior to washing with a detergent and distilled water solution.

- D. Wash and scrub equipment with a detergent and distilled water solution.
- E. Triple-rinse equipment with distilled water and allow the equipment to air dry.
- F. Transfer all decontamination waters to 55-gallon drums with other wastes generated during field activities.
- G. Place the polyethylene sheeting in a 55-gallon drum as investigation-derived waste.

As a part of field quality assurance/quality control, a sample of the final rinse water may be collected and submitted for analysis of the target parameters for the project. The Project Manager will discuss field quality assurance/quality control measures prior to initiating field activities.

5.2 Decontamination Pad

Based on the size of certain field equipment (in particular equipment used during monitoring well installation), a decontamination pad will need to be utilized for decontamination activities. The decontamination pad will have minimum dimensions of eight (8) feet by eight (8) feet and will be constructed of 2-inch by 8-foot lumber for the sides and two (2) overlapping sheets of 6-mil polyethylene sheeting for the bottom.

- A. Construct the decontamination pad. The ground surface in the area in which the decontamination pad will be constructed should be level and free of any large stones, sticks or other debris that could puncture or rip the sheeting.
- B. Prior to placing reusable equipment in the decontamination pad, remove and containerize all gross material/debris/contamination.
- C. Place the reusable equipment in the decontamination pad.
- D. Wet down the equipment and thoroughly wash the inside and outside of the equipment using a detergent and distilled water solution. The use of various-sized scrub brushes will be necessary to wash the equipment.
- E. Using the power washer and potable water, triple-rinse the equipment.
- F. Allow the equipment to air dry.

- G. Repeat decontamination procedures as necessary if any material remains on the equipment.
- H. As necessary or at the completion of decontamination activities, transfer and containerize all decontamination waters in the decontamination pad into 55-gallon drums.
- I. Disassemble the decontamination pad. The polyethylene sheeting will be placed in a 55-gallon drum as investigation-derived waste.

6.0 DOCUMENTATION

Equipment decontamination activities will be documented in project field notes.

7.0 ADDITIONAL INFORMATION

Not applicable.

Field Standard Operating Procedures

#007 – Investigation-Derived Waste



November 2007
Revision 3.1 December 2016

REVISION HISTORY

Below is a summary of the revisions to this Standard Operating Procedure.

Date	Revisions
October 2010	Investigation-Derived Waste SOP developed
June 2015	Extensive revisions and reformatting of Investigation-Derived Waste SOP performed
December 2016	Revisions to font, added new company logo

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FSOP #007 – INVESTIGATION-DERIVED WASTE STANDARD OPERATING PROCEDURES**1.0 PURPOSE AND APPLICABILITY**

This SOP has been prepared for use by HzW personnel only. The purpose of this SOP is to establish consistent methods to handle, manage and sample investigation-derived waste (IDW) generated as part of field activities. The types of IDW anticipated to be generated by HzW include the following:

- Drill/soil cuttings;
- Liquids (e.g., purge water, rinse waters from field decontamination activities and product removal; equipment cleaning fluids);
- Personal protective equipment (PPE) (e.g., gloves, boot covers, spent respirator cartridges, boot covers and coveralls); and
- Disposable equipment (e.g., soil sample liners, bailers and tubing).

The Project Manager is responsible for supervising the handling, management and sampling of IDW at a site in accordance with this SOP and any site- or project-specific requirements until the IDW is properly disposed. Field personnel are responsible for implementing the procedures presented in this SOP and thoroughly documenting field activities pertaining to the handling, management and sampling of IDW.

2.0 HEALTH AND SAFETY

Property health and safety precautions must be observed during monitoring well installation activities. The site-specific Health and Safety Plan (HASP) or HzW's general HASP provides guidelines on health and safety precautions. Field personnel should rely on the site-specific or general HASP to evaluate field conditions at a site such as potential chemical hazards, what is the appropriate personal protective equipment and site monitoring activities.

3.0 DEFINITIONS

Investigation-derived waste: Waste that is generated in the process of investigating or examining an actual or potentially contaminated site. It includes solid and hazardous waste, media (including groundwater, surface water, soils, and sediments), personal protective equipment and debris that contain listed hazardous wastes or exhibit a characteristic of a hazardous waste. It includes media and debris that is not hazardous but is contaminated with hazardous constituents. Not all IDW is hazardous waste.

Containerize: To place IDW generated as part of an investigation into an appropriate container suitable for the IDW in order to prevent a release to the environment.

4.0 EQUIPMENT AND MATERIALS

The equipment and materials necessary for handling, managing and sampling IDW are presented below.

4.1 Handling and Managing IDW

- Appropriate Containers for Waste (e.g., Steel, DOT-Approved 55-Gallon Drums; Plastic, DOT-Approved 55-Gallon Drums; 5-Gallon Sealable Containers, etc.)
- Hazardous/Non-Hazardous Waste Drum Labels
- Paint Pen
- Permanent Marker
- Field Notebook
- All Necessary PPE for Handling IDW

4.2 Sampling IDW

Should analytical data from samples collected at a site/facility (i.e., soil or groundwater samples) not be utilized or incomplete for properly characterizing IDW, field personnel will collect a composite sample(s) from each type of IDW generated. The following equipment is necessary to obtain composite sample(s) of IDW (generally either soil or groundwater).

- Polyethylene Sheeting (6-mil thickness)
- Hand Auger
- Stainless Steel Hand Trowel
- Stainless Steel Bowl with Cover
- Polyethylene Bailer
- Coliwasas
- 1-Liter Unpreserved, Clean, Laboratory-Supplied, Glass Container (for compositing purposes)
- Appropriate PPE
- Clean, Labeled and Preserved (As Applicable) Laboratory-Supplied Containers
- Field Decontamination Equipment
- Field Notebook

5.0 PROCEDURES

The procedures to containerize, label, sample and dispose IDW are presented below.

5.1 Containerizing IDW

- A. Containerize all IDW generated as part of an investigation in appropriate containers.
- B. Place IDW containers in an accessible area designated by the Project Manager or a site/facility representative.
- C. IDW generated will not be mixed with different types of IDW in the same container (e.g., soil cuttings and purge water will not be placed in the same container).

Soil samples collected using Geoprobe® subsurface drilling and sampling techniques minimize the amount of IDW generated at a site/facility. Soils that remain following sample collection using Geoprobe® drilling and sampling techniques will be returned to the open borehole as a suitable IDW management option presented in the United States Environmental Protection Agency's *Guide to Management of Investigation-Derived Wastes* (January 1992).

5.2 Labeling IDW

Containers used to store IDW must be labeled properly either as hazardous waste or as non-hazardous waste. Previous data from the site/facility may assist in labeling containers appropriately; however, in most cases, IDW characteristics are not known until receipt of analytical data for the IDW or from sampling activities at a site. In accordance with the United States Environmental Protection Agency's *Guide to Management of Investigation-Derived Wastes* (January 1992), IDW from a site will not be considered a hazardous waste until analytical data supports that conclusion.

- A. Hazardous Waste Label Requirements
 - 1. Fill out hazardous waste labels with permanent marker. Hazardous waste labels must include the following information:
 - a. Description of waste (e.g., soil cuttings, purge water) or waste code(s)
 - b. Generator information
 - c. US EPA Identification Number

- d. Date when waste first accumulated
 2. Affix waste labels to the side of each IDW container. Labels should be visible when stored.
 3. Record the type and number of IDW containers at a site in field notes.
- B. Non-Hazardous Waste Label Requirements
 1. Fill out non-hazardous waste labels with permanent marker. Non-hazardous waste labels must include the following information:
 - a. Description of waste (e.g., soil cuttings, purge water)
 - b. Date when waste first accumulated
 2. Affix waste labels to the side of each IDW container. Labels should be visible when stored.
 3. Record the type and number of IDW containers at a site in field notes.

5.3 Sampling IDW

Composite samples of IDW will be collected for each type of IDW generated. For solid IDW, the number of composite samples is typically based on volume of soil IDW present at a site. The disposal contractor should be consulted prior to collecting samples of IDW as disposal facilities may require a certain number of samples for a specific volume of solid IDW (e.g., 1 composite sample for every 300 cubic yards of solid IDW or 1 composite sample for X number of 55-gallon drums). For liquid IDW, one (1) composite sample may be sufficient provided that the composite sample is representative of the entire IDW being characterized. The disposal contractor will be able to provide guidance on the number of composite samples necessary for liquid IDW.

- A. Place a piece of polyethylene sheeting on the ground surface in with IDW samples will be collected.
- B. Prepare laboratory supplied containers for collection of soil or water samples.
- C. Obtain a vertical column sample of the IDW (soil or water) within the

container(s). In all cases, equal amounts of soil or water will be obtained from the IDW containers.

1. For soil, the vertical column sample will be collected using a hand auger. Soils collected in the hand auger will be transferred to a stainless steel bowl with cover.
2. For water, the vertical column sample will be collected using a polyethylene bailer or coliwasa. The water collected in the bailer or coliwasa will be transferred to a clean, laboratory-supplied, 1-liter unpreserved glass container.

D. Composite the IDW samples.

1. Mix soils within the stainless steel bowl to composite the sample. Requisite sample aliquots will be obtained from the composite soil sample using clean, labeled, laboratory-supplied sample containers and, if necessary, a stainless steel hand trowel.
2. Thoroughly mix water in the unpreserved glass container by gently agitating and slowly inverting the container. Care should be exercised while agitating and inverting the container so as not to create air bubbles or cause volatilization of any volatile compounds in the sample. The composite water sample will be transferred directly to clean, labeled, laboratory-supplied sample containers.

E. Return any excess soil or water to the appropriate IDW container.

F. Decontaminate all reusable sampling equipment in accordance with the Field Decontamination SOP. All disposable equipment and PPE will be placed in the appropriate IDW container.

5.4 Disposal of IDW

- A. Upon receipt of IDW analytical data, retain a IDW disposal contractor to handle and dispose the IDW in accordance with all federal and state laws and regulations.
- B. The IDW will be disposed at appropriate, licensed facilities and a copy of the disposal manifest retained in the project file.
- C. IDW should not remain at a site/facility in excess of 90 calendar days,

particularly for IDW determined to be hazardous waste and regulated under the Resource Conservation Recovery Act.

- D. Hazardous or non-hazardous waste manifests will be used to document transportation and disposal of the wastes at the approved disposal facility. The generator and original copies of the manifests will be sent to the waste generator.
- E. Management of PPE and disposable equipment generated will be based on the analytical data from the IDW.

6.0 DOCUMENTATION

The containerizing, labeling and sampling (if necessary) of IDW generated as part of an investigation will be documented in field notes. Copies of waste disposal manifests will be retained in the project file as the original waste disposal manifests will be sent to the waste generator.

7.0 ADDITIONAL INFORMATION

Not applicable.

Field Standard Operating Procedures

#101 – Soil Boring Installation



November 2007
Revision 3.1 December 2016

REVISION HISTORY

Below is a summary of the revisions to this Standard Operating Procedure.

Date	Revisions
March 2009	Soil Boring Installation SOP extensively updated
February 2010	Slight modifications to Soil Boring Installation SOP, but not recorded
October 2010	Soil boring methodologies expanded and SOP updated
June 2011	Slight modifications to Soil Boring Installation SOP, but not recorded
June 2015	Extensive revisions and reformatting of Soil Boring Installation SOP performed
December 2016	Revisions to font, added new company logo

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FSOP #101 – SOIL BORING INSTALLATION STANDARD OPERATING PROCEDURE**1.0 PURPOSE AND APPLICABILITY**

This SOP has been prepared for use by HZW personnel only. Prior to installing soil borings at a site, a soil sampling strategy or conceptual site model for purposes of assessing soils should be developed based on the objectives of the investigation. After developing a soil sampling strategy or conceptual site model, the appropriate equipment and methodologies must be used to conduct the investigation. This SOP discusses the typical methodologies for installing soil borings at a site.

2.0 HEALTH AND SAFETY

Property health and safety precautions must be observed during soil boring installation activities. The site-specific Health and Safety Plan (HASP) or HZW's general HASP provides guidelines on health and safety precautions. Field personnel should rely on the site-specific or general HASP to evaluate field conditions at a site such as potential chemical hazards, what is the appropriate personal protective equipment and site monitoring activities.

Prior to initiating soil boring installation activities, the locations of all utilities (public and private) at a site and their locations should be identified. Typically, the state One-Call system will be contacted for publicly-owned utilities and private property owners or maintenance personnel will be contacted for privately-owned utilities.

Specific and technical training of direct-push equipment is required to operate the equipment in a safe manner. All personnel operating direct-push equipment must be trained and knowledgeable in how the equipment operates, the limitations of the equipment and safety precautions while operating equipment.

3.0 DEFINITIONS

Direct-Push Drilling Methodologies: The use of hydraulic or percussive methods to drive or push small-diameter rods and tooling into unconsolidated subsurface materials to collect soil samples and install small diameter groundwater monitoring wells.

Conventional Drilling Methodologies: The use of a rotary drill head that advances auger flights into unconsolidated subsurface materials

Hollow-Stem Augers: An auger flight in which the center stem is open to allow collection of soil samples with a split-spoon sampler and installation of groundwater monitoring wells in unconsolidated subsurface materials.

Split-Spoon Sampler: An 18- to 24-inch long steel or stainless steel cylinder that splits in half length-wise to yield a cored soil sample. Soil samples are collected by lowering the split-spoon sampler to the base of the borehole with drill rods and driving it into the subsurface with a 140 pound weight (or, hammer).

Rotosonic Drilling Methodologies: The use of a drill head that transmits high-frequency vibrations via a core barrel to the cutting (or advancing) edge of the drill string. This vibratory action advances the drill stem and lead barrel through the subsurface materials, retaining a continuous sample of the materials encountered that can be inspected megascopically. The rig advances the drill stem in 10-foot intervals.

4.0 EQUIPMENT AND MATERIALS

Soil borings are typically installed using manual or hydraulic direct-push drilling methodologies. On occasion, soil borings may be installed using a conventional drilling rig equipped with hollow-stem augers and a split-spoon sampler or using a rotosonic drilling rig. Since the use of a conventional drilling rig or a rotosonic drilling rig require retaining the services of a drilling contractor, methodologies for soil boring installation using these drilling rigs is not included in this SOP.

The equipment and materials to install soil borings by HzW is presented below. The listing below is not exhaustive and individual tooling pieces are not listed as the equipment and material list would be extensive. Field personnel operating the direct-push equipment are to refer to the tooling information provided by Geoprobe Systems® to identify and maintain the individual components of the tooling systems.

- Proposal or Sampling & Analysis Plan
- Map of Proposed Soil Boring Locations
- Field Notebook
- Permanent Markers, Ball-Point Pens, Pencils
- Geoprobe® 7782DT, 54LT or 5400 Drilling Units with Trailers (as applicable)
- Support Vehicles (as applicable)
- Manual Slide Hammer Tooling System (Manual Boring Installation)
- DT22 Dual Tube Soil Sampling System (Hydraulic Boring Installation)
- Macro-Core® MC5 Soil Sampling System (Hydraulic Boring Installation)

- Various Sized Pipe Wrenches, Pliers, Hammers
- Shovels, Pick-Axe, Brooms
- Hammer Drill and Bits
- Generator
- Extension Cords
- Retractable Utility Knife with Hook Blades
- Stainless Steel Spatula or Spoon
- Sample Table
- Photoionization Detector
- Weighted Tape Measures
- Polyethylene Sheeting (6-mil thickness)
- Bentonite (Granular and Chips)
- Concrete and Asphalt
- DOT-Approved 55-Gallon Drums and Drum Labels
- Nitrile Gloves
- Distilled Water and Non-Phosphate Detergent for Decontamination
- Additional Five (5) Gallon Buckets and Brushes for Decontamination
- Sorbent Pads (in the event free-phase non-aqueous phase liquid is encountered)
- Global Positioning Systems Unit
- 300-Foot Tape Measures

5.0 PROCEDURES

Soil borings are typically installed using manual or hydraulic direct-push drilling methodologies. Manual direct-push drilling methodologies utilize a slide hammer for boring installation and Geoprobe® hydraulic direct-push drilling methodologies utilize either the Geoprobe® DT22 dual tube or Geoprobe® Macro-Core® MC5 soil sampling system methodologies. The procedures to install soil borings using manual slide hammer, DT22 dual tube soil sampling system and Macro-Core® MC5 soil sampling system methodologies are presented below.

5.1 Manual Slide Hammer Methodologies

- A. Wear the appropriate personnel protective equipment for installing soil borings.
- B. Locate and observe all underground and aboveground utilities particularly in relation to proposed soil boring locations.
- C. Assemble the tooling string, which will consist of a lead 24-inch sample tube containing an acetate sample liner and equipped with a cutting shoe, a slide hammer anvil and 1.25-inch diameter probe rods. A 24-inch

probe rod should be placed between the drive head of the sample tube and slide hammer anvil to limit damage to the drive head.

- D. When assembled, the 30- or 45-pound slide hammer will be raised and lowered manually to drive the sample tube into the subsurface.
- E. Upon reaching the sample liner length for the sample tube (24-inches), the sample tube and probe rods will be retracted using a probe rod jack.
- F. Remove the sample liner with the soil core from the sample tube and insert a new acetate sample liner into the sample tube.
- G. Re-assemble the tooling string (adding probe rods as necessary), and continue driving the sample tube and tooling string to the next sample liner length.
- H. The sample tube and probe rods will be retracted using the probe rod jack.
- I. The process of removing the sample liner with the soil core, inserting a new acetate sample liner into the sample tube, re-assembling the tooling string and retracting the sample tube and probe rods will continue until reaching boring terminal depth.
- J. Upon reaching boring terminal depth and removal of the sample tube and tooling string, the open borehole will be filled with granular bentonite. The bentonite will be hydrated as it is placed in the open borehole. The surface of the borehole will be finished to match the surrounding surface.

Note: Soil borings installed using the manual hammer slide methodologies are typically installed to terminal depths no greater than six (6) feet below grade as non-cohesive soils begin to collapse within the borehole below four (4) feet and cohesive soils limit driving the sample tube below six (6) feet.

- K. Locate the boring locations using the GPS unit or a tape measure with reference to a fixed point.

5.2 Geoprobe® DT22 Dual Tube Soil Sampling System Methodologies

The Geoprobe® DT22 dual tube soil sampling system is used to collect continuous soil samples within a sealed casing as the system uses a series of two (2) probe rods.

- A. Wear the appropriate personnel protective equipment for installing soil borings.
- B. Locate and observe all underground and aboveground utilities particularly in relation to proposed soil boring locations.
- C. Assemble the lead sample tube, which will be either 48-inches or 60-inches in length. A cutting shoe is connected to the leading edge of the sample tube with an appropriately-sized acetate sample liner inserted into the lead sample tube. At the top of the acetate sample liner, a liner drive head is inserted into the liner and a drive bumper and the drive cap placed on top of the liner drive head.
- D. Place the assembled lead sample tube under the drive head of the hydraulic direct push machine. The tube should be positioned with the cutting shoe between the toes of the probe foot.
- E. Lower the hydraulic hammer onto the drive cap and advance the sample tube to the sample liner length using continuous percussion.
- F. Once at sample liner depth, raise the hydraulic hammer and move the probe assembly back in order to access the tooling string.
- G. Remove the drive cap and drive bumper.
- H. Thread a 1.25-inch lightweight inner rod onto the liner drive head. Raise the inner rod and sample liner from the lead sample tube.
- I. Remove the liner drive head from the acetate sample liner. Insert the liner drive head into a new acetate sample liner.
- J. Insert the new acetate sample liner in the lead sample tube that remains in the ground and thread a 1.25-inch lightweight inner rod onto the liner drive head. The inner rod will extend above the lead sample tube (i.e., an outer casing).

- K. Place a 2.25-inch outer probe rod over the inner rods and thread the outer probe rod to the lead sample tube until tightened.
- L. Place a drive bumper and drive cap over the inner rod and outer probe rod.
- M. Lower the hydraulic hammer onto the drive cap and advance the tooling string the length of the sample liner. Apply the hydraulic hammer as necessary to drive the lead sample tube and tooling string.
- N. Upon reaching the next sample liner length depth, raise the hydraulic hammer and move the probe assembly back in order to access the tooling string.
- O. Remove the drive cap and drive bumper.
- P. Thread a 1.25-inch lightweight inner rod onto the inner rod in the ground to raise the inner rods and sample liner.
- Q. Remove the liner drive head from the acetate sample liner. Insert the liner drive head into a new acetate sample liner.

Repeat steps J through Q until advancing to boring terminal depth.

- R. Upon completion of soil boring installation and removal of the sample liner and inner rods, retrieve the outer probe rods from the borehole using the rod grip pull system for the direct-push machine.
- S. Fill the open borehole with granular bentonite. The bentonite will be hydrated as it is placed in the open borehole. The surface of the borehole will be finished to match the surrounding surface.
- T. Locate the boring locations using the GPS unit or a tape measure with reference to a fixed point.

5.3 Geoprobe® Macro-Core® MC5 Soil Sampling System Methodologies

The Geoprobe® Macro-Core® MC5 soil sampling system is used to collect continuous soil from an uncased boring as the lead sample tube is advanced and retrieved from the boring for each soil sample interval.

- A. Wear the appropriate personnel protective equipment for installing soil borings.

- B. Locate and observe all underground and aboveground utilities particularly in relation to proposed soil boring locations.
 - C. Attach an MC spacer ring onto the threaded end of an MC5 cutting shoe. The spacer ring should be pushed on until it snaps into the machined groove on the cutting shoe.
 - D. Attach an MC5 acetate sample liner onto the spacer ring and insert the cutting shoe with spacer ring and sample liner onto one end of the MC5 sample tube. Tighten the threaded end of the cutting shoe onto the sample tube.
 - E. On the opposite end of the MC5 sample tube, thread and tighten a drive head. Place a drive cap onto the drive head.
 - F. Raise the hydraulic hammer to the highest position by fully extending the probe cylinder.
 - G. Position the MC5 sample tube assembly directly under the hammer with the cutting shoe centered between the toes of the probe feet.
 - H. Lower the hydraulic hammer onto the drive cap and advance the tooling string the length of the sample liner. Apply the hydraulic hammer as necessary to drive the lead sample tube and tooling string.
 - I. Upon reaching sample liner depth, remove the drive cap and thread a pull cap onto the sampler drive head.
 - J. Lower the hydraulic hammer and hook the hammer latch over the pull cap. Raise the hydraulic hammer to pull the sample tube completely out of the ground.
- Note:** When advancing or retrieving the sample tube from the ground, use caution as the sample tube and probe rods can drop down the open borehole when released. A pipe wrench should be used to limit the potential of losing the sample tube or probe rods when using the MC5 sample system.
- K. Unthread the cutting shoe from the sample tube to pull out the sample liner. The use of pipe or flat wrenches and/or a hammer may be necessary to loosen the cutting shoe threads.

- L. Attach an MC spacer ring onto the threaded end of an MC5 cutting shoe. The spacer ring should be pushed on until it snaps into the machined groove on the cutting shoe.
- M. Attach an MC5 acetate sample liner onto the spacer ring and insert the cutting shoe with spacer ring and sample liner onto one end of the MC5 sample tube. Tighten the threaded end of the cutting shoe onto the sample tube.
- N. On the opposite end of the MC5 sample tube, thread and tighten a drive head. Thread a 1.25-inch lightweight probe rod onto the drive head.
- O. Insert the sample tube with a probe rod into the open borehole.
- P. Raise the hydraulic hammer to the highest position by fully extending the probe cylinder.
- Q. Lower the hydraulic hammer onto the drive cap and advance the tooling string the length of the sample liner. Apply the hydraulic hammer as necessary to drive the lead sample tube and tooling string.
- R. Upon reaching sample liner depth, remove the drive cap and thread a pull cap onto the sampler drive head.
- S. Lower the hydraulic hammer and hook the hammer latch over the pull cap. Raise the hydraulic hammer to pull the sample tube completely out of the ground.
- T. Unthread the cutting shoe from the sample tube to pull out the sample liner. The use of pipe or flat wrenches and/or a hammer may be necessary to loosen the cutting shoe threads.

Repeat steps L through T until advancing to boring terminal depth.

- U. Upon completion of soil boring installation, fill the open borehole with granular bentonite. The bentonite will be hydrated as it is placed in the open borehole. The surface of the borehole will be finished to match the surrounding surface.
- V. Locate the boring locations using the GPS unit or a tape measure with reference to a fixed point.

5.4 Decontamination

Since soil cores obtained with the manual slide hammer, DT22 soil sampling system and Macro-Core® MC5 soil sampling system methodologies are collected in disposable acetate sample liners, sampling equipment does not need to be decontaminated between sampling locations. However, if gross contamination is encountered or if the potential for cross-contamination is suspected, the sampling equipment will be decontaminated in accordance with the established decontamination procedures. These decontamination procedures for the sampling equipment are consistent with the Ohio EPA's Discrete Soil Sampling Field Standard Operating Procedure 2.1.1 dated February 12, 2013.

6.0 DOCUMENTATION

Soil boring installation and drilling methodologies will be documented in project field notes and in field boring logs. Field conditions and any deviation from proposed activities or equipment issues in the field will be recorded.

7.0 ADDITIONAL INFORMATION

Not applicable.

Field Standard Operating Procedures

#102 – Soil Sampling



HZW Environmental
Consultants

November 2007
Revision 3.2 June 2017

REVISION HISTORY

Below is a summary of the revisions to this Standard Operating Procedure.

Date	Revisions
March 2009	Soil Sampling SOP extensively updated
February 2010	Slight modifications to Soil Sampling SOP, but not recorded
October 2010	Soil sampling methodologies expanded for EPA Method 5035 and SOP updated
June 2011	Slight modifications to Soil Sampling SOP, but not recorded
June 2015	Extensive revisions and reformatting of Soil Sampling SOP performed
December 2016	Revisions to font, added new company logo
June 2017	Added language in the field screening of soil samples to be analyzed by EPA Method 5035

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FSOP #102 – SOIL SAMPLING STANDARD OPERATING PROCEDURES**1.0 PURPOSE AND APPLICABILITY**

This SOP has been prepared for use by HZW personnel only. Soil sampling and analysis will be conducted to allow for comparison to standards and/or values applicable to a particular site. Should subsurface impacts be identified the data acquired during the soil sampling activities will be used to determine whether further assessment and/or remedial actions are necessary.

Prior to conducting a soil sampling investigation, a soil sampling strategy or conceptual site model for soil sampling should be developed based on the objectives of the investigation. After developing a soil sampling strategy or conceptual site model, the appropriate equipment and methodologies must be used to conduct the investigation. This SOP discusses the various soil sample collection methods, sample handling, and available sampling equipment which have been shown to be technically appropriate.

2.0 HEALTH AND SAFETY

Property health and safety precautions must be observed during soil sampling activities. The site-specific Health and Safety Plan (HASP) or HZW's general HASP provides guidelines on health and safety precautions. Field personnel should rely on the site-specific or general HASP to evaluate field conditions at a site such as potential chemical hazards, what is the appropriate personal protective equipment and site monitoring activities.

3.0 DEFINITIONS

Direct-Push Drilling Methodologies: The use of hydraulic or percussive methods to drive or push small-diameter rods and tooling into unconsolidated subsurface materials to collect soil samples and install small diameter groundwater monitoring wells.

Conventional Drilling Methodologies: The use of a rotary drill head that advances auger flights into unconsolidated subsurface materials

Hollow-Stem Augers: An auger flight in which the center stem is open to allow collection of soil samples with a split-spoon sampler and installation of groundwater monitoring wells in unconsolidated subsurface materials.

Split-Spoon Sampler: An 18- to 24-inch long steel or stainless steel cylinder that splits in half length-wise to yield a cored soil sample. Soil samples are collected by lowering the split-spoon sampler to the base of the borehole with drill rods and driving it into the subsurface with a 140 pound weight (or, hammer).

Rotosonic Drilling Methodologies: The use of a drill head that transmits high-frequency vibrations via a core barrel to the cutting (or advancing) edge of the drill string. This vibratory action advances the drill stem and lead barrel through the subsurface materials, retaining a continuous sample of the materials encountered that can be inspected megascopically. The rig advances the drill stem in 10-foot intervals.

Constituent of Concern: A chemical or a collective group of chemicals that samples of environmental media will be analyzed. A constituent of concern is typically identified based on current and/or historical uses of a site, which may include operations, practices or storage of chemicals.

4.0 EQUIPMENT AND MATERIALS

Soil samples will typically be collected with a stainless steel hand trowel, a hand auger or a “direct push” sampling device. On occasion, soil samples may be collected using conventional split-spoon or rotosonic methodologies if a drilling rig is utilized. The equipment to be used will depend on the purpose of the sampling and sampling depth. A brief description of the equipment used to collect soil samples as well as a listing of equipment and materials that may be necessary to perform soil sampling is presented below.

4.1 Stainless Steel Hand Trowel

A stainless steel hand trowel is typically utilized to collect surficial soil samples, soil samples from sidewalls of shallow open excavations (depths less than four [4] feet), or soil samples from sidewalls of deeper open excavations (depths greater than four [4] feet) in which an excavator will collect the sidewall sample at depth.

4.2 Hand Auger

Hand augers are typically utilized to collect shallow subsurface soil samples, hand clear utilities to a depth of five (5) feet below ground surface, collect soil samples from soil stockpiles generally no higher than five (5) feet in height, and to collect soil samples from 55-gallon drums of investigation-derived waste. In general, two (2) types of hand augers will be utilized: an open auger and a

closed-barrel auger. The auger buckets are approximately six (6) inches in length with a cutting head that is pushed and twisted into the ground, then removed as the bucket is filled. The auger holes are advanced one bucket at a time. The practical depth of investigation using a hand auger depends upon the soil properties. In general, hand auger depths will be limited to four (4) to six (6) feet below ground surface as soils (particularly less cohesive soils) tend to collapse below depths of four (4) to six (6) feet.

4.3 Direct Push Sampling

Soil sampling is most often conducted using direct-push (e.g., Geoprobe®) subsurface drilling and sampling methodologies. Direct-push methodologies consist of manually or hydraulically driving a series of two (2), four (4) or five (5) foot long stainless steel or hardened steel rods into the subsurface. The lead rod on the tooling string consists of a stainless steel sample tube which is lined with a clean, disposable acetate (plastic) liner. Soil samples may be collected continuously or at a predetermined depth using direct-push drilling and sampling methodologies. The two (2) types of sampling systems commonly utilized with direct-push methodologies is Macro-Core® and Dual Tube. While both systems collect soil samples continuously, the Macro-Core system consists of a single sample tube that is retracted from the borehole each time in order to retrieve the soil sample liner, whereas the Dual Tube consists of two (2) probe rods in which the inner rods are retracted to retrieve the soil sample liner. Most often, the Dual Tube system is utilized since it minimizes the potential cross-contamination of contaminated and uncontaminated soils.

4.4 Split-Spoon Sampling

Split-spoon soil sampling is commonly used with hollow-stem augers as the split-spoon sampler goes within the hollow-stem auger and ahead of the lead auger bit. The split-spoon sampler is approximately 24-inches long and is driven into the subsurface with a 140 pound hammer.

4.5 Rotosonic Sampling

A rotosonic drilling rig uses a drill head that transmits high-frequency vibrations via a core barrel to the cutting (or advancing) edge of the drill string. This vibratory action advances the drill stem and lead barrel through the subsurface materials, retaining a continuous sample of the materials encountered that can be inspected megascopically. The rig advances the drill stem in 10-foot intervals (or “strokes”). Rotosonic drilling results in virtually no drill cuttings, in that the subsurface materials “extracted” through drilling are retained within an inner core tube. However, the process does generate a

certain amount of investigation-derived waste as water is used in the process to maintain a controlled temperature at the advancing edge of the drill string. Since water is used in the drilling process, soils recovered from roto-sonic drilling methodologies are generally not collected for laboratory analysis.

4.6 Additional Equipment and Materials

The following equipment and materials will be necessary to complete soil sampling activities. Certain equipment and materials may not be applicable for a particular site given the purpose and scope of soil sampling activities.

- Proposal or Sampling & Analysis Plan
- Map of Proposed Soil Boring Locations
- Field Notebook
- Permanent Markers, Ball-Point Pens, Pencils
- Retractable Utility Knife with Hook Blades
- Stainless Steel Spatula or Spoon
- Sample Containers and Labels
- Cooler and Ice
- Sample Table
- Disposable Polyethylene Bags (Generally Sandwich-Size)
- Photoionization Detector
- Tape Measure (25 feet)
- Polyethylene Sheeting (6-mil thickness)
- DOT-Approved 55-Gallon Drums and Drum Labels for IDW
- Nitrile Gloves
- Distilled Water and Non-Phosphate Detergent for Decontamination
- Additional Five (5) Gallon Buckets and Brushes for Decontamination
- Sorbent Pads (in the event free-phase non-aqueous phase liquid is encountered)
- Global Positioning Systems Unit

Certain field equipment may be supplied by a commercial environmental rental supply company, which will be calibrated prior to leaving the premises of the environmental rental supply company. The environmental rental supply company will provide documentation of the calibration performed. For any equipment owned by HZW, the equipment will be calibrated in accordance with the manufacturer's specifications and the calibration documented in project field notes. If a project will be conducted over several days, all equipment requiring calibration will be calibrated in accordance with the manufacturer's specifications at the beginning of each day.

5.0 PROCEDURES

The procedures to collect soil samples at a site are presented below. Procedures for soil samples to be analyzed for volatile organic compounds (VOCs) by bulk sampling methods and in conformance with U.S. EPA SW 846 Methods 5035 and 5035A are presented below as certain handling and management of soil samples being analyzed for VOCs is required. In all cases, soil samples to be analyzed for VOCs will be collected first prior to collecting soil samples for other analyses.

In general, soil samples collected as part of assessment activities are collected in two-foot intervals. Therefore, when a four (4) or five (5) foot long sampling rods are utilized in direct-push drilling and sampling methodologies, the samples will be split into two-foot intervals. In addition, when using direct-push drilling and sampling methodologies or a split-spoon sampler, care should be exercised to identify any potential caved or sloughed material from the open borehole being present in a sample liner overlying the targeted interval or depth to be sampled. If caved or sloughed material is present, this material should not be sampled as part of the targeted interval or depth and should be discarded.

5.1 Soil Sample Collection for VOC Analysis Using Bulk Sampling Methods

- A. Obtain the sample directly from the sampling device (hand trowel, direct-push sample tubes, etc.). If the sample tube will not be opened immediately, the ends of the sample tube should be capped.
- B. The soil sample will be divided into two (2) portions. The first portion will be placed in a clean, labeled, laboratory-supplied sample container and filled so that no or only a minimal volume of headspace is present in the sample container. The second (duplicate) portion will be placed in a new, labeled, sandwich-sized sealable polyethylene bag for field screening purposes. If the soil sample is collected from the direct-push sample tubes or split-spoon sampler, the two-foot interval will be split longitudinally to obtain the two (2) sample portions.

If the soil sample is collected from the two-foot interval retrieved from the direct-push sample tubes or split-spoon sampler, a representative sample will be collected from the two-foot interval unless obvious evidence of contamination is identified in which case the specific depth may be sampled instead of the entire two-foot interval. In order to collect a representative sample from the two-foot interval, soil will be collected at a minimum of four (4) locations at increments no greater than six (6) inches along the two-foot interval.

- C. Any soil or debris should be cleaned from the outside of the labeled sample container.
- D. Immediately place the labeled sample containers in a cooler with ice for preservation in the field.
- E. Log (record) the subsurface lithology/materials observed in the soil sample in the project field notes or project boring logs.
- F. Field screen the soil sample/soil sample intervals in accordance with the **Field Soil Screening SOP**. Record the field screening for each sample/sample depth/sample depth interval.
- G. Submit selected soil samples to the analytical laboratory under appropriate and complete chain-of-custody documentation.
- H. Decontaminate any reusable equipment (such as a stainless steel spatula) used during sampling activities prior to collecting the next soil sample.
- I. Locate the soil sample locations using the GPS unit or a tape measure with reference to a fixed point.

5.2 Soil Sample Collection for VOC Analysis Using U.S. EPA Methods 5035 and 5035A

The following protocol is recommended for assessing the extent of VOCs in soils, but may not be applicable in all situations such as Bureau of Underground Storage Tank Regulations investigations, Toxicity Characteristic Leaching Procedure sampling or large diameter materials. The specific sampling containers and sampling tools required will depend upon the detection levels and intended data use. Once this information has been established, selection of the appropriate sampling procedure and preservation method can be made.

Environmental samples usually contain low concentrations of VOCs and should be collected using low-concentration sampling methodology. If high-concentration sampling methodology is required based upon the study DQOs and detection limit requirements, consult SW846 Method 5035 for sample collection guidance. For low-concentration VOC samples, pre-weighed 40 milliliter VOC vials will be used. Depending on field conditions, the vials may be pre-preserved with methanol, sodium bisulfate or organic-free reagent-grade water. If un-preserved samples are collected, they must either be frozen or transported or shipped to the laboratory for preservation within 48 hours. The sample vials should be stored horizontally to reduce stress on the sides of the

glass vials. VOC trip blanks and spikes should be utilized to insure the integrity of the septum seal on the vial is not compromised.

Soil samples collected for VOC analysis by U.S. EPA Methods 5035 and 5035A will be collected using either EnCore® or TerraCore® VOC samplers. If surface soil samples are collected, the sample should be placed directly into the VOC sampling device if possible (i.e., from ground to the EnCore® or TerraCore® VOC samplers). If subsurface soil samples are collected (typically using direct-push sampling or a split-spoon sampler), field screening of the recovered soil samples (e.g., entire soil column sampled), the recovered two-foot sample interval or a specific sample depth will need conducted prior to collecting the soil sample. The procedures for performing the field screening on subsurface soil samples and collecting soil samples with the EnCore® or TerraCore® VOC samplers is presented below.

Field Screening Procedures

- A. Calibrate the photoionization detector to the manufacturer's specifications.
- B. To the extent practical, in an area that is protected from certain weather conditions (e.g., wind, rain, extreme heat and sun), cut open the sample liner from the direct-push sample tube or open the split-spoon sampler. The entire sample liner should not be exposed in order to minimize VOC loss.
- C. Using a stainless steel spatula, loosen the recovered soil core at approximate six (6) inch intervals and place the probe tip of the photoionization detector within the loosened soil. Care should be exercised to not let the probe tip come into contact with the loosened soil such that soil could become lodged in the probe tip or drawn into the detector, which would result in erroneous field screening readings.
- D. The soils exhibiting the highest concentration of organic vapors as measured on the photoionization detector should be sampled with the EnCore® or TerraCore® VOC samplers.

Note: While field screening and sampling activities using the EnCore® or TerraCore® VOC samplers should be done quickly, care should be exercised to ensure that potential errors are reduced and sample collection methods are not compromised.

EnCore™ VOC Sampler

The EnCore® VOC sampler is a commercially available device which has been approved by EPA for collection, storage, and shipping of unpreserved soil VOC samples. EnCore® samplers are available in 5 gram and 25 gram volumes. The volume of sample required is based upon the VOC analysis that will be conducted.

Before Taking Sample:

- A. Hold coring body and push plunger rod down until small o-ring rests against tabs. This will assure that plunger moves freely.
- B. Depress locking lever on EnCore® T-Handle. Place coring body, plunger end first, into open end of T-Handle, aligning the (2) slots on the coring body with the (2) locking pins in the T-Handle. Twist coring body clockwise to lock pins in slots. Check to ensure sampler is locked in place. Sampler is ready for use.

Taking Sample:

- C. Turn T-Handle with T-up and coring body down. This positions plunger bottom flush with bottom of coring body (ensure that plunger bottom is in position). Using T-Handle, push sampler into soil until coring body is completely full. When full, small o-ring will be centered in T-Handle viewing hole. Remove sampler from soil. Wipe excess soil from coring body exterior.
- D. Cap coring body while it is still on T-Handle. Push cap over flat area of ridge and twist to lock cap in place. CAP MUST BE SEATED TO SEAL SAMPLER.

Preparing Sampler for Shipment:

- E. Remove the capped sampler by depressing locking lever of T-Handle while twisting and pulling sampler from T-Handle.
- F. Lock plunger by rotating extended plunger rod fully counter-clockwise until wings rest firmly against tabs.
- G. Attach label or tag to cap on coring body.

- H. Return full EnCore® sampler to plastic bag. Place a custody seal on the bag and place on ice. The unpreserved samples will be placed in an iced cooler in the field. Samples collected with an EnCore® sampler must be transported or shipped to the laboratory within 48 hours of collection for preservation. Therefore, daily transport or shipment to the laboratory is required. Submit selected soil samples to the analytical laboratory under appropriate and complete chain-of-custody documentation.
- I. Record the sample location with either a Global Positioning System unit or a tape measure from a fixed reference point.

TerraCore® VOC Sampler

The TerraCore® VOC sampler is a commercially available device which has been approved by EPA for collection, storage, and shipping of field preserved soil VOC samples. TerraCore® samplers are available in 5 gram and 10 gram volumes and field preserve soil VOC samples using sodium bisulfate or organic free, laboratory-grade water and methanol. TerraCore® sampling kits consist of two (2) 40 mL vials containing either sodium bisulfate or organic free, laboratory-grade water for low-level VOC analysis, one (1) 40 mL vial containing methanol for high-level VOC analysis, a dry weight container and a TerraCore® sampler (a plastic T-shaped sampling device). The instructions for use are as follows:

- A. Label all vials in the TerraCore® sampling kit as well as any accompanying sealable polyethylene bags with the appropriate sample identification.
- B. Prepare the three (3) 40 mL vials and the dry weight container for sampling.
- C. Push the TerraCore® T-handle sampler into the exposed soil sample location until the sample chamber is filled. The sample chamber will be filled with 5 or 10 grams of aliquot.
- D. Wipe excess soil from the exterior of the TerraCore® sampler or that extends beyond the mouth of the sampler.
- E. Place the sample aliquot in the TerraCore® sampler chamber into a 40 mL vial by rotating the TerraCore® sampler plunger 90 degrees and depressing. Ensure that the mouth of the TerraCore® sampler is within the 40 mL vial. Immediately secure the 40 mL vial cap once the sample aliquot has been transferred.

- F. Repeat Steps 3, 4 and 5 to fill the remaining two (2) 40 mL vials.
- G. Once 5 or 10 gram sample aliquots have been placed in the 40 mL vials, fill the dry weight container to a minimum of half full with soil.
- H. Place all sample containers in the TerraCore® sampling kit foam holder and place the foam holder in a sealable polyethylene bag.
- I. Close the sealable polyethylene bag and place the bag in an iced cooler in the field. Samples collected with a TerraCore® sampler and preserved with laboratory-grade water must be transported or shipped to the laboratory within 48 hours of collection and frozen. Therefore, daily transport or shipment to the laboratory is required. Submit selected soil samples to the analytical laboratory under appropriate and complete chain-of-custody documentation.
- J. Locate the soil sample locations using the GPS unit or a tape measure with reference to a fixed point.

Special Techniques and Considerations

Effervescence

Effervescence, the rapid formation of bubbles, occurs when there is a reaction between the sample media and the preservative. If there is uncertainty regarding low concentration samples effervescing from contact with the preservative, then either a test for effervescence must be performed during a reconnaissance, the field investigator should be equipped to collect samples both preserved or un-preserved, or all samples should be collected in an un-preserved container. To check for effervescence, collect a test sample and add to a pre-preserved vial. If preservation of the sample results in effervescence, the preservation by acidification is not acceptable, and the sample must be collected un-preserved.

In the event effervescence occurs unexpectedly and only pre-preserved vials are available, the preservative solution may be placed into an appropriate hazardous waste container and the vials triple rinsed with organic free water. An appropriate amount of organic free water, equal to the amount of preservation solution, should be placed into the vial. The sample may then be collected as an un-preserved sample. Note that the amount of organic free water placed into the vials will have to be accurately measured and the weight recorded.

Sample Size

While this method of sampling is an improvement over earlier methods, field investigators must be aware of an inherent limitation. Due to the extremely small sample size, sample representativeness of VOCs may be reduced when compared to samples with larger volumes collected for other constituents. The sampling design and objectives of the investigation should take this into consideration.

Percent Moisture

Sufficient sample volume must be sent to the laboratory to determine percent moisture in the VOC soil sample to correct the results to dry weight. If other analyses requiring percent moisture determination are being performed upon the sample, these results may be used. If not, a separate sample (minimum of 2 ounces) for percent moisture determination is required.

Sample Holding Times

Field investigators should note that the holding time for an unpreserved VOC soil/sediment sample is 48 hours. Arrangements should be made to ship the soil/sediment VOC samples to the laboratory by overnight delivery the day they are collected so the laboratory may prepare and preserve the sample within 48 hours of collection.

Shipping Sodium Bisulfate and Methanol

Shipping sodium bisulfate and methanol is considered a hazardous material. Therefore, shipping of the sample containers with the preservative is regulated by the U.S. Department of Transportation and the International Air Transport Association (IATA). The rules of shipment set in Title 49 of the Code of Federal Regulations (49 CFR parts 171 to 180) and the current edition of the IATA Dangerous Goods Regulation must be followed when shipping sodium bisulfate and methanol between the laboratory and the field. Consult the above documents or the shipping company for additional information.

Summary

Table 1 presents the options suggested for compliance with SW846 Method 5035. The advantages and disadvantages for each option are noted.

Table 1
SW846 Method 5035 Comparison

PROCEDURE	ADVANTAGES	DISADVANTAGES
Collect 2 – 40 mL vials with 5 grams of sample and 1 – 2-oz., glass w/septum lid for screening and % moisture	Screening conducted by lab.	A 48 hour holding time for unpreserved samples.
Collect 3 Encore™; and 1 -2-oz., glass w/septum lid for screening and % moisture	Lab conducts all preservation/preparation procedures.	A 48 hour holding time for preparation of samples.
Collect 2 – 40 ml vials with 5 grams of sample and preserved with sodium bisulfate or organic free water, 1 – 40 ml vial with 5 grams of sample and preserved with methanol, and 1 – 2-oz., glass w/septum lid for screening and % moisture.	Longer holding time for samples preserved with sodium bisulfate and methanol.	A 48 hour holding time for samples preserved with water to be frozen by laboratory. Hazardous materials used in field.

5.3 Soil Sample Collection for Non-VOC Analyses

Soil samples may be collected for non-VOC analyses whether VOCs are a constituent of concern or not. Selection of samples/sample depths/sample depth intervals for non-VOC analyses may be consistent with samples submitted for VOC analysis (i.e., highest field screening readings) or from pre-determined or specific depths depending on project objectives.

- A. Place representative soils (either of a specific location, depth or of a sample interval) in a clean, labeled, laboratory-supplied sample container and filled so that no or only a minimal volume of headspace is present in the sample container. While headspace volume is generally not a concern with non-VOC analyses, the purpose in attempting to completely fill the non-VOC analyses sample containers is to provide the analytical laboratory with a sufficient sample volume for analyses to be performed.
- B. The sample containers should be filled in the order of decreasing sensitivity to volatilization (semi-volatile organic compounds→pesticides/polychlorinated biphenyls→metals).
- C. Any soil or debris should be cleaned from the outside of the labeled sample container.
- D. Log (record) the subsurface lithology/materials observed in the soil sample in the project field notes or project boring logs.
- E. Immediately place the labeled sample containers in a cooler with ice for preservation in the field.
- F. Decontaminate any reusable equipment (such as a stainless steel spatula) used during sampling activities prior to collecting the next soil sample.
- G. Record the sample location with either a Global Positioning System unit or a tape measure from a fixed reference point.
- H. Submit selected soil samples to the analytical laboratory under appropriate and complete chain-of-custody documentation.
- I. Locate the soil sample locations using the GPS unit or a tape measure with reference to a fixed point.

6.0 DOCUMENTATION

Soil sampling activities will be documented in project field notes, on field boring logs, calibration sheets (as applicable), sample labels and chains-of-custody. The drilling methodologies, sample collection procedures, field conditions and analytical parameters will be documented as well as any deviation from proposed activities or equipment issues in the field.

7.0 ADDITIONAL INFORMATION

Not applicable.

Field Standard Operating Procedures

#103 – Soil Sample Field Screening



HZW Environmental
Consultants

November 2007
Revision 3.1 December 2016

REVISION HISTORY

Below is a summary of the revisions to this Standard Operating Procedure.

Date	Revisions
March 2009	Soil Sample Field Screening SOP extensively updated
June 2015	Extensive revisions and reformatting of Soil Sample Field Screening SOP performed
December 2016	Revisions to font, added new company logo

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FSOP #103 – SOIL SAMPLE FIELD SCREENING STANDARD OPERATING PROCEDURE**1.0 PURPOSE AND APPLICABILITY**

This SOP has been prepared for use by HzW personnel only. Field screening of soil samples will be conducted as part of a soil investigation of a site and is generally performed to identify which soil samples will be submitted to an analytical laboratory for analysis. Prior to conducting a soil investigation, a soil sampling strategy or conceptual site model for soil sampling should be developed based on the objectives of the investigation. After developing a soil sampling strategy or conceptual site model, the appropriate equipment and methodologies must be used to conduct the investigation. This SOP discusses the field screening of soil samples once the samples have been collected in accordance with the Soil Sampling SOP. Procedures for field screening soils to be analyzed for VOCs by EPA Method 5035 not presented in this SOP. Rather, procedures for field screening of soils to be analyzed for VOCs by EPA Method 5035 is presented in the Soil Sampling SOP as field screening is an integral part of the sampling procedures for EPA Method 5035.

2.0 HEALTH AND SAFETY

Property health and safety precautions must be observed during soil sample field screening activities. The site-specific Health and Safety Plan (HASP) or HzW's general HASP provides guidelines on health and safety precautions. Field personnel should rely on the site-specific or general HASP to evaluate field conditions at a site such as potential chemical hazards, what is the appropriate personal protective equipment and site monitoring activities. Care should be exercised when performing field screening activities as volatile compounds are concentrated in field screening containers. The Project Manager or the Health and Safety Officer should be consulted on sites where high concentrations of volatile compounds are anticipated to be found as field screening methodologies may need to be modified or specific health and safety measures implemented to conduct field screening activities.

3.0 DEFINITIONS

Not applicable.

4.0 EQUIPMENT AND MATERIALS

The equipment and materials used to conduct field screening of soil samples is presented below.

- Proposal or Sampling & Analysis Plan
- Map of Proposed Soil Boring/Sample Locations
- Field Notebook
- Permanent Markers, Ball-Point Pens, Pencils
- Sample Containers and Labels
- Sample Table
- Disposable Polyethylene Bags (Generally Sandwich-Size)
- Photoionization Detector
- DOT-Approved 55-Gallon Drums and Drum Labels for IDW
- Nitrile Gloves

Certain field equipment may be supplied by a commercial environmental rental supply company, which will be calibrated prior to leaving the premises of the environmental rental supply company. The environmental rental supply company will provide documentation of the calibration performed. For any equipment owned by HZW, the equipment will be calibrated in accordance with the manufacturer's specifications and the calibration documented in project field notes. If a project will be conducted over several days, all equipment requiring calibration will be calibrated in accordance with the manufacturer's specifications at the beginning of each day.

5.0 PROCEDURE

5.1 Field Screening Considerations

- A. A photoionization detector (PID) will only detect molecules that can be ionized. PIDs are typically equipped with an ultraviolet lamp of an ionization energy of 10.6 electron volts (eV). In order to detect the molecule, the ionization energy of the ultraviolet lamp must be higher than the ionization potential of the compound(s) being screened.
- B. PID performance is adversely affected by temperature fluctuations and PID readings are affected by the presence of water vapor and methane. Use of a PID in extremely wet or cold conditions should be avoided.

- C. Dusty environments may affect the PID inlet filter and reduce performance of the ultraviolet lamp. Filters should be inspected and changed after use in a dusty environment.
- D. During field screening activities, neither liquid nor solid materials should be allowed to be drawn into the instrument probe.
- E. Do not expose the PID to a known source of highly concentrated organic vapors.

5.2 Field Screening of Soil Samples

- A. Calibrate the PID in accordance with the Equipment Calibration Standard Operating Procedure.
- B. Allow the sample container lined with aluminum foil or sealable polyethylene bag in which the duplicate field screening soil sample was collected during soil sampling activities (see Soil Sampling Standard Operating Procedure) to warm in an ambient air temperature of approximately 70 degrees Fahrenheit for 10 to 15 minutes.

If field screening activities are not able to be performed in the field, place the duplicate field screening soil samples collected during soil sampling activities in an iced cooler and do not or limit exposure to light in order to minimize volatilization of chemicals.

- C. Insert the PID probe tip through the aluminum foil or through a small opening in the sealable polyethylene bag.
- D. Monitoring the PID readings for a time period of approximately 10 seconds. Longer time periods can be used as long as the time period is the same for each sample.
- E. Record the highest PID reading during the time interval on the soil boring log and/or project field notes.
- F. Dispose of the field screening soil samples as investigation-derived waste.

6.0 DOCUMENTATION

Field screening activities/readings will be documented in project field notes and/or on field boring logs and calibration sheets (as applicable). Any deviations from this SOP will be included in the field notes.

7.0 ADDITIONAL INFORMATION

Not applicable.

Field Standard Operating Procedures

#201 – Monitoring Well Installation



HZW Environmental
Consultants

November 2007
Revision 3.2 June 2017

REVISION HISTORY

Below is a summary of the revisions to this Standard Operating Procedure.

Date	Revisions
March 2009	Monitoring Well Installation SOP extensively updated
February 2010	Slight modifications to Monitoring Well Installation SOP, but not recorded
June 2015	Extensive revisions and reformatting of Monitoring Well Installation SOP performed
December 2016	Revisions to font, added new company logo
June 2017	Addition of Well Log and Drilling Report submittal to Ohio Department of Natural Resources and the local health department in Section 6.0.

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FSOP #201 – MONITORING WELL INSTALLATION STANDARD OPERATION PROCEDURE**1.0 PURPOSE AND APPLICABILITY**

This SOP has been prepared for use by HZW personnel only. Prior to installing soil borings at a site, a soil sampling strategy or conceptual site model for purposes of assessing soils should be developed based on the objectives of the investigation. After developing a soil sampling strategy or conceptual site model, the appropriate equipment and methodologies must be used to conduct the investigation. This SOP discusses the typical methodologies for installing soil borings at a site.

2.0 HEALTH AND SAFETY

Property health and safety precautions must be observed during monitoring well installation activities. The site-specific Health and Safety Plan (HASP) or HZW's general HASP provides guidelines on health and safety precautions. Field personnel should rely on the site-specific or general HASP to evaluate field conditions at a site such as potential chemical hazards, what is the appropriate personal protective equipment and site monitoring activities.

Prior to initiating monitoring well installation activities, the locations of all utilities (public and private) at a site and their locations should be identified. Typically, the state One-Call system will be contacted for publicly-owned utilities and private property owners or maintenance personnel will be contacted for privately-owned utilities.

Specific and technical training of drilling equipment is required to operate the equipment in a safe manner. All personnel operating drilling equipment must be trained and knowledgeable in how the equipment operates, the limitations of the equipment and safety precautions while operating equipment.

3.0 DEFINITIONS

Direct-Push Drilling Methodologies: The use of hydraulic or percussive methods to drive or push small-diameter rods and tooling into unconsolidated subsurface materials to collect soil samples and install small diameter groundwater monitoring wells.

Conventional Drilling Methodologies: The use of a rotary drill head that advances auger flights into unconsolidated subsurface materials

Hollow-Stem Augers: An auger flight in which the center stem is open to allow collection of soil samples with a split-spoon sampler and installation of groundwater monitoring wells in unconsolidated subsurface materials.

Split-Spoon Sampler: An 18- to 24-inch long steel or stainless steel cylinder that splits in half length-wise to yield a cored soil sample. Soil samples are collected by lowering the split-spoon sampler to the base of the borehole with drill rods and driving it into the subsurface with a 140 pound weight (or, hammer).

Rotosonic Drilling Methodologies: The use of a drill head that transmits high-frequency vibrations via a core barrel to the cutting (or advancing) edge of the drill string. This vibratory action advances the drill stem and lead barrel through the subsurface materials, retaining a continuous sample of the materials encountered that can be inspected megascopically. The rig advances the drill stem in 10-foot intervals.

4.0 EQUIPMENT AND MATERIALS

Monitoring wells may be installed using hydraulic direct-push drilling methodologies (such as pre-pack monitoring wells), but are more commonly installed using a conventional drilling rig equipped with hollow-stem augers and a split-spoon sampler or using a rotosonic drilling rig. Since the use of a conventional drilling rig or a rotosonic drilling rig require retaining the services of a drilling contractor, methodologies for soil boring installation using these drilling rigs is not included in this SOP.

The equipment and materials to install monitoring wells by HZW is presented below. The listing below is not exhaustive and individual tooling pieces are not listed as the equipment and material list would be extensive. Field personnel operating the direct-push equipment are to refer to the tooling information provided by Geoprobe Systems® to identify and maintain the individual components of the tooling systems.

- Proposal or Sampling & Analysis Plan
- Map of Proposed Monitoring Well Locations
- Field Notebook
- Permanent Markers, Ball-Point Pens, Pencils
- Geoprobe® 7782DT Drilling Unit with Trailer
- Tooling for Monitoring Well Installation (Auger Flights, Cutting Heads, Center Bit, Wooden Plugs, Concrete Corer)
- DT325 Soil Sampling System
- DT22 Soil Sampling System
- Support Vehicles

- Two (2) Inch, Schedule 40 0.01-Inch Machine-Slotted PVC Screen (5- or 10-foot lengths)
- Two (2) Inch, Schedule 40 PVC Riser (10-foot lengths)
- One (1) Inch Pre-Packed Screen Monitoring Well (5-foot lengths)
- One (1) Inch, Schedule 40 PVC Riser (5-foot lengths)
- One (1) Inch, Schedule 40 0.01-Inch Machine-Slotted PVC Screen (5-foot lengths)
- PVC End (Bottom) Caps
- Expansion/Friction (Top) Caps
- Flushmount Manhole Covers
- Protective Casings
- Various Sized Pipe Wrenches, Pliers, Hammers
- Shovels, Pick-Axe, Brooms
- Power Washer
- Generator
- Extension Cords
- Washed, Medium Sand
- Bentonite Chips
- Concrete and Asphalt
- Weighted Tape Measures
- Polyethylene Sheeting (6-mil thickness)
- DOT-Approved 55-Gallon Drums and Drum Labels for Drill Cuttings and Decontamination Water
- Nitrile Gloves
- Distilled Water and Non-Phosphate Detergent for Decontamination
- Decontamination Pad
- Additional Five (5) Gallon Buckets and Brushes for Decontamination
- Sorbent Pads (in the event free-phase non-aqueous phase liquid is encountered)
- Global Positioning Systems Unit
- 300-Foot Tape Measures

5.0 PROCEDURES

Monitoring wells are typically two (2) inches in diameter and are installed using conventional hollow-stem auger drilling methodologies. However, one (1) inch prepack monitoring wells can be installed by direct-push drilling methodologies. In addition, although not considered a “monitoring well”, temporary well points are often used to screen groundwater and are installed using direct-push drilling methodologies. The procedures to install two (2) inch monitoring wells, one (1) inch prepack monitoring wells and temporary well points are presented below.

5.1 Two (2) Inch Monitoring Wells

Two (2) inch monitoring wells are typically installed using conventional hollow-stem auger drilling methodologies. Hollow-stem augers used for two (2) inch monitoring well installation have an inside diameter of 4.25-inches.

- A. Wear the appropriate personnel protective equipment for installing monitoring wells.
- B. Locate and observe all underground and aboveground utilities particularly in relation to proposed monitoring well locations.
- C. If asphalt or concrete pavement is present in the proposed monitoring well location, attach the concrete core barrel to the auger head to core through the pavement.
- D. Attach an auger cutting head to a five-foot auger flight by threading two (2) hex bolts through the cutting head into the auger flight.
- E. In order to prevent soils from entering the hollow-stem augers, install a wooden plug near the base of the auger cutting head or place a center cutting bit with inner rods and a T-shaped threaded cap in the center of the hollow-stem augers.
- F. Position the hollow-stem auger assembly directly under the auger head of the drilling rig with the cutting head centered between the toes of the probe feet. Lower the auger head onto the top of the lead auger flight and connect the auger head to the auger flight with threaded hex bolts.
- G. Begin rotary and downforce advancement of the augers. Advance the lead auger flight to approximately six (6) inches above grade such that the next auger flight can be placed on top of the lead auger flight and the hex bolts threaded through the second auger flight onto the lead auger flight. Shovel any drill cuttings returning to the surface into DOT-approved 55-gallon drums for temporary storage until characterized and disposed.
- H. Raise the auger head to the highest height to allow for the second auger flight to be placed on top of the lead auger flight.
- I. Remove the T-shaped threaded cap from the inner rod for the center cutting bit. Thread an inner rod onto the inner rod in the first auger flight, which will extend above the lead auger flight.

- J. Using the winch, obtain the next five-foot auger flight. Raise and slowly lower the next auger flight over the inner rod and connect the second auger flight to the lead auger flight with threaded hex bolts.
- K. Thread the T-shaped cap onto the inner rods for the center cutting bit.
- L. Lower the auger head onto the top of the lead auger flight and connect the auger head to the auger flight with threaded hex bolts.

Repeat steps F through K until the auger flights are advanced to monitoring well terminal depth.

- M. Upon advancement to monitoring well terminal depth, either knock out the wooden plug near the base of the auger cutting head or retrieve the center cutting bit assembly from the hollow-stem augers.
- N. Assemble sections of the two (2) inch, schedule 40 0.01-inch machine-slotted PVC screen fitted with a PVC end cap and two (2) inch, schedule 40 PVC riser pipe fitted with an expansion (friction) cap for the appropriate well depth and lower into the center of the hollow-stem augers.
- O. Once the PVC pipe is in place, begin slowly pouring washed, medium sand in the annular space around the PVC pipe. Use a weighted tape measure or, if necessary, probe rods lowered into the hollow-stem augers to prevent bridging of the sand. The weighted tape measure will be used to monitor placement and depth of the sand around the PVC pipe.
- P. Begin retracting the auger flights as sand continues to be poured into the annular space around the PVC pipe. Sand will continue to be added to the annular space to a depth of approximately two (2) feet above the top of the PVC screen.
- Q. At the upper terminus of the sand, pour bentonite chips into the annular space while retracting the auger flights. Bentonite chips will continue to be added to create a two-foot thick bentonite seal above the sand. Water will be added after placement of one (1) foot of bentonite chips to hydrate the bentonite and create an adequate seal.
- R. The remainder of the annular space from the top of the bentonite seal to approximately one (1) foot below ground surface will be filled with hydrated bentonite chips or a bentonite/cement grout. A weighted tape

measure or probe rods will continue to be used as the auger flights are retracted to prevent bridging.

- S. Cut the PVC pipe (as necessary) to complete the monitoring well at grade or above grade (stick-up).
- T. Place either a flushmount manhole cover (to finish a monitoring well at grade) or a protective casing (to finish a monitoring well above grade) in the annular space over the PVC pipe.
- U. Mix and pour concrete around the remaining annular space to secure the flushmount manhole cover or protective casing in place. For protective casings, the concrete should extend above grade and out from the protective casing at least one (1) foot. In addition, the concrete should be sloped away from the protective casing to prevent surface water from ponding or potentially entering the interior well casing.
- V. Locate the monitoring well locations using the GPS unit or a tape measure with reference to a fixed point.

5.2 One (1) Inch Prepack Monitoring Wells

One (1) inch prepack monitoring wells are installed using the DT325 dual tube sampling system with the Geoprobe® 7822DT drilling unit. Typically, one (1) inch prepack monitoring wells are installed to depths no greater than 30 feet below grade.

- A. Wear the appropriate personnel protective equipment for installing soil borings.
- B. Locate and observe all underground and aboveground utilities particularly in relation to proposed monitoring well locations.
- C. If asphalt or concrete pavement is present in the proposed monitoring well location, attach the concrete core barrel to the auger head to core through the pavement.
- D. Assemble the first rod of the tool string for the DT325 dual tube sampling system. Attach an expendable point assembly onto the unthreaded end of a 3.25-inch expendable point holder probe rod. Place a 3.25-inch drive cap over the threaded end of the expendable point holder probe rod.

- E. Raise the hydraulic hammer to the highest position by fully extending the probe cylinder.
- F. Position the expendable point holder probe rod assembly directly under the hammer with the expendable point centered between the toes of the probe feet.
- G. Lower the hydraulic hammer onto the drive cap and advance the tooling string the length of the expendable point holder probe rod. Apply the hydraulic hammer as necessary to drive the probe rod.
- H. Upon reaching the expendable point holder probe rod depth, remove the drive cap and thread a 3.25-inch probe rod onto the expendable point holder probe rod.
- I. Raise the hydraulic hammer to the highest position by fully extending the probe cylinder.
- J. Lower the hydraulic hammer onto the drive cap and advance the tooling string the length of the expendable point holder probe rod. Apply the hydraulic hammer as necessary to drive the probe rod.
- K. Upon reaching the probe rod depth, remove the drive cap and thread another 3.25-inch probe rod onto the expendable point holder probe rod.

Repeat steps H through K until reaching the depth at which the prepack monitoring well will be installed. The probe rods should be advanced approximately 1.5-inches below the bottom of the desired well screen interval.

- L. Prepare the prepack monitoring well assembly for installation through the 3.25-inch probe rods.
 - 1. Thread a PVC bottom plug onto the bottom prepack well screen.
 - 2. Connect additional five-foot sections of prepack well screen to obtain the desired screen interval.
 - 3. Place an O-ring on the PVC of the top prepack well screen.
- M. Begin to slowly lower the prepack well screen through the center of the 3.25-inch probe rods.

- N. Add five-foot sections of one (1) inch PVC riser as the prepack well screen is lowered through the 3.25-inch probe rods. O-rings should be installed between the five-foot sections of PVC riser.
- O. Continue adding five-foot section of PVC riser until reaching the bottom expendable point. The PVC riser should extend a minimum of one (1) foot above the top of the probe rods. Place a expansion (friction) cap into the top riser.
- P. Using the rod grip puller for the DT325 dual tube soil sampling system, begin retracting the probe rods. Observe if any movements occur with the PVC riser.
 - 1. If the riser moves up with the probe rods, a second person may need to hold the PVC riser in place with an additional section of PVC riser while the probe rods are being retracted.
 - 2. If the riser continues to move up with the probe rods and cannot be held in place by hand, sand heave has likely occurred and is bound to the inside of the probe rods. Extension rods will be necessary to use.
 - a. Assemble the extension rods and a screen push adapter. Continue adding extension rods until the screen push adapter contacts the bottom of the well screens.
 - b. Slowly retract the probe rods while a second person pushes and taps on the well screen bottom with the extension rods. Once the probe rods are retracted past the prepack well screens, the riser should stay in place.
- Q. Once the probe rods have been retracted from the borehole, begin slowly pouring washed, medium sand in the annular space around the PVC pipe. Use a weighted tape measure or, if necessary, probe rods lowered into the borehole to prevent bridging of the sand. The weighted tape measure will be used to monitor placement and depth of the sand around the PVC pipe. Sand will continue to be added to the annular space to a depth of approximately two (2) feet above the top of the PVC screen.
- R. At the upper terminus of the sand, pour bentonite chips into the annular space. Bentonite chips will continue to be added to create a two-foot thick bentonite seal above the sand. Water will be added after placement

of one (1) foot of bentonite chips to hydrate the bentonite and create an adequate seal.

- S. The remainder of the annular space from the top of the bentonite seal to approximately one (1) foot below ground surface will be filled with hydrated bentonite chips or a bentonite/cement grout. A weighted tape measure or probe rods will continue to be used to prevent bridging.
- T. Cut the PVC pipe (as necessary) to complete the monitoring well at grade or above grade (stick-up).
- U. Place either a flushmount manhole cover (to finish a monitoring well at grade) or a protective casing (to finish a monitoring well above grade) in the annular space over the PVC pipe.
- V. Mix and pour concrete around the remaining annular space to secure the flushmount manhole cover or protective casing in place. For protective casings, the concrete should extend above grade and out from the protective casing at least one (1) foot. In addition, the concrete should be sloped away from the protective casing to prevent surface water from ponding or potentially entering the interior well casing.
- W. Locate the monitoring well locations using the GPS unit or a tape measure with reference to a fixed point.

5.3 Temporary Well Points

Temporary well points are typically installed using the DT22 dual tube sampling system to depths no greater than 30 feet below grade.

- A. Wear the appropriate personnel protective equipment for installing temporary well points.
- B. Locate and observe all underground and aboveground utilities particularly in relation to proposed temporary well point locations.
- C. If asphalt or concrete pavement is present in the proposed temporary well point location, use the drill steel and concrete bit to core through the pavement.
- D. Assemble the first rod of the tool string for the DT22 dual tube sampling system. Attach an expendable point assembly onto the unthreaded end of a 2.25-inch expendable point holder probe rod. The lead probe rod onto

which the expendable point assembly is attached may be sample tube in which soil samples can be collected. Refer to Section 5.2 of FSOP #101 for details on collecting soil samples using the DT22 dual tube sampling system. Place a 2.25-inch drive cap over the threaded end of the expendable point holder probe rod.

- E. Raise the hydraulic hammer to the highest position by fully extending the probe cylinder.
- F. Position the expendable point holder probe rod assembly directly under the hammer with the expendable point centered between the toes of the probe feet.
- G. Lower the hydraulic hammer onto the drive cap and advance the tooling string the length of the expendable point holder probe rod. Apply the hydraulic hammer as necessary to drive the probe rod.
- H. Upon reaching the expendable point holder probe rod depth, remove the drive cap and thread a 2.25-inch probe rod onto the expendable point holder probe rod. In instances where soil samples are being collected, a new plastic sample liner, drive cap assembly and a lightweight inner rod will need to be utilized. Refer to Section 5.2 of FSOP #101 for soil sampling procedures using the DT22 dual tube sampling system.
- I. Raise the hydraulic hammer to the highest position by fully extending the probe cylinder.
- J. Lower the hydraulic hammer onto the drive cap and advance the tooling string the length of the expendable point holder probe rod. Apply the hydraulic hammer as necessary to drive the probe rod.
- K. Upon reaching the probe rod depth, remove the drive cap and thread another 2.25-inch probe rod onto the expendable point holder probe rod.

Repeat steps H through K until reaching the depth at which the temporary well point will be installed.

- L. Assemble sections of the one (1) inch, schedule 40 0.01-inch machine-slotted PVC screen fitted with a PVC end cap and one (1) inch, schedule 40 PVC riser pipe and lower into the center of the 2.25-inch probe rods.
- M. Using the rod grip puller for the DT22 dual tube soil sampling system, begin retracting the probe rods. It may be necessary to knock out the

expendable point from the lead rod using the assembled PVC screen and riser.

- N. Once the probe rods have been removed and a groundwater sample collected from the temporary well point, remove the one (1) inch PVC screen and riser from the borehole.
- O. Fill the open borehole with granular bentonite. The bentonite will be hydrated as it is placed in the open borehole. The surface of the borehole will be finished to match the surrounding surface.
- P. Locate the temporary well points locations using the GPS unit or a tape measure with reference to a fixed point.

5.4 Decontamination

Two (2) Inch and One (1) Inch Prepack Monitoring Wells

A decontamination pad will be constructed to thoroughly decontaminate all the reusable equipment for the hollow-stem augers and the DT325 dual tube soil sampling system between monitoring well locations. The decontamination pad will have minimum dimensions of eight (8) feet by eight (8) feet and will be constructed of 2-inch by 8-foot lumber for the sides and two (2) sheets of 6-mil polyethylene sheeting for the bottom.

- A. Prior to placing reusable equipment in the decontamination pad, remove and containerize all gross debris/contamination.
- B. Place the reusable equipment in the decontamination pad.
- C. Wet down the equipment and thoroughly clean (wash) the inside and outside of the equipment using a non-phosphate detergent and various-sized scrub brushes.
- D. Using the power washer and potable water, triple-rinse the equipment.
- E. Repeat decontamination procedures as necessary if any material remains on the equipment.

Temporary Well Points

For the reusable equipment for the DT22 dual tube soil sampling system, the use of a decontamination pad is not necessary as a series of five-gallon buckets is

typically adequate to adequately decontaminate the DT22 dual tube soil sampling system equipment.

- A. Wet down the reusable equipment with distilled water.
- B. Thoroughly clean (wash) the inside and outside of the equipment using a non-phosphate detergent and various sized-scrub brushes.
- C. Triple-rinse the equipment using distilled water.
- D. Repeat decontamination procedures as necessary if any material remains on the equipment.

6.0 DOCUMENTATION

Monitoring well installation and drilling methodologies will be documented in project field notes and in field well completion logs. Field conditions and any deviation from proposed activities or equipment issues in the field will be recorded. A Well Log and Drilling Report will be filed with the Ohio Department of Natural Resources and the local health department for all permanent monitoring wells installed by HZW.

7.0 ADDITIONAL INFORMATION

Not applicable.

Field Standard Operating Procedures

#202 – Monitoring Well Development



HZW Environmental
Consultants

November 2007
Revision 3.2 June 2017

REVISION HISTORY

Below is a summary of the revisions to this Standard Operating Procedure.

Date	Revisions
March 2009	Monitoring Well Development SOP extensively updated
February 2010	Slight modifications to Monitoring Well Development SOP, but not recorded
October 2010	Well development methodologies expanded and SOP updated
June 2011	Slight modifications to Monitoring Well Development SOP, but not recorded
June 2015	Extensive revisions and reformatting of Monitoring Well Development SOP performed
December 2016	Revisions to font, added new company logo
June 2017	Corrected well development activities for surging and purging and an inertial lift pump

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FSOP #202 – MONITORING WELL DEVELOPMENT STANDARD OPERATING PROCEDURE**1.0 PURPOSE AND APPLICABILITY**

This SOP has been prepared for use by HZW personnel only. Compliance with this SOP will ensure that monitoring wells are developed correctly. Monitoring wells installed and sampled by HZW are typically between one (1) and two (2) inches in diameter. This SOP does not contemplate development of monitoring wells greater than two (2) inches in diameter as development equipment and procedures may vary.

Monitoring well development is performed to a) remove fluids that may have been introduced during well installation activities, b) remove fine sediment from the vicinity of the well screen, and c) ensure good hydraulic interconnection between the sand filter pack and the adjacent geologic materials in which the well screen is installed. Property development is especially critical for wells used to evaluate turbidity-sensitive groundwater constituents such as metals and for wells used to evaluate hydraulic conductivity or groundwater yield.

2.0 HEALTH AND SAFETY

Property health and safety precautions must be observed during monitoring well development activities. The site-specific Health and Safety Plan (HASP) or HZW's general HASP provides guidelines on health and safety precautions. Field personnel should rely on the site-specific or general HASP to evaluate field conditions at a site such as potential chemical hazards, what is the appropriate personal protective equipment and site monitoring activities.

3.0 DEFINITIONS

Well Development: Stressing the geologic formation around a groundwater monitoring well so that a graded filter pack is created around the screen and particulate matter and fluids (when used) remaining from well drilling and construction are removed. Well development restores hydraulic conditions and enhances yield of the saturated zone, stabilizes chemical changes that may have occurred during drilling and construction, and produces a well that is capable of yielding a sample of acceptably low turbidity.

Hydraulic Conductivity: The rate of flow of water in gallons per day through a cross-section of one square foot under a unit hydraulic gradient at the prevailing temperature.

Turbidity: The visible presence of suspended mineral and organic particles in a groundwater sample. Turbidity is not an indicator of groundwater chemical stabilization and does not distinguish between stagnant casing water and formation water. However, turbidity can be useful to measure during well development or purging activities as relatively high or erratic measurements may indicate inadequate well construction, inadequate well development or improper sampling procedures, such as purging at an excessive rate that exceeds the well yield.

4.0 EQUIPMENT AND MATERIALS

The following equipment and materials will be necessary to complete monitoring well development activities. Certain equipment and materials may not be applicable for a particular site given the purpose and scope of monitoring well development activities.

- Proposal or Sampling & Analysis Plan
- Map of Well Locations
- Field Sampling Data Sheets
- Permanent Markers, Ball-Point Pens, Pencils
- Socket Set (Standard and Metric)
- Sample Containers and Labels
- Cooler and Ice
- Electronic Static Water Level Meter or Interface Probe
- Disposable Polyethylene Bailers or PVC Bailers
- Cement-Filled Bailer
- Nylon or Polypropylene String
- Low-Flow Bladder Pump (with Controller and Power Source)
- Additional Replacement Bladders
- Electric Submersible Pump (with Controller and Power Source)
- Generator
- Inertial Lift Pump System
- Peristaltic Pump
- Appropriate-Sized and Project-Specific Tubing
- Water Quality Meter (with Flow-Through Cell if Performing with Pump)
- Photoionization Detector and/or Multi-Gas Meter
- Calibrated Five (5) Gallon Buckets
- Graduated Cylinder
- Polyethylene Sheeting (6-mil thickness)
- DOT-Approved 55-Gallon Drums and Drum Labels for Purge Water
- Nitrile Gloves

- Paper Towels
- Timing Device
- Distilled Water and Non-Phosphate Detergent for Decontamination
- Additional Five (5) Gallon Buckets and Brushes for Decontamination
- Sorbent Pads (in the event free-phase non-aqueous phase liquid is encountered)
- Global Positioning Systems Unit

Certain field equipment will be supplied by a commercial environmental rental supply company, which will be calibrated prior to leaving the premises of the environmental rental supply company. The environmental rental supply company will provide documentation of the calibration performed. For any equipment owned by HzW, the equipment will be calibrated in accordance with the manufacturer's specifications and the calibration documented in project field notes. If a project will be conducted over several days, all equipment requiring calibration will be calibrated in accordance with the manufacturer's specifications at the beginning of each day.

5.0 PROCEDURES

Four (4) methodologies or a combination of one or more methodologies are typically utilized to develop a monitoring well. The four (4) methodologies are described below.

- **Surging and Pumping:** Surging and pumping is typically performed using an electric submersible pump or a bladder pump with or without a surge block. This methodology is typically used in monitoring wells installed in bedrock, gravel or sand.
- **Purging with an Inertial Lift Pump:** A manually operated inertial lift pump (e.g., a Waterra Pump) with or without a surge block is used to develop monitoring wells installed in bedrock, gravel, sand, silt or clay. Although groundwater and sediment is removed from the well more slowly than surging and pumping, purging with an inertial lift pump is an effective development method.
- **Overpumping:** The process of repeatedly pumping a monitoring well at a high rate to rapidly draw down the groundwater level as far as possible, then turning off the pump and allow the well to recharge. Overpumping is typically performed with an electric submersible pump or a peristaltic pump and is less effective at well development than surging and pumping or use of an inertial lift pump. However, overpumping may be useful in wells screened in silt or clay.

- **Bailing:** A bailer can be used to development monitoring wells installed in bedrock, gravel, sand, silt and clay. However, bailing is not an effective well development methodology and is recommended to be avoided. A modified bailing methodology may produce better results such as surging the well with a cement-filled bailer followed by the removal of sediment with a bailer.

5.1 Monitoring Well Development Considerations

- A. Allow a monitoring well to cure 24-48 hours before performing well development activities.
- B. Do not develop a monitoring well that contains non-aqueous phase liquids. For instances in which non-aqueous phase liquids are present in monitoring wells, efforts should focus on removing and monitoring for the presence of the non-aqueous phase liquids.
- C. Excessive or vigorous surging of a monitoring well can permanently damage the filter pack. Monitoring wells equal to or less than two (2) inches in diameter should not be surged for a time interval greater than three (3) minutes before pumping or manually purging and should not be surged for more than 15 minutes total. Surging should be performed slowly and gently.
- D. Monitoring wells that are screened in clayey silt or clay should not be surged as an excessive amount of fines could be drawn into the filter pack and reduce the hydraulic interconnection between the filter pack and clayey silt or clay.
- E. If more than 10 percent of the well screen has filled with sediment, excess sediment should be removed using a bailer or inertial lift pump before utilizing an electric submersible or bladder pump.

5.2 Monitoring Well Development Methodologies

Pre-Development Activities

- A. Wear appropriate personal protective equipment. The Project Manager or the HASP should provide information on the appropriate personal protective equipment for a particular site.

- B. If concerns exist for a hazardous atmosphere within the well casing, open each monitoring well and monitor the atmosphere within the breathing zone above the well casing and within the well casing using a photoionization detector and/or a multi-gas meter.
 - 1. If VOC concentrations in the breathing zone are greater than the background concentrations and/or lower explosive level readings in the breathing zone are greater than 10% do not perform well development activities until conditions can be mitigated and appropriate health and safety measures implemented.
 - 2. If VOC concentrations in the well casing are greater than the background concentrations and/or lower explosive level readings in the well casing are greater than 10%, but VOC concentrations and lower explosive levels in the breathing zone are below these readings, monitor site conditions during well development activities. If conditions change, well development activities may be terminated.
- C. Obtain depth to groundwater and total depth measurements from each monitoring well.
 - 1. Remove the water level indicator or interface probe from its case. Clean the indicator or probe according to established decontamination procedures. Be sure that the contact electrode is dry before attempting to take measurements.
 - 2. Water level should be measured from the same spot on the casing each time. If the well was not installed by HZW and the casing is not marked or notched to designate the measuring point, measure on the side of the casing proximal to the lock on the protective cover and make note of that in your field notes. All wells installed on HZW projects should have a measuring point designated.
 - 3. Carefully lower the indicator or probe until the electrode touches the groundwater and/or non-aqueous phase liquid surface. At that point, the electronic circuit of the probe will be complete and will respond with both an audible and visual alarm. If free-phase light non-aqueous phase liquid is detected, the probe should continue down in the well until the probe encounters the groundwater surface beneath the non-aqueous phase liquid.

4. Record the reading(s) on the indicator or probe tape to the nearest one hundredth of a foot (example: 15.01 feet). Note this reading as SWL = XXX.XX feet BTOC (below top of casing).
 5. Upon obtaining the static groundwater level and/or non-aqueous phase liquid measurements, the total depth of the monitoring well should be obtained. The indicator or probe should be lowered to the bottom of the well and the total depth recorded on the field sampling data sheets. Total depth measurements should be obtained from the same location on the well casing as the static groundwater level and/or non-aqueous phase liquid measurements were obtained.
 6. If one measures water levels in a non-conventional monitoring well that contains a submersible pump or other downhole apparatus, be very careful about how, and where, one lowers the electrode. Be sensitive to how the line feels as it is lowered. It is very easy to tangle a line in a well, getting it out once tangled can result in a broken line.
 7. Once the depth to groundwater and non-aqueous phase liquid (if present) has been determined, decontaminate the indicator or probe in accordance with established decontamination procedures prior to measuring another well.
- D. Calculate the volume of water to be removed during well development activities. Typically, five (5) well volumes are removed during development activities.
1. Using the static groundwater level and total depth measurements, calculate the length of the water column present within the monitoring well.
 2. One (1) well volume of groundwater in the well can be calculated by multiplying the length of the water column in a monitoring well by a conversion factor. The most common well diameters and corresponding conversion factors are presented below.

Well Diameter (inches)	Conversion Factor (gallons/foot)
1	0.041
2	0.163
4	0.653
6	1.47

The equation to calculate one (1) well volume of groundwater in a monitoring well is presented below.

$$\begin{array}{ccccc} \text{Water Column} & & \text{Conversion} & & \\ \text{Length (feet)} & \times & \text{Factor} & = & \text{One (1) Well Volume} \\ & & \text{(gallons/foot)} & & \text{(gallons)} \end{array}$$

- E. Calibrate any field equipment that will be used as part of well development activities.

Well Development Activities

A. Surging and Pumping

1. Start at the bottom of the well screen and gradually work upwards in 2 to 3 foot intervals to the top of the well, surging slowly with a surge block, a pump equipped with a surge block or the pump.
2. Surge for 1 minute and then pump the well to remove at least one (1) well volume of sediment-laden water.
3. Repeat this process three to five times and continue to pump the well at a sustainable rate.

B. Inertial Lift Pump

1. If using an inertial lift pump with a surge block attachment, start at the bottom of the well screen and gradually work upwards in 2 to 3 foot intervals to the bottom of the well, surging slowly.
2. Surge for 1 minute then purge the well to remove at least one (1) well volume of sediment-laden water.

3. Repeat this process three to five times and continue to purge the well at a sustainable rate.
4. If using an inertial lift pump without a surge block attachment, purge the well at a sustainable rate. The pump foot valve should be within two (2) inches of the bottom of the well during purging to remove sediment.

C. Overpumping

1. Lower the pump intake to the top of the well screen.
2. Purge the well at a pumping rate high enough to drawdown the water level to the pump intake.
3. Turn off the pump and allow the water level to recover to at least two (2) feet above the pump intake.
4. Lower the pump intake approximately two (2) feet deeper and repeat the process.
5. Repeat this process three to five times and continue to purge the well at a sustainable rate.

D. Bailing

1. For a monitoring well installed in bedrock, gravel, sand, sandy silt or silt, surge the screened interval with the bailer using the same methodology described for Surging and Pumping, above.
 - a. While surging, gently tap the bailer on the bottom of the well to remove sediment.
 - b. Remove at least one (1) well volume of water after each period of surging.
 - c. Continue to bail the well at a sustainable rate. Bailing should proceed from the top of the water column.

2. For a monitoring well installed in silty clay or clay:
 - a. Purge the well by lowering the bailer to the bottom of the well for each withdrawal so that it is lowered and raised through the entire length of the well screen.
 - b. Gently tap the bailer on the bottom of the well to remove sediment.
 - c. After removal of three (3) well volumes, continue to bail the well at a sustainable rate. Bailing should proceed from the top of the water column.
- E. Well development activities will continue until five (5) well volumes have been removed and field water quality parameters have stabilized. Field water quality parameters will be monitored during well development activities. Typically, field water quality parameters will be collected upon initiation of purging activities and following removal of each well volume from the monitoring well. The Project Manager will determine how often field water quality parameters will be collected.

At a minimum, field water quality parameters that will be monitored during well development activities will consist of temperature, pH and conductivity. Additional field water quality parameters may be monitored at the discretion of the Project Manager. The additional field water quality parameters may include one or more of the following: turbidity, dissolved oxygen, total dissolved solids and oxidation-reduction potential. The stabilization criteria for the field water quality parameters are listed below.

Field Water Quality Parameter	Stabilization Criteria
pH	± 0.2 Standard Units
Conductivity	± 3%
Temperature	± 0.5°C
Turbidity	≤10 NTUs or ± 10% (>10 NTUs)
Dissolved Oxygen	± 0.3 mg/L
Oxidation-Reduction Potential	± 20 millivolts

6.0 DOCUMENTATION

Monitoring well development activities will be documented in project field notes, on the monitoring well field data sheets, calibration sheets (as applicable), sample

labels and chains-of-custody. The well development methodology, field water quality parameter measurements, static water levels, sample collection procedures and field conditions will be documented as well as any deviation from proposed activities or equipment issues in the field.

7.0 ADDITIONAL INFORMATION

A copy of HZW's Monitoring Well Field Data Form is attached to this Monitoring Well Development SOP.



HzW Job Number: _____

Monitoring Well ID: _____

MONITORING WELL FIELD DATA FORM

PROJECT NAME: _____

PERSONNEL ON-SITE: _____

WEATHER CONDITIONS: _____

EQUIPMENT USED: _____

WELL DATA:

$$\frac{\text{Total Depth (ft.)}}{\text{Total Depth (ft.)}} - \frac{\text{SWL (ft.)}}{\text{SWL (ft.)}} = \frac{\text{Water Column (ft.)}}{\text{Water Column (ft.)}}$$

DATE EQUIPMENT CALIBRATED: _____

PURGE DATE: _____

TIME PURGE BEGAN: _____

TIME PURGE COMPLETED: _____

VOLUME PURGED: _____

*****SEE NEXT PAGE FOR FIELD PARAMETER MEASUREMENTS DURING PURGING*****

SAMPLING DATE: _____

TIME SAMPLING BEGAN: _____

TIME SAMPLING ENDED: _____

APPEARANCE OF SAMPLE (color, turbidity, odors, etc.)

ADDITIONAL NOTES:

SAMPLER NAME (PRINT)

SIGNATURE OF SAMPLER



Monitoring Well ID: _____

FIELD PARAMETER MEASUREMENTS:

Stabilization Criteria

pH: ± 0.2 standard units	Conductivity: $\pm 3\%$	SWL Stabilized @
DO: ± 0.2 mg/L or $\pm 10\%$	Turbidity: ≤ 10 NTUs or $\pm 10\%$ (>10 NTUs)	
Temperature: $\pm 0.5^\circ\text{C}$	ORP: ± 20 millivolts	

SIGNATURE OF SAMPLER

Field Standard Operating Procedures

#203 – Groundwater Sampling



HZW Environmental
Consultants

November 2007
Revision 3.2 June 2017

REVISION HISTORY

Below is a summary of the revisions to this Standard Operating Procedure.

Date	Revisions
March 2009	Groundwater Sampling SOP extensively updated
February 2010	Slight modifications to Groundwater Sampling SOP, but not recorded
October 2010	Groundwater sampling methodologies expanded and SOP updated
June 2011	Slight modifications to Groundwater Sampling SOP, but not recorded
June 2015	Extensive revisions and reformatting of Groundwater Sampling SOP performed
December 2016	Revisions to font, added new company logo
June 2017	Provided clarification language on the pumping rate groundwater samples should be collected using low-flow purging and sampling methodologies

I:\Geology Group\SOPs\Revised SOPs - December 2016\FSOP 203 - Groundwater Sampling FSOP.doc

FSOP #203 – GROUNDWATER SAMPLING STANDARD OPERATING PROCEDURES**1.0 PURPOSE AND APPLICABILITY**

This SOP has been prepared for use by HZW personnel only. Compliance with this SOP will ensure that representative ground water samples are obtained from all monitoring well locations.

Ground water sampling and analysis will be conducted to allow for comparison to standards and/or values applicable to a particular site. Should subsurface impacts be identified the data acquired during the ground water monitoring will be used to determine whether further assessment (ground water) and/or remedial actions are necessary.

2.0 HEALTH AND SAFETY

Property health and safety precautions must be observed during groundwater sampling activities. The site-specific Health and Safety Plan (HASP) or HZW's general HASP provides guidelines on health and safety precautions. Field personnel should rely on the site-specific or general HASP to evaluate field conditions at a site such as potential chemical hazards, what is the appropriate personal protective equipment and site monitoring activities.

3.0 DEFINITIONS

The following terminology is applicable to groundwater sampling activities.

Groundwater Sample: an aqueous (water) sample that is representative of the groundwater contained in an underlying aquifer.

Aquifer: a geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield economical quantities of water to wells and springs.

Aquitard: a geologic formation, group of formations, or part of a formation of low permeability through which virtually no water moves.

Water Table: a surface in an aquifer where groundwater pressure is equal to atmospheric pressure.

Static Water Level: the level of water in a well that is not affected by withdrawal of groundwater.

Recharge: the addition of water to the zone of saturation, or the “refill” of the well following purging.

Porosity: the percentage of the bulk volume of a rock or soil that is occupied by space, whether isolated or connected; the ratio of the volume of void spaces in a geologic formation to the total volume of the geologic formation.

Permeability: the capacity of a porous rock, sediment, or soil to transmit a fluid; it is a measure of the relative ease of fluid flow under unequal pressure.

Hydraulic Conductivity: the rate of flow of water in gallons per day through a cross-section of one square foot under a unit hydraulic gradient at the prevailing temperature.

Equipotential Line: a contour line on the water table, i.e. a line along which the pressure head of groundwater in an aquifer is the same.

Transmissivity: the rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient.

Bailer: a tall, narrow, stainless steel, teflon, PVC, or polyethylene pipe with a check valve on the bottom that is used to withdraw water from a monitoring well.

Electronic Water Level Indicator or Electronic Water Level Interface Probe: an electronic instrument used to measure the depth to water or free-phase light non-aqueous phase liquid in a well.

Well Casing: stainless steel, or PVC pipe used to keep the well borehole open.

Well Screen: pipe with slots or holes open to the aquifer to allow groundwater to enter the well.

Riser Pipe: the well casing extending from the well screen to the ground surface.

Stick-up: well casing that extends above the ground surface.

Protective Cover: a length of oversized diameter pipe with a locking cap to cover and secure the well stick-up.

Flushmount: a bolted-down circular manhole cover installed over a well completed at grade.

4.0 EQUIPMENT AND MATERIALS

The following equipment and materials will be necessary to complete groundwater sampling activities. Certain equipment and materials may not be applicable for a particular site given the purpose and scope of groundwater sampling activities.

- Proposal or Sampling & Analysis Plan
- Map of Well Locations
- Field Sampling Data Sheets
- Permanent Markers, Ball-Point Pens, Pencils
- Socket Set (Standard and Metric)
- Sample Containers and Labels
- Cooler and Ice
- Electronic Static Water Level Meter or Interface Probe
- Disposable Polyethylene Bailers
- Nylon or Polypropylene String
- Low-Flow Bladder Pump (with Controller and Power Source)
- Additional Replacement Bladders
- Appropriate-Sized and Project-Specific Tubing
- Water Quality Meter (with Flow-Through Cell if Performing Low-Flow Sampling)
- Calibrated Five (5) Gallon Buckets
- Graduated Cylinder
- Polyethylene Sheeting (6-mil thickness)
- DOT-Approved 55-Gallon Drums and Drum Labels for Purge Water
- Nitrile Gloves
- Paper Towels
- Distilled Water and Non-Phosphate Detergent for Decontamination
- Additional Five (5) Gallon Buckets and Brushes for Decontamination
- Sorbent Pads (in the event free-phase non-aqueous phase liquid is encountered)
- Global Positioning Systems Unit

Certain field equipment will be supplied by a commercial environmental rental supply company, which will be calibrated prior to leaving the premises of the environmental rental supply company. The environmental rental supply company will provide documentation of the calibration performed. For any equipment owned by HZW, the equipment will be calibrated in accordance with the manufacturer's specifications and the calibration documented in project field notes. If a project will be conducted over several days, all equipment requiring calibration will be calibrated in accordance with the manufacturer's specifications at the beginning of each day.

5.0 PROCEDURES

5.1 General

Collection of groundwater samples from monitoring wells may be required to document an observed release or collect baseline data for a project. To properly document groundwater flow direction and gradient, a minimum of three (3) monitoring wells are required (one upgradient and two downgradient wells). In order to determine the hydraulic gradient of the groundwater prior to sampling, water level measurements can be obtained from published groundwater surveys by the U.S. Geological Survey (USGS), from State agencies (i.e., Ohio Department of Natural Resources [ODNR]), from county and local health departments, or local well drillers.

In general, the following factors should be considered during selection of an existing monitoring well as a groundwater sampling point.

- Regional groundwater flow direction
- Depth of the aquifer of concern
- Well location and accessibility
- Topography of the site and well elevations
- Physical condition of well and well construction
- Analytical problems caused by contaminant interaction with well construction materials
- Presence of fixed samplers or pumps
- Well depth and water levels

Once monitoring wells have been chosen, or installed, for sample collection, proper sampling procedures **must** be employed to obtain a sample that is representative of the groundwater at the location and to ensure that the sample is neither altered nor contaminated by the sampling and handling procedures. Prior to sampling, water levels must be measured, well casing volumes calculated, and stagnant water purged from the wells.

5.2 Field Preparation Activities

- A. Obtain site information from the Project Manager including the appropriate groundwater sampling methodologies, well construction details, known conditions of wells (e.g., the potential presence of non-aqueous phase liquid is present), field sampling data sheets and management of purge water.

- B. Check condition of all equipment and sample containers to be used on the project.

5.3 Inspecting a Monitoring Well

Upon arrival at a site, the following procedures should be followed to inspect a monitoring well:

- A. Note weather conditions, including precipitation, storm events prior to arrival, temperature, etc.
- B. Visually inspect the protective cover or flushmount for damage. Record any damage in field notes or field sampling data sheets. If a lock is present, check to see if it is secure. If the lock is “frozen”, use graphite to loosen it. Do not use a petroleum-based product to attempt to loosen a lock.
- C. Note any unusual conditions, such as standing water around the protective cover or flushmount and any other conditions that could contribute to surface contamination.
- D. Unlock the well cover (for protective covers) and carefully open the lid. Undesirable insects (wasps, hornets, etc.) often will lay claim to a protective cover. Do not use any chemical spray to kill insects as it may contaminate the well.
- E. Note any unusual odors emitted from the well that may be present within the breathing zone (4 to 6 feet above ground surface).

5.4 Determining Depth to Groundwater or Non-Aqueous Phase Liquid and Total Depth Using an Electronic Water Level Indicator or Interface Probe

- A. Wear appropriate personal protective equipment. The Project Manager or the HASP should provide information on the appropriate personal protective equipment for a particular site.
- B. Remove the water level indicator or interface probe from its case. Clean the indicator or probe according to established decontamination procedures. Be sure that the contact electrode is dry before attempting to take measurements.
- C. Water level should be measured from the same spot on the casing each time. If the well was not installed by HZW and the casing is not marked or

notched to designate the measuring point, measure on the side of the casing proximal to the lock on the protective cover and make note of that in your field notes. All wells installed on HZW projects should have a measuring point designated.

- D. Carefully lower the indicator or probe until the electrode touches the groundwater and/or non-aqueous phase liquid surface. At that point, the electronic circuit of the probe will be complete and will respond with both an audible and visual alarm. If free-phase light non-aqueous phase liquid is detected, the probe should continue down in the well until the probe encounters the groundwater surface beneath the non-aqueous phase liquid.
- E. Record the reading(s) on the indicator or probe tape to the nearest one hundredth of a foot (example: 15.01 feet). Note this reading as SWL = XXX.XX feet BTOC (below top of casing).
- F. Upon obtaining the static groundwater level and/or non-aqueous phase liquid measurements, the total depth of the monitoring well should be obtained. The indicator or probe should be lowered to the bottom of the well and the total depth recorded on the field sampling data sheets. Total depth measurements should be obtained from the same location on the well casing as the static groundwater level and/or non-aqueous phase liquid measurements were obtained.
- G. If one measures water levels in a non-conventional monitoring well that contains a submersible pump or other downhole apparatus, be very careful about how, and where, one lowers the electrode. Be sensitive to how the line feels as it is lowered. It is very easy to tangle a line in a well, getting it out once tangled can result in a broken line.

Once the depth to groundwater and non-aqueous phase liquid (if present) has been determined, decontaminate the indicator or probe in accordance with established decontamination procedures prior to measuring another well.

5.5 Volumetric Purging and Sampling

To obtain a representative groundwater sample, the stagnant water within the monitoring well must first be removed. This can be accomplished by hand-bailing or with a pump. The procedure for purging and sampling monitoring wells using volumetric methodologies is presented below.

- A. Wear appropriate personal protective equipment. The Project Manager or the HASP should provide information on the appropriate personal protective equipment for a particular site.
- B. Place polyethylene sheeting (typically 6 mil thickness) on the ground surface adjacent to the monitoring well to be purged and sampled. All equipment that will be used as part of purging and sampling activities should be placed on the polyethylene sheeting.

Purging Activities

Purging is the process of removing stagnant water from a monitoring well, immediately prior to sampling, causing its replacement by ground water from the adjacent formation, which is representative of actual aquifer conditions.

- A. Using the static groundwater level and total depth measurements, calculate the length of the water column present within the monitoring well.
- B. One (1) well volume of groundwater in the well can be calculated by multiplying the length of the water column in a monitoring well by a conversion factor. The most common well diameters and corresponding conversion factors are presented below.

Well Diameter (inches)	Conversion Factor (gallons/foot)
1	0.041
2	0.163
4	0.653
6	1.47

The equation to calculate one (1) well volume of groundwater in a monitoring well is presented below.

$$\begin{array}{ccccc} \text{Water Column} & & \text{Conversion Factor} & & \text{One (1) Well Volume} \\ \text{Length (feet)} & \times & \text{(gallons/foot)} & = & \text{(gallons)} \end{array}$$

Three (3) to five (5) well volumes will be removed from a monitoring well during volumetric purging activities.

- C. Field water quality parameters will be monitored during volumetric purging activities. Typically, field water quality parameters will be collected upon initiation of purging activities and following removal of

each well volume from the monitoring well. The Project Manager will determine how often field water quality parameters will be collected.

At a minimum, field water quality parameters that will be monitored during volumetric purging activities will consist of temperature, pH and conductivity. Additional field water quality parameters may be monitored at the discretion of the Project Manager. The additional field water quality parameters may include one or more of the following: turbidity, dissolved oxygen, total dissolved solids and oxidation-reduction potential.

Field water quality parameters will typically stabilize after removal of three (3) well volumes. However, in the event that field water quality parameters have not stabilized after removal of three (3) well volumes, volumetric purging activities will continue until field water quality parameters stabilize. The stabilization criteria for the field water quality parameters are listed below.

Field Water Quality Parameter	Stabilization Criteria
pH	± 0.2 Standard Units
Conductivity	± 3%
Temperature	± 0.5°C
Turbidity	≤10 NTUs or ± 10% (>10 NTUs)
Dissolved Oxygen	± 0.3 mg/L
Oxidation-Reduction Potential	± 20 millivolts

- D. Low yield wells in which a minimum of three (3) well volumes cannot be removed can typically be bailed dry. In these situations, this generally constitutes an adequate purge and the well can be sampled following sufficient recovery (enough volume to allow filling of all sample containers). It is not necessary that the well be evacuated three times before it is sampled. Sampling of a well that has been bailed dry should be performed within 24 hours of purging.

Attempts should be made to avoid purging wells to dryness. This can be accomplished, for example, by slowing the purge rate. If a well is pumped dry, it may result in the sample being comprised partially of water contained in the sand pack, which may be reflective, at least in part, of initial, stagnant conditions. In addition, as water re-enters a well that is in an evacuated condition, it may cascade down the sand pack or the well screen, stripping volatile organic constituents that may be present and/or introducing soil fines into the water column.

E. The use of bailers requires certain considerations:

1. If disposable bailers are used, keep them in the original wrappers until used. Carefully open the end of the wrapper at the top of the bailer. Tie string onto the bailer using a retraced Figure 8 knot or a slip knot.
2. If non-disposable bailers are used, these must be thoroughly decontaminated using established decontamination procedures prior to placing into the well.
3. Carefully observe the first bailer of water removed from the well to see if immiscible layers are present.
4. Control the speed that a bailer is lowered into a well in order to minimized agitation of the groundwater surface and mobilizing any sediment that may be at the bottom of the well.
5. Do not allow the bailer string to contact the ground. Keep it in your hands at all times or the bailer string may be placed on the plastic sheeting around the well during purging and sampling activities.

F. The use of a pump requires certain considerations:

1. Place the pump at the center of the well screen in order to prevent any disturbance of sediment in the bottom of the well.
2. Static groundwater levels should be monitored and stabilized within the first 15 minutes of pumping.
3. The pumping rate should be set to the lowest rate initially and increased until drawdown of the static groundwater level is minimized or stabilizes.
4. Be sure that the recharge water does not cascade into the well. If this occurs, lower the pumping rate accordingly.
5. The static groundwater level should not fall below the pump intake level or below the well screen.

G. Groundwater removed from a well will be collected in a calibrated container (e.g., a five-gallon bucket) to document the volume of groundwater removed during purging activities. All purge waters will be

transferred to DOT-approved 55-gallon drums for temporary storage until disposal arrangements are made.

Sampling Activities

It is particularly important that wells be sampled as soon as possible after purging. If adequate volume is available, the well must be sampled immediately. If not, sampling should occur as soon as adequate volume has recovered. Groundwater entering the well for periods longer than two (2) or three (3) hours may render samples unrepresentative of aquifer.

- A. Groundwater samples should be collected in order of their volatility as indicated below. Parameters that are not pH sensitive or subject to loss through volatilization should be collected last.
 - Volatile organic compounds (VOCs)
 - Purgeable organic carbon
 - Purgeable organic halogens
 - Total organic halogens (TOX)
 - Total organic carbon (TOC)
 - Extractable organics
 - Total metals
 - Dissolved metals
 - Phenols
 - Cyanide
 - Sulfate and chloride
 - Nitrate and ammonia
 - Radionuclides
- B. Check with the Project Manager on the number of bottles, quantity of sample required for the given parameters, preservatives, etc.
- C. The Project Manager will indicate if field filtration is necessary.
- D. If a bailer is used to purge a well, the same bailer should be used to collect a sample from the well. The following procedures should be followed when sampling a well with a bailer:
 1. Carefully (slowly) lower the bailer into the well to mid-screen depth to collect the sample. **Do not** allow the bailer to freely drop into the well or scrape the sides of the well casing when collecting the sample.

2. Carefully (slowly) raise the bailer from the well, coiling the bailer line as the sample is retrieved. **Do not** allow the bailer line or other sampling equipment to come in contact with the ground.
 3. Immediately collect the VOC sample (if required). Gently fill the sample vial for VOC analysis until the meniscus of the water is above the top of the vial. Screw on the lid, invert and check for bubbles. If bubbles are present, add more water.
 4. Repeat the sampling procedure until sufficient sample quantity has been collected for all analytical parameters.
 5. Immediately place the labeled sample containers in a cooler with ice for preservation in the field.
 6. In the event the bailer string snaps or the knot loosens on the top of the bailer, retrieve the bailer using a non-lead fishing jig attached to a length of monofilament line.
- E. If a pump is used to purge a well, the pump can be used to collect a sample from the well. The following procedures should be followed when sampling with a pump:
1. Sampling pump rates should be between 100 and 500 milliliters per minute.
 2. Immediately collect the VOC sample (if required). Gently fill the sample vial for VOC analysis until the meniscus of the water is above the top of the vial. Screw on the lid, invert and check for bubbles. If bubbles are present, add more water.
 3. Repeat the sampling procedure until sufficient sample quantity has been collected for all analytical parameters.
 4. Immediately place the labeled sample containers in a cooler with ice for preservation in the field.
 5. Properly decontaminate the pump in accordance with established decontamination procedures prior to initiating volumetric purging and sampling activities in another monitoring well.
- F. Locate the monitoring well locations using the GPS unit or a tape measure with reference to a fixed point.

Additional guidance is given in:

- US EPA, RCRA Ground-Water Monitoring: Draft Technical Guidance, November 1992, Office of Solid Waste, EPA/530-R-93-001
- US EPA, Test Methods for Evaluating Solid Waste, Volume II: Field Manual, Physical/Chemical Methods, November 1986, Office of Solid Waste and Emergency Response, SW-846.
- The Ohio Environmental Agency's *Technical Guidance Manual for Hydrogeological Investigations and Ground Water Monitoring*, February 1995 (with subsequent updated chapters)

5.6 Low-Flow Purging and Sampling

Low-flow purging, also referred to as low-stress purging, low-impact purging, minimal drawdown purging, or Micropurging®, is a method of well purging/sampling that does not require large volumes of water to be withdrawn. This method minimizes drawdown of the water column in the well, to avoid disturbance of the stagnant water above the well screen, and draw fresh water through the screen at a rate that minimizes sample disturbance. Water will generally be drawn through the screened interval at a rate less than 500 ml/min and may be as low as 100 ml/min. Once drawdown stabilizes and indicator parameters have stabilized, the sampled water is isolated from the stagnant water in the well casing, thus eliminating the need for its removal.

- A. Place the pump in the center of the well screen interval to help prevent disturbance of any sediments at the bottom of the well. The Project Manager will provide information on well construction.
- B. Once the pump has had a minimum time of 15 minutes to equilibrate, initiate purging activities with the pump set to the lowest speed setting. The speed can be slowly increased until water begins discharging.
- C. Monitor the static water level (at least every three to five minutes) until little or no drawdown is occurring or drawdown has stabilized. Record the depth at which the static water level stabilized. The static groundwater level should not fall below the pump intake level or below the well screen.
- D. Once drawdown is minimal or has stabilized, begin monitoring of field water quality parameters. Field water quality parameters along with the static water level will be monitored every three (3) to five (5) minutes.

Monitoring of the field water quality parameters will be performed with a multi-parameter water quality meter and an in-line flow through cell such that groundwater from the well is pumped from the well through the flow-through cell and discharged into a calibrated container (e.g., five-gallon bucket). The Project Manager will determine the field water quality parameters to be monitored; however, the typical field water quality parameters will consist of pH, conductivity, temperature, turbidity, dissolved oxygen and oxidation-reduction potential. The stabilization criteria for these field water quality parameters are presented below.

Field Water Quality Parameter	Stabilization Criteria
pH	± 0.2 Standard Units
Conductivity	± 3%
Temperature	± 0.5°C
Turbidity	≤10 NTUs or ± 10% (>10 NTUs)
Dissolved Oxygen	± 0.3 mg/L
Oxidation-Reduction Potential	± 20 millivolts

- E. When three (3) consecutive readings of field water quality parameters meet the stabilization criteria, a groundwater sample can be collected from the monitoring well.
- F. The Project Manager will determine if field filtration is necessary. If field filtration is necessary during sample collection, an in-line filter will be used and sized as outlined in the Ohio EPA's *Technical Guidance Manual for Hydrogeological Investigations and Ground Water Monitoring* or as determined by a regulatory agency.
- G. At the time of sample collection, the pumping rate will remain the same as the purging rate so that groundwater will remain representative of the groundwater bearing zone. Although not required with low-flow purging and sampling methodologies, groundwater samples will be collected in order of their volatility as indicated below. Parameters that are not pH sensitive or subject to loss through volatilization should be collected last.
- Volatile organic compounds (VOCs)
 - Purgeable organic carbon
 - Purgeable organic halogens
 - Total organic halogens (TOX)
 - Total organic carbon (TOC)
 - Extractable organics

- Total metals
 - Dissolved metals
 - Phenols
 - Cyanide
 - Sulfate and chloride
 - Nitrate and ammonia
 - Radionuclides
- H. Should the recharge rate of the well be less than the lowest achievable pumping rate, and the well is dewatered during purging, a sample should be taken as soon as the water level has recovered sufficiently to collect the sample, even if the parameters have not stabilized.
- I. Immediately place the labeled sample containers in a cooler with ice for preservation in the field.
- J. Groundwater removed from a well will be collected in a calibrated container (e.g., a five-gallon bucket) to document the volume of groundwater removed during purging activities. All purge waters will be transferred to DOT-approved 55-gallon drums for temporary storage until disposal arrangements are made.

Note: When conducting low flow sampling at new wells or established wells being sampled for the first time by low flow procedure, it is recommended the purging process be verified by continuing to purge nine to fifteen minutes, then retaking the stabilization parameters. If the parameters remained stable, then the purging procedure can be established for that well based on pump location, rate of purging, and frequency of obtaining the three sets of stabilization parameters.

- K. Locate the monitoring well locations using the GPS unit or a tape measure with reference to a fixed point.

5.7 Sampling “Non-Monitoring Wells”

Non-monitoring wells primarily deals with monitoring domestic (private) “household” potable wells. Generally speaking, domestic wells are not used for environmental monitoring. There are occasions when it is necessary to measure water levels or sample these types of wells. The following are guidelines for monitoring domestic wells.

- A. Arrange access to a particular property, which may include obtaining an access agreement. The landowner must sign a form granting permission

to monitor the well. **Do not** open any well prior to obtaining this signature.

- B. Determine if the wellhead is accessible for measurement. Many wells, especially those with “Jet” pumps, have a sealed cap. Some of these caps have vent plugs that will allow a water level meter probe to enter. Do not loosen any sealed caps. If the wellhead is fitted with a cap that can easily be removed (e.g., wells with submersible pumps) loosen the bolts and gently tap the cover off. These type of caps are not sealed. CAUTION – this type of cap often harbor bees nests in them.
- C. Use a flashlight to determine the best spot to lower the water level indicator probe. Be very careful with electrical lines and pump support ropes so as not to tangle the water level indicator in these lines/support ropes.
- D. If the well has a sanitary seal or a “pitless” adapter, one will not be able to obtain a measurement.
- E. DO NOT REMOVE ANY PUMP APPURTANCES TO OBTAIN MEASUREMENTS.
- F. Obtain a water sample from a faucet, do not lower a bailer into a domestic well.
- G. Water samples taken from a domestic supply system (e.g., a faucet) are not truly representative of the actual groundwater as the sample is coming from, or through, the holding tank, supply lines, and water conditioning (softener, etc.) units. Check for a faucet in the system prior to going through one of these appurtenances.
- H. When sampling for bacterial content, the sample container should not be rinsed before use due to possible contamination of the sample container or removal of the thiosulfate dechlorinating agent (if used). When filling any sample container, care should be taken that no splashing drops of water from the ground or sink do not enter into either the bottle or cap.
- I. The following procedures should be followed when collecting samples from potable water supplies:
 - 1. Ideally, the sample should be collected from a tap or spigot located at or near the well head or pump house and before the water supply is introduced into any storage tanks or treatment units. If

the sample must be collected at a point in the water line beyond a pressurization or holding tank, a sufficient volume of water should be purged to provide a complete exchange of fresh water into the tank and at the location where the sample is collected. If the sample is collected from a tap or spigot located just before a storage tank, spigots located inside the building or structure should be turned on to prevent any backflow from the storage tank to the sample tap or spigot. It is generally advisable to open several taps during the purge to ensure a rapid and complete exchange of water in the tanks.

2. Purge the system for at least 15 minutes when possible. After purging for several minutes, measure the turbidity, pH, specific conductivity, and temperature of the water. Continue to monitor these parameters until three consistent readings are obtained. If possible, obtain three consistent readings after the 15 minute purge.
3. After three consistent readings have been obtained, samples may be collected.
4. Immediately place the labeled sample containers in a cooler with ice for preservation in the field.

6.0 DOCUMENTATION

Groundwater sampling activities will be documented in project field notes, on the monitoring well field data sheets, calibration sheets (as applicable), sample labels and chains-of-custody. The purging methodology, field water quality parameter measurements, static water levels, sample collection procedures, field conditions and analytical parameters will be documented as well as any deviation from proposed activities or equipment issues in the field.

7.0 ADDITIONAL INFORMATION

A copy of HZW's Monitoring Well Field Data Form is attached to this Groundwater Sampling SOP.



HzW Job Number: _____

Monitoring Well ID: _____

MONITORING WELL FIELD DATA FORM

PROJECT NAME: _____

PERSONNEL ON-SITE: _____

WEATHER CONDITIONS: _____

EQUIPMENT USED: _____

WELL DATA:

$$\frac{\text{Total Depth (ft.)}}{\text{Total Depth (ft.)}} - \frac{\text{SWL (ft.)}}{\text{SWL (ft.)}} = \frac{\text{Water Column (ft.)}}{\text{Water Column (ft.)}}$$

DATE EQUIPMENT CALIBRATED: _____

PURGE DATE: _____

TIME PURGE BEGAN: _____

TIME PURGE COMPLETED: _____

VOLUME PURGED: _____

*****SEE NEXT PAGE FOR FIELD PARAMETER MEASUREMENTS DURING PURGING*****

SAMPLING DATE: _____

TIME SAMPLING BEGAN: _____

TIME SAMPLING ENDED: _____

APPEARANCE OF SAMPLE (color, turbidity, odors, etc.)

ADDITIONAL NOTES:

SAMPLER NAME (PRINT)

SIGNATURE OF SAMPLER



Monitoring Well ID: _____

FIELD PARAMETER MEASUREMENTS:

Stabilization Criteria

SAMPLER NAME (PRINT)

SIGNATURE OF SAMPLER

Field Standard Operating Procedures

#301 – Soil Gas Sampling



November 2007
Revision 3.1 December 2016

REVISION HISTORY

Below is a summary of the revisions to this Standard Operating Procedure.

Date	Revisions
March 2009	Soil Gas Sampling SOP extensively updated
June 2015	Extensive revisions and reformatting of Soil Gas Sampling SOP performed
December 2016	Revisions to font, added new company logo

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FSOP #301 – SOIL GAS SAMPLING STANDARD OPERATING PROCEDURES**1.0 PURPOSE AND APPLICABILITY**

This SOP has been prepared for use by HZW personnel only. Soil gas monitoring in the vadose zone is a method used to directly measure characteristics of the soil atmosphere that are frequently used as an indirect indicator of processes occurring in and below a sampling horizon. Soil gas monitoring is used as a method to suggest the presence, composition, and origin of contaminants in and below the vadose zone. A soil gas survey is very effective as a rapid and relatively inexpensive method of detecting volatile contaminants in the vadose zone. Soil gas measurements can be used to both determine the presence or absence of a volatile material in the subsurface and to determine relative concentrations.

Volatile materials diffuse through unsaturated soils to the surface, achieving equilibrium with other soil gases. Their equilibrium concentration will be a function of their source concentration (separate phase product, soils, and groundwater), their volatility, and the distance they have to travel.

2.0 HEALTH AND SAFETY

Property health and safety precautions must be observed during soil gas sampling activities. The site-specific Health and Safety Plan (HASP) or HZW's general HASP provides guidelines on health and safety precautions. Field personnel should rely on the site-specific or general HASP to evaluate field conditions at a site such as potential chemical hazards, what is the appropriate personal protective equipment and site monitoring activities.

Prior to initiating soil gas sampling activities, the locations of all utilities (public and private) at a site and their locations should be identified. Typically, the state One-Call system will be contacted for publicly-owned utilities and private property owners or maintenance personnel will be contacted for privately-owned utilities.

Specific and technical training of drilling equipment is required to operate the equipment in a safe manner. All personnel operating drilling equipment must be trained and knowledgeable in how the equipment operates, the limitations of the equipment and safety precautions while operating equipment.

3.0 DEFINITIONS

Soil Gas: Volatile compounds in the gaseous phase from ground surface to the soil/groundwater interface.

Vadose Zone: The zone between the ground surface and the groundwater table. It includes the root zone, intermediate zone and capillary fringe.

Sub-Slab Soil Gas: Soil gas that is beneath a building floor slab and is within the advective envelope of the building-driven depressurization.

Vapor Pin®: A sub-slab soil gas sample point assembly that consists of an approximate 3-inch stainless steel barb with a silicone sleeve, which is installed using a rotary hammer drill and hand tools into a concrete floor slab. Vapor Pins® may be used in a temporary or long-term application.

Summa Canister: A silicone-lined, chemically inert, pre-evacuated, passivated stainless steel vessel in which indoor air or soil gas samples are collected. Summa canisters are re-usable and are cleaned by the analytical laboratory after use.

Post-Run Tubing System: A temporary, single-use system in which soil gas samples are collected at specific depths by advancing direct-push probe rods, inserting tubing inside the probe rods and sealing the probe rods in order to collect a soil gas sample.

Direct-Push Drilling Methodologies: The use of hydraulic or percussive methods to drive or push small-diameter rods and tooling into unconsolidated subsurface materials to collect soil gas samples and install small diameter soil gas wells.

4.0 EQUIPMENT AND MATERIALS

The equipment and materials to perform soil gas sampling by HZW is presented below. The listing below is not exhaustive and individual tooling pieces are not listed as the equipment and material list would be extensive. Field personnel operating the direct-push equipment are to refer to the tooling information provided by Geoprobe Systems® to identify and maintain the individual components of the tooling systems.

- Proposal or Sampling & Analysis Plan
- Map of Proposed Soil Gas Sample Locations

- Field Notebook
- Ball-Point Pens, Pencils
- Geoprobe® 7782DT, 54LT or 5400 Drilling Units with Trailers (as applicable)
- Support Vehicles (as applicable)
- Manual Slide Hammer Tooling System (Manual Boring Installation)
- DT22 Dual Tube Soil Sampling System (Hydraulic Boring Installation)
- Various Sized Pipe Wrenches, Pliers, Hammers
- Shovels, Pick-Axe, Brooms
- Hammer Drill and Bits
- Generator
- Extension Cords
- Vapor Pin Kit (Containing Vapor Pins, Silicone Sleeves, Bottle Brush, Caps, Installation/Extraction Tool and Two-Inch PVC Coupling)
- Retractable Utility Knife
- Plastic 60 cc Syringes
- Teflon® and Tygon® Tubing
- Stainless Steel Vapor Implants
- Multi-Gas Meter (Must Know Flow Rate)
- Stainless Steel Summa Canisters, Flow Controllers and Vacuum Gauges
- Weighted Tape Measures
- Polyethylene Sheeting (6-mil thickness)
- Granular Bentonite
- Flushmounts
- Two-Inch PVC Pipe (Schedule 40)
- Concrete and Asphalt
- Washed, Medium Sand
- Nitrile Gloves
- Distilled Water and Non-Phosphate Detergent for Decontamination
- Additional Five (5) Gallon Buckets and Brushes for Decontamination
- Global Positioning Systems Unit
- 300-Foot Tape Measures

5.0 PROCEDURES

5.1 Overview of Soil Gas Sampling Methods

Soil gas sampling is generally used to indicate presence and horizontal delineation of subsurface volatile contaminants. Four soil gas sampling methods are utilized to collect soil gas samples.

1. **Active Soil Gas Sampling Method:** Quantitatively assessing soil gas through the collection of soil gas that involves the forced movement of bulk soil atmosphere for sample collection.
2. **Passive Soil Gas Sampling Method:** Qualitatively assessing soil gas through the collection of soil gas using an absorbent material left in the subsurface for a period of time. The absorbent material is then retrieved and analyzed. Passive soil gas sampling may be useful in the following situations:
 - Collection of soil gas in which subsurface materials have a low permeability and high moisture content;
 - Detecting constituents at very low concentrations; and
 - Evaluating potential preferential vapor migration pathways.
3. **Emission Flux Chamber Method:** Qualitatively assessing soil gas through the collection of a contaminant flux at the ground surface in a flux chamber. Bulk atmosphere or soil atmosphere components from the near-surface are collected in the flux chamber for a period of time and the contaminant flux analyzed. This method is useful to some very specific applications such as monitoring soil contaminant emissions from soil or water to assess the health hazard risk to the general public.
4. **Indoor/Subslab Differential Pressure Measurements:** Although this method does not collect soil gas samples, this method is useful in interpreting the direction of vapor movement, either into or out from a structure. The vapor movement is determined by measuring the pressure gradient between the sub-slab and overlying structure.

The Active Soil Gas Sampling Method, which will be used by HZW personnel, is explained in detail, below.

5.2 Limitations of Soil Gas Sampling

- A. A soil gas survey is only applicable to volatile contaminants;
- B. Any barrier that interferes with vapor migration such as perched water, clay or made-made structures can lead to a low or false negative reading; soil gas readings taken within 24 to 48 hours of heavy precipitation can produce drastically reduced or non-existent readings; and
- C. Biodegradation can reduce the soil gas levels of many hydrocarbons, including BTEX compounds; the deeper the contamination relative to the

soil gas sample point, the more the impact of biodegradability is likely to be.

5.3 Soil Gas Sampling Considerations

The likelihood of the success of the soil gas sampling technique selected is controlled in part by the methodology in application of that sampling technique. This methodology should be guided by the project objectives and by the perceived spatial and temporal array of the potential sampling targets. In order to design a successful soil gas survey, the following considerations must be taken into account:

A. Development of a sampling grid

1. Collected data must be distributed spatially;
2. The selection of grid size is strongly dependent on the relationship between project confidence level requirements and cost budget;
3. Small survey targets and complex vadose zone geology require decreased spacing between samples;
4. Overly large grid cell spacings result in inadequate, over-interpreted data; and
5. Grid arrays can be designed as regularly spaced, predetermined locations or they can be irregularly spaced and continually field modified.

B. Contaminant profiling

1. Consists of sampling at closely spaced intervals in a linear array, the results being displayed as contaminant concentration versus distance on an X - Y plot; concentration data is often displayed logarithmically;
2. Profile intervals (i.e., spacing between samples) can range from about 25 to a maximum of 100 feet; and
3. Useful as a corroborative tool for other monitoring methods.

C. Multiple depth sampling

1. Allows monitoring of changes in soil gas contaminant fractions with depth
2. Some sampling systems can recover soil gas samples as probes are advanced deeper into the vadose zone; and

3. This practice is helpful in determining the optimum sampling depth for a particular site or to demonstrate the presence or absence of soil atmosphere contamination in a certain horizon.
- D. Time variant methodologies
1. Consists of monitoring soil gas in the vadose zone over time;
 2. Can help monitor the effectiveness of remedial air-injection or suction systems as well as the migration of contaminants from a source; and
 3. Proper maintenance of long-term monitoring systems is essential.
- E. Combining with other vadose zone monitoring systems such as determining the best location for other monitoring devices.

5.4 Active Soil Gas Sampling Methods

Soil gas samples may be collected sub-slab within a building, in crawl spaces beneath a building or on exterior portions of a property. The methodologies presented below apply to sub-slab and exterior soil gas sampling. Collection of soil gas samples in crawl spaces (without a slab) will be sampled similar to indoor air.

Sub-Slab Soil Gas Sampling

Sub-slab soil gas sampling will be performed using stainless steel Vapor Pins®, which can be installed for one-time use or permanently. Vapor Pins® are intended to be installed in the concrete floor slab of a building.

- A. Wear the appropriate personnel protective equipment for installing sub-slab soil gas sample points and collecting sub-slab soil gas samples.
- B. Locate and observe all underground utilities, cracks in the concrete floor and other potential preferential pathways in relation to proposed soil gas sample locations.
- C. If a Vapor Pin® will be permanently installed, drill a 1.5-inch diameter hole in the concrete floor to a depth of 1.75-inches. Concrete dust generated from drilling should be evacuated using a wet/dry vacuum equipped with the appropriate filter.

- D. Drill a 5/8-inch diameter hole (within the 1.5-inch diameter hole, if drilled) through the concrete floor slab and approximately three (3) to four (4) inches below the floor slab.
- E. Thoroughly clean out the 5/8-inch diameter hole with a 5/8-inch diameter bottle brush. Use a wet/dry vacuum equipped with the appropriate filter to evacuate the concrete dust removed by the bottle brush. The wet/dry vacuum should not be placed directly over the drilled hole.
- F. Attach a new silicone sleeve to a stainless steel Vapor Pin® and place the lower end of the Vapor Pin® assembly into the drilled hole.
- G. Using the Vapor Pin® installation/extraction tool, tap the Vapor Pin® into the concrete floor slab. Ensure that the Vapor Pin® remains vertical and the installation/extraction tool remains in-line/parallel to the Vapor Pin® to avoid damage to the barb fitting on the Vapor Pin.
- H. Tap the Vapor Pin® into the concrete floor slab until a slight bulge appears between the concrete floor slab and the Vapor Pin®. If a slight bulge does not appear or the Vapor Pin® was not installed correctly, remove the Vapor Pin® from the concrete and the silicone sleeve. Install a new silicone sleeve on the Vapor Pin® and install the Vapor Pin® as indicated in steps F through H.
- I. Place the protective cap on the barb fitting of the Vapor Pin®.
- J. If a Vapor Pin® is being installed permanently, install the flush mount cover in the 1.5-inch diameter hole.
- K. Allow the sub-slab soil gas to equilibrate. The equilibration time may range from one (1) to three (3) hours.
- L. After the appropriate equilibration time has elapsed, a soil gas sample can be collected. Soil gas samples will be collected in one (1) or six (6) Liter, batch-certified clean, stainless steel Summa canisters equipped with sample train consisting of a flow controller regulated at 200 milliliters per minute and a vacuum gauge. The Summa canister should have an attached tag identifying the soil gas sample as well as places to indicate sample collection start and end times and sample collection start and end vacuums.

1. Assemble the Summa canister, flow controller and vacuum gauge. Make sure the valve on the Summa canister remains closed.
2. Attach a short length (several inches) of Teflon® tubing to the sample end of the sample train.
3. Attach a plastic 60 cc syringe to the Teflon® tubing and perform a “shut-in” test on the sample train and Summa canister to ensure that no leaks are occurring at these connections. If a vacuum cannot be held on the sample train, check all fittings and repeat the “shut-in” test until a vacuum can be maintained.
4. As appropriate or necessary, place a shroud over the Vapor Pin® in order to perform leak testing during sample collection. Leak testing will be conducted by filling the shroud with helium and measuring the helium concentrations within the shroud and comparing helium percentages in the shroud with percentages in the soil gas sample.

A mechanical leak test can be conducted on the Vapor Pin® by placing a two (2) inch PVC pipe coupling with VOC-free plumber’s putty around the Vapor Pin®. Once the tubing is connected from the Vapor Pin® to the sample train on the Summa canister, distilled water is poured into the PVC coupling and the water level monitored. If the water level drops noticeably, the Vapor Pin® will need to be removed and reinstalled at least one (1) foot away from the original location.

5. Attach a 3-way stopcock to the Teflon® tubing on the end of the sample train in Step 3, above, and attach Teflon® tubing from the Vapor Pin® to the 3-way stopcock. The shortest length of tubing should be used from the Vapor Pin® to the 3-way stopcock. If any flexible tubing is necessary to make connections, very short lengths (generally, one inch or less) of Tygon® tubing should be used.
6. Using a dedicated, plastic, 60 cc syringe, open the 3-way stopcock to purge the volume of ambient air in the tubing from the Vapor Pin® to the 3-way stopcock.
7. Once the tubing is purged, turn the 3-way stopcock for the soil gas sample to be collected by the Summa canister.

8. Open the valve on the Summa canister and begin collecting the soil gas sample. Note the date, sample collection start and end times, and vacuum gauge start and end vacuums. In general, a vacuum of -2 to -5 mmHg will remain on the Summa canisters at sample collection termination. Close the valve on the Summa canister when the vacuum gauge is between -2 to -5 mmHg.
 9. Upon completion of sub-slab soil gas sampling activities, remove the Vapor Pin® from the concrete floor slab using the installation/extraction tool and fill the hole with concrete.
 10. Submit the Summa canister to the analytical laboratory for analysis.
- M. Locate the sub-slab soil gas sample locations using the GPS unit or a tape measure with reference to a fixed point.

Post-Run Tubing System Soil Gas Samples

The post-run tubing system is used to collect grab soil gas samples at depths of five (5) feet below grade or deeper using manual or hydraulic direct push drilling methodologies. Typically, the post-run tubing system is used to collect one-time soil gas samples on exterior portions of a site. Most soil gas samples are collected with the post-run tubing system using hydraulic direct push drilling methodologies. Therefore, the following procedures present the methodology to collect post-run tubing soil gas samples using hydraulic direct push drilling methodologies.

- A. Wear the appropriate personnel protective equipment for installing post-run tubing soil gas sample points and collecting soil gas samples.
- B. Locate and observe all underground and aboveground utilities as well as other potential preferential pathways in relation to proposed soil gas sample locations.
- C. Attach a post-run tubing (PRT) system adapter into the end of appropriately-sized Teflon® tubing. Tape may be used on the outside of the adapter and tubing to prevent the tubing from spinning freely around the adapter during connection, which happens with Teflon® tubing.

- D. Attach a PRT system expendable point holder and an expendable drive point onto the bottom of a 1.25-inch lightweight probe rod. Place a threaded drive cap onto the top of the lightweight probe rod.
- E. Raise the hydraulic hammer to the highest position by fully extending the probe cylinder.
- F. Position the PRT assembly directly under the hammer with the expendable drive point centered between the toes of the probe feet.
- G. Lower the hydraulic hammer onto the drive cap and advance the tooling string the length of the probe rod. Apply the hydraulic hammer as necessary to drive the probe rod.
- H. Upon reaching the probe rod depth, remove the drive cap and thread a second 1.25-inch lightweight probe rod onto the probe rod in the ground. Place the threaded drive cap on top of the second probe rod.
- I. Lower the hydraulic hammer onto the drive cap and advance the tooling string to the terminal depth or the length of the probe rod. Apply the hydraulic hammer as necessary to drive the probe rod.

If soil gas sampling activities are anticipated to be deeper than the depth of the second probe rod, repeat steps H and I until advancing to sample depth.

- J. Upon reaching sample depth, insert the PRT adapter and Teflon® tubing inside the probe rods until it hits the expendable point holder on the bottom. Leave approximately 4-6 feet of excess tubing to extend out of the hole. Attach a 3-way stopcock to the end of the tubing.
- K. Grasp the excess tubing and apply some downward pressure on the tubing and PRT adapter while turning the tubing and PRT adapter in a counterclockwise direction to engage the PRT adapter threads with the expendable point holder.
- L. Pull up lightly on the tubing to test the engagement of the threads. Failure of the PRT adapter to thread to the expendable point holder may indicate an intrusion of soil during advancement of the rods or disengagement of the expendable drive point. In this instance, a new PRT point will need to be installed approximately three (3) feet from the original location.

- M. Once the PRT adapter is properly threaded into the expendable point holder, retract the probe rods six (6) inches to create a void from which to sample the soil gas. The top of the probe rods once retracted should be no shallower than five (5) feet below grade.
- N. Mix up a thick hydrated bentonite and place the thick bentonite around 1) where the probe rods and ground surface meet, and 2) where the Teflon® tubing exits the top of the probe rods. The thick hydrated bentonite is placed in these locations to ensure that an adequate seal maintained.
- O. Allow the sub-slab soil gas to equilibrate. The equilibration time as indicated in the Ohio EPA's *Sample Collection and Evaluation of Vapor Intrusion to Indoor Air* Guidance Document dated May 2010 is 15 minutes.
- P. After the appropriate equilibration time has elapsed, a soil gas sample can be collected. Soil gas samples will be collected in one (1) or six (6) Liter, batch-certified clean, stainless steel Summa canisters equipped with sample train consisting of a flow controller regulated at 200 milliliters per minute and a vacuum gauge. The Summa canister should have an attached tag identifying the soil gas sample as well as places to indicate sample collection start and end times and sample collection start and end vacuums.
 - 1. Assemble the Summa canister, flow controller and vacuum gauge. Make sure the valve on the Summa canister remains closed.
 - 2. Attach a short length (several inches) of Teflon® tubing to the sample end of the sample train.
 - 3. Attach a plastic 60 cc syringe to the Teflon® tubing and perform a "shut-in" test on the sample train and Summa canister to ensure that no leaks are occurring at these connections. If a vacuum cannot be held on the sample train, check all fittings and repeat the "shut-in" test until a vacuum can be maintained.
 - 4. Use a piece of Teflon tubing to connect the sample train on the Summa canister to the 3-way stopcock on the PRT sample point tubing. A minimal length of tubing should be used to connect the sample train and the 3-way stopcock.
 - 5. Attach a short length of Teflon® tubing to the remaining port on the 3-way stopcock. This remaining port will be used to purge

ambient air from the tubing prior to sample collection. Purging activities may be completed using a dedicated, plastic 60 cc syringe or a multi-gas meter that is capable of monitoring oxygen levels provided that the flow rate of the multi-gas meter is known to be approximately 200 milliliters per minute. The use of the multi-gas meter to measure oxygen levels may provide additional information on how adequate the seal is on the PRT sample system.

6. Using a dedicated, plastic, 60 cc syringe or a multi-gas meter, open the 3-way stopcock to purge the tubing three (3) volumes of air. Calculations for tubing volumes are included in the soil gas sampling field data sheets.
 7. Once the tubing is purged, turn the 3-way stopcock for the soil gas sample to be collected by the Summa canister.
 8. Open the valve on the Summa canister and begin collecting the soil gas sample. Note the date, sample collection start and end times, and vacuum gauge start and end vacuums. In general, a vacuum of -2 to -5 mmHg will remain on the Summa canisters at sample collection termination. Close the valve on the Summa canister when the vacuum gauge is between -2 to -5 mmHg.
 9. Submit the Summa canister to the analytical laboratory for analysis.
- Q. Upon completion of soil gas sampling activities, unthread the tubing and PRT adapter from the expendable point holder by turning the tubing and PRT adapter in a clockwise direction.
- R. Thread a pull cap onto the 1.25-inch lightweight probe rods.
- S. Lower the hydraulic hammer and hook the hammer latch over the pull cap. Raise the hydraulic hammer to pull the probe rods and expendable point holder completely out of the ground.
- T. Upon removing the probe rods, fill the open borehole with granular bentonite. The bentonite will be hydrated as it is placed in the open borehole. The surface of the borehole will be finished to match the surrounding surface.

- U. Locate the soil gas sample locations using the GPS unit or a tape measure with reference to a fixed point.

Permanent Soil Gas Implants

Permanent soil gas implants are installed to varying depths using the DT22 dual tube soil sampling system and hydraulic direct push drilling methodologies.

- A. Wear the appropriate personnel protective equipment for installing soil gas implants.
- B. Locate and observe all underground and aboveground utilities as well as other preferential pathways in relation to proposed soil gas implant locations.
- C. Assemble the lead sample tube, which will be either 48-inches or 60-inches in length. A cutting shoe is connected to the leading edge of the sample tube with an appropriately-sized acetate sample liner is inserted into the lead sample tube. At the top of the acetate sample liner, a liner drive head is inserted into the liner and a drive bumper and the drive cap placed on top of the liner drive head.
- D. Place the assembled lead sample tube under the drive head of the hydraulic direct push machine. The tube should be positioned with the cutting shoe between the toes of the probe foot.
- E. Lower the hydraulic hammer onto the drive cap and advance the sample tube to the sample liner length using continuous percussion.
- F. Once at sample liner depth, raise the hydraulic hammer and move the probe assembly back in order to access the tooling string.
- G. Remove the drive cap and drive bumper.
- H. Thread a 1.25-inch lightweight inner rod onto the liner drive head. Raise the inner rod and sample liner from the lead sample tube.
- I. Remove the liner drive head from the acetate sample liner. Insert the liner drive head into a new acetate sample liner. The purpose of retrieving soil samples during soil gas implant installation is to verify subsurface conditions and materials.

- J. Insert the new acetate sample liner in the lead sample tube that remains in the ground and thread a 1.25-inch lightweight inner rod onto the liner drive head. The inner rod will extend above the lead sample tube (i.e., an outer casing).
- K. Place a 2.25-inch outer probe rod over the inner rods and thread the outer probe rod to the lead sample tube until tightened.
- L. Place a drive bumper and drive cap over the inner rod and outer probe rod.
- M. Lower the hydraulic hammer onto the drive cap and advance the tooling string the length of the sample liner. Apply the hydraulic hammer as necessary to drive the lead sample tube and tooling string.
- N. Upon reaching the soil gas implant depth or next sample liner length depth, raise the hydraulic hammer and move the probe assembly back in order to access the tooling string.
- O. Remove the drive cap and drive bumper.
- P. Thread a 1.25-inch lightweight inner rod onto the inner rod in the ground to raise the inner rods and sample liner.
- Q. Remove the liner drive head from the acetate sample liner. Insert the liner drive head into a new acetate sample liner.

Repeat steps J through Q until advancing to soil gas implant depth.

- R. Once at soil gas implant depth, remove the inner rods.
- S. Attach the six (6) inch stainless steel vapor implant to Teflon® tubing.
- T. Begin slowly retracting the outer 2.25-inch probe rods from the borehole using the rod grip pull system for the direct-push machine.
- U. Slowly pour approximately three (3) to four (4) inches of washed, medium sand in the bottom of the borehole. Use a weighted tape measure to verify placement of the sand.
- V. Lower the stainless steel vapor implant and Teflon® tubing to the top of the sand in the borehole. A 3-way stopcock will be attached to the top end of the tubing.

- W. Slowly pour washed, medium sand in the annular space around and approximately three (3) to four (4) inches above the vapor implant as the probe rods continue to be retracted. Use a weighted tape measure or, if necessary, probe rods lowered into the borehole to prevent bridging of the sand. The weighted tape measure will be used to monitor placement and depth of the sand around the vapor implant.
- X. At the upper terminus of the sand, pour approximately two (2) inches of dry, granular bentonite into the borehole. Continue retracting the probe rods and slowly pouring granular bentonite into the borehole. Begin hydrating the granular bentonite by delivering water in small amounts using a plastic 60 cc syringe and polyethylene tubing placed down the borehole.
- Y. Granular bentonite will continue to be added and hydrated to the borehole to approximately one (1) foot below grade. At approximately one (1) foot below grade, a piece of two (2) inch PVC pipe will be placed around the Teflon tubing connected to the vapor implant.
- Z. A flushmount manhole cover will be placed over the Teflon tubing and two (2) inch PVC pipe. The ground or pavement around the borehole may need to be cored or excavated to accommodate the manhole cover.
- AA. Mix and pour concrete around the remaining annular space (two-inch PVC pipe to the exterior side of the manhole cover) to secure the flushmount manhole cover.
- AB. After allowing the sandpack to equilibrate for a period of 24 hours, purge one (1) volume of the sandpack and three (3) volumes of the tubing. Attach a short length of Teflon® tubing to one (1) of the two (2) available ports on the 3-way stopcock. This port will be used to purge the vapor implant sandpack and tubing prior to sample collection. Purging activities may be completed using a dedicated, plastic 60 cc syringe or a multi-gas meter that is capable of monitoring oxygen levels provided that the flow rate of the multi-gas meter is known to be approximately 200 milliliters per minute. The use of the multi-gas meter to measure oxygen levels may provide additional information on how adequate the seal is on the vapor implant.
- AC. Upon completion of purging activities, a soil gas sample can be collected. Soil gas samples will be collected in one (1) or six (6) Liter, batch-certified clean, stainless steel Summa canisters equipped with sample train

consisting of a flow controller regulated at 200 milliliters per minute and a vacuum gauge. The Summa canister should have an attached tag identifying the soil gas sample as well as places to indicate sample collection start and end times and sample collection start and end vacuums. Some of the sample steps will be conducted prior to purging the vapor implant sandpack and tubing.

1. Assemble the Summa canister, flow controller and vacuum gauge. Make sure the valve on the Summa canister remains closed.
 2. Attach a short length (several inches) of Teflon® tubing to the sample end of the sample train.
 3. Attach a plastic 60 cc syringe to the Teflon® tubing and perform a “shut-in” test on the sample train and Summa canister to ensure that no leaks are occurring at these connections. If a vacuum cannot be held on the sample train, check all fittings and repeat the “shut-in” test until a vacuum can be maintained.
 4. Use a piece of Teflon® tubing to connect the sample train on the Summa canister to the 3-way stopcock on the vapor implant tubing. A minimal length of tubing should be used to connect the sample train and the 3-way stopcock.
 5. Once the tubing is purged, turn the 3-way stopcock for the soil gas sample to be collected by the Summa canister.
 6. Open the valve on the Summa canister and begin collecting the soil gas sample. Note the date, sample collection start and end times, and vacuum gauge start and end vacuums. In general, a vacuum of -2 to -5 mmHg will remain on the Summa canisters at sample collection termination. Close the valve on the Summa canister when the vacuum gauge is between -2 to -5 mmHg.
 7. Submit the Summa canister to the analytical laboratory for analysis.
- AD. Locate the sub-slab soil gas sample locations using the GPS unit or a tape measure with reference to a fixed point.

5.5 Decontamination

Sub-Slab Soil Gas Sampling

The stainless steel Vapor Pins® used to collect sub-slab soil gas samples can be re-used once thoroughly decontaminated.

- A. Upon removal from the concrete floor slab, the silicone sleeve will be removed and discarded.
- B. Immerse and wash the Vapor Pin® in a distilled water and non-phosphate detergent solution.
- C. Triple-rinse the Vapor Pins® with distilled water.
- D. Heat the Vapor Pins® to a minimum temperature of 265 degrees Fahrenheit (or 130 degrees Celsius).

Post-Run Tubing System Soil Gas Samples

Decontaminate all reusable post-run tubing system equipment by washing the equipment in a distilled water and non-phosphate detergent system and triple-rinsing with distilled water before moving to another sample location.

Permanent Soil Gas Implants

Decontaminate all reusable permanent soil gas implant equipment by washing the equipment in a distilled water and non-phosphate detergent system and triple-rinsing with distilled water prior to moving to another sample location.

6.0 DOCUMENTATION

Soil gas sampling activities will be documented in project field notes, on field logs (as applicable), sample labels and chains-of-custody. The soil gas sampling methodologies, sample collection procedures, field conditions and analytical parameters will be documented as well as any deviation from proposed activities or equipment issues in the field.

7.0 ADDITIONAL INFORMATION

A copy of HZW's Soil Gas/Indoor Air Sampling Field Data Form is attached to this Soil Gas Sampling SOP.

Field sampling form

Field Standard Operating Procedures

#401 – Indoor and Ambient Air Sampling



HZW Environmental
Consultants

November 2007
Revision 3.1 December 2016



REVISION HISTORY

Below is a summary of the revisions to this Standard Operating Procedure.

Date	Revisions
March 2009	Indoor and Ambient Air Sampling SOP extensively updated
June 2015	Extensive revisions and reformatting of Indoor and Ambient Air Sampling SOP performed
December 2016	Revisions to font, added new company logo

I:\Geology Group\SOPs\Revised SOPs - December 2016\FSOP 401 - Indoor and Ambient Air Sampling FSOP.doc

FSOP #401 – INDOOR AND AMBIENT AIR SAMPLING STANDARD OPERATING PROCEDURES**1.0 PURPOSE AND APPLICABILITY**

This SOP has been prepared for use by HZW personnel only. This SOP describes the collection of ambient and indoor air samples. Indoor air samples are collected from predetermined locations within buildings and typically analyzed for VOCs by United States Environmental Protection Agency Method TO-15.

2.0 HEALTH AND SAFETY

Property health and safety precautions must be observed during monitoring well installation activities. The site-specific Health and Safety Plan (HASP) or HZW's general HASP provides guidelines on health and safety precautions. Field personnel should rely on the site-specific or general HASP to evaluate field conditions at a site such as potential chemical hazards, what is the appropriate personal protective equipment and site monitoring activities.

3.0 DEFINITIONS

Summa Canister: A silicone-lined, chemically inert, pre-evacuated, passivated stainless steel vessel in which indoor air or soil gas samples are collected. Summa canisters are re-usable and are cleaned by the analytical laboratory after use.

4.0 EQUIPMENT AND MATERIALS

The equipment and materials necessary to perform indoor air and ambient air sampling is presented below.

- Proposal or Sampling & Analysis Plan
- Map of Proposed Indoor Air and Ambient Air Locations
- Field Notebook
- Ball-Point Pens, Pencils
- Crescent Wrench(es)
- Stainless Steel Summa Canisters, Flow Controllers and Vacuum Gauges
- Plastic 60 cc Syringe
- Teflon® or Tygon® Tubing
- Nitrile Gloves
- Global Positioning Systems Unit
- 300-Foot Tape Measures

5.0 PROCEDURE

Indoor and ambient air samples are collected using an evacuated, batch- or individually-certified clean, six (6) Liter stainless steel Summa canister equipped with a sample train. The sample train will consist of a flow regulator (which can vary from 30 minutes to 24-hours) and a vacuum gauge.

5.1 Pre-Sampling Activities

- A. An oral interview and written questionnaire should be conducted/prepared with building occupants prior to indoor air sampling in order to identify, reduce or eliminate the impact of building occupant activities.
- B. Conduct an inventory of and identify all chemicals stored or used and any other potential sources of volatile compounds in the building.
- C. Identify potential indoor air and ambient air sampling locations. Sampling locations should be placed at a representative height, such as the breathing zone, approximately four (4) to six (6) feet above ground/floor surface. Ambient air sample locations should be in an area of unobstructed airflow. Locations that may influence the ability to collect a representative sample (near structures, bodies of water), or locations that may have a negative impact on sample collection activities (e.g., exhaust fans) should be avoided for ambient air sampling.
- D. Assemble the Summa canister, flow controller and vacuum gauge. Make sure the valve on the Summa canister remains closed.
- E. Attach a short length (several inches) of Teflon® tubing to the sample end of the sample train. Insert a plastic 60 cc syringe to the Teflon® tubing and perform a “shut-in” test on the sample train and Summa canister to ensure that no leaks are occurring at these connections. If a vacuum cannot be held on the sample train, check all fittings and repeat the “shut-in” test until a vacuum can be maintained.
- F. Begin preparing the Summa canister tag label. Information on the canister tag label should consist of the project name or identification, sample number, canister identification number, sample start and end times and vacuum start and end readings.

5.2 Indoor Air and Ambient Air Sampling Methodologies

Indoor air and ambient air samples can be collected as grab samples or as time-integrated samples by using a flow controller. The main difference is that grab samples are collected over a very short time period instantaneously, while time-integrated samples are collected at a controlled rate over a specific period of time and are able provide a representative sample for the specific time period sampled. In general, indoor air and ambient air samples will be collected as time-integrated samples with the time-integrated methodology presented below.

- A. Once the indoor air and ambient air sampling locations have been identified and the oral interviews and written questionnaires completed, place the Summa canisters (equipped with the sample trains [appropriate flow controller and vacuum gauge]) at each sample location.
 1. Sample canisters are typically placed at the normal breathing zone, which is approximately four (4) to six (6) feet above the ground or floor.
 2. Indoor air sample canisters should be placed in the lowest indoor areas or areas that are likely to capture the highest indoor air concentrations.
 3. Basements with dirt floors or crawl spaces require modification of sample canister placement.
- B. Open the canister valve to begin sample collection. Record the sample collection start time and the initial pressure of the canister.
- C. Return to the sample location approximately 30 minutes prior to sample collection termination. A vacuum should remain on the sample canister.
- D. Stop sample collection at the appropriate time by closing the valve on the Summa canister. Record the sample end time and final vacuum reading, which should be between -2 and -5 mmHg.
- E. Identify the indoor air and ambient air sampling locations on a map. If able, locate the indoor air sample locations using a tape measure with reference to a fixed point.

- F. Disconnect the sample train and finish filling in the required information on the canister tag label.
- F. Submit the Summa canister to the analytical laboratory for analysis.

6.0 DOCUMENTATION

Indoor air and ambient air sampling activities will be documented in project field notes, sample labels and chains-of-custody. The indoor air and ambient air sampling methodologies, sample collection procedures, field conditions and analytical parameters will be documented as well as any deviation from proposed activities or equipment issues in the field.

7.0 ADDITIONAL INFORMATION

A copy of HZW's Soil Gas/Indoor Air Sampling Field Data Form is attached to this Indoor Air and Ambient Air Sampling SOP.

APPENDIX B

HZW's FIELD FORMS



SOIL GAS/INDOOR AIR SAMPLING DATA FORM

Project Name: _____ HZW Job Number: _____
Personnel On-Site: _____ Date: _____

Site: _____

Site Address: _____

Weather*: _____

Instrument(s) Used: _____

Type of Sampling Performed: _____

*Include temperature, wind speed and direction, humidity, barometric pressure and note if there was a precipitation event >0.1 inches in the last 12 hours

SAMPLE NUMBER: _____

Sample Point Purging Information (As Applicable)

Sample Depth: _____ (if sub-slab, note as sub-slab)

Tubing Inside Diameter and Approximate Volume of Tubing (circle one)

1/8 inch = 0.125 inch → **2.5 mL/foot**

3/16 inch = 0.1875 inch → **5 mL/foot**

1/4 inch = 0.25 inch → **10 mL/foot**

5/16 inch = 0.3125 inch → **15 mL/foot**

3/8 inch = 0.375 inch → **20 mL/foot**

1. Use the following formula to calculate one (1) well volume of air in tubing:

One (1) Well Volume = Tubing Length (include sample train) x Approximate Volume of Tubing

 mL = _____ feet x _____ mL/foot

2. If a permanent soil gas well is installed, at least one (1) well volume of air in the sandpack should be purged the first time the soil gas well is purged. Use the following formula to calculate one (1) well volume of air in sandpack (for permanent soil gas wells):

One (1) Well Volume = $\pi r^2 h$

$\pi = 3.142$

$r^2 = r \times r$ (r = borehole diameter divided by 2)

h = length of sandpack

Borehole Diameter: _____ inches

Length of Sandpack: _____ inches

One (1) Well Volume of Air in Sandpack = $(3.142) \times r^2 (\text{in}^2) \times h (\text{inches})$

_____ in^3 = 3.142 x _____ in^2 x _____ in

Convert in^3 to mL: _____ in^3 (from above) x 16.39 mL/ in^3 = mL



SAMPLE NUMBER: _____

****Purge Minimum of Three (3) Well Volumes from Sample Point If Using Syringe or a Multi-Gas Meter****

Equipment Used to Purge: ☐ 60 cc/mL Syringe ☐ Multi-RAE Gas Meter (200 mL/min flow rate)

Well Volume/Time	Field Screening Information				
	%LEL	%O ₂	CO, ppm	H ₂ S, ppm	VOCs, ppm

Sample Information

Type of Sampling Event:

☐ Soil Gas (Vapor Intrusion) ☐ Indoor Air

Sample Media:

☐ Tedlar Bag ☐ 6-Liter Summa Canister ☐ 1-Liter Summa Canister

	Date (mm/dd/yy)	Time
Sample Set-Up:	_____	_____
Sample Start Time:	_____	_____
Sample End Time:	_____	_____

Regulator Calibrated For: ☐ No Regulator ☐ 8-Hour ☐ 12-Hour ☐ 24-Hour ☐ 200 mL/min

Initial Canister Vacuum: _____ in. Hg or mm Hg
Final Canister Vacuum: _____ in. Hg or mm Hg

Sampling Notes:



CALIBRATION RECORD FORM

Project Name: _____

HZW Job Number: _____

Personnel: _____

Instrument: _____

Date:				
Time:				
pH 4:				
pH 7:				
pH 10:				
Conductivity:				
Dissolved Oxygen:				
Isobutylene:				
Methane:				



HzW Job Number: _____

Monitoring Well ID: _____

MONITORING WELL FIELD DATA FORM

PROJECT NAME: _____

PERSONNEL ON-SITE: _____

WEATHER CONDITIONS: _____

EQUIPMENT USED: _____

WELL DATA:

$$\frac{\text{Total Depth (ft.)}}{\text{Total Depth (ft.)}} - \frac{\text{SWL (ft.)}}{\text{SWL (ft.)}} = \frac{\text{Water Column (ft.)}}{\text{Water Column (ft.)}}$$

DATE EQUIPMENT CALIBRATED: _____

PURGE DATE: _____

TIME PURGE BEGAN: _____

TIME PURGE COMPLETED: _____

VOLUME PURGED: _____

*****SEE NEXT PAGE FOR FIELD PARAMETER MEASUREMENTS DURING PURGING*****

SAMPLING DATE: _____

TIME SAMPLING BEGAN: _____

TIME SAMPLING ENDED: _____

APPEARANCE OF SAMPLE (color, turbidity, odors, etc.)

ADDITIONAL NOTES:

SAMPLER NAME (PRINT)

SIGNATURE OF SAMPLER



Monitoring Well ID: _____

FIELD PARAMETER MEASUREMENTS:

Stabilization Criteria

SAMPLER NAME (PRINT)

SIGNATURE OF SAMPLER



SOIL GAS/INDOOR AIR SAMPLING DATA FORM

Project Name: _____ HZW Job Number: _____
Personnel On-Site: _____ Date: _____

Site: _____

Site Address: _____

Weather*: _____

Instrument(s) Used: _____

Type of Sampling Performed: _____

*Include temperature, wind speed and direction, humidity, barometric pressure and note if there was a precipitation event >0.1 inches in the last 12 hours

SAMPLE NUMBER: _____

Sample Point Purging Information (As Applicable)

Sample Depth: _____ (if sub-slab, note as sub-slab)

Tubing Inside Diameter and Approximate Volume of Tubing (circle one)

1/8 inch = 0.125 inch → **2.5 mL/foot**

3/16 inch = 0.1875 inch → **5 mL/foot**

1/4 inch = 0.25 inch → **10 mL/foot**

5/16 inch = 0.3125 inch → **15 mL/foot**

3/8 inch = 0.375 inch → **20 mL/foot**

1. Use the following formula to calculate one (1) well volume of air in tubing:

One (1) Well Volume = Tubing Length (include sample train) x Approximate Volume of Tubing

 mL = _____ feet x _____ mL/foot

2. If a permanent soil gas well is installed, at least one (1) well volume of air in the sandpack should be purged the first time the soil gas well is purged. Use the following formula to calculate one (1) well volume of air in sandpack (for permanent soil gas wells):

One (1) Well Volume = $\pi r^2 h$

$\pi = 3.142$

$r^2 = r \times r$ (r = borehole diameter divided by 2)

h = length of sandpack

Borehole Diameter: _____ inches

Length of Sandpack: _____ inches

One (1) Well Volume of Air in Sandpack = $(3.142) \times r^2 (\text{in}^2) \times h (\text{inches})$

_____ in^3 = 3.142 x _____ in^2 x _____ in

Convert in^3 to mL: _____ in^3 (from above) x 16.39 mL/ in^3 = mL



SAMPLE NUMBER: _____

****Purge Minimum of Three (3) Well Volumes from Sample Point If Using Syringe or a Multi-Gas Meter****

Equipment Used to Purge: ☐ 60 cc/mL Syringe ☐ Multi-RAE Gas Meter (~200 mL/min flow rate)

Well Volume/Time	Field Screening Information				
	%LEL	%O ₂	CO, ppm	H ₂ S, ppm	VOCs, ppm

Sample Information

Type of Sampling Event:

☐ Soil Gas (Vapor Intrusion) ☐ Indoor Air

Sample Media:

☐ Tedlar Bag ☐ 6-Liter Summa Canister* ☐ 1-Liter Summa Canister*

**If Summa canister, perform shut-in test before use*

	<u>Date (mm/dd/yy)</u>	<u>Time</u>
Sample Set-Up:	_____	_____
Sample Start Time:	_____	_____
Sample End Time:	_____	_____

Regulator Calibrated For: ☐ No Regulator ☐ 8-Hour ☐ 12-Hour ☐ 24-Hour ☐ 200 mL/min

Initial Canister Vacuum: _____ in. Hg or mm Hg

Final Canister Vacuum: _____ in. Hg or mm Hg

Sample Canister Height: _____ (indoor air sampling only)

Sampling Notes:

APPENDIX C

WELL CONSTRUCTION DETAILS

Hull

& associates, inc.

Former District 5 Headquarters
Newark, OH

Project Number: ODT021

Project Manager: Bill Behl

Date Started : 04-20-2004
Date Completed : 04-20-2004
Logged by : Matt McCoy
Reviewed by :
Drilling Contractor : Summit
Drilling Method : Direct Push
Sampling Method : Dual Tube w/Acetate liner
Total Depth (ft.) : 28.0'
S. Water Level Date :
S. Water Level (ft.) :

LOG OF BORING DPB-1

(Page 1 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model : N/A
PID/FID Calibration : N/A

Depth in Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6'-6"-6")	Samples	GRAPHIC	Soil Samples	DESCRIPTION
							☒ Sample Recovered ☐ Sample Sent to Lab	
0	4.0/2.9	DP1/SS1	0	NA				0.0 to 0.3 - Topsoil.
								0.3 to 1.0 - Soft grey and black CINDER/ FILL, slightly moist.
								1.0 to 1.6 - Soft to firm brown clayey SILT/FILL, moist, iron stains, rootlets.
2		DP1/SS2	0	NA				1.6 to 2.9 - Soft red/brown clayey SILT, moist, sl. plastic, few iron stains,
4	4.0/0.4	DP2/SS3	0	NA				4.0 to 4.4 - Soft light brown/grey silty SAND & GRAVEL, slightly moist.
6								
8	4.0/0.6	DP3/SS4	12	NA				8.0 to 8.6 - Same As Above (SAA).
10								
12	4.0/1.8	DP4/SS5	0	NA				12.0 to 13.0 - SAA.
14								
16								

REMARKS:

EOB @ 28' bgs. Boring backfilled with bentonite.

Hull

& associates, inc.

Date Started : 04-20-2004
 Date Completed : 04-20-2004
 Logged by : Matt McCoy
 Reviewed by :
 Drilling Contractor : Summit
 Drilling Method : Direct Push
 Sampling Method : Dual Tube w/Acetate liner
 Total Depth (ft.) : 28.0'
 S. Water Level Date :
 S. Water Level (ft.) :

LOG OF BORING DPB-1

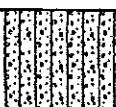
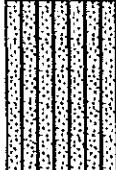
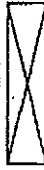
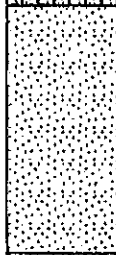
(Page 2 of 2)

Former District 5 Headquarters
 Newark, OH

Project Number: ODT021

Project Manager: Bill Behl

G. Elev. (ft. USGS) :
 Latitude :
 Longitude :
 PID/FID Model : N/A
 PID/FID Calibration : N/A

Depth In Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6'-6"-6")	Samples	GRAPHIC	Soil Samples
							 Sample Recovered  Sample Sent to Lab
DESCRIPTION							
16	4.0/2.2	DP6/SS6	0	NA			16.0 to 17.4 - SAA: sand seams at 17.1.
18							17.4 to 18.0 - Soft brown fine to medium SAND, trace gravel, wet, iron stain band at 17.4.
							18.0 to 18.2 - Firm brown SILT, wet.
20	4.0/2.2	DP6/SS7	0	NA			20.0 to 20.6 - SAA.
22							20.6 to 22.2 - Firm interbedded brown/grey SILT & brown SAND with few gravel.
24	4.0/1.2	DP7/SS8	0	NA			24.0 to 25.2 - Firm brown/grey SILTY SAND & GRAVEL, wet.
26							
28							
30							
32							

REMARKS:

EOB @ 28' bgs. Boring backfilled with bentonite.

Hull

& associates, inc.

Former District 5 Headquarters
Newark, OH

Project Number: ODT021

Project Manager: Bill Belhl

Date Started : 04-21-2004
Date Completed : 04-21-2004
Logged by : Matt McCoy
Reviewed by :
Drilling Contractor : Summit
Drilling Method : Direct Push
Sampling Method : Dual Tube w/Acetate liner
Total Depth (ft.) : 32.0'
S. Water Level Date :
S. Water Level (ft.) :

LOG OF BORING DPB-2

(Page 1 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model : N/A
PID/FID Calibration : N/A

Depth in Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6'-6")	Samples	GRAPHIC	Soil Samples	DESCRIPTION
							☒ Sample Recovered ☐ Sample Sent to Lab	
0	4.0/2.9	DP1/SS1	0	NA				0.0 to 2.9 - Soft brown SILTY SAND/FILL, trace gravel, moist, iron stains.
2		DP1/SS2	0	NA				
4	4.0/2.8	DP2/SS3	0	NA				4.0 to 6.8 - Same As Above (SAA).
6		DP2/SS4	0	NA				
8	4.0/2.0	DP3/SS5	1	NA				8.0 to 9.3 - SAA.
10								9.3 to 10.0 - Soft silty SAND & GRAVEL, black staining, moist, iron stains.
12	4.0/0.0	DP4/		NA				12.0 to 16.0 - NO RECOVERY.
14								
16								

REMARKS:

EOB @ 32' bgs. Boring backfilled with bentonite.

Hull

& associates, inc.

Date Started : 04-21-2004
 Date Completed : 04-21-2004
 Logged by : Matt McCoy
 Reviewed by :
 Drilling Contractor : Summit
 Drilling Method : Direct Push
 Sampling Method : Dual Tube w/Acetalate liner
 Total Depth (ft.) : 32.0'
 S. Water Level Date :
 S. Water Level (ft.) :

LOG OF BORING DPB-2

(Page 2 of 2)

Former District 5 Headquarters
 Newark, OH

Project Number: ODT021

Project Manager: Bill Belhl

G. Elev. (ft. USGS) :
 Latitude :
 Longitude :
 PID/FID Model : N/A
 PID/FID Calibration : N/A

Depth in Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6'-6"-6")	Samples	GRAPHIC	Soil Samples	DESCRIPTION
							☒ Sample Recovered ☐ Sample Sent to Lab	
16	4.0/1.5	DP6/SS6	3	NA				16.0 to 17.5 - SAA.
18								
20	4.0/2.0	DP8/SS7	18	NA				20.0 to 22.0 - SAA: sand seam 20.7 - 21.7, black staining at 21.7, wet.
22								
24	4.0/1.4	DP7/SS8	2	NA				24.0 to 25.7 - SAA: grey below 24.9.
26								
28	4.0/2.9	DP8/SS9	0	NA				28.0 to 28.3 - Soft grey SILT, wet.
30		DP9/SS10	0	NA				28.3 to 30.9 - Firm to hard grey silty CLAY, few gravel, moist sand seam at 29.7.
32								

REMARKS:

EOB @ 32' bgs. Boring backfilled with bentonite.

Hull

& associates, inc.

Former District 5 Headquarters
Newark, OH

Project Number: ODT021

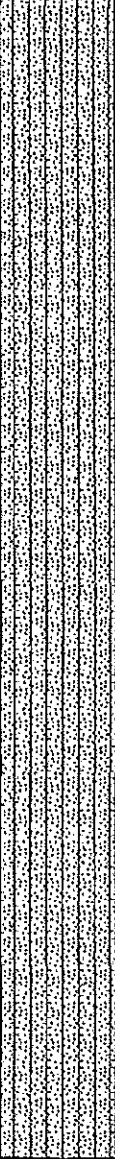
Project Manager: Bill Balhl

Date Started : 04-21-2004
Date Completed : 04-21-2004
Logged by : Matt McCoy
Reviewed by :
Drilling Contractor : Summit
Drilling Method : Direct Push
Sampling Method : Dual Tube w/Acetate liner
Total Depth (ft.) : 28.0'
S. Water Level Date :
S. Water Level (ft.) :

LOG OF BORING DPB-3

(Page 1 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model : N/A
PID/FID Calibration : N/A

Depth In Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6'-6"-6")	Samples	GRAPHIC	Soil Samples
							 Sample Recovered  Sample Sent to Lab
DESCRIPTION							
0	4.0/2.6	DP1/SS1	0	NA			0.0 to 2.6 - Soft brown silty SAND/FILL, trace gravel, moist, moisture increases with depth, iron stains.
2		DP1/SS2	0	NA			
4	4.0/3.3	DP2/SS3	0	NA			4.0 to 7.3 - Same As Above (SAA); very moist.
6		DP2/SS4	0	NA			
8	4.0/2.3	DP3/SS5	1	NA		 	8.0 to 10.3 - SAA; black staining below 9.6.
10							
12	4.0/1.9	DP4/SS6	1	NA			12.0 to 13.9 - SAA.
14							
16							

REMARKS:

EOB @ 28' bgs. Boring backfilled with bentonite.

Hull

& associates, inc.

Former District 5 Headquarters
Newark, OH

Project Number: ODT021

Project Manager: Bill Belhl

Date Started : 04-21-2004
Date Completed : 04-21-2004
Logged by : Matt McCoy
Reviewed by :
Drilling Contractor : Summit
Drilling Method : Direct Push
Sampling Method : Dual Tube w/Acetate liner
Total Depth (ft.) : 28.0'
S. Water Level Date :
S. Water Level (ft.) :

LOG OF BORING DPB-3

(Page 2 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model : N/A
PID/FID Calibration : N/A

Depth In Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6"-6"-6")	Samples	GRAPHIC	Soil Samples	DESCRIPTION
							☒ Sample Recovered ☐ Sample Sent to Lab	
16	4.0/0.0	DP5/		NA				16.0 to 20.0 - NO RECOVERY.
18								
20	4.0/2.0	DP6/SS7	10	NA				20.0 to 21.2 - SAA: wet. 21.2 to 22.0 - SAA: grey very moist to wet, increasing silt.
22								
24	4.0/0.3	DP7/SS8	26	NA				24.0 to 26.6 - Soft to firm grey/brown silty SAND & GRAVEL, wet, iron stained.
26								
28								
30								
32								

REMARKS:

EOB @ 28' bgs. Boring backfilled with bentonite.

Date Started : 04-21-2004
 Date Completed : 04-21-2004
 Logged by : Malt McCoy
 Reviewed by :
 Drilling Contractor : Summit
 Drilling Method : Direct Push
 Sampling Method : Dual Tube w/Acetate liner
 Total Depth (ft.) : 28.0'
 S. Water Level Date :
 S. Water Level (ft.) :

LOG OF BORING DPB-4

(Page 1 of 2)

Former District 5 Headquarters
 Newark, OH

Project Number: ODT021

Project Manager: Bill Behl

G. Elev. (ft. USGS) :
 Latitude :
 Longitude :
 PID/FID Model : N/A
 PID/FID Calibration : N/A

Depth in Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6'-6")	Samples	GRAPHIC	Soil Samples	DESCRIPTION
							☒ Sample Recovered ☐ Sample Sent to Lab	
0	4.0/2.6	DP1/SS1	0	NA				0.0 to 2.6 - Soft brown silty SAND/Fill, trace gravel, moist, cinders at 0.3.
2		DP1/SS2	0	NA				
4	4.0/2.0	DP2/SS3	0	NA				4.0 to 6.0 - Same As Above: very moist, Iron stains.
6								
8	4.0/1.1	DP3/SS4	0	NA				8.0 to 9.1 - SAA: dark brown, increasing silt, trace clay.
10								
12	4.0/2.2	DP4/SS5	2	NA				12.0 to 12.8 - SAA.
14								12.8 to 14.2 - Soft brown/grey silty SAND & GRAVEL, moist, Iron stains, sand seam at 13.3, trace black staining at 13.0.
16								

REMARKS:

EOB @ 28' bgs. Boring backfilled with bentonite.

Hull

& associates, inc.

Former District 5 Headquarters
Newark, OH

Project Number: ODT021

Project Manager: Bill Belhl

Date Started : 04-21-2004
Date Completed : 04-21-2004
Logged by : Matt McCoy
Reviewed by :
Drilling Contractor : Summit
Drilling Method : Direct Push
Sampling Method : Dual Tube w/Acetate liner
Total Depth (ft.) : 28.0'
S. Water Level Date :
S. Water Level (ft.) :

LOG OF BORING DPB-4

(Page 2 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model : N/A
PID/FID Calibration : N/A

Depth in Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6'-6"-6")	Samples	GRAPHIC	Soil Samples
							 Sample Recovered  Sample Sent to Lab
DESCRIPTION							
16	4.0/2.5	DP5/SS6	0	NA			16.2 to 18.9 - SAA: ??? at 16.7, wet below 17.8.
18		DP5/SS7	2	NA			
20	4.0/2.2	DP6/SS8	0	NA			20.0 to 22.2 - SAA: grey below 21.9, silt seam between 21.5-21.7
22							
24	4.0/1.5	DP7/SS9	0	NA			24.0 to 25.5 - SAA: black and green staining <0.1 bands throughout.
26							
28							
30							
32							

REMARKS:

EOB @ 28' bgs. Boring backfilled with bentonite.

Hull

& associates, inc.

Date Started : 04-21-2004
 Date Completed : 04-21-2004
 Logged by : Matt McCoy
 Reviewed by :
 Drilling Contractor : Summit
 Drilling Method : Direct Push
 Sampling Method : Dual Tube w/Acetate liner
 Total Depth (ft.) : 28.0'
 S. Water Level Date :
 S. Water Level (ft.) :

LOG OF BORING DPB-5

(Page 1 of 2)

Former District 5 Headquarters
 Newark, OH

Project Number: ODT021

Project Manager: Bill Beihl

G. Elev. (ft. USGS) :
 Latitude :
 Longitude :
 PID/FID Model : N/A
 PID/FID Calibration : N/A

Depth in Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6"-6"-6")	Samples	GRAPHIC	Soil Samples	DESCRIPTION
							☒ Sample Recovered ☐ Sample Sent to Lab	
0	4.0/2.4	DP1/SS1	0	NA				0.0 to 2.4 - Soft brown silty SAND/FILL, trace gravel, moist, iron stains.
2								
4	4.0/2.0	DP2/SS2	0	NA				4.0 to 6.0 - Same As Above (SAA).
6								
8	4.0/0.6	DP3/SS3	0	NA				8.0 to 8.5 - SAA: very moist.
10								
12	4.0/1.0	DP4/SS4	0	NA				12.0 to 13.0 - Soft brown silty SAND & GRAVEL, moist, iron stains, sand seam at 12.7.
14								
16								

REMARKS:

EOB @ 28' bgs. Boring backfilled with bentonite.

Hull

& associates, inc.

Former District 5 Headquarters
Newark, OH

Project Number: ODT021

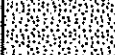
Project Manager: Bill Beihl

Date Started : 04-21-2004
Date Completed : 04-21-2004
Logged by : Matt McCoy
Reviewed by :
Drilling Contractor : Summit
Drilling Method : Direct Push
Sampling Method : Dual Tube w/Acetate liner
Total Depth (ft.) : 28.0'
S. Water Level Date :
S. Water Level (ft.) :

LOG OF BORING DPB-5

(Page 2 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model : N/A
PID/FID Calibration : N/A

Depth In Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6'-6"-6")	Samples	GRAPHIC	Soil Samples
							 Sample Recovered  Sample Sent to Lab
DESCRIPTION							
16	4.0/2.4	DP5/SS5	3	NA			16.0 to 16.8 - Soft grey/brown medium coarse SAND, trace gravel, moist.
18							16.0 to 18.4 - Soft to firm brown and grey silty SAND & GRAVEL, wet, iron stained bands.
20	4.0/2.3	DP6/SS6	0	NA			20.0 to 22.3 - SAA: sand seam at 20.9.
22							24.0 to 26.6 - Soft grey SAND & GRAVEL, wet, few silt.
24	4.0/3.0	DP7/SS7	0	NA			26.6 to 27.0 - Firm grey silty SAND & GRAVEL, moist, green staining.
26		DP7/SS8	2	NA			
28							
30							
32							

REMARKS:

EOB @ 28' bgs. Boring backfilled with bentonite.

Hull

& associates, inc.

Former District 5 Headquarters
Newark, OH

Project Number: ODT021

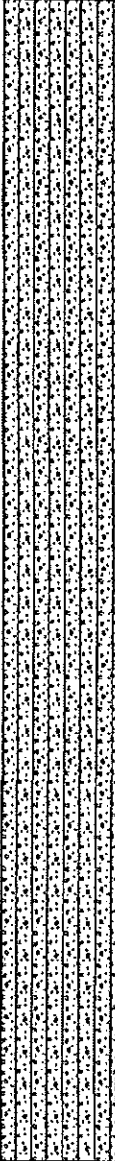
Project Manager: Bill Beihl

Date Started : 04-21-2004
Date Completed : 04-21-2004
Logged by : Matt McCoy
Reviewed by :
Drilling Contractor : Summit
Drilling Method : Direct Push
Sampling Method : Dual Tube w/Acetate liner
Total Depth (ft.) : 28.0'
S. Water Level Date :
S. Water Level (ft.) :

LOG OF BORING DPB-6

(Page 1 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model : N/A
PID/FID Calibration : N/A

Depth in Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6"-6"-6")	Samples	GRAPHIC	Soil Samples
							 Sample Recovered  Sample Sent to Lab
DESCRIPTION							
0	4.0/3.2	DP1/SS1	0	NA			0.0 to 3.2 - Soft brown silty SAND & GRAVEL/FILL, moist, decreasing gravel with depth.
2		DP1/SS2	0	NA			
4	4.0/1.5	DP2/SS3	0	NA			4.0 to 5.5 - Same As Above (SAA).
6							
8	4.0/1.2	DP3/SS4	0	NA			8.0 to 8.2 - SAA. 8.2 to 9.2 - Soft grey/brown silty SAND & GRAVEL, moist, iron and black stains.
10							
12	4.0/2.5	DP4/SS5	1	NA			12.0 to 14.5 - SAA.
14							
16							

REMARKS:

EOB @ 28' bgs. Boring backfilled with bentonite.

Hull

& associates, inc.

Former District 6 Headquarters
Newark, OH

Project Number: ODT021

Project Manager: Bill Beihl

Date Started : 04-21-2004
Date Completed : 04-21-2004
Logged by : Matt McCoy
Reviewed by :
Drilling Contractor : Summit
Drilling Method : Direct Push
Sampling Method : Dual Tube w/Acetate liner
Total Depth (ft.) : 28.0'
S. Water Level Date :
S. Water Level (ft.) :

LOG OF BORING DPB-6

(Page 2 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model : N/A
PID/FID Calibration : N/A

Depth in Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6'-6"-6")	Samples	GRAPHIC	Soil Samples
							 Sample Recovered  Sample Sent to Lab
DESCRIPTION							
16	4.0/2.5	DP5/SS6	4	NA			16.0 to 18.6 - SAA: grey sand seam 16.6 - 16.9, heavy Iron stains below 17.3.
18							
20	4.0/1.6	DP6/SS7	5	NA			20.0 to 21.5 - SAA, grey below 21.1, wet.
22							
24	4.0/1.0	DP7/SS8	1	NA			24.0 to 25.0 - Soft grey silty fine SAND, wet.
26							
28							
30							
32							

REMARKS:

EOB @ 28' bgs. Boring backfilled with bentonite.

Hull

& associates, inc.

Date Started : 04-21-2004
 Date Completed : 04-21-2004
 Logged by : Matt McCoy
 Reviewed by :
 Drilling Contractor : Summit
 Drilling Method : Direct Push
 Sampling Method : Dual Tube w/Acetate liner
 Total Depth (ft.) : 28.0'
 S. Water Level Date :
 S. Water Level (ft.) :

LOG OF BORING DPB-7

(Page 1 of 2)

Former District 5 Headquarters
 Newark, OH

Project Number: ODT021

Project Manager: Bill Beihl

G. Elev. (ft. USGS) :
 Latitude :
 Longitude :
 PID/FID Model : N/A
 PID/FID Calibration : N/A

Depth In Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6'-6")	Samples	GRAPHIC	Soil Samples	DESCRIPTION
							☒ Sample Recovered ☐ Sample Sent to Lab	
0	4.0/3.1	DP1/SS1	0	NA				0.0 to 3.1 - Soft brown silty SAND/FILL, trace gravel, moist.
2		DP1/SS2	0	NA				
4	4.0/2.0	DP2/SS3	0	NA				4.0 to 6.0 - Same As Above (SAA).
6								
8	4.0/1.0	DP3/SS4	0	NA				8.0 to 9.0 - SAA: dark brown, increasing gravel, trace clay.
10								
12	4.0/2.3	DP4/SS6	0	NA				12.0 to 14.6 - Soft to firm brown/grey silty SAND & GRAVEL, moist, iron stains, bottom oil very sandy.
14								
16								

REMARKS:

EOB @ 32' bgs. Boring backfilled with bentonite.

Hull

& associates, inc.

Former District 5 Headquarters
Newark, OH

Project Number: ODT021

Project Manager: Bill Belhl

Date Started : 04-21-2004
Date Completed : 04-21-2004
Logged by : Matt McCoy
Reviewed by :
Drilling Contractor : Summit
Drilling Method : Direct Push
Sampling Method : Dual Tube w/Acetate liner
Total Depth (ft.) : 28.0'
S. Water Level Date :
S. Water Level (ft.) :

LOG OF BORING DPB-7

(Page 2 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model : N/A
PID/FID Calibration : N/A

Depth in Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6'-6"-6")	Samples	GRAPHIC	Soil Samples	DESCRIPTION
							☒ Sample Recovered ☐ Sample Sent to Lab	
16	4.0/2.5	DP5/SS6	2	NA				16.0 to 18.5 - SAA; grey below 17.4, heavy Iron staining at 16.1, 17.2, some orange and dark grey ? below 17.4, wet.
18		DP5/SS7	5	NA				
20	4.0/2.4	DP6/SS8	2	NA				20.0 to 21.5 - SAA; brown/orange grey at 21.4.
22	4.0/1.6	DP7/SS9	2	NA				21.5 to 22.1 - Soft grey silty fine SAND, wet.
24		DP7/SS10	0	NA				22.1 to 22.4 - Firm grey silty SAND & GRAVEL, wet.
26								24.0 to 25.6 - SAA.
28	4.0/2.3	DP8/SS11	0	NA				26.0 to 29.9 - SAA.
30								29.6 to 30.3 - Soft firm grey silty SAND & GRAVEL, wet, green staining.
32								

REMARKS:

EOB @ 32' bgs. Boring backfilled with bentonite.

Hull

& associates, inc.

Former District 5 Headquarters
Newark, OH

Project Number: ODT021

Project Manager: Bill Belhl

Date Started : 04-21-2004
Date Completed : 04-22-2004
Logged by : Matt McCoy
Reviewed by :
Drilling Contractor : Summit
Drilling Method : Direct Push
Sampling Method : Dual Tube w/Acetate liner
Total Depth (ft.) : 28.0'
S. Water Level Date :
S. Water Level (ft.) :

LOG OF BORING DPB-8

(Page 1 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model : N/A
PID/FID Calibration : N/A

Depth in Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6'-6"-6")	Samples	GRAPHIC	Soil Samples
							 Sample Recovered  Sample Sent to Lab
DESCRIPTION							
0	4.0/2.6	DP1/SS1	0	NA			0.0 to 2.6 Soft brown and grey SILT CLAY/FILL, few sand and gravel, cinders throughout, iron and black stains, moist.
2		DP1/SS2	0	NA			
4	4.0/3.8	DP2/SS3	0	NA			4.0 to 6.1 - Same As Above (SAA).
6		DP2/SS4	0	NA			6.1 to 7.8 - Soft orange/brown clayey SILT, few sand/fill, moist, iron stained, sandy below 7.4.
8	4.0/1.8	DP3/SS5	0	NA			8.0 to 9.8 - SAA.
10							
12	4.0/1.0 4.0/1.0	DP4/SS6 DP5/SS7	0 0	NA NA			12.0 to 13.0 - Soft brown/grey silty SAND & GRAVEL, moist, iron stains, increasing sand at bottom.
14							
16							

REMARKS:

EOB @ 28' bgs. Boring backfilled with bentonite.

Hull

& associates, inc.

Date Started : 04-21-2004
 Date Completed : 04-22-2004
 Logged by : Matt McCoy
 Reviewed by :
 Drilling Contractor : Summitt
 Drilling Method : Direct Push
 Sampling Method : Dual Tube w/Acetate liner
 Total Depth (ft.) : 28.0'
 S. Water Level Date :
 S. Water Level (ft.) :

LOG OF BORING DPB-8

(Page 2 of 2)

Former District 5 Headquarters
 Newark, OH

Project Number: ODT021

Project Manager: Bill Beihl

G. Elev. (ft. USGS) :
 Latitude :
 Longitude :
 PID/FID Model : N/A
 PID/FID Calibration : N/A

Depth in Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6'-6")	Samples	GRAPHIC	Soil Samples	DESCRIPTION
							☒ Sample Recovered ☐ Sample Sent to Lab	
16	4.0/2.4	DP6/SS8	1	NA				16.0 to 18.4 - SAA: grey below 16.9 then sand seam 16.0 - 16.9, iron stains below 16.9.
18								
20	4.3/3.0	DP7/SS9	2	NA				20.0 to 23.0 - SAA: wet.
22		DP7/SS10	0	NA				
24	4.0/2.2	DP8/SS11	0	NA				24.0 to 25.4 - Firm grey clayey SILT, moist.
26								25.4 to 26.2 - Firm grey silty SAND & GRAVEL, moist, iron and green stains.
28								
30								
32								

REMARKS:

EOB @ 28' bgs. Boring backfilled with bentonite.

Date Started : 04-21-2004
 Date Completed : 04-21-2004
 Logged by : Matt McCoy
 Reviewed by :
 Drilling Contractor : Summit
 Drilling Method : Direct Push
 Sampling Method : Dual Tube w/Acetate liner
 Total Depth (ft.) : 28.0'
 S. Water Level Date :
 S. Water Level (ft.) :

LOG OF BORING DPB-9

(Page 1 of 2)

Former District 5 Headquarters
 Newark, OH

Project Number: ODT021

Project Manager: Bill Beihl

G. Elev. (ft. USGS) :
 Latitude :
 Longitude :
 PID/FID Model : N/A
 PID/FID Calibration : N/A

Depth In Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6"-6"-6")	Samples	GRAPHIC	Soil Samples
							 Sample Recovered  Sample Sent to Lab
DESCRIPTION							
0	4.0/3.2	DP1/SS1	0	NA			0.0 to 3.2 - Soft brown silty SAND & GRAVEL/FILL, moist.
2		DP1/SS2	0	NA			
4	4.0/3.8	DP2/SS3	0	NA			4.0 to 7.8 - Same As Above (SAA): increasing moisture with depth, iron stains.
6		DP2/SS4	0	NA			
8	4.0/2.8	DP3/SS5	0	NA			8.0 to 10.8 - SAA: wet below 9.4.
10		DP3/SS6	0	NA			
12	4.0/2.4	DP4/SS7	2	NA			12.0 to 13.2 - SAA: dark brown increasing clay.
14		DP4/SS8	3	NA			13.2 to 14.5 - Soft brown silty SAND & GRAVEL, moist, iron stained.
16							

REMARKS:

EOB @ 28' bgs. Boring backfilled with bentonite.

Hull

& associates, inc.

Former District 5 Headquarters
Newark, OH

Project Number: ODT021

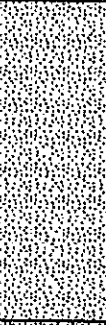
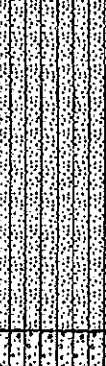
Project Manager: Bill Beihl

Date Started : 04-21-2004
Date Completed : 04-21-2004
Logged by : Matt McCoy
Reviewed by :
Drilling Contractor : Summit
Drilling Method : Direct Push
Sampling Method : Dual Tube w/Acetate liner
Total Depth (ft.) : 28.0'
S. Water Level Date :
S. Water Level (ft.) :

LOG OF BORING DPB-9

(Page 2 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model : N/A
PID/FID Calibration : N/A

Depth in Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6"-6"-6")	Samples	GRAPHIC	Soil Samples
							 Sample Recovered  Sample Sent to Lab
DESCRIPTION							
16	4.0/1.3	DP5/SS9	3	NA			16.0 to 17.0 - SAA.
18							17.0 to 17.3 - Soft brown SAND & GRAVEL, wet.
20	4.0/1.4	DP6/SS10	0	NA			20.0 - 21.4 - SAA: grey below 20.4, silt stains between 20.4-20.5.
22							21.4 to 21.7 - Soft to firm grey silty fine SAND, wet.
24	4.0/2.5	DP7/SS11	0	NA			24.0 to 26.0 - SAA.
26							DP8/SS12
28							
30							
32							

REMARKS:

EOB @ 28' bgs. Boring backfilled with bentonite.

Hull

& associates, inc.

Former District 5 Headquarters
Newark, OH

Project Number: ODT021

Project Manager: Bill Belhl

Date Started : 04-21-2004
Date Completed : 04-21-2004
Logged by : Matt McCoy
Reviewed by :
Drilling Contractor : Summit
Drilling Method : Direct Push
Sampling Method : Dual Tube w/Acetate liner
Total Depth (ft.) : 28.0'
S. Water Level Date :
S. Water Level (ft.) :

LOG OF BORING DPB-10

(Page 1 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model : N/A
PID/FID Calibration : N/A

Depth In Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6'-6"-6")	Samples	GRAPHIC	Soil Samples	
							Sample Recovered Sample Sent to Lab	
							DESCRIPTION	
0	4.0/2.2	DP1/SS1	0	NA			0.0 to 2.2 - Soft brown silty SAND & GRAVEL/FILL, traces of clay at depth, moist below 1.2, iron stains.	
2								
4	4.0/0.9	DP2/SS2	1	NA				4.0 to 4.9 - Same As Above (SAA); no clay.
6								
8	4.0/1.8	DP3/SS3	2	NA				8.0 to 9.8 - SAA: trace clay near top.
10								
12	4.0/2.7	DP4/SS4	3	NA			12.0 to 14.7 - SAA: light grey between 12.0 - 13.8, orange brown below 13.8, slight moist to moist.	
14		DP4/SS5	5	NA				
16								

REMARKS:

EOB @ 32' bgs. Boring backfilled with bentonite.

Hull

& associates, inc.

Date Started : 04-21-2004
Date Completed : 04-21-2004
Logged by : Matt McCoy
Reviewed by :
Drilling Contractor : Summit
Drilling Method : Direct Push
Sampling Method : Dual Tube w/Acetate liner
Total Depth (ft.) : 28.0'
S. Water Level Date :
S. Water Level (ft.) :

LOG OF BORING DPB-10

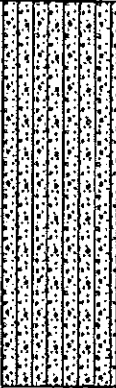
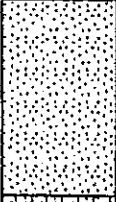
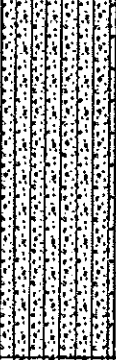
(Page 2 of 2)

Former District 5 Headquarters
Newark, OH

Project Number: ODT021

Project Manager: Bill Beihl

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model : N/A
PID/FID Calibration : N/A

Depth in Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6"-6"-6")	Samples	GRAPHIC	Soil Samples
							 Sample Recovered  Sample Sent to Lab
							DESCRIPTION
16							
18	4.0/2.2	DP5/SS6	10	NA			18.0 to 20.2 - SAA: brown/grey, wet below 18.9.
20	4.0/2.3	DP6/SS7	7	NA			20.0 to 21.3 - SAA: becoming grey, increasing fine sand.
22							21.3 to 22.3 - Soft grey fine SAND, olive green below 21.8 with trace gravel, wet, native.
24	4.0/1.8	DP7/SS8	8	NA			24.0 to 25.8 - Soft grey silty SAND & GRAVEL, increasing gravel with depth, wet.
26							
28	4.0/2.0	DP8/SS9	5	NA			28.0 to 29.0 - SAA: transition zone 28.9 -29.0
30							29.0 to 30.0 - Firm grey silty CLAY, few gravel, trace coarse sand, moist, red plastic.
32							

REMARKS:

EOB @ 32' bgs. Boring backfilled with bentonite.

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Former District 5 Headquarters
Newark, OH

Project Number: ODT021

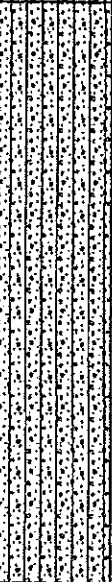
Project Manager: Bill Beihl

Date Started : 04-21-2004
Date Completed : 04-21-2004
Logged by : Matt McCoy
Reviewed by :
Drilling Contractor : Summit
Drilling Method : Direct Push
Sampling Method : Dual Tube w/Acetate liner
Total Depth (ft.) : 28.0'
S. Water Level Data :
S. Water Level (ft.) :

LOG OF BORING DPB-11

(Page 1 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model : N/A
PID/FID Calibration : N/A

Depth in Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6'-6"-6")	Samples	GRAPHIC	Soil Samples
							 Sample Recovered  Sample Sent to Lab
DESCRIPTION							
0	4.0/2.5	DP1/SS1	0	NA			0.0 to 0.6 - ASPHALT, stepped off 1' to East ?
							0.6 to 1.0 - Sub base SAND & GRAVEL/FILL
							1.0 to 1.7 - Soft brown silty CLAY/Fill, black mottling, slight moist to moist, medium plastic. 1.7 to 3.0 - Soft to firm silty CLAY, trace coarse sand, moist, iron stained, plastic.
2		DP1/SS2	0	NA			
4	4.0/0.0	DP2/	0	NA			4.0 to 8.0 - NO RECOVERY.
6							
8	4.0/1.0	DP3/SS3	0	NA			8.0 to 9.0 - Loose light brown silty SAND & GRAVEL, slight moist, iron stained zones.
10							
12	4.0/1.5	DP4/SS4	0	NA			12.0 to 13.5 - Same As Above (SAA); cleaner sorted sands at 12.7 & 13.3, bottom interval becoming grey, medium sand.
14							
16							

REMARKS:

EOB @ 32' bgs. Boring backfilled with bentonite.

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Date Started : 04-21-2004
Date Completed : 04-21-2004
Logged by : Matt McCoy
Reviewed by :
Drilling Contractor : Summit

LOG OF BORING DPB-11

(Page 2 of 2)

Former District 5 Headquarters
Newark, OH

Drilling Method : Direct Push
Sampling Method : Dual Tube w/Acetate liner
Total Depth (ft.) : 28.0'
S. Water Level Date :
S. Water Level (ft.) :

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model : N/A
PID/FID Calibration : N/A

Project Number: ODT021

Project Manager: Bill Beihl

Depth in Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6'-6"-6")	Samples	GRAPHIC	Soil Samples
							Sample Recovered Sample Sent to Lab
DESCRIPTION							
16	4.0/2.7	DP5/SS5	0	NA			16.0 to 18.7 - SAA: heavy iron stains at bottom, no sand seams.
18		DP5/SS6	0	NA			
20	4.0/2.0	DP6/SS7	1	NA			20.0 to 22.0 - SAA: wet below 21.1.
22							
24	4.0/2.2	DP7/SS8	1	NA			24.0 to 24.9 - SAA: wet.
26							24.9 to 26.2 - Firm grey silty CLAY, trace gravel, moist, plastic.
28							
30							
32							

REMARKS:

EOB @ 32' bgs. Boring backfilled with bentonite.

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Former District 5 Headquarters
Newark, OH

Project Number: ODT021

Project Manager: Bill Beihl

Date Started : 04-21-2004
Date Completed : 04-21-2004
Logged by : Matt McCoy
Reviewed by :
Drilling Contractor : Summit
Drilling Method : Direct Push
Sampling Method : Dual Tube w/Acetate liner
Total Depth (ft.) : 24.0'
S. Water Level Date :
S. Water Level (ft.) :

LOG OF BORING DPB-13

(Page 1 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model : N/A
PID/FID Calibration : N/A

Depth in Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (6"-6"-6"-6")	Samples	GRAPHIC	Soil Samples	DESCRIPTION
							☒ Sample Recovered ☐ Sample Sent to Lab	
0	4.0/2.5	DP1/SS1	0	NA				0.0 to 0.5 - ASPHALT.
								0.5 to 1.2 - Soft brown/black subbase SAND & GRAVEL/FILL, slightly moist.
2		DP1/SS2	0	NA				1.2 to 2.2 - Soft dark brown silty SAND & GRAVEL/FILL, moist, trace stein glass frag.
								2.2 to 3.0 - Soft reddish brown silty CLAY, trace gravel and coarse sand, moist, plastic.
4	4.0/1.0	DP2/SS3	0	NA				4.0 to 5.0 - Same As Above (SAA): increasing gravel.
6								
8	4.0/1.0	DP3/SS4	0	NA				8.0 to 8.4 - SAA.
								8.4 to 8.9 - Soft brown silty SAND & GRAVEL, slight moist, iron stains.
10								
12	4.0/2.4	DP4/SS5	0	NA				12.0 to 14.4 - SAA: sand zone between 12.7 - 13.0 and 13.2 - 13.6, iron staining in bands at 12.7, 13.6, 13.7.
14		DP4/SS6	0	NA				
16								

REMARKS:

EOB @ 24' bgs. Boring backfilled with bentonite.

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Former District 5 Headquarters
Newark, OH

Project Number: ODT021

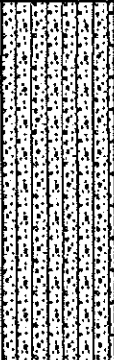
Project Manager: Bill Beihl

Date Started : 04-21-2004
Date Completed : 04-21-2004
Logged by : Matt McCoy
Reviewed by :
Drilling Contractor : Summit
Drilling Method : Direct Push
Sampling Method : Dual Tube w/Acetate liner
Total Depth (ft.) : 24.0'
S. Water Level Date :
S. Water Level (ft.) :

LOG OF BORING DPB-13

(Page 2 of 2)

G. Elev. (ft USGS) :
Latitude :
Longitude :
PID/FID Model : N/A
PID/FID Calibration : N/A

Depth in Feet	Sample Interval/ Sample Recovery	Sampler Type/ Sample Number	PID / FID (ppm)	Blow Count (5"-6"-6"-6")	Samples	GRAPHIC	Soil Samples
							 Sample Recovered  Sample Sent to Lab
DESCRIPTION							
16	4.0/2.5	DP5/SS7	0	NA			16.0 to 18.5 - SAA: becomes grey below 17.6, few iron stains throughout.
18		DP5/SS8	0	NA			
20	4.0/1.7	DP6/SS9	0				20.0 to 21.0 - SAA, wet.
22							21.0 to 21.7 - Firm grey silty CLAY, few gravel and coarse sand, slightly moist.
24							
26							
28							
30							
32							

REMARKS:

EOB @ 24' bgs. Boring backfilled with bentonite.

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Former ODOT District 5 Headquarters
115 1/2 Maholm Street, Newark, Ohio
ODT021

Date Started : 05/14/2004
Date Completed : 05/14/2004
Logged By : M. McCoy
Reviewed By : B. Biehl
Drilling Contractor : Summit Drilling
Drilling Method : Geoprobe - Macrocore
Sampling Method : Dual Tube
Total Depth : 24'

LOG OF BORING SB-14

(Page 1 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model :
FID/FID Calibration :

Depth in Feet	Length Drive/ Sample Recovery (ft.)	Sample Number/ Sample Interval	PID	Blow Count (6"-12"-6")	Sample	GRAPHIC	Soil Samples	Water Levels
							 Sample Interval  Lab Sample	 Static  During drilling
DESCRIPTION								
0	4.0/3.2	SS-1 0.0-3.2	0	NA			Soft black FILL, clayey loam, slightly moist, rootlets.	
1								
2							Soft to firm brown silty CLAY, trace gravel below 2.6', moist, plastic, Iron stains.	
3								
4	4.0/1.6	SS-2 4.0-5.6	0	NA			Same as above.	
5							Soft brown clay SILT/silty SAND, moist, trace gravel.	
6							Soft brown clayey SAND, moist, friable.	
7								
8	4.0/1.1	SS-3 8.0-9.1	0	NA			Same as above.	
9							Soft brown/grey silty SAND and GRAVEL, trace fines, moist, Iron stained.	
10								
11								
12	4.0/3.0	SS-4 12.0-15.0	0	NA			Same as above.	
13								
14								
15								
16	4.0/3.7	SS-5 16.0-19.7	0	NA			Same as above, sandy lens noted at 16.5-17.8'.	
17								
18							Same as above, heavy Iron staining	
19								
20								

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Former ODOT District 5 Headquarters
115 1/2 Maholm Street, Newark, Ohio
ODT021

Date Started : 05/14/2004
Date Completed : 05/14/2004
Logged By : M. McCoy
Reviewed By : B. Biehl
Drilling Contractor : Summit Drilling
Drilling Method : Geoprobe - Macrocore
Sampling Method : Dual Tube
Total Depth : 24'

LOG OF BORING SB-14

(Page 2 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model :
FID/FID Calibration :

Depth in Feet	Length Drive/ Sample Recovery (ft.)	Sample Number/ Sample Interval	PID	Blow Count (6"-12"-6")	Sample	GRAPHIC	Soil Samples	Water Levels	DESCRIPTION
							☐ Sample Interval ☐ Lab Sample	☐ Static ☐ During drilling	
20	4.0/3.8	SS-6 20.0-23.8	0	NA					Same as above.
21									Same as above, becoming grey.
22									
23									
24									Firm grey silty CLAY, trace gravel, moist.
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									

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Former ODOT District 5 Headquarters
115 1/2 Maholm Street, Newark, Ohio
ODT021

Date Started : 05/14/2004
Date Completed : 05/14/2004
Logged By : M. McCoy
Reviewed By : B. Biehl
Drilling Contractor : Summit Drilling
Drilling Method : Geoprobe - Macrocore
Sampling Method : Dual Tube
Total Depth : 26'

LOG OF BORING SB-15

(Page 1 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model :
FID/FID Calibration :

Depth In Feet	Length Drive/ Sample Recovery (ft.)	Sample Number/ Sample Number	PID	Blow Count (6"-12"-6")	Sample	GRAPHIC	Soil Samples	Water Levels
							 Sample Interval  Lab Sample	 Static  During drilling
DESCRIPTION								
0	4.0/1.4	SS-1 0.0-1.4	0	NA			Asphalt, brick, concrete with associated FILL sub-base, slightly moist.	
1								
2							Soft brown silty CLAY/clayey SILT, slightly moist, plastic.	
3								
4	4.0/3.4	SS-2 4.0-7.4	0	NA			Same as above, light brown, increase in moisture, trace gravel with depth.	
5								
6								
7								
8	4.0/3.2	SS-3 8.0-11.2	0	NA			Same as above, iron staining.	
9								
10								
11								
12	4.0/3.0	SS-4 12.0-15.0	0	NA			Soft brown/grey silty SAND and GRAVEL, friable, slightly moist, iron staining.	
13								
14								
15								
16	4.0/4.0	SS-5 16.0-20.0	0	NA			Same as above.	
17								
18								
19							Same as above, 0.1' fine sand seams, iron staining, wet at 19.1'.	
20								

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Former ODOT District 5 Headquarters
115 1/2 Maholm Street, Newark, Ohio
ODT021

Date Started : 05/14/2004
Date Completed : 05/14/2004
Logged By : M. McCoy
Reviewed By : B. Blehl
Drilling Contractor : Summit Drilling
Drilling Method : Geoprobe - Macrocore
Sampling Method : Dual Tube
Total Depth : 28'

LOG OF BORING SB-15

(Page 2 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model :
FID/FID Calibration :

Depth In Feet	Length Drive/ Sample Recovery (ft.)	Sample Number/ Sample Number	PID	Blow Count (6"-12"-6")	Sample	GRAPHIC	Soil Samples	Water Levels	
							Sample Interval Lab Sample	▼ Static ▽ During drilling	
DESCRIPTION									
20	4.0/3.6	SS-6 24.0-27.6	0	NA			Same as above.		
21							Same as above, becoming grey.		
22									
23	4.0/2.0	SS-7 24.0-26.0	0	NA			Same as above, less gravel.		
24									
25									
26								Firm grey silty CLAY, some sand, trace gravel, moist, plastic.	
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									

Former ODOT District 5 Headquarters
115 1/2 Maholm Street, Newark, Ohio
ODT021

Date Started : 06/01/2004
Date Completed : 06/01/2004
Logged By : M. Young
Reviewed By : B. Blehl
Drilling Contractor : Summit Drilling
Drilling Method : 4 1/4 ID HSA
Sampling Method : 2x2 Split Spoon
Total Depth : 30'

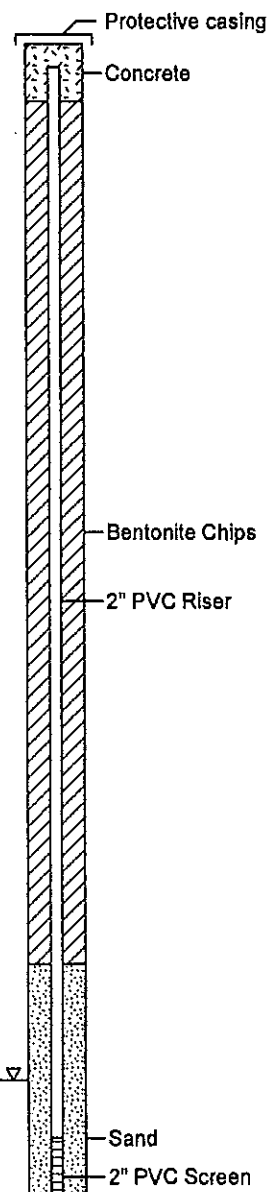
LOG OF BORING MW-14

(Page 1 of 2)

PID Calibration : 06/01/2004
PID Model : Photovac 2020

Depth in Feet	Length Drive/ Sample Recovery (ft.)	Sample Number/ Sample Interval	PID	Blow Count (6"-12"-6")	Samples	GRAPHIC	Soil Samples		Water Levels		DESCRIPTION
							 Sample Interval	 Lab Sample	 Static	 During drilling	
0											Crushed limestone FILL
1											Medium dense dark brown clayey FILL, some sand and gravel, trace cinders and brick fragments, moist.
2	24/18	SS-1 2.0-3.5	0	11-23-17							
3											
4	24/18	SS-2 4.0-5.5	0	17-11-6							Same as above, becoming stiff.
5											
6	24/24	SS-3 6.0-8.0	0	3-11-8							Stiff brown clayey SILT, trace sand and gravel, moist, rootlets and iron staining noted.
7											Same as above.
8	24/8	SS-4 8.0-8.5	0	8-41-21							Dense brown medium to coarse SAND, some gravel, trace silt, slightly moist, loose.
9											Same as above, large broken cobble in end of spoon.
10	24/12	SS-5 10.0-11.0	0	12-36-17							Same as above, few large gravel noted.
11											
12	24/18	SS-6 12.0-13.5	0	10-20-15							Same as above, becoming less dense.
13											
14	24/18	SS-7 14.0-15.5	0	10-27-11							Same as above, decrease in gravel.
15											
16	24/18	SS-8 16.0-17.5	0	13-29-13							Same as above, becoming moist, increase gravel.
17											
18	24/12	SS-9 18.0-19.0	0	8-22-13							Same as above, becoming grey in color, wet, trace clay throughout sample.
19											
20											

Well: MW-14





Former ODOT District 5 Headquarters
115 1/2 Maholm Street, Newark, Ohio
ODT021

Date Started : 06/01/2004
Date Completed : 06/01/2004
Logged By : M. Young
Reviewed By : B. Biehl
Drilling Contractor : Summit Drilling
Drilling Method : 4 1/4 ID HSA
Sampling Method : 2x2 Split Spoon
Total Depth : 30'

LOG OF BORING MW-14

(Page 2 of 2)

PID Calibration : 06/01/2004
PID Model : Photovac 2020

Depth In Feet	Length Drive/ Sample Recovery (ft.)	Sample Number/ Sample Interval	PID	Blow Count (5"-12"-6")	Samples	GRAPHIC	Soil Samples	Water Levels	DESCRIPTION
							☒ Sample Interval ☐ Lab Sample	Static During drilling	
20	20/16	SS-10 20.0-21.2	0	10-28-18	☒				Well: MW-14 2" PVC Screen Sand
21					☒				
22	24/20	SS-11 22.0-23.7	0	10-25-15	☒				
23					☒				
24	24/12	SS-12 24.0-25.0	0	8-31-19	☒				
25					☒				
26	24/4	SS-13 26.0-26.3	0	13-31-18	☒				
27					☒				
28	24/18	SS-14 28.0-29.5	0	5-17-13	☒				
29					☒				
30					☒				Very stiff grey silty CLAY, trace sand and gravel, moist, plastic. End of boring at 30 feet.
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									



Former ODOT District 5 Headquarters
115 1/2 Maholm Street, Newark, Ohio
ODT021

Date Started : 05/14/2004
Date Completed : 05/14/2004
Logged By : M. McCoy
Reviewed By : B. Biehl
Drilling Contractor : Summit Drilling
Drilling Method : 4.25" HSA
Sampling Method : 2x2 split spoon
Total Depth : 28'

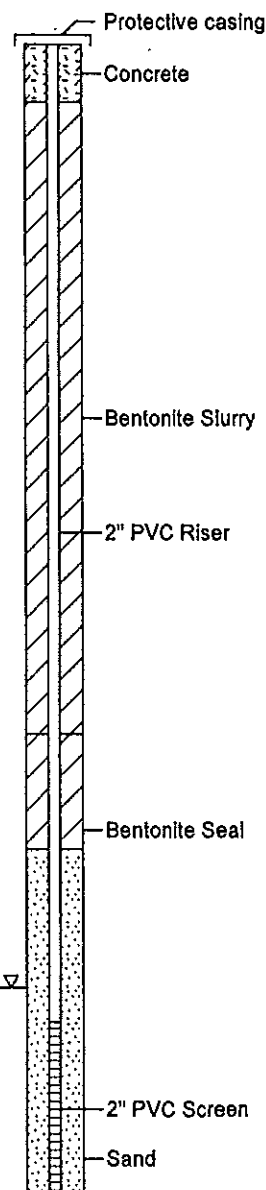
LOG OF BORING MW-15

(Page 1 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model :
FID/FID Calibration : 100 ppm butylene

Depth in Feet	Length Drive/ Sample Recovery (ft.)	Sample Number/ Sample Interval	PID	Blow Count (6"-12"-6")	Sample	GRAPHIC	Soil Samples	Water Levels	DESCRIPTION
							Sample Interval Lab Sample	Static During drilling	
0	2.0/1.1	SS-1 0.0-1.1	0	8-20-6					Brown and black sandy FILL, slag and ash, moist, rootlets.
1									Stiff brown silty CLAY, moist, rootlets, plastic, black mottling noted.
2	2.0/1.0	SS-2 2.0-3.0	0	8-11-7					Same as above, trace gravel at depth, increasing moisture, iron staining.
3									
4	2.0/0.9	SS-3 4.0-4.9	0						Same as above, some sand increasing with depth.
5									Brown silty SAND and GRAVEL, very moist, iron staining.
6	2.0/1.3	SS-4 6.0-7.3	0						Brown / grey SAND, fine to medium, slightly moist, iron staining.
7									Dense brown and grey silty SAND and GRAVEL, slightly moist, iron staining, friable.
8	2.0/0.9	SS-5 8.0-9.9	0	9-31-17					Same as above.
9									
10	2.0/0.9	SS-6 10.0-10.9	0	9-37-20					Same as above.
11									
12	2.0/1.3	SS-7 12.0-13.3	0	14-24-13					Same as above.
13									
14	2.0/1.1	SS-8 14.0-15.1	0	11-32-12					Same as above.
15									
16	2.0/1.2	SS-9 16.0-17.2	0	12-20-11					Medium dense grey SAND, some gravel, sorting noticed with depth, wet at 16.4', iron staining at 16.9'.
17									
18	2.0/1.2	SS-10 18.0-19.2	0	5-24-16					Medium dense brown silty SAND and GRAVEL, wet.
19									
20									Medium dense grey SAND, little gravel, wet.

well: MW-15





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Former ODOT District 5 Headquarters
115 1/2 Maholm Street, Newark, Ohio
ODT021

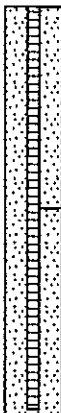
Date Started : 05/14/2004
Date Completed : 05/14/2004
Logged By : M. McCoy
Reviewed By : B. Blehl
Drilling Contractor : Summit Drilling
Drilling Method : 4.25" HSA
Sampling Method : 2x2 split spoon
Total Depth : 28'

LOG OF BORING MW-15

(Page 2 of 2)

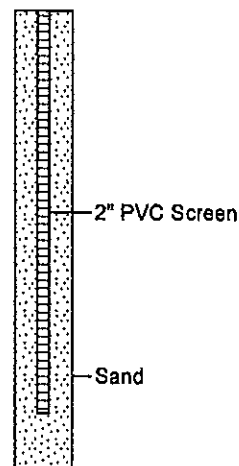
G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model :
FID/FID Calibration : 100 ppm butylene

Depth In Feet	Length Drive/ Sample Recovery (ft.)	Sample Number/ Sample Interval	PID	Blow Count (6"-12"-6")	Sample	GRAPHIC	Soil Samples	Water Levels	well: MW-15
							 Sample Interval  Lab Sample	 Static  During drilling	
DESCRIPTION									
20	2.0/0.6	SS-11 20.0-20.6	0	9-23-19			Same as above.		
21									
22	2.0/1.6	SS-12 22.0-23.6	0	8-36-9					
23									
24	2.0/0.5	SS-13 24.0-24.5	0	5-17-12			Same as above.		
25									
26	2.0/1.8	SS-14 26.0-27.8	0	8-24-15			Same as above, transition 27.0 to 27.2 becoming clayey.		
27									
28						Grey silty CLAY, trace gravel, moist, plastic.			
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									



2" PVC Screen

Sand



Hull

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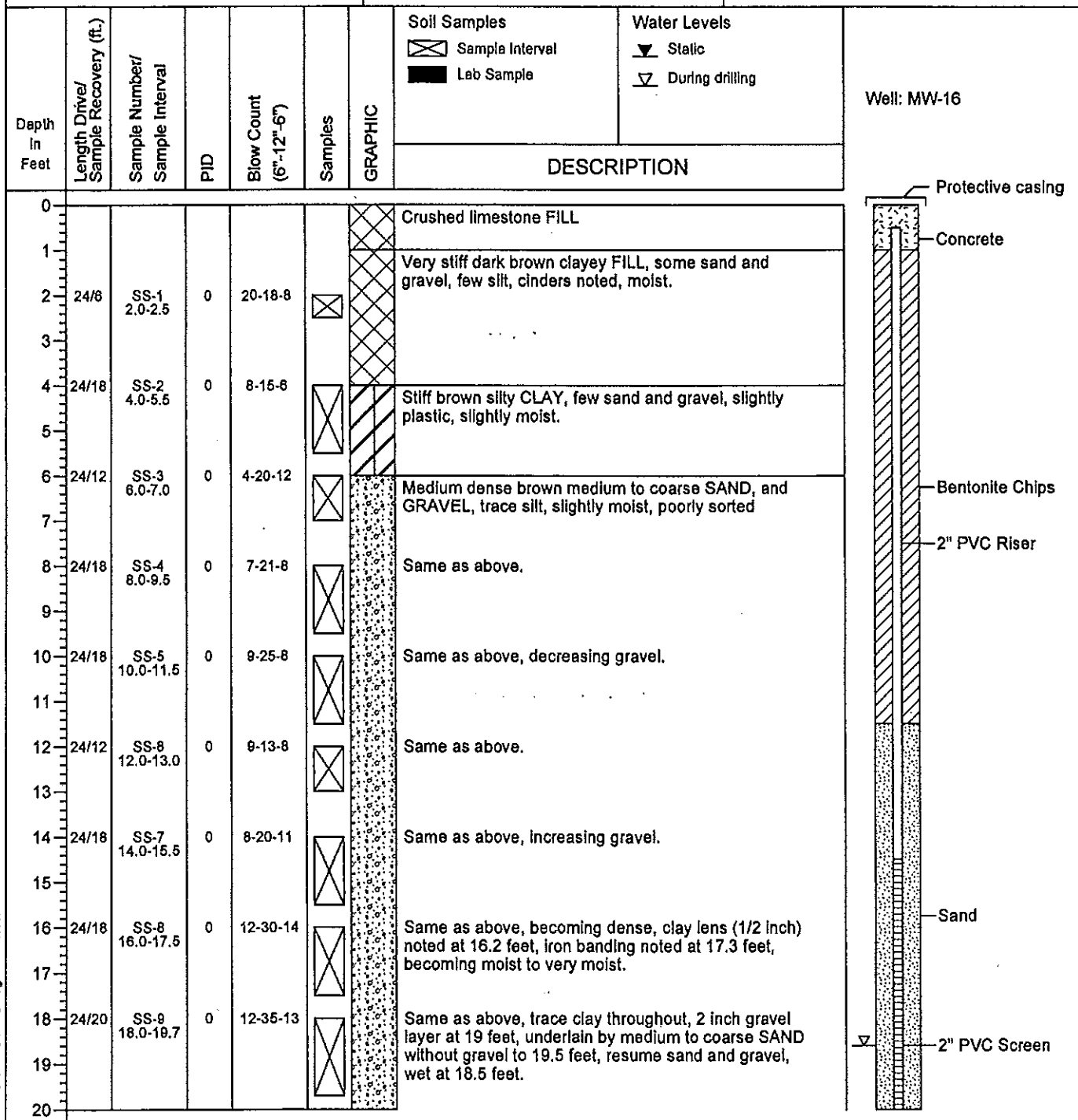
Former ODOT District 5 Headquarters
115 1/2 Maholm Street, Newark, Ohio
ODT021

Date Started : 06/02/2004
Date Completed : 06/02/2004
Logged By : M. Young
Reviewed By : B. Blehl
Drilling Contractor : Summit Drilling
Drilling Method : 4 1/4 ID HSA
Sampling Method : 2x2 Split Spoon
Total Depth : 28'

LOG OF BORING MW-16

(Page 1 of 2)

PID Calibration : 06/02/2004
PID Model : Photovac 2020





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Former ODOT District 5 Headquarters
115 1/2 Maholm Street, Newark, Ohio
ODT021

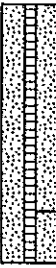
Date Started : 06/02/2004
Date Completed : 06/02/2004
Logged By : M. Young
Reviewed By : B. Blehl
Drilling Contractor : Summit Drilling
Drilling Method : 4 1/4 ID HSA
Sampling Method : 2x2 Split Spoon
Total Depth : 28'

LOG OF BORING MW-16

(Page 2 of 2)

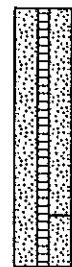
PID Calibration : 06/02/2004
PID Model : Photovac 2020

Depth in Feet	Length Drive/ Sample Recovery (ft.)	Sample Number/ Sample Interval	PID	Blow Count (6"-12"-6")	Samples	GRAPHIC	Soil Samples	Water Levels	Well: MW-16
							 Sample Interval  Lab Sample	 Static  During drilling	
DESCRIPTION									
20	20/18	SS-10 20.0-21.5	0	20-32-17			Same as above, 1/2 inch clay lens at 21 feet.		
21									
22	24/12	SS-11 22.0-23.0	0	28-26-10			Same as above, cobble, with grey clay in end of spoon.		
23									
24	24/18	SS-12 24.0-25.5	0	5-13-9			Stiff grey silty CLAY, trace sand and gravel, plastic, moist.		
25									
26	24/18	SS-13 26.0-27.5	0	6-11-7			Same as above, 2 inch silt layer at 26.5 feet.		
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									



Sand

2" PVC Screen



Sand

2" PVC Screen

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115 1/2 Maholm Street, Newark, Ohio
ODT021

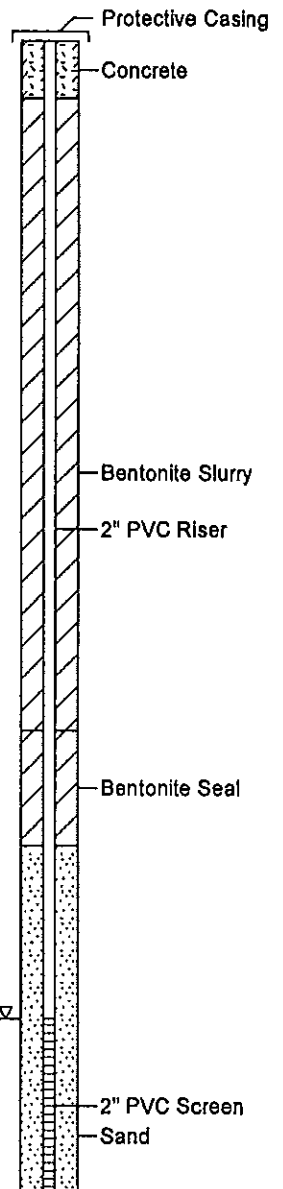
Date Started : 05/13/2004
Date Completed : 05/13/2004
Logged By : M. McCoy
Reviewed By : B. Blehl
Drilling Contractor : Summit Drilling
Drilling Method : 4.25" HSA
Sampling Method : 2x2 split spoon
Total Depth : 29'

LOG OF BORING MW-17

(Page 1 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model :
FID/FID Calibration : 100 ppm butylene

Depth in Feet	Length Drive/ Sample Recovery (ft.)	Sample Number/ Sample Interval	PID	Blow Count (6"-12"-6")	Sample	GRAPHIC	Soil Samples	Water Levels	Well: MW-17
							 Sample Interval  Lab Sample	 Stellec  During drilling	
							DESCRIPTION		
0	1.0/1.0	SS-1 0.0-1.0	2	NA			Soft dark brown/black silt TOPSOIL, moist, rootlets, cinder fragments.		
1	1.0/1.0	SS-2 1.0-2.0	0	NA			Same as above, brown, iron staining.		
2	1.0/1.0	SS-3 2.0-3.0	0	NA			Dark brown / black FILL, moist, cinder fragments.		
3	1.0/1.0	SS-4 3.0-4.0	0	NA			Same as above.		
4	1.0/1.0	SS-5 4.0-5.0	0	NA			Soft brown / grey silty SAND and GRAVEL, moist, friable.		
5	2.0/1.3	SS-6 5.0-6.3	0	5-19-13			Medium dense brown silty SAND and GRAVEL, slightly moist, iron staining, unsorted.		
6									
7	2.0/1.2	SS-7 7.0-8.2	0	5-26-12			Same as above, increasing moisture with depth, sorting noted from 9.0 to 9.2'.		
8									
9	2.0/1.6	SS-8 9.0-10.6	0	5-20-13			Same as above, moist, less silty.		
10									
11	2.0/1.3	SS-9 11.0-12.3	0	7-25-15			Brown SAND and Gravel, moist, occasional <0.1" clayey lenses.		
12									
13	2.0/1.4	SS-10 13.0-14.4	0	8-26-20			Same as above, poorly sorted and iron staining.		
14									
15	2.0/1.1	SS-11 15.0-16.1	0	8-28-22					
16									
17	2.0/1.2	SS-12 17.0-18.2	0	8-36-26			Same as above, becoming dense, wet, with large gravel at 17.8.		
18									
19	2.0/1.2	SS-13 19.0-20.2	0	6-30-36			Same as above, silty, wet.		
20							Grey fine to medium SAND, wet.		



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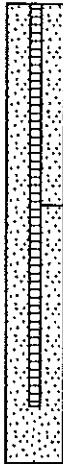
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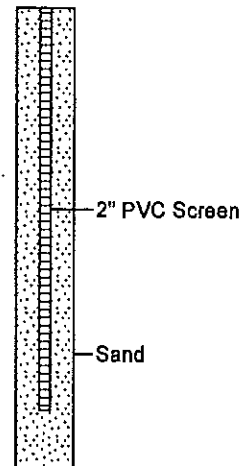
Date Started : 05/13/2004
Date Completed : 05/13/2004
Logged By : M. McCoy
Reviewed By : B. Blehl
Drilling Contractor : Summit Drilling
Drilling Method : 4.25" HSA
Sampling Method : 2x2 split spoon
Total Depth : 29'

LOG OF BORING MW-17

(Page 2 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model :
FID/FID Calibration : 100 ppm butylene

Depth in Feet	Length Drive/ Sample Recovery (ft.)	Sample Number/ Sample Interval	PID	Blow Count (6"-12"-6")	Sample	GRAPHIC	Soil Samples	Water Levels	Well: MW-17
							 Sample Interval  Lab Sample	 Static  During drilling	
							DESCRIPTION		
20							Brown silty SAND and GRAVEL, wet, Limestone fragments noted.		 
21	2.0/1.6	SS-14 21.0-22.8	0	4-19-13			Medium dense grey/brown fine to medium SAND, wet, trace gravel.		
22							Bark brown silty SAND and GRAVEL, trace clay, very moist, iron and black staining.		
23	2.0/1.8	SS-15 23.0-24.8	0	6-19-10			Grey silty CLAY/Clayey SILT, trace coarse sand, very moist.		
24							Grey silty CLAY/Clayey SILT, trace coarse sand, very moist.		
25	2.0/1.8	SS-18 25.0-26.8	0	4-17-12			Stiff grey clayey SILT, trace increasing sand and gravel, moist.		
26							Medium dense grey SILT, wet.		
27	2.0/1.8	SS-17 27.0-28.6	0	5-13-13			Stiff grey silty CLAY, trace gravel, moist.		
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									



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ODT021

Date Started : 06/01/2004
Date Completed : 06/01/2004
Logged By : M. Young
Reviewed By : B. Blehl
Drilling Contractor : Summit Drilling
Drilling Method : 4 1/4 ID HSA
Sampling Method : 2x2 Split Spoon
Total Depth : 26'

LOG OF BORING MW-18

(Page 1 of 2)

PID Calibration : 06/01/2004
PID Model : Photovac 2020

Depth in Feet	Length Drive/ Sample Recovery (ft.)	Sample Number/ Sample Interval	PID	Blow Count (6"-12"-6")	Samples	GRAPHIC	Soil Samples	Water Levels	DESCRIPTION	
							☒ Sample Interval ☐ Lab Sample	☒ Static ☐ During drilling		
0									Crushed limestone FILL	Protective casing
1										Concrete
2	24/18	SS-1 2.0-3.5	0	25-14-7					Stiff dark brown silty clay FILL, some gravel and sand, trace clinders, slightly moist, slightly plastic.	
3										
4	24/14	SS-2 4.0-5.1	0	5-13-12					Stiff brown silty CLAY, some gravel and sand, slightly moist, slightly plastic.	
5										
6	24/24	SS-3 6.0-8.0	0	6-21-9					Same as above.	Bentonite Seal
7									Medium dense brown med to coarse SAND and GRAVEL, trace silt, slightly moist, unsorted.	2" PVC Riser
8	24/12	SS-4 8.0-9.0	0	5-21-13					Same as above.	
9										
10	24/18	SS-5 10.0-11.5	0	11-26-15					Same as above, trace clay from 10-10.5 feet.	
11										
12	24/12	SS-6 12.0-13.0	0	9-25-11					Same as above, Iron staining noted.	
13										
14	24/18	SS-7 14.0-15.5	0	10-22-9					Same as above, trace clay at 14.5 to 14.8 feet.	
15										
16	24/18	SS-8 16.0-17.5	0	13-34-15					Same as above, becoming grey in color and more dense, moist from 17.0 to 17.5 feet.	Sand
17										
18	24/16	SS-9 18.0-19.3	0	10-39-27					Same as above, grey in color, wet, minor amounts of iron staining noted.	2" PVC Screen
19										
20										

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115 1/2 Maholm Street, Newark, Ohio
ODT021

Date Started : 06/01/2004
Date Completed : 06/01/2004
Logged By : M. Young
Reviewed By : B. Biehl
Drilling Contractor : Summit Drilling
Drilling Method : 4 1/4 ID HSA
Sampling Method : 2x2 Split Spoon
Total Depth : 26'

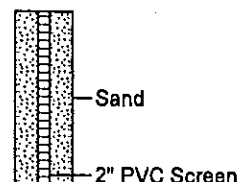
LOG OF BORING MW-18

(Page 2 of 2)

PID Calibration : 06/01/2004
PID Model : Photovac 2020

Depth in Feet	Length Drive/ Sample Recovery (ft.)	Sample Number/ Sample Interval	PID	Blow Count (6"-12"-6")	Samples	GRAPHIC	Soil Samples	Water Levels	DESCRIPTION
							☐ Sample Interval ☐ Lab Sample	☐ Static ☐ During drilling	
20	20/12	SS-10 20.0-21.0	0	10-36-27					Same as above, trace clay at 20.2 to 20.5 feet.
21									
22	24/18	SS-11 22.0-23.5	0	10-24-18					Same as above.
23									Very stiff grey silty CLAY, trace sand and gravel, moist, plastic, 3 mm sand seam noted at 23.2 feet.
24	24/24	SS-12 24.0-26.0	0	10-26-16					Same as above.
25									End of boring at 26 feet.
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									

Well: MW-18



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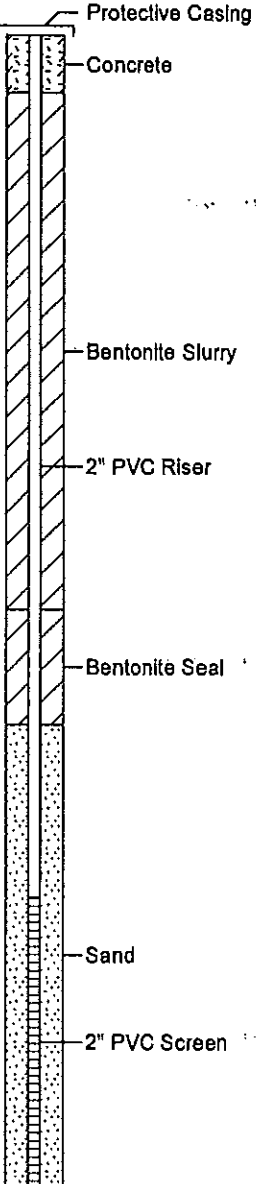
Former ODOT District 5 Headquarters
115 1/2 Maholm Street, Newark, Ohio
ODT021

Date Started : 05/13/2004
Date Completed : 05/13/2004
Logged By : M. McCoy
Reviewed By : B. Blehl
Drilling Contractor : Summit Drilling
Drilling Method : 4.25" HAS
Sampling Method : 2x2 split spoon
Total Depth : 27'

LOG OF BORING MW-19

(Page 1 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model :
FID/FID Calibration : 100 ppm butylene

Depth In Feet	Length Drive/ Sample Recovery (ft.)	Sample Number/ Sample Interval	PID	Blow Count (6"-12"-6")	Sample	GRAPHIC	Soil Samples	Water Levels	Well: MW-19
							 Sample Interval  Lab Sample	 Static  During drilling	
DESCRIPTION									
0	1.0/1.0	SS-1 0.0-1.0	0	NA			Black to dark brown silt loam TOPSOIL, moist, rootlets, trace gravel.		
1	1.0/1.0	SS-2 1.0-2.0	0	NA			Soft dark brown silty clay FILL, trace gravel, trace glass and ash, moist, rootlets.		
2	1.0/1.0	SS-3 2.0-3.0	0	NA					
3	1.0/1.0	SS-4 3.0-4.0	0	NA					
4	1.0/1.0	SS-5 4.0-5.0	0	NA					
5	2.0/1.7	SS-6 5.0-6.7	0	6-13-5			Same as above, becoming dark brown, more plastic.		
6									
7	2.0/2.0	SS-7 7.0-9.0	0	13-15-8			Same as above.		
8									
9	2.0/1.0	SS-8 9.0-10.0	0	4-13-7			Medium dense brown / grey silty SAND and GRAVEL, slightly moist to moist, iron staining.		
10							Same as above, increasing moisture.		
11	2.0/1.5	SS-9 11.0-12.5	0	6-9-4			Same as above, becoming loose, two <0.1" grey fine to medium sand seams noted		
12									
13	2.0/1.2	SS-10 13.0-14.2	0	5-9-7			Same as above.		
14									
15	2.0/1.2	SS-11 15.0-16.2	0	7-15-8			Same as above, grey, heavy iron staining below 16', medium dense.		
16									
17	2.0/1.9	SS-12 17.0-18.9	0	9-36-19			Same as above, iron staining, becoming dense		
18									
19	2.0/1.1	SS-13 19.0-20.1	0	10-45-30			Same as above becoming grey, increasing gravel, cobble in shoe of sampler.		
20									

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ODT021

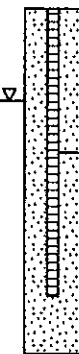
Date Started : 05/13/2004
Date Completed : 05/13/2004
Logged By : M. McCoy
Reviewed By : B. Blehl
Drilling Contractor : Summit Drilling
Drilling Method : 4.25" HAS
Sampling Method : 2x2 split spoon
Total Depth : 27'

LOG OF BORING MW-19

(Page 2 of 2)

G. Elev. (ft. USGS) :
Latitude :
Longitude :
PID/FID Model :
FID/FID Calibration : 100 ppm butylene

Depth in Feet	Length Drive/ Sample Recovery (ft.)	Sample Number/ Sample Interval	PID	Blow Count (6"-12"-6")	Sample	GRAPHIC	Soil Samples	Water Levels	DESCRIPTION
							☒ Sample Interval ☒ Lab Sample	☒ Static ☒ During drilling	
20									
21	2.0/0.7	SS-14 21.0-21.7	0	19-61-12	☒				Same as above, stone in sampler, wet below 21.6', very dense.
22									
23	2.0/0.0	SS-15 23.0-23.0	NA	5-15-10					No Recovery, rock in sampler.
24									
25	2.0/1.5	SS-16 25.0-26.5	0	7-13-7	☒				Stiff grey silty CLAY, trace gravel, moist, plastic.
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									



2" PVC Screen
Sand

Well: MW-19

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ODT0211

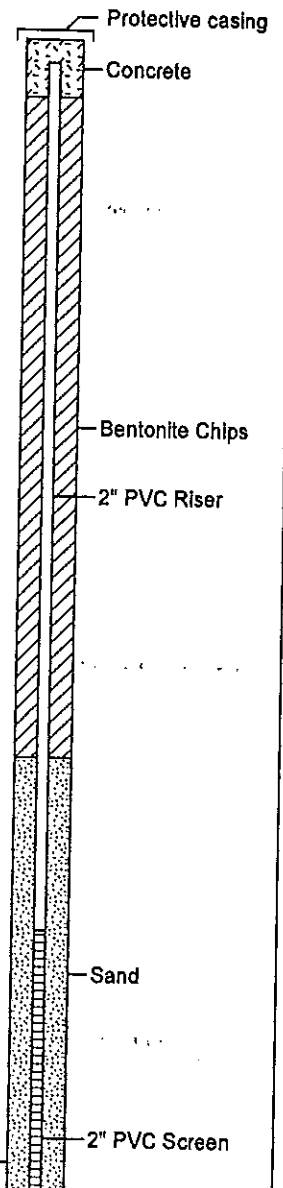
Date Started : 06/02/2004
Date Completed : 08/02/2004
Logged By : M. Young
Reviewed By : B. Blehl
Drilling Contractor : Summit Drilling
Drilling Method : 4 1/4 ID HSA
Sampling Method : 2x2 Split Spoon
Total Depth : 27'

LOG OF BORING MW-20

(Page 1 of 2)

PID Calibration : 06/02/2004
PID Model : Photovac 2020

Depth In Feet	Length Drive/ Sample Recovery (ft.)	Sample Number/ Sample Interval	PID	Blow Count (6"-12"-6")	Samples	GRAPHIC	DESCRIPTION	Soil Samples ☒ Sample Interval ■ Lab Sample	Water Levels ▼ Static ▽ During drilling	Well: MW-20
0							Crushed limestone FILL			
1	HA	SS-1 1.0-3.0	0				Medium stiff, light brown clayey SILT, trace sand and gravel, moist.			
2										
3	HA	SS-2 3.0-5.0	0							
4										
5	24/12	SS-3 5.0-6.0	0	1-4-2			Same as above, increased sand and gravel.			
6										
7	24/6	SS-4 7.0-7.5	0	4-5-4			Same as above, large cobble in end of spoon.			
8										
9	24/6	SS-5 9.0-9.5	0	4-24-19			Same as above, becoming very stiff, large cobble in end of spoon.			
10										
11	24/18	SS-6 11.0-12.5	0	14-40-23			Same as above, increased moisture.			
12							Dense brown medium to coarse SAND and GRAVEL, trace silt, slightly moist, loose, unsorted.			
13	24/18	SS-7 13.0-14.5	0	12-36-24			Same as above, iron staining noted.			
14										
15	24/18	SS-8 15.0-16.5	0	12-30-11			Same as above, iron staining noted.			
16										
17	24/18	SS-9 17.0-18.5	0	15-61-33			Same as above, becoming very dense.			
18										
19	20/18	SS-10 19.0-20.5	0	19-35-12			Same as above, clay globules noted throughout, wet at 19.5 feet, less dense.			
20										



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ODT0211

Date Started : 06/02/2004
Date Completed : 06/02/2004
Logged By : M. Young
Reviewed By : B. Biehl
Drilling Contractor : Summit Drilling
Drilling Method : 4 1/4 ID HSA
Sampling Method : 2x2 Split Spoon
Total Depth : 27'

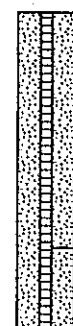
LOG OF BORING MW-20

(Page 2 of 2)

PID Calibration : 06/02/2004
PID Model : Photovac 2020

Depth in Feet	Length Drive/ Sample Recovery (ft.)	Sample Number/ Sample Interval	PID	Blow Count (6"-12"-6")	Samples	GRAPHIC	Soil Samples		Water Levels		DESCRIPTION
							☒ Sample Interval	☐ Lab Sample	☒ Static	☒ During drilling	
20											
21	24/12	SS-11 21.0-22.0	0	23-21-8							Same as above
22											
23	24/12	SS-12 23.0-24.0	0	8-21-13							Grey medium to coarse SAND, trace gravel, no fines, wet.
24											
25	24/12	SS-13 25.0-26.0	0	2-15-10							Stiff grey silty CLAY, trace sand and gravel, moist, plastic.
26											
27											End of boring at 27 feet.
28											
29											
30											
31											
32											
33											
34											
35											
36											
37											
38											
39											
40											

Well: MW-20



Sand

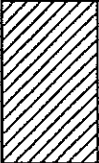
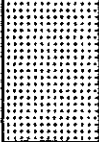
2" PVC Screen

MW-1

FILE COPY

ODOT Newark

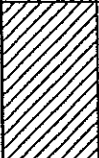
Project Number	6178S	Drill Rig	
Geologist	Kim Stemen	Ground Elevation	Feet
Date Drilled	12/21/93	Total Depth of Borehole	27.5 Feet
Borehole Diameter	4 Inches	Depth to Water	17.5 Feet

Graphic Log	Description	Depth	Sample	Undefined	Blow Counts	Completion
	black FILL, sandy sediments with glass, gravels, and organic fibrous materials					
	orange/brown CLAY, silty, grading down to sandy, some coarse grained sandy gravel	5				
	brown SAND and GRAVEL, coarse	10				
	gray SAND, fine to medium grained	15				
	orange/brown SAND, fine to medium grained, first water at 17.5					
	brown SAND, wet, fine to medium grained, little recovery	20				
	brown GRAVEL, sandy, wet, groundwater at 22.5	25				
	gray CLAY, silty, moist					
	Bottom of Borehole at 27.5	30				
		35				

MW-2

ODOT Newark

Project Number	6178S	Drill Rig	
Geologist	Kim Stemen	Ground Elevation	Feet
Date Drilled	12/21/93	Total Depth of Borehole	27.5 Feet
Borehole Diameter	4 Inches	Depth to Water	22 Feet

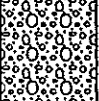
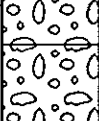
Graphic Log	Description	Depth	Sample	Undefined	Blow Counts	Completion
	black/dark brown FILL, some gravel, bricks and concrete					
	brown CLAY, silty, grading down to brown sandy, silty clay, grading to orange/brown sandy, silty clay with trace coarse gravel	5				
	brown GRAVEL, sandy	10				
	brown GRAVEL, sandy, grading to fine to medium grained, thin bedded, brown sand with some orange/brown sandy gravel	15				
	brown SAND, silty with interbedded gray medium to coarse sand, grading to brown silty sand, wet at 22'	20				
	brown SAND, silty grading down to gray silty clay, some very coarse sandy gravel, wet	25				
	Bottom of Borehole at 27.5	30				
		35				

C:\Program Files\Well Logger 2\Newark.wf2

MW-3

ODOT Newark

Project Number	6178S	Drill Rig	
Geologist	Kim Stemen	Ground Elevation	Feet
Date Drilled	12/21/93	Total Depth of Borehole	27.5 Feet
Borehole Diameter	4 Inches	Depth to Water	20 Feet

Graphic Log	Description	Depth	Sample	Undefined	Blow Counts	Completion
	black/dark gray FILL, sand with gravel and asphalt					
	dark brown/orange FILL with gravel, sand and asphalt					
	brown GRAVEL, sandy	5				
	brown GRAVEL, sandy, grading to medium to coarse grained sand, grading to fine to medium grained sand	10				
	gray GRAVEL, sandy, medium to coarse grained, wet at 20'	15				
	gray GRAVEL, coarse, sandy, grading to gray silty clay, stiff	20				
		25				
	Bottom of borehole at 27.5	30				
		35				

MW-4

ODOT Newark

Project Number	6178S	Drill Rig	
Geologist	Kim Stemen	Ground Elevation	Feet
Date Drilled	12/21/93	Total Depth of Borehole	27.5 Feet
Borehole Diameter	4 Inches	Depth to Water	22 Feet

Graphic Log	Description	Depth	Sample	Undefined	Blow Counts	Completion
	brown FILL, sandy with gravel to 1.5', gray/green sandy fill to 2.5'					
	gray/green FILL with black sandy fill, grading to brown sandy fill with gravel	5				
	orange/brown GRAVEL, sandy	10				
	brown GRAVEL, sandy, grading down to medium to coarse grained sand, grading to gray medium grained sand, stained with rust	15				
	orange/brown GRAVEL, very coarse and sandy, wet at 22'	20				
	GRAVEL as above, grading to gray silty clay, wet	25				
	Bottom of Borehole at 27.5'	30				
		35				

MW-5D Drilled November 9 and 11.

PROJECT: ODOT-Newark

TYPE: Hollow Stem Auger

LOCATION: Newark, Ohio

0-32' drilled with 12 1/4" HSA, 32-52' drilled with 4 1/4" HSA.

Drillers: Sprowls Drilling Company

Depth	Sample	Recovery	Effort	Legend	Sample Depth	SOIL DESCRIPTION
—	SS# 1				0-30'	Augered with center plug to 30'. Set 10" protective casing.
—					30-32'	Gray, moist, TILL, very stiff, dense.
—		24"			32-34'	15" Heave, soft till and grout.
—	SS#2					9" Gray, moist TILL, silty clay, some fine to very coarse sand, little fine gravel.
—						trace medium to coarse gravel, hard. PID = 0
—						
—	SS#2	20"			34-36'	4-10-10-12
—						7" Heave
—						13" Gray damp TILL, silty clay, some fine to coarse sand, little to
—	SS#3					trace fine to medium gravel, very stiff, dense. PID = 0
—		24"			36-38'	3-7-13-14
—						8" Heave
—	SS#4					16" Gray, damp, TILL A/A, increase in fine gravel, very stiff, dense.
—		24"			38-40'	PID = 0
—						5-9-11-13
—	SS#5					24" Gray, damp TILL A/A, slight increase in sand, plastic IP. PID = 0
—		17"			40-42'	8-18-18-14
—						12" Gray damp TILL A/A.
—	SS#6					5" Gray, wet fine to very coarse SAND, little fine gravel, little silt, loose.
—		14"			42-44'	PID = 0
—						Second water at 41' 7".
—	SS#7					6-9-11-11
—		19"			44-46'	14" Gray, wet, fine to very coarse SAND, some fine to medium gravel, little to trace
—						silt to very fine sand, loose. PID = 0
—	SS#8					7-16-16-14
—		17"			46-48'	7" Heave.
—						12" Gray, wet, fine to very coarse SAND, some fine to medium gravel,
—						trace coarse gravel, little silty clay, loose OA, firmer than above. PID = 0
—						5-8-14-25
—						17" Gray, wet, fine GRAVEL, some medium to very coarse sand,
—						little medium gravel, little silt to very fine sand, loose OA. 3/4" silty clay
—						@ 14", wet, plastic IP. PID = 0

PROJECT: ODOT-Newark

LOCATION: Newark, Ohio

Drillers: Sprowls Drilling Company

Page 2 of 2 Klm Stemen
Geologist

PROJECT: ODOT-Newark
LOCATION: Newark, Ohio

Kim Stemen
Geologist

MW-6S Drilled November 10, 1994,
 TYPE: Hollow Stem Auger
 Drillers: Sprowls Drilling Company

PROJECT: ODOT-Newark
 LOCATION: Newark, Ohio

Depth	Sample	Recovery	Effort	Legend	Sample Depth	SOIL DESCRIPTION
1	SS#9	15"			20-22'	6-15-15-20
2						8" Gray, wet, fine to very coarse SAND A/A.
3						7" Gray, very moist to moist SILTY CLAY and fine to very coarse SAND, some fi
4						gravel, trace medium to coarse gravel, dense, firm. PID = 0
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MW-7S Drilled November 10.
 TYPE: Hollow Stem Auger
 Drillers: Sprowls Drilling Company

PROJECT: ODOT-Newark
 LOCATION: Newark, Ohio

Depth	Sample	Recovery	Effort	Legend	Sample Depth	SOIL DESCRIPTION
—	SS#1	12"			0-4' 4-6'	Cut through street pavement and subbase/fill. 2-2-1-2 2" Gray and brown, moist, coarse GRAVEL, little silty clay, firm. 10" Brown, moist, fine to medium SAND, some silty clay, little fine to medium gravel, firm. PID = 0
—	SS#2	13"			6-8'	2-1-1-1 13" Brown, moist, SILTY CLAY, some fine to very coarse sand, little fine to medium gravel, trace coarse gravel. firm. PID = 0
—	SS#3	11"			8-10'	2-2-2-2 11" Brown mottled with gray and orange, moist, SILTY CLAY, some fine to very coarse sand, little fine gravel, trace medium to coarse gravel, soft IP, firm OA. PID = 0
—	SS#4	14"			10-12'	2-3-4-4 14" Brown, moist, fine to very coarse SAND, some silty clay, little fine to medium gravel, trace coarse gravel, loose IP. increase in fine to medium sand in bottom 2". PID = 0
—	SS#5	13"			12-14'	6-8-5-5 3" Heave/Cave 10" Brown, wet, fine to very coarse SAND, some silty clay, little fine to medium gravel, trace coarse gravel, firm OA, loose IP. PID = 0 Water @ 12'
—	SS#6	15"			14-16'	2-3-5-6 15" Brown, wet, fine to very coarse SAND AND fine to medium GRAVEL, little silty clay, trace coarse gravel, loose OA, PID = 0
—	SS#7	16"			16-18'	3-4-6-6 3" Heave. 13" Brown, wet, fine to very coarse SAND, some to little silty clay, little fine to medium gravel, trace coarse gravel, loose OA, firm @ silty clay (2-5" from top of spoon). PID = 0
—	SS#8	18"			18-20'	5-7-15-20 4" Heave 14" Brown, wet, fine to very coarse SAND, little silty clay, little fine gravel trace medium gravel, loose OA, slight compact in middle 6-10". PID = 0 DTD = 20'

MW-8S Composite Boring Log

PROJECT: ODOT-Newark

TYPE: Split Spoon

LOCATION: Newark, Ohio

Drilled & Installed: January 27, 1995, using a Geoprobe 0-13' and ATV rig 13-27'.

Drillers: Burlington Environmental, Inc.

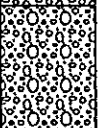
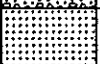
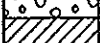
Note: Inside drilling without derrick, blow counts not recorded.

Depth	Sample	Recovery	Effort	Legend	Sample Depth	SOIL DESCRIPTION
0-7'					0-7'	Cut through concrete floor slab and construction fill to 7'.
7-9'	SS# 1	12"			7-9'	Brown, damp, fine to very coarse SAND, little fine to coarse gravel, trace silt to very fine sand, loose. PID = 0
9-11'	SS#2	15"			9-11'	Brown, damp, fine to coarse SAND, little fine to coarse gravel, trace medium gravel, loose, faint odor. PID = 0
11-13'	SS#3	22"			11-13'	Brown, damp, fine to coarse SAND, as above, very faint odor. PID = 0
13-15'	SS #4	5"			13-15'	Brown, damp, SILTY CLAY, some fine to medium sand, little coarse to very coarse sand, trace fine gravel, stiff, firm. PID = 0
15-17'	SS #5	7"			15-17'	Brown to gray-brown, moist, SILTY CLAY, some fine to medium sand, trace coarse sand, stiff, firm. PID = 0.2
17-19'	SS #6	6"			17-19'	3" Brown to gray-brown, SILTY CLAY, as above; 3" Brown, wet, fine to very coarse SAND AND fine GRAVEL, trace medium gravel, some silty clay, loose IP, firm OA. PID = 0.2 Water @~18'
20-21'	SS #7	4"			20-21'	2" as above; 2" Brown, damp SILTY CLAY, little very fine to medium sand micaceous, firm, dense. PID = 0 Question sample, fill in lead auger
21-23'		7"			21-23'	Brown to gray-brown, wet, fine to very coarse SAND, some fine gravel, trace medium gravel, some silty clay, dense OA, loose IP. PID = 0
						Drill ahead to 27.5', set well to 27'.

MW-9

ODOT Newark

Project Number	6178S	Drill Rig	
Geologist	Michelle Derenberger	Ground Elevation	Feet
Date Drilled	4/3/95	Total Depth of Borehole	22 Feet
Borehole Diameter	4 Inches	Depth to Water	Feet

Graphic Log	Description	Depth	Sample	Undefined	Blow Counts	Completion
	no sample					
	brown/black FILL, organic					
	orange/brown FILL with gravel	5				
	brown SAND, clay matrix, some pebbles	10				
	brown SAND and GRAVEL	15				
	gray SAND and GRAVEL, wet	20				
	gray TILL					
	Bottom of borehole at 22'					
		25				
		30				
		35				

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MW-10

ODOT Newark

Project Number	6178S	Drill Rig	
Geologist	Michelle Derenberger	Ground Elevation	Feet
Date Drilled	4/3/95	Total Depth of Borehole	22 Feet
Borehole Diameter	4 Inches	Depth to Water	Feet

Graphic Log	Description	Depth	Sample	Undefined	Blow Counts	Completion
	No sample					
		5				
		10				
	brown/gray SAND and GRAVEL, very coarse grained	15				
	gray SAND and GRAVEL, wet					
	gray TILL	20				
	Bottom of Borehole at 22'					
		25				
		30				
		35				

MW-11

ODOT Newark

Project Number	6178S	Drill Rig	
Geologist	Michelle Derenberger	Ground Elevation	Feet
Date Drilled	6/2/97	Total Depth of Borehole	24 Feet
Borehole Diameter	4 Inches	Depth to Water	20 Feet

Graphic Log	Description	Depth	Sample	Undefined	Blow Counts	Completion
	no sample taken					
		5				
		10				
		15				
		20				
	brown SAND and GRAVEL becoming silty very fine grained sand at 21.5, wet at 20'					
	gray/dark gray SILT					
	Bottom of Borehole at 24'	25				
		30				
		35				

MW-12

ODOT Newark

Project Number	6178S	Drill Rig	
Geologist	Michelle Derenberger	Ground Elevation	Feet
Date Drilled	6/1/95	Total Depth of Borehole	28 Feet
Borehole Diameter	4 Inches	Depth to Water	Feet

Graphic Log	Description	Depth	Sample	Undefined	Blow Counts	Completion
	no sample					
	brown CLAY with pebbles	5				
	brown/gray CLAY, sandy with gravel					
	brown SAND, silty with gravel	10				
		15				
	gray SAND, silty with gravel					
		20				
	brown SAND, silty with gravel, wet at 22'					
		25				
	brown SAND, fine to very coarse grained, silty					
		30				
	gray/dark gray SILT					
	Bottom of Borehole at 28;					
		35				

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MW-13

ODOT Newark

Project Number	6178S	Drill Rig	
Geologist	Michelle Derenberger	Ground Elevation	Feet
Date Drilled	6/2/97	Total Depth of Borehole	26 Feet
Borehole Diameter	4 Inches	Depth to Water	22 Feet

Graphic Log	Description	Depth	Sample	Undefined	Blow Counts	Completion
	no sample taken					
		5				
		10				
		15				
		20				
	brown/gray SAND and GRAVEL, silty, moist					
	wet at 22'					
	gray SAND very fine to medium grained	25				
	gray/dark gray SILT					
	Bottom of Borehole at 26'					
		30				
		35				

Boring Log

JR Kolmer + Associates, Inc.

Environmental Consultants

Project Dynacraft Facility

Client Dynacraft

Boring No. MW-1

Drilling Data		Well Data		Sampler Type		Groundwater Data	
Boring No <u>MW-1</u>		Hole Dia <u>6 inch</u>		Type <u>Split Spoon</u>		Gnd Ele <u> </u>	
Loc <u> </u>		Hole Depth <u>27 ft.</u>		Push <u>N/A</u>		TOC Ele <u> </u>	
Date <u>24 Jun 97</u>		Casing Dia <u>2 inch</u>		Hammer <u>140 lb.</u>		Development <u> </u>	
Driller <u>Belasco</u>		Casing Lth <u>17 ft.</u>		Fall <u>30 in.</u>		Date <u> </u> Depth to Water <u> </u>	
Rig Type <u>Auger</u>		Screen Lth <u>10 ft</u>		Other <u> </u>			
Logger <u>J.R. Kolmer</u>		Slot Size <u>.010</u>					

Depth Below Surface	Sample Information				Comments
	Interval	Blows per ft.	Rec.	Description	
0				Asphalt paving with 1 ft. of subgrade/fill below asphalt	
				Reddish brown silty clay below subgrade/fill	
5		15		No recovery	
		3	14"	Reddish brown silty fine to coarse sand with fine to medium gravel	PID= 12.2 ppm
10					
		31	18"	Reddish brown silty fine to coarse sand with fine to medium gravel	PID= 31.9 ppm
15					
		38	17"	Reddish brown silty fine to coarse sand with fine to medium gravel	PID= 2.5 ppm
20					
		51	22"	Dark gray silty fine to coarse sand with fine to medium gravel. Bottom 8" of spoon dark gray fine to medium sand	PID= 1.2 ppm
25					
		26	19"	26.5 Dark gray silty clay with fine gravel inclusions	PID= 1.9 ppm Varved glaciolacustrine clay Bottom of hole 27.0 ft.
30					

Boring Log

JR Kolmer + Associates, Inc.

Environmental Consultants

Project Dynacraft Facility

Client Dynacraft

Boring No. MW-2

Drilling Data		Well Data		Sampler Type		Groundwater Data	
Boring No <u>MW-2</u>		Hole Dia <u>6 inch</u>		Type <u>Split Spoon</u>		Gnd Ele <u> </u>	
Loc <u> </u>		Hole Depth <u>28 ft.</u>		Push <u>N/A</u>		TOC Ele <u> </u>	
Date <u>23 Jun 97</u>		Casing Dia <u>2 inch</u>		Hammer <u>140 lb.</u>		Development <u> </u>	
Driller <u>Belasco</u>		Casing Lth <u>18 ft.</u>		Fall <u>30 in.</u>		Date <u> </u>	Depth to Water <u> </u>
Rlg Type <u>Auger</u>		Screen Lth <u>10 ft</u>		Other <u> </u>			
Logger <u>J.R. Kolmer</u>		Slot Size <u>.010</u>					
Depth Below Surface	Sample Information					Comments	
	Interval	Blows per ft.	Rec.	Description			
0				Asphalt paving			
5		7	6"	Reddish brown sandy silt with fine gravel	PID= 0.0 ppm Looks like fill		
10		18	8"	Reddish brown silty fine to coarse sand with fine to medium gravel interbedded with same but reddish tan color	PID= 1.2 ppm		
15		49	20"	Reddish brown silty fine to coarse sand with fine to coarse gravel	PID= 156 ppm		
20		74	18"	Reddish brown silty fine to coarse sand with fine to coarse gravel changing to dark gray fine to coarse sand with some fine gravel	PID= 0.0 ppm		
		82		Dark gray silty fine to coarse sand with fine to coarse gravel and trace cobbles, dark gray fine to coarse sand seam at bottom of spoon	PID= 32.3 ppm		
25		53		Dark gray silty fine to coarse sand in top of spoon. Same with fine to coarse gravel in bottom of spoon	PID= 19.8 ppm		
				26.9 ft. Dark gray silty clay with sm gravel inclusions in tip of shoe	Varved glaciolacustrine clay Bottom of hole 28.0 ft.		
30							

Boring Log

JR Kolmer + Associates, Inc.

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Project Dynacraft Facility

Client Dynacraft

Boring No. MW-3

Drilling Data		Well Data		Sampler Type		Groundwater Data	
Boring No. <u>MW-3</u>		Hole Dia. <u>6 inch</u>		Type <u>Split Spoon</u>		Gnd Ele. _____	
Loc. _____		Hole Depth <u>28 ft.</u>		Push <u>N/A</u>		TOC Ele. _____	
Date <u>23 Jun 97</u>		Casing Dia. <u>2 inch</u>		Hammer <u>140 lb.</u>		Development _____	
Driller <u>Belasco</u>		Casing Lth. <u>18 ft.</u>		Fall <u>30 in.</u>		Date _____ Depth to Water _____	
Rig Type <u>Auger</u>		Screen Lth. <u>10 ft.</u>		Other _____			
Logger <u>J.R. Kolmer</u>		Slot Size <u>.010</u>					

Depth Below Surface	Sample Information				Comments
	Interval	Blows per ft.	Rec.	Description	
0				8" Asphalt and thin gravel layer under asphalt	
				Reddish brown clayey silt	
5		18	9"	Reddish brown sandy silty with some small to medium gravel inclusions	PID= 0.0 ppm Looks like fill
10		25	12"	Reddish brown silty fine to medium sand with fine to medium gravel	PID= 1.5 ppm
15		29	18"	Reddish brown silty fine to coarse sand with fine to medium gravel	PID= 0.0 ppm Wet sample Water at about 15 ft.
20		49	18"	Reddish brown fine to coarse sand with some small gravel overlying dark gray silty fine to coarse sand with significant quantity of fine to large gravel	PID= .2 ppm
		73	17"	Dark gray silty fine to coarse sand with small gravel	
25		38	18"	Dark gray silty fine to coarse sand with fine gravel at top of spoon and remaining 10" of spoon was dark gray silty fine to medium sand	PID= 0.0 ppm
		24	19"	Dark gray fine to coarse sand with small gravel	
				26.7 ft Dark gray silty clay with fine gravel inclusions	Varved glaciolacustrine clay Bottom of hole 28.0 ft.
30					

Boring Log

JR Kolmer + Associates, Inc.

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Project Dynacraft Facility

Client Dynacraft

Boring No. MW-4

Drilling Data		Well Data		Sampler Type		Groundwater Data	
Boring No <u>MW-4</u>		Hole Dia <u>6 inch</u>		Type <u>Split Spoon</u>		Gnd Ele <u></u>	
Loc <u></u>		Hole Depth <u>25 ft.</u>		Push <u>N/A</u>		TOC Ele <u></u>	
Date <u>23 Jun 97</u>		Casing Dia <u>2 inch</u>		Hammer <u>140 lb.</u>		Development <u></u>	
Driller <u>Belasco</u>		Casing Lth <u>15 ft.</u>		Fall <u>30 in.</u>		Date <u></u> Depth to Water <u></u>	
Rig Type <u>Auger</u>		Screen Lth <u>10 ft</u>		Other <u></u>			
Logger <u>J.R. Kolmer</u>		Slot Size <u>.010</u>					

Depth Below Surface	Sample Information				Comments
	Interval	Blows per ft.	Rec.	Description	
0				Reddish brown silty fine to coarse sand with some fine to medium gravel	Looks like fill
				Same as above but black	Looks like fill
5		12	4"	Reddish brown sandy silt with small to medium gravel	PID= 0.0 ppm
10		38	24"	Reddish brown slightly silty fine to coarse sand with some fine to medium gravel	PID= .4 ppm
15		37	23"	Reddish brown fine to coarse sand with fine to medium gravel interbedded with reddish tan fine sand interbedded with dark gray fine to coarse sand	PID= 7.8 ppm
20		73	23"	Top half sample dark gray fine to coarse sand bottom half dark gray fine to coarse sand with fine to medium gravel inclusions	PID= 10.3 ppm
25		52	24"	23.0 ft. Dark gray silty clay-glaciolacustrine	Bottom of hole 25.0 ft.
30					

Boring Log

JR Kolmer + Associates, Inc.

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Project Dynacraft Facility

Client Dynacraft

Boring No. MW-5

Drilling Data	Well Data	Sampler Type	Groundwater Data
Boring No <u>MW-5</u>	Hole Dia <u>6 inch</u>	Type <u>Split Spoon</u>	Gnd Ele _____
Loc _____	Hole Depth <u>27 ft.</u>	Push <u>N/A</u>	TOC Ele _____
Date <u>20 June 97</u>	Casing Dia <u>2 inch</u>	Hammer <u>140 lb.</u>	Development _____
Driller <u>Belasco</u>	Casing Lth <u>17 ft.</u>	Fall <u>30 in.</u>	Date _____ Depth to Water _____
Rig Type <u>Auger</u>	Screen Lth <u>10 ft</u>	Other _____	
Logger <u>J.R. Kolmer</u>	Slot Size <u>.010</u>		

Depth Below Surface	Sample Information				Comments
	Interval	Blows per ft.	Rec.	Description	
0				Asphalt paving gravel fill/subgrade	
5		7	4"	Reddish brown silty clay with small gravel inclusions	No PID Reading Looks like fill material
10		10	6"	Reddish brown clayey silt with fine to coarse sand and some small gravel	PID= 0.0 ppm
15		26	15"	Reddish brown silty fine to coarse sand with some small gravel	PID= 9.0 ppm
20		50	18"	Reddish brown fine to coarse sand with some fine to medium gravel interbedded with fine to medium dark gray sand	PID= 0.0 ppm
25				Dark gray fine to medium sand	PID= 5 ppm
25		25		Dark gray silty clay with rounded gravel inclusions at 25.5 ft.	Glaciolacustrine varved clay Bottom of hole 27.0 ft.
30					

Boring Log

JR Kolmer + Associates, Inc.
Environmental Consultants

Project Dynacraft Facility

Client Dynacraft

Boring No. MW-6

Drilling Data		Well Data		Sampler Type		Groundwater Data	
Boring No. <u>MW-6</u>		Hole Dia. <u>6 inch</u>		Type <u>Split Spoon</u>		Gnd Ele. _____	
Loc. _____		Hole Depth <u>24 Ft.</u>		Push <u>N/A</u>		TOC Ele. _____	
Date <u>20 June 97</u>		Casing Dia. <u>2 inch</u>		Hammer <u>140 lb.</u>		Development _____	
Driller <u>Belasco</u>		Casing Lth. <u>14 Ft.</u>		Fall <u>30 in.</u>		Date _____ Depth to Water _____	
Rig Type <u>Auger</u>		Screen Lth. <u>10 ft</u>		Other _____			
Logger <u>J.R. Kolmer</u>		Slot Size <u>.010</u>					

Depth Below Surface	Sample Information				Comments
	Interval	Blows per ft.	Rec.	Description	
0				Asphalt paving Gravel fill and paving subgrade	
5		8	8"	Reddish brown silty clay with small gravel inclusions looks like fill	PID= 0.3 ppm Looks like fill
10		5	8"	Reddish brown silty fine to coarse sand	PID= 0.0 ppm Sample was wet/moist
15		49	14"	Reddish brown silty fine to coarse sand with some gravel, relatively clean sand in top 2"	PID= 7.4 ppm Sample was wet/moist
20		40	16"	Reddish brown silty clayey fine to coarse sand with some small gravel inclusions, interbedded with dark gray fine to medium sand	PID= 3.0 ppm Water coming off rods when taken from hole
		24		Dark gray fine to coarse sand with small gravel at base of layer	PID= 0.0 ppm
				23.5" dark gray silty clay with rounded gravel inclusions.	Varved glaciolacustrine clay Bottom of hole 24.0 ft.
25					
30					

Boring Log

JR Kolmer + Associates, Inc.

Environmental Consultants

Project Dynacraft Facility

Client Dynacraft

Boring No. MW-7

Drilling Data		Well Data		Sampler Type		Groundwater Data	
Boring No <u>MW-7</u>		Hole Dia <u>6 inch</u>		Type <u>Split Spoon</u>		Gnd Ele <u> </u>	
Loc <u> </u>		Hole Depth <u>26 ft.</u>		Push <u>N/A</u>		TOC Ele <u> </u>	
Date <u>23 Jun 97</u>		Casing Dia <u>2 inch</u>		Hammer <u>140 lb.</u>		Development <u> </u>	
Driller <u>Belasco</u>		Casing Lth <u>16 ft.</u>		Fall <u>30 in.</u>		Date <u> </u> Depth to Water <u> </u>	
Rig Type <u>Auger</u>		Screen Lth <u>10 ft</u>		Other <u> </u>			
Logger <u>J.R. Kolmer</u>		Slot Size <u>.010</u>					

Depth Below Surface	Sample Information				Comments
	Interval	Blows per ft.	Rec.	Description	
0				Asphalt and gravel fill/subgrade	
				Reddish brown silty fine to coarse sand with some small gravel	Looks like fill
				Same as above but black	
5		6	16"	Reddish brown sandy silt with fine gravel	PID= 1.1 ppm
10		11	16"	Light reddish brown silty fine to coarse sand with some small gravel	PID= .6 ppm
15		51	18"	Reddish brown silty fine to coarse sand with fine to medium gravel, slightly moist	PID= .4 ppm
20		36	18"	Reddish brown silty fine to coarse sand with small medium gravel, 3" fine to medium sand in upper part of spoon	PID= .1 ppm Sample wet Hit water at 20 ft.
25		48	18"	Reddish brown silty fine to coarse sand with small to medium gravel, 3" to 4" interbedded of gray fine to coarse sand, also 2" of slightly silty fine to medium sand	PID= 0.0 ppm
				25.8 ft. Dk gray silty clay with sm gravel inclusions	Varved glaciolacustrine clay Bottom of hole 26.0 ft.
30					

Boring Log

JR Kolmer + Associates, Inc.

Environmental Consultants

Project Dynacraft Facility

Client Dynacraft

Boring No. MW-8

Drilling Data		Well Data		Sampler Type		Groundwater Data	
Boring No <u>MW-8</u>		Hole Dia <u>6 inch</u>		Type <u>Split Spoon</u>		Gnd Ele <u> </u>	
Loc <u> </u>		Hole Depth <u>22 ft.</u>		Push <u>N/A</u>		TOC Ele <u> </u>	
Date <u>9 Oct 97</u>		Casing Dia <u>2 inch</u>		Hammer <u>140 lb.</u>		Development <u> </u>	
Driller <u>Belasco</u>		Casing Lth <u>22 ft.</u>		Fall <u>30 in.</u>		Date <u> </u> Depth to Water <u> </u>	
Rig Type <u>Auger</u>		Screen Lth <u>10 ft</u>		Other <u> </u>			
Logger <u>J.R. Kolmer</u>		Slot Size <u>.010</u>					

Depth Below Surface	Sample Information				Comments
	Interval	Blows per ft.	Rec.	Description	
0				Top Soil	
5		32	14"	Reddish brown and gray silty fine to medium sand with small to large gravel	
10		28	12"	Same as above but no gray and fine to medium gravel	
15		40	15"	Same as above with 6" seam of reddish brown mottled yellow silty fine to coarse sand with some small gravel Gray fine to medium sand in sampling shoe Water at 15 ft.	
20		26	12"	Brown to reddish brown silty medium to coarse sand with fine to large gravel	
				Bottom of hole 22 ft.	Dark gray silty varved glacio-lacustrine clay in tip of spoon. Small gravel in clay. Top of clay at 21.9 ft.
25					
30					

Boring Log

JR Kolmer + Associates, Inc.

Environmental Consultants

Project Dynacraft Facility

Client Dynacraft

Boring No. MW-9

Drilling Data	Well Data	Sampler Type	Groundwater Data
Boring No. <u>MW-9</u>	Hole Dia. <u>6 inch</u>	Type <u>Split Spoon</u>	Gnd Ele. _____
Loc. _____	Hole Depth <u>22 ft.</u>	Push <u>N/A</u>	TOC Ele. _____
Date <u>9 Oct 97</u>	Casing Dia. <u>2 inch</u>	Hammer <u>140 lb.</u>	Development _____
Driller <u>Belasco</u>	Casing Lth <u>12 ft.</u>	Fall <u>30 in.</u>	Date _____ Depth to Water _____
Rig Type <u>Auger</u>	Screen Lth <u>10 ft.</u>	Other _____	
Logger <u>J.R. Kolmer</u>	Slot Size <u>.010</u>		

Depth Below Surface	Sample Information				Comments
	Interval	Blows per ft.	Rec.	Description	
0				2" asphalt paving and 6" gravel subgrade	
5		8	8"	Reddish brown silty fine to medium sand	
10		13	18"	Same as above with fine gravel changing to fine to medium reddish brown sand with fine gravel in the middle of the sample	
15		21	18"	Reddish brown and gray silty fine to coarse sand with fine to coarse gravel Water at 15 ft.	
20		21	17"	Same as above but fine to medium gravel with a seam of reddish brown fine to medium sand	21.3 ft. Dark gray varved glacio-lacustrine clay with fine to medium gravel inclusions in upper portion of sample
25				Bottom of hole 22 ft.	
30					

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Ohio Department of Transportation
Pilot Study
Newark, Ohio

ODT049
Project Manager: Bill Biehl

Date Started : 09-12-2007
Date Completed : 09-12-2007
Logged By : M. Bell
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : Direct Push
Sampling Method : Dual Tube
Total Depth : 32'

LOG OF BORING TMWA-1

(Page 1 of 2)

PID Model : Minirae-10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels
						 Sample Interval  Lab Sample	 Static  During drilling
DESCRIPTION							
0	48/30	DT-1 0.0-2.0	0.3			Loose brown SAND and GRAVEL, trace silt.	
1							
2		2.0-2.5				Same as above, some silt, trace dark clay at 2'.	
3							
4	48/30	DT-2 4.0-6.0	0.6			Brown clayey fine SAND, moist.	
5							
6		6.0-6.5				Same as above, trace coarse sand.	
7							
8	48/22	DT-3 8.0-10.0	0.0			Brown clayey SAND and GRAVEL, moist.	
9							
10						Same as above, trace clay.	
11							
12	48/24	DT-4 12.0-14.0	0.0			Brown medium to coarse SAND, little gravel, loose.	
13							
14							
15							
16	48/36	DT-5 16.0-18.0	0.0			Same as above.	
17							
18		18.0-19.0					
19							
20							



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Ohio Department of Transportation
Pilot Study
Newark, Ohio

ODT049
Project Manager: Bill Biehl

Date Started : 09-12-2007
Date Completed : 09-12-2007
Logged By : M. Bell
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : Direct Push
Sampling Method : Dual Tube
Total Depth : 32'

LOG OF BORING TMWA-1

(Page 2 of 2)

PID Model : Minirae-10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels	
						 Sample Interval  Lab Sample	 Static  During drilling	
DESCRIPTION								
20	48/48	DT-6 20.0-22.0	0.0			Same as above, wet.		
21								
22		22.0-24.0				Same as above, wet.		
23								
24	48/48	DT-7 24.0-26.0	0.0			Brown SAND and GRAVEL, trace silt, trace clay, wet.		
25								
26		26.0-28.0				Grey SAND and GRAVEL, trace silt, trace clay, wet.		
27						Same as above, some clay.		
28	48/48	DT-8 28.0-30.0	0.0			Grey SAND and GRAVEL, wet.		
29								
30		30.0-32.0				Grey silty CLAY, moist.		
31								
32	EOB @ 32'							
33								
34								
35								
36								
37								
38								
39								
40								

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Ohio Department of Transportation
Pilot Study
Newark, Ohio

ODT049

Project Manager: Bill Biehl

Date Started : 09-12-2007
Date Completed : 09-12-2007
Logged By : M. Beil
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : Direct Push
Sampling Method : Dual Tube
Total Depth : 32'

LOG OF BORING TMWA-2

(Page 1 of 2)

PID Model : Minirae-10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels	
						 Sample Interval  Lab Sample	 Static  During drilling	
DESCRIPTION								
0	48/28	DT-1 0.0-2.0	0.0			Loose brown SAND and GRAVEL, dry.		
1								
2		2.0-2.2						
3								
4	48/25	DT-2 4.0-6.0	0.0			Same as above.		
5								
6		6.0-6.1				Same as above, clayey.		
7								
8	48/0	DT-3				No recovery.		
9								
10								
11								
12	48/0	DT-4				No recovery.		
13								
14								
15								
16	48/36	DT-5 16.0-18.0	0.0			Loose brown SAND and GRAVEL, dry.		
17								
18		18.0-19.0	NM					
19								
20								



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Pilot Study
Newark, Ohio

ODT049

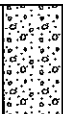
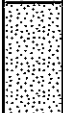
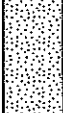
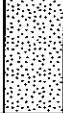
Project Manager: Bill Biehl

Date Started : 09-12-2007
Date Completed : 09-12-2007
Logged By : M. Beil
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : Direct Push
Sampling Method : Dual Tube
Total Depth : 32'

LOG OF BORING TMWA-2

(Page 2 of 2)

PID Model : Minirae-10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels
						 Sample Interval  Lab Sample	 Static  During drilling
DESCRIPTION							
20	48/48	DT-6 20.0-22.0	0.0			Brown SAND and GRAVEL, trace clay, wet.	
21						Grey fine SAND, trace clay and silt, wet.	
22		22.0-24.0	NM				
23						Grey medium-coarse SAND, little gravel, wet.	
24	48/48	DT-7 24.0-28.0	NM				
25							
26							
27							
28	48/48	DT-8 28.0-30.0	NM		Loose grey medium SAND, some gravel, wet.		
29							
30		30.0-32.0	NM		Same as above, mostly gravel, wet.		
31							
32	EOB @ 32'						
33							
34							
35							
36							
37							
38							
39							
40							

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Ohio Department of Transportation
Pilot Study
Newark, Ohio

ODT049
Project Manager: Bill Beihl

Date Started : 09-12-2007
Date Completed : 09-12-2007
Logged By : M. Beil
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : Direct Push
Sampling Method : Dual Tube
Total Depth : 32'

LOG OF BORING TMWA-3

(Page 1 of 2)

PID Model : Minirae-10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels
						Sample Interval Lab Sample	Static During drilling
DESCRIPTION							
0	48/30	DT-1 0.0-2.0	NM			Loose brown fine to medium SAND, dry.	
1							
2		2.0-4.0	NM			Same as above	
3							
4	48/15	DT-2 4.0-4.2	NM			Same as above.	
5						Brown clayey fine to medium SAND, moist to wet.	
6							
7							
8	48/20	DT-3 8.0-9.8	NM			Same as above.	
9							
10							
11							
12	48/20	DT-4 12.0-13.8	NM			Loose brown SAND and GRAVEL, dry.	
13							
14							
15							
16	48/42	DT-5 16.0-18.0	NM			Same as above.	
17							
18		18.0-19.5	NM			Same as above, oxidation from 17.5-18.5'.	
19							
20							



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Newark, Ohio

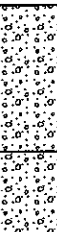
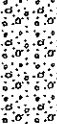
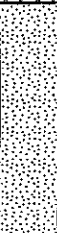
ODT049
Project Manager: Bill Beihl

Date Started : 09-12-2007
Date Completed : 09-12-2007
Logged By : M. Beil
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : Direct Push
Sampling Method : Dual Tube
Total Depth : 32'

LOG OF BORING TMWA-3

(Page 2 of 2)

PID Model : Minirae-10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels
						 Sample Interval  Lab Sample	 Static  During drilling
DESCRIPTION							
20	48/36	DT-6 20.0-22.0	NM			Brown oxidized SAND and GRAVEL, trace clay, wet.	
21							
22		22.0-23.0	NM				
23						Grey SAND and GRAVEL, wet.	
24	48/48	DT-7 24.0-26.0	NM				
25						Brown SAND and GRAVEL, some fine sand, oxidation, wet.	
26		26.0-28.0	NM				
27						Same as above, turning grey.	
28	48/24	DT-8 28.0-30.0	NM				
29						Grey medium SAND, some gravel.	
30							
31							
32	EOB @ 32'						
33							
34							
35							
36							
37							
38							
39							
40							

EOB @ 32'

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Ohio Department of Transportation
Pilot Study
Newark, Ohio

ODT049

Project Manager: Bill Biehl

Date Started : 09-12-2007
Date Completed : 09-12-2007
Logged By : M. Bell
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : Direct Push
Sampling Method : Dual Tube
Total Depth : 32'

LOG OF BORING MW-21-01

(Page 1 of 2)

PID Model : Minirae-10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels
						 Sample Interval  Lab Sample	 Static  During drilling
DESCRIPTION							
0	48/30	DT-1 0.0-2.0	1.4			Loose brown SAND and GRAVEL, dry.	
1							
2		2.0-4.0	0.6				
3							
4	48/24	DT-2 4.0-6.0	5.1			Same as above, loose, trace clay, dry.	
5							
6		6.0-8.0					
7							
8	48/36	DT-3 8.0-10.0	3.8			Same as above, oxidation, trace clay, moist.	
9							
10		10.0-12.0	2.6			Same as above.	
11							
12	48/36	DT-4 12.0-14.0	3.7			Brown SAND and GRAVEL, some clay, moist.	
13						Wet seam 13-13.1'	
14		14.0-16.0	2.8			Same as above.	
15							
16	48/48	DT-5 16.0-18.0	2.2			Medium dense brown SAND and GRAVEL, slightly moist.	
17							
18		18.0-20.0					
19							
20							

Loose brown SAND and GRAVEL, dry.

Same as above, loose, trace clay, dry.

Same as above, oxidation, trace clay, moist.

Same as above.

Brown SAND and GRAVEL, some clay, moist.

Wet seam 13-13.1'

Same as above.

Medium dense brown SAND and GRAVEL, slightly moist.



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Ohio Department of Transportation
Pilot Study
Newark, Ohio

ODT049

Project Manager: Bill Biehl

Date Started : 09-12-2007
Date Completed : 09-12-2007
Logged By : M. Beil
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : Direct Push
Sampling Method : Dual Tube
Total Depth : 32'

LOG OF BORING MW-21-01

(Page 2 of 2)

PID Model : Minirae-10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels
						 Sample Interval  Lab Sample	 Static  During drilling
DESCRIPTION							
20	48/34	DT-6 20.0-22.0	3.7			Same as above, wet.	
21							
22		22.0-24.0	3.8			Same as above, slightly moist.	
23							
24	48/24	DT-7 24.0-26.0	2.9			Same as above, very moist. Same as above, slightly moist.	
25							
26		26.0-28.0					
27							
28	48/24	DT-8 28.0-30.0	2.8			Same as above, some oxidation, slightly moist.	
29							
30		30.0-32.0					
31							
32	EOB @ 32'						
33							
34							
35							
36							
37							
38							
39							
40							



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Ohio Department of Transportation
Pilot Study
Newark, Ohio

ODT049
Project Manager: Bill Biehl

Date Started : 09-12-2007
Date Completed : 09-12-2007
Logged By : M. Beil
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : Direct Push
Sampling Method : Dual Tube
Total Depth : 32'

LOG OF BORING MW-21-02

(Page 1 of 2)

PID Model : Minirae-10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels
						 Sample Interval  Lab Sample	 Static  During drilling
DESCRIPTION							
0	48/24	DT-1 0.0-2.0	NM			Medium dense brown SAND and GRAVEL, slightly moist.	
1							
2		2.0-4.0	NM				
3							
4	48/18	DT-2 4.0-6.0	NM			Same as above, some fill fragments (brick), slightly moist.	
5							
6		6.0-8.0	NM				
7							
8	48/24	DT-3 8.0-10.0	NM			Same as above, no fill, become very moist with depth.	
9							
10		10.0-12.0	NM				
11							
12	48/30	DT-4 12.0-14.0	NM			Same as above, dry to slightly moist.	
13							
14		14.0-16.0	NM			Same as above.	
15							
16	48/30	DT-5 16.0-18.0	NM			Same as above.	
17							
18		18.0-20.0	NM			Same as above.	
19							
20							



Ohio Department of Transportation
Pilot Study
Newark, Ohio

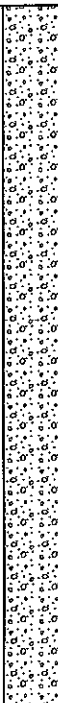
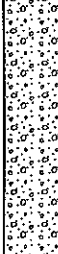
ODT049
Project Manager: Bill Biehl

Date Started : 09-12-2007
Date Completed : 09-12-2007
Logged By : M. Beil
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : Direct Push
Sampling Method : Dual Tube
Total Depth : 32'

LOG OF BORING MW-21-02

(Page 2 of 2)

PID Model : Minirae-10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels
						Sample Interval Lab Sample	Static During drilling
DESCRIPTION							
20	48/36	DT-6 20.0-22.0	NM			Same as above. Dark brown SAND and GRAVEL, wet.	
21							
22		22.0-24.0	NM				
23							
24	48/24	DT-7 24.0-26.0	NM			Same as above, wet.	
25							
26		26.0-28.0	NM				
27							
28	48/24	DT-8 28.0-30.0	NM			Same as above, wet.	
29							
30		30.0-32.0	NM				
31							
32	EOB @ 32'						
33							
34							
35							
36							
37							
38							
39							
40							

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Ohio Department of Transportation
Pilot Study
Newark, Ohio

ODT049
Project Manager: Bill Blehl

Date Started : 09-13-2007
Date Completed : 09-13-2007
Logged By : M. Beil
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : Direct Push
Sampling Method : Dual Tube
Total Depth : 32'

LOG OF BORING MW-21-3

(Page 1 of 2)

PID Model : Minirae-10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels
						 Sample Interval  Lab Sample	 Static  During drilling
DESCRIPTION							
0	48/34	DT-01 0.0-2.0	0.0			Medium dense brown SAND and GRAVEL, some oxidation, slightly moist.	
1							
2		2.0-4.0	0.0			Same as above.	
3							
4	48/30	DT-03 4.0-6.0	0.0			Same as above, some oxidation.	
5							
6		6.0-8.0	0.0			Same as above, some oxidation.	
7							
8	48/36	DT-05 8.0-10.0	0.0			Same as above.	
9							
10		10.0-12.0	0.5			Same as above, becoming moist to very moist.	
11							
12	48/24	DT-07 12.0-14.0	0.0			Same as above, very gravelly from 12-13'.	
13							
14		14.0-16.0				Same as above, very moist.	
15							
16	48/30	DT-09 16.0-18.0	0.0			Same as above.	
17							
18		18.0-20.0	0.0			Same as above, very gravelly.	
19							
20							



Ohio Department of Transportation
Pilot Study
Newark, Ohio

ODT049
Project Manager: Bill Biehl

Date Started : 09-13-2007
Date Completed : 09-13-2007
Logged By : M. Beil
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : Direct Push
Sampling Method : Dual Tube
Total Depth : 32'

LOG OF BORING MW-21-3

(Page 2 of 2)

PID Model : Minirae-10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels
						Sample Interval Lab Sample	Static During drilling
DESCRIPTION							
20	48/36	DT-11 20.0-22.0				Same as above, wet.	
21							
22		22.0-24.0	0.0			Same as above.	
23							
24	48/48	DT-13 24.0-26.0	0.0			Medium dense grey SAND and GRAVEL, some oxidation, wet.	
25							
26		26.0-28.0					
27						Brown SAND and GRAVEL, slightly moist.	
28	48/48	DT-15 28.0-30.0	0.0			SAND and GRAVEL, wet.	
29							
30		30.0-32.0				Same as above.	
31							
32	EOB @ 32'						
33							
34							
35							
36							
37							
38							
39							
40							

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Ohio Department of Transportation
Pilot Study
Newark, Ohio

ODT049
Project Manager: Bill Biehl

Date Started : 09-13-2007
Date Completed : 09-13-2007
Logged By : M. Beil
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : Direct Push
Sampling Method : Dual Tube
Total Depth : 28'

LOG OF BORING MW-22-1

(Page 1 of 2)

PID Model : Minirae-10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels
						 Sample Interval  Lab Sample	 Static  During drilling
DESCRIPTION							
0	48/34	DT-01 0.0-2.0	0.0			Medium dense SAND and GRAVEL, slightly moist.	
1							
2		2.0-4.0	0.0			Same as above, some clay and silt.	
3							
4	48/22	DT-03 4.0-6.0	0.0			Same as above, silty clay/clayey silt, slightly moist.	
5							
6		6.0-8.0	0.0				
7							
8	48/24	DT-05 8.0-10.0	0.0			Medium dense light brown SAND and GRAVEL, becoming moist with depth.	
9							
10		10.0-12.0	0.0				
11							
12	48/32.4	DT-07 12.0-14.0	0.0			Same as above.	
13							
14		14.0-16.0				Same as above.	
15							
16	48/34	DT-09 16.0-18.0	0.0			Same as above.	
17							
18		18.0-20.0	0.0			Same as above.	
19							
20							



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Ohio Department of Transportation
Pilot Study
Newark, Ohio

ODT049
Project Manager: Bill Biehl

Date Started : 09-13-2007
Date Completed : 09-13-2007
Logged By : M. Bell
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : Direct Push
Sampling Method : Dual Tube
Total Depth : 28'

LOG OF BORING MW-22-1

(Page 2 of 2)

PID Model : Minirae-10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels
						 Sample Interval  Lab Sample	 Static  During drilling
DESCRIPTION							
20	48/34	DT-11 20.0-22.0	107			Same as above, grading into dark brown/grey stiff silty clay, slightly moist.	
21							
22		22.0-24.0	0.0			Same as above, very moist.	
23							
24	48/18	DT-13 24.0-26.0	0.0			Dark grey silty CLAY, some gravel, slightly moist, stiff.	
25							
26		26.0-28.0	0.0				
27							
28	EOB @ 28'						
29							
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							

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Ohio Department of Transportation
Pilot Study
Newark, Ohio

ODT049
Project Manager: Bill Biehl

Date Started : 09-13-2007
Date Completed : 09-13-2007
Logged By : M. Bell
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : Direct Push
Sampling Method : Dual Tube
Total Depth : 28'

LOG OF BORING MW-22-2

(Page 1 of 2)

PID Model : Minirae-10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels
						 Sample Interval  Lab Sample	 Static  During drilling
DESCRIPTION							
0	48/36	DT-01 0.0-2.0	0.0			Medium dense dark brown SAND and GRAVEL, slightly moist.	
1							
2		2.0-4.0	2.1			Medium stiff brown silty CLAY, slightly moist.	
3							
4	48/24	DT-02 4.0-6.0	3.3			Same as above.	
5							
6		6.0-8.0				Medium dense light brown SAND and GRAVEL, slightly moist.	
7							
8	48/24	DT-03 8.0-10.0	3.5			Same as above.	
9							
10		10.0-12.0				Same as above.	
11							
12	48/36	DT-04 12.0-14.0	3.4			Same as above.	
13							
14		14.0-16.0	3.3			Same as above, very moist.	
15							
16	48/36	DT-05 16.0-18.0	3.6			Same as above.	
17							
18		18.0-20.0	3.7			Same as above, very moist to wet.	
19							
20							



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Ohio Department of Transportation
Pilot Study
Newark, Ohio

ODT049
Project Manager: Bill Biehl

Date Started : 09-13-2007
Date Completed : 09-13-2007
Logged By : M. Bell
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : Direct Push
Sampling Method : Dual Tube
Total Depth : 28'

LOG OF BORING MW-22-2

(Page 2 of 2)

PID Model : Minirae-10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels
						 Sample Interval  Lab Sample	 Static  During drilling
DESCRIPTION							
20	48/28	DT-6 20.0-22.0	12.4			Same as above, very moist to wet.	
21						Medium stiff clayey SILT/silty CLAY, very moist.	
22		22.0-24.0	3.2				
23							
24	48/36	DT-7 24.0-26.0	3.0			Medium stiff dark brown silty CLAY, very moist.	
25							
26		26.0-28.0	2.9			Same as above.	
27							
28	EOB @ 28'						
29							
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							



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Ohio Department of Transportation
Pilot Study
Newark, Ohio

ODT049
Project Manager: Bill Biehl

Date Started : 09-13-2007
Date Completed : 09-13-2007
Logged By : M. Beil
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : Direct Push
Sampling Method : Dual Tube
Total Depth : 28'

LOG OF BORING MW-22-3

(Page 1 of 2)

PID Model : Minirae-10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels
						 Sample Interval  Lab Sample	 Static  During drilling
DESCRIPTION							
0	48/28	DT-01 0.0-2.0	0.4			Medium dense brown to dark brown SAND and GRAVEL, slightly moist.	
1							
2		2.0-4.0	0.0			Same as above.	
3							
4	48/12	DT-02 4.0-6.0	0.0			Medium stiff brown SILTY CLAY, trace gravel, slightly moist.	
5						Medium dense light brown SAND and GRAVEL, slightly moist.	
6		6.0-8.0					
7							
8	48/24	DT-03 8.0-10.0	0.0			Same as above, slightly moist.	
9							
10		10.0-12.0					
11							
12	48/36	DT-04 12.0-14.0	0.0			Same as above.	
13							
14		14.0-16.0	0.0			Same as above.	
15							
16	48/36	DT-05 16.0-18.0	0.0			Same as above.	
17							
18		18.0-20.0	0.0			Same as above.	
19							
20							



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Ohio Department of Transportation
Pilot Study
Newark, Ohio

ODT049
Project Manager: Bill Biehl

Date Started : 09-13-2007
Date Completed : 09-13-2007
Logged By : M. Beil
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : Direct Push
Sampling Method : Dual Tube
Total Depth : 28'

LOG OF BORING MW-22-3

(Page 2 of 2)

PID Model : Minirae-10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels
						 Sample Interval  Lab Sample	 Static  During drilling
DESCRIPTION							
20	48/24	DT-6 20.0-22.0	50.3			Medium dense dark brown/grey SAND and GRAVEL, some wilt, very moist to wet.	
21							
22		22.0-24.0					
23	48/42						
24		DT-7 24.0-26.0	6.0			Same as above.	
25						Medium stiff dark brown silty CLAY, trace gravel, slightly moist.	
26		26.0-28.0	0.0			Same as above.	
27							
28	EOB @ 28'						
29							
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							



Ohio Department of Transportation
Pilot Study
Newark, Ohio

ODT049
Project Manager: Bill Biehl

Date Started : 09-04-2007
Date Completed : 09-04-2007
Logged By : M. Beil
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : 4 1/4" HSA
Sampling Method : 5' Macrocore
Total Depth : 35'

LOG OF BORING MW-25

(Page 1 of 2)

PID Model : Minirae - 10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels	DESCRIPTION
						☐ Sample Interval ☐ Lab Sample	☐ Static ☐ During drilling	
0						Straight Drill to 20 ft.		
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

Well: MW-25

Protective casing

Concrete

2" PVC Riser

Bentonite Chips

Sand

Hull

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Ohio Department of Transportation
Pilot Study
Newark, Ohio

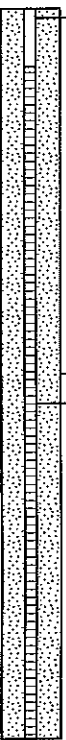
ODT049
Project Manager: Bill Biehl

Date Started : 09-04-2007
Date Completed : 09-04-2007
Logged By : M. Bell
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : 4 1/4" HSA
Sampling Method : 5' Macrocore
Total Depth : 35'

LOG OF BORING MW-25

(Page 2 of 2)

PID Model : Minirae - 10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels	DESCRIPTION	
						 Sample Interval  Lab Sample	 Static  During drilling		
20	60/48	SS-1 20.0-22.0	0.0					Grey coarse SAND and GRAVEL.	 2" PVC Riser Sand 2" PVC Screen
21								Same as above, 21'.	
22		22.0-25.0	0.0					Grey fine to coarse SAND, trace gravel, wet.	
23									
24									
25	60/60	SS-2 25.0-27.0	0.0					Grey SAND and GRAVEL, wet.	
26									
27		27.0-29.0	0.0					Same as above.	
28									
29		29.0-30.0	0.0					Same as above.	
30	60/60	SS-3 30.0-32.0	0.0					Grey medium SAND, wet.	
31									
32		32.0-34.0	0.0					Grey silty CLAY, some fine gravel, slightly plastic, slightly moist.	
33									
34		34.0-35.0	0.0					Same as above, 1/2 fine sand seam at 34'.	
35								EOB @ 35'	
36									
37									
38									
39									
40									

Ohio Department of Transportation
Pilot Study
Newark, Ohio

ODT049
project Manager: Bill Biehl

Date Started : 09-04-2007
Date Completed : 09-04-2007
Logged By : M. Beil
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : 4 1/4" HSA
Sampling Method : 5' Macrocore
Total Depth : 35'

LOG OF BORING MW-24

(Page 1 of 2)

PID Model : Minirae - 10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels	DESCRIPTION	Well: MW-24
						Sample Interval Lab Sample	▼ Static ▽ During drilling		
0								Straight Drill to 15 ft.	Protective casing
1									Concrete
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15	60/48	SS-1 15.0-17.0	0.0					Brown coarse SAND, some medium sand, some gravel, trace silt, slightly moist to moist.	2" PVC Riser Bentonite Chips
16									
17		17.0-20.0	0.0					Same as above.	
18									
19									
20									Sand

Ohio Department of Transportation
Pilot Study
Newark, Ohio

ODT049
project Manager: Bill Biehl

Date Started : 09-04-2007
Date Completed : 09-04-2007
Logged By : M. Beil
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : 4 1/4" HSA
Sampling Method : 5' Macrocore
Total Depth : 35'

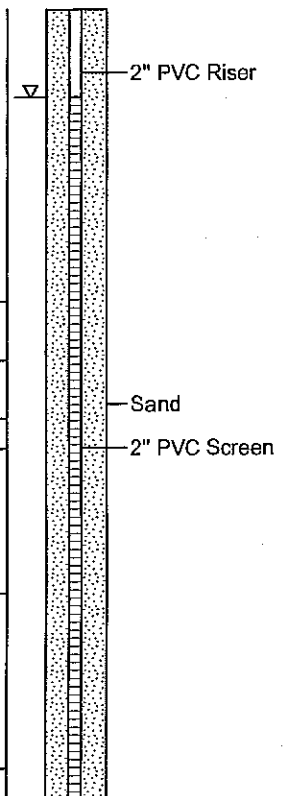
LOG OF BORING MW-24

(Page 2 of 2)

PID Model : Minirae - 10.6
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels	DESCRIPTION
						☒ Sample Interval ■ Lab Sample	▼ Static ▽ During drilling	
20	60/48	SS-2 20.0-22.0	0.0	■				Brown coarse SAND, some gravel, trace clay and silt.
21								Same as above, wet.
22		22.0-25.0	0.0	■				
23								
24								
25	60/48	SS-3 25.0-27.0	0.0	■				Grey medium to coarse SAND, wet.
26								Grey SAND and GRAVEL, wet.
27		27.0-30.0	0.0	■				Grey clayey SILT, wet.
28								Grey SAND and GRAVEL, wet.
29								
30	60/48	SS-4 30.0-32.0	0.0	■				Grey medium to coarse SAND, wet.
31								
32		32.0-35.0	0.0	☒				
33								Grey silty CLAY, some fine gravel, slightly plastic, slightly moist.
34								
35								EOB @ 35'

Well: MW-24



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Ohio Department of Transportation
Pilot Study
Newark, Ohio
ODT049
Bill Biehl

Date Started : 9/4/07
Date Completed : 9/4/07
Logged By : M. Beil
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : Direct Push
Sampling Method : Dual Tube
Total Depth : 35'

LOG OF BORING SB-26

(Page 1 of 2)

PID Model : 10.6 Minirae
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels
						☐ Sample Interval ☐ Lab Sample	☐ Static ☐ During drilling
DESCRIPTION							
0						Straight Drill to 20'.	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							



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Ohio Department of Transportation
Pilot Study
Newark, Ohio
ODT049
Bill Biehl

Date Started : 9/4/07
Date Completed : 9/4/07
Logged By : M. Bell
Reviewed By : M. McCoy
Drilling Contractor : Envirocore
Drilling Method : Direct Push
Sampling Method : Dual Tube
Total Depth : 35'

LOG OF BORING SB-26

(Page 2 of 2)

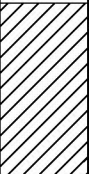
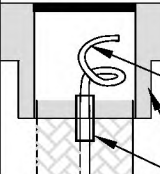
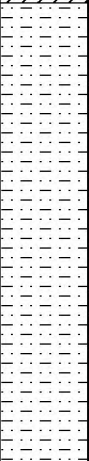
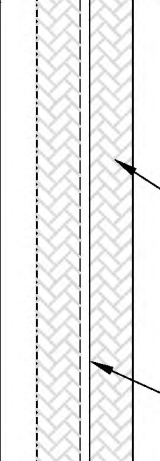
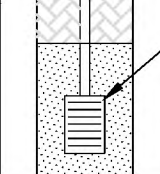
PID Model : 10.6 Minirae
PID Calibration : 100 ppm ISO

Depth in Feet	Length Drive/ Sample Recovery (in.)	Sample Number/ Sample Interval	PID	Sample	GRAPHIC	Soil Samples	Water Levels
						 Sample Interval  Lab Sample	 Static  During drilling
DESCRIPTION							
20	60/54	SS-1 20.0 - 22.0	NM			Brown red SAND and GRAVEL, wet.	
21						Grey fine to coarse SAND and GRAVEL, wet.	
22		22.0 - 22.5	NM				
23							
24							
25	60/60	SS-2 25.0 - 27.0	NM			Red SAND and GRAVEL.	
26							
27		27.0 - 30.0	NM			Same as above, fine to medium.	
28						Fractured LIMESTONE.	
29						Grey SILT.	
30	60/60	SS-3 30.0 32.0	NM			Fine to medium SAND.	
31						Grey fine to medium SAND.	
32		32.0 - 35.0	NM			Grey silty CLAY.	
33							
34							
35						EOB @ 35'	
36							
37							
38							
39							
40							

BORING LOG / SOIL GAS WELL CONSTRUCTION DIAGRAM

SGW-13

Client:	Ohio Department of Transportation	Northing:	139,913	Easting:	1,990,119
Location:	Former District 5 Headquarters 115½ Malholm Street, Newark, Ohio	▽ Depth to 1st water (feet BGS):	None		
		▼ Static Water Depth (feet BGS):	NA	Elevation:	NA
Project Number:	7362 19 1133.07	Date:	NA		
Geologist:	Rich Cherico	Ground Surface Elevation (feet):	Not measured		
Date Drilled:	04/16/2020	Top of Casing Elevation (feet):	Not applicable		
		Total Depth (feet BGS):	7.0		

GRAPHIC LOG	DEPTH (FEET)	DESCRIPTION	SOIL GAS WELL COMPLETION DATA	SOIL GAS WELL CONSTRUCTION INFORMATION	SAMPLE INFORMATION		COMMENTS
					BLOW COUNTS	SAMPLE RECOVERY (FEET)	
	1	Asphalt and Granular Fill		Flush Mount Cap in Concrete Pad Extra Tubing with Stopcock Coiled Inside Cap Concrete 2" PVC Pipe	Hand Augered	3.0/3.0	
	2						
	3	Sandy Clay with Silt (CL) - some gravel, moist, brown.		Benseal Backfill 1/4" OD Teflon Tubing	Not Applicable	2.5/4.0	
	4						
	5						
	6	Sand (SC) - fine to coarse, some gravel, dry, brown.		6" Stainless Steel Soil Vapor Implant 4" Sand above Implant Screened Interval 6.3'-6.8' BGS Bottom of Implant at 6.8' BGS 3" Sand below Implant Total Depth at 7.0' BGS			
	7						
	8	End of Boring at 7.0' BGS.					
	9						

Driller: Envirocore, Inc.	Comments: BGS - Below ground surface NA - Not Applicable	Prepared By: RLB Checked By: RJC
Drilling/Sampling Method (type & size): Direct Push Dual Tube		
Screened Interval: 6.3' - 6.8' BGS	SGW-13 wood.	
Screen Size: 0.15 mm pore		
Well Material: ¼-inch O.D. Teflon Tubing		
Grout Type: Bentonite grout		

Bore ID: MW-26

Project No.: H13048-11

Project: Fmr. ODOT District 5 Headquarters

HZW Representative: SCS/JAH

Location: 115 1/2 Maholm Street, Newark, Ohio

SWL:



HZW ENVIRONMENTAL
CONSULTANTS, LLC

Drill Date: 12/9/2013

Drilled By: HzW Environmental

Drill Method: Hollow-Stem Auger/Auger Ret

Sample Method: Geoprobe Direct Push

TOC Elevation: 0

SWL Date:

Depth (feet)	Symbol	Description	PID (ppm)	Remarks
0		Ground Surface		
1		Brown CLAY w/ trace sand, dry, firm		Flushmount Friction Cap
2				
3				
4				
5		Brown sandy CLAY w/ small gravel, dry, firm		
6				
7				
8				2" PVC Riser
9				
10		Brown and gray coarse SAND w/ gravel, dry		
11		Trace clay from 15-20 feet		
12				Bentonite
13				
14				
15				
16				
17				
18				
19				
20		Brown medium to coarse SAND w/ gravel, wet		
21				
22				
23				2" PVC Screen (0.01-slot)
24				
25		Gray SILT w/ trace sand and shale fragments, moist		
26				Sand Pack
27				
28				
29				
30				
31		End of Bore		



Log of Borehole: MW-3R

Project No.: H16016-12

Project: ODOT District 5 HQ

HZW Representative: BJL

Location: 115 1/2 Maholm St., Newark, Ohio

Drill Date: 10/4/2016

Drilled By: Envirocore

Drill Method: Direct Push/HSA

Sample Method: Auger Return

Depth (ft)	Symbol	Description	PID (ppm)	Well Completion Details	Comments
-3					
-2					
-1					
0		Ground Surface			
1		**LITHOLOGY FROM MW-3 WELL LOG**			
2		Black and dark gray FILL with sand, gravel and asphalt.			Concrete (0-1')
3		Dark brown and orange FILL with sand, gravel and asphalt.			
4					
5					Bentonite (1-15.5')
6					
7					
8		Brown GRAVEL with alternating layers of medium to coarse and fine to medium grained sand.			2" PVC Riser (-3-17.5')
9					
10					
11					
12					
13					
14					
15					
16					
17					
18		Gray GRAVEL with medium to coarse grained sand, wet at 20 feet.			0.010" Slotted PVC Screen (17.5-27.5')
19					
20					
21					
22					
23					
24					
25		Gray SILTY CLAY.			Sand Pack (15.5-27.5')
26					
27					
28		End of Bore			
29					
30					
31					



HZW
Environmental
Consultants

Log of Borehole: MW-4R

Project No.: H17023-06

Project: ODOT District 5 HQ

HZW Representative: BJL

Location: 115 1/2 Maholm St., Newark, Ohio

Drill Date: 3/23/2017

Drilled By: Envirocore

Drill Method: Direct Push/HSA

Sample Method: Dual Tube

Depth (ft)	Symbol	Description	PID (ppm)	Well Completion Details	Comments
-3					
-2					
-1					
0		Ground Surface			
1		**LITHOLOGY LOGGED IN FIELD BY FIELD GEOLOGIST**			Concrete (0-1')
2		Brown medium SAND w/ small gravel, moist			
3		Trace clay from 6-12 feet			
4					
5					
6					
7					
8					Bentonite (1-18')
9					
10					
11					
12		Brown medium SAND w/ small gravel, moist			2" PVC Riser (-3-20')
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					2" 0.010-Inc Slotted PVC Screen (20-30')
23					
24		Gray silty CLAY, moist, firm			
25					
26					Sand Pack (18-30')
27		Brown coarse SAND & GRAVEL, moist becomes saturated at 28 feet			
28					
29		Gray SILT w/ clay and gravel, moist, firm			
30					
31					
32		Gray coarse SAND w/ gravel and sandstone			
33					
34		End of Bore			



HZW
Environmental
Consultants

Log of Borehole: MW-6R

Project No.: H17023-06

Project: ODOT District 5 HQ

HZW Representative: BJL

Location: 115 1/2 Maholm St., Newark, Ohio

Drill Date: 3/22/2017

Drilled By: Envirocore

Drill Method: Direct Push/HSA

Sample Method: Dual Tube

Depth (ft)	Symbol	Description	PID (ppm)	Well Completion Details	Comments
0		Ground Surface			
0		**LITHOLOGY LOGGED IN FIELD BY FIELD GEOLOGIST**			
1		CONCRETE			Concrete (0-1')
2		Gray GRAVEL			
3					
4		Brown medium and coarse SAND w/ small gravel, moist			Bentonite (1-10')
5					
6					
7					
8					
9					2" PVC Riser (-3-12')
10					
11					
12		Brown medium and coarse SAND w/ some large gravel and trace silt, moist			
13		Becomes saturated at 16 feet			
14					
15					2" 0.010-Inc Slotted PVC Screen (12-22')
16					
17					
18		Brown fine grading to coarse SAND w/ some large gravel and trace silt, saturated			
19					Sand Pack (10-22')
20					
21					
22		Gray CLAY, firm			
23		End of Bore			



Log of Borehole: MW-7R

Project No.: H17023-06

Project: ODOT District 5 HQ

HZW Representative: BJL

Location: 115 1/2 Maholm St., Newark, Ohio

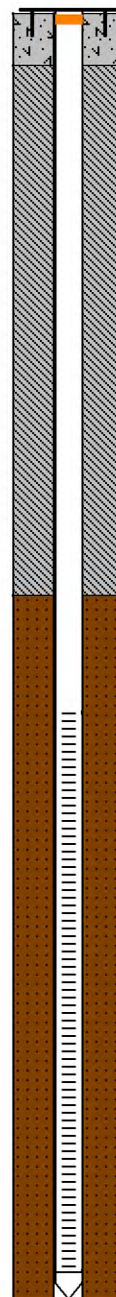
Drill Date: 3/23/2017

Drilled By: Envirocore

Drill Method: Direct Push/HSA

Sample Method: Dual Tube

Depth (ft)	Symbol	Description	PID (ppm)	Well Completion Details	Comments
0		Ground Surface			
1		**LITHOLOGY LOGGED IN FIELD BY FIELD GEOLOGIST**			
1		CONCRETE			Concrete (0-1')
2		Crushed LIMESTONE (#57 stone)			
3		Brown medium SAND w/ small gravel, moist			
4		Trace silt from 5-8 feet			
5		With sandstone fragments from 16-19 feet			
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20		Gray coarse SAND, saturated			
21		Gray SANDSTONE			
22		Gray coarse SAND, saturated			
23		Gray medium silty SAND, moist			
24		End of Bore			





Log of Borehole: MW-10R

Project No.: H17023-06

Project: ODOT District 5 HQ

HZW Representative: BJL

Location: 115 1/2 Maholm St., Newark, Ohio

Drill Date: 3/22/2017

Drilled By: Envirocore

Drill Method: Direct Push/HSA

Sample Method: Dual Tube

Depth (ft)	Symbol	Description	PID (ppm)	Well Completion Details	Comments
0		Ground Surface			
1		**LITHOLOGY LOGGED IN FIELD BY FIELD GEOLOGIST** ASPHALT and FILL			Concrete (0-1')
2		Brown sandy CLAY w/ some gravel, moist, firm			
3					
4					Bentonite (1-10.5')
5					
6					
7					
8					
9					2" PVC Riser (0-12.5')
10					
11					
12		Brown medium SAND w/ gravel, moist			
13					
14					
15					2" 0.010-Inc Slotted PVC Screen (12.5-22.5')
16		Brown medium SAND w/ gravel, saturated			
17					
18					
19					Sand Pack (10.5-22.5')
20		Gray coarse SAND w/ gravel, saturated			
21					
22					
23		Gray CLAY w/ sandstone fragments			
24		Gray SANDSTONE			

CLIENT: **ODOT**
 PROJECT NAME: **ODOT District 5**
 LOCATION: **115 1/2 Maholm Street, Newark, Ohio 43055**
 PROJECT NO: **3031221133.06.01**
 GEOLOGIST: **R. Hicks**
 DATE DRILLED: **7/10/2023**

NORTHING:
 EASTING:
 GROUND SURFACE ELEVATION (feet):
 TOP OF CASING ELEVATION (feet):
 TOTAL DEPTH OF BORING (feet bgs): **32**

TMW-AR

SHEET **1** OF **1**

STRATA	DEPTH FEET	DESCRIPTION	WELL CONSTRUCTION DETAIL	SAMPLE INFORMATION			
				Sample Interval (feet)	Recovery (feet / feet)	PID Reading (ppm)	COMMENTS
		TOPSOIL	Procover	0 - 2	2 / 2	8.1	Hand Augered.
	2	SAND (SW), fine to medium, brown, dry to moist, loose		2 - 4	2 / 2	20.8	Hand Augered
	4	SAND (SP), fine to coarse, with clay, trace gravel, dark gray, moist, loose to compact		4 - 6	1 / 2	36.2	
	6	SILTY CLAY (CL), little fine sand, reddish brown, dry to moist, firm to soft, low plasticity		6 - 8	1.2 / 2	0.6	
	8	NO RECOVERY		8 - 10	1 / 2	1.0	
	10	SILTY CLAY (CL), reddish brown to brown, moist, soft to firm, low plasticity	Bentonite Seal	10 - 12	0.6 / 2	0.7	
	12	SAND (SW), fine to coarse, with fine to medium gravel, trace clay, brown, moist, loose		12 - 14	0.6 / 2	1.0	
	14	NO RECOVERY		14 - 16	1 / 2	1.5	
	16	SAND (SW), fine to coarse, trace to little gravel, brown, very moist, loose		16 - 18	1.8 / 2	2.5	
	18	NO RECOVERY		18 - 20	1.8 / 2	4.3	
	20	NO RECOVERY	#5 Washed Silica Sand	20 - 22	0 / 2	NA	
	22	SAND and GRAVEL (SP-GP), medium to coarse sand, fine to coarse gravel, some clay, brown, saturated, loose.		22 - 24	1.8 / 2	1.4	
	24	SAND (SP), fine sand, some fine to coarse gravel, gray, saturated, loose	0.010 inch prepacked well Screen	24 - 26	1.4 / 2	1.1	
	26	SAND (SP), fine, brown, saturated, loose		26 - 28	2 / 2	12.9	
	28	SAND (SW), medium to coarse, trace fine gravel, brown, saturated, loose		28 - 30	2 / 2	2.5	
	30	SAND (SW), fine, trace gravel, gray, saturated, loose		30 - 32	2 / 2	0.1	
	32	SILTY SAND (SM), gray, saturated, loose	#5 Washed Silica Sand				
		SAND (SP), fine, little silt, trace gravel, gray, saturated, loose					
		SILTY CLAY (CL), trace sand, gray, saturated, very stiff					
		SILT (ML), trace clay, gray, saturated, dense					
		CLAY (CL), trace sand, gray, saturated, very stiff					
		SILT (ML), trace clay, gray, saturated, dense					
		SILTY CLAY (CL), trace sand, gray, saturated, very stiff					

Driller: Envirocore
 Method (type & size): HSA
 Screened Interval (ft. bgs): 20-30
 Screen Size: 0.010-inch slot
 Well Material: 2-inch I.D., schedule 40 PVC
 Grout Type: Bentonite Chips

REMARKS

Prepared & Checked by: **RLH/RJC**

wsp

WSP USA
 Miamisburg, Ohio Office: (937) 859-3600

APPENDIX D

VISL CALCULATOR RESULTS (TRIGGER LEVELS) FOR SOIL GAS, INDOOR AIR AND GROUNDWATER (COMMERCIAL/INDUSTRIAL AND RESIDENTIAL LAND USES)

EPA-OLEM VAPOR INTRUSION ASSESSMENT
Vapor Intrusion Screening Level (VISL) Calculator Version 3.5.1 (May 2016 RSLs)

The primary objective of risk-based screening is to identify sites or buildings unlikely to pose a health concern through the vapor intrusion pathway. Generally, at properties where subsurface concentrations of vapor-forming chemicals (e.g., groundwater or "near source" soil gas concentrations) fall below screening levels (i.e., VISLs), no further action or study is warranted, so long as the exposure assumptions match those taken into account by the calculations and the site fulfills the conditions and assumptions of the generic conceptual model underlying the screening levels. In a similar fashion, the results of risk-based screening can help the data review team identify areas, buildings, and/or chemicals that can be eliminated from further assessment. The generic conceptual model underlying these screening levels is described in OSWER Publication 9200.2-154 (OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway From Subsurface Vapor Sources to Indoor Air) (EPA 2015; Section 6.5)

Parameter	Symbol	Value	Instructions
Exposure Scenario	Scenario	Commercial	Select residential or commercial scenario from pull down list
Target Risk for Carcinogens	TCR	1.00E-05	Enter target risk for carcinogens
Target Hazard Quotient for Non-Carcinogens	THQ	1	Enter target hazard quotient for non-carcinogens
Average Groundwater Temperature (°C)	Tgw	11	Enter average of the stabilized groundwater temperature to correct Henry's Law Constant for groundwater target concentrations

CAS		Does the chemical meet the definition for volatility?	Does chemical have inhalation toxicity data?	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Soil Source?	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Groundwater Source?	Target Indoor Air Conc. @ TCR = 10E-06 or THQ = 1	Toxicity Basis	Target Sub-Slab and Exterior Soil Gas Conc. @ TCR = 10E-06 or THQ = 1	Target Ground Water Conc. @ TCR = 10E-06 or THQ = 1	Is Target Ground Water Conc. < MCL?	Pure Phase Vapor Conc. @ 25°C	Maximum Groundwater Vapor Conc.	Temperature for Max. Groundwater Vapor Conc.	Lower Explosive Limit**	LEL Source	Inhalation Unit Risk	IUR Source*	Reference Concentration	RFC Source*	Mutagenic Indicator i	Target Indoor Air Conc. for Carcinogens @ TCR = 10E-06	Target Indoor Air Conc. for Non-Carcinogens @ THQ = 1	
				Cvp > Cia,target?	Chc > Cia,target?	MIN(Cia,c,Cia,nc)		Csg	Cgw	Cgw<MCL?	Cvp	Chc	Tgw or 25	LEL							Cia,c	Cia,nc	
				Chemical Name	Yes/No	Yes/No		(ug/m ³)	C/N/C	(ug/m ³)	(ug/L)	Yes/No (MCL ug/L)	(ug/m ³)	(ug/m ³)							C	(% by vol)	(ug/m ³) ⁻¹
x	67-64-1	Acetone	Yes	Yes	Yes	1.4E+05	NC	4.5E+06	1.8E+08	–	7.23E+08	7.64E+08	11	2.6	E			3.10E+01	A		1.6E+01	1.4E+05	
x	71-43-2	Benzene	Yes	Yes	Yes	1.6E+01	C	5.2E+02	1.4E+02	No (5)	3.98E+08	2.07E+08	11	1.2	N	7.80E-06	I	3.00E-02	I		1.3E+02	1.3E+02	
x	56-23-5	Carbon Tetrachloride	Yes	Yes	Yes	2.0E+01	C	6.8E+02	3.5E+01	No (5)	9.52E+08	4.66E+08	11			6.00E-06	I	1.00E-01	I		2.0E+01	4.4E+02	
x	108-90-7	Chlorobenzene	Yes	Yes	Yes	2.2E+02	NC	7.3E+03	3.9E+03	No (100)	7.25E+07	2.80E+07	11	1.3	N			5.00E-02	P		2.2E+02	2.2E+02	
x	67-66-3	Chloroform	Yes	Yes	Yes	5.3E+00	C	1.8E+02	6.7E+01	Yes (8.0E+01(F)	1.27E+09	6.37E+08	11			2.30E-05	I	9.80E-02	A		5.3E+00	4.3E+02	
x	74-87-3	Chloromethane	Yes	Yes	Yes	3.9E+02	NC	1.3E+04	1.6E+03	–	1.17E+10	1.29E+09	11	8.1	N			9.00E-02	I			3.9E+02	
x	75-34-3	Dichloroethane, 1,1-	Yes	Yes	Yes	7.7E+01	C	2.6E+03	6.2E+02	–	1.21E+09	6.23E+08	11	5.4	N	1.60E-06	CA				7.7E+01		
x	107-06-2	Dichloroethane, 1,2-	Yes	Yes	Yes	4.7E+00	C	1.6E+02	2.0E+02	No (5)	4.20E+08	2.04E+08	11	6.2	N	2.60E-05	I	7.00E-03	P		4.7E+00	3.1E+01	
x	75-35-4	Dichloroethylene, 1,1-	Yes	Yes	Yes	8.8E+02	NC	2.9E+04	1.4E+03	No (7)	3.13E+09	1.52E+09	11	6.5	N			2.00E-01	I			8.8E+02	
x	156-59-2	Dichloroethylene, 1,2-cis-	Yes	No	No Inhal. Tox. Info	No Inhal. Tox. Info									M								
x	156-60-5	Dichloroethylene, 1,2-trans-	Yes	No	No Inhal. Tox. Info	No Inhal. Tox. Info					1.73E+09	9.49E+08	11	9.7	M								
x	75-09-2	Methylene Chloride	Yes	Yes	Yes	2.6E+03	NC	8.8E+04	3.5E+04	No (5)	1.99E+09	9.63E+08	11	13	N	1.00E-08	I	6.00E-01	I	Mut	1.2E+04	2.6E+03	
x	127-18-4	Tetrachloroethylene	Yes	Yes	Yes	1.8E+02	NC	5.8E+03	5.4E+02	No (5)	1.65E+08	6.74E+07	11			2.60E-07	I	4.00E-02	I		4.7E+02	1.8E+02	
x	108-88-3	Toluene	Yes	Yes	Yes	2.2E+04	NC	7.3E+05	1.7E+05	No (1000)	1.41E+08	6.67E+07	11	1.1	N			5.00E+00	I			2.2E+04	
x	71-55-6	Trichloroethane, 1,1,1-	Yes	Yes	Yes	2.2E+04	NC	7.3E+05	6.0E+04	No (200)	8.90E+08	4.71E+08	11	7.5	N			5.00E+00	I			2.2E+04	
x	79-01-6	Trichloroethylene	Yes	Yes	Yes	8.8E+00	NC	2.9E+02	4.4E+01	No (5)	4.88E+08	2.53E+08	11	8	N	see note	I	2.00E-03	I	TCE	3.0E+01	8.8E+00	
x	75-01-4	Vinyl Chloride	Yes	Yes	Yes	2.8E+01	C	9.3E+02	3.7E+01	No (2)	1.00E+10	6.60E+09	11	3.6	N	4.40E-06	I	1.00E-01	I	VC	2.8E+01	4.4E+02	

Notes:

(1)	Inhalation Pathway Exposure Parameters (RME):																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													</
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Mutagenic Chemicals

The exposure durations and age-dependent adjustment factors for mutagenic-mode-of-action are listed in the table below:

Note: This section applies to trichloroethylene and other mutagenic chemicals, but not to vinyl chloride.

Age Cohort	Exposure Duration (years)	Age-dependent adjustment factor
0 - 2 years	2	10
2 - 6 years	4	3
6 - 16 years	10	3
16 - 26 years	10	1

Mutagenic-mode-of-action (MMOA) adjustment factor 25 This factor is used in the equations for mutagenic chemicals.

See the Navigation Guide equation for Cia,c for vinyl chloride.

Notation:

NVT = Not sufficiently volatile and/or toxic to pose inhalation risk in selected exposure scenario for the indicated medium

C = Carcinogenic

NC = Non-carcinogenic

I = IRIS: EPA Integrated Risk Information System (IRIS). Available online at:

P = PPRTV, EPA Provisional Peer Reviewed Toxicity Values (PPRTVs). Available online at:

A = Agency for Toxic Substances and Disease Registry (ATSDR) Minimum Risk Levels (MRLs). Available online at:

CA = California Environmental Protection Agency/Office of Environmental Health Hazard Assessment assessments. Available online at:

H = HEAST. EPA Superfund Health Effects Assessment Summary Tables (HEAST) database. Available online at:

S = See RSL User Guide, Section 5

X = PPRTV Appendix

E = The Engineering ToolBox. Available online at http://www.engineeringtoolbox.com/explosive-concentration-limits-d_423.html

N = Centers for Disease Control and Prevention (CDC) National Institute for Occupational Safety and Health (NIOSH). Pocket Guide to Chemical Hazards. Available online at:

M = Chemical-specific MSDS

Mut = Chemical acts according to the mutagenic-mode-of-action, special exposure parameters apply (see footnote (4) above).

VC = Special exposure equation for vinyl chloride applies (see Navigation Guide for equation).

TCE = Special mutagenic and non-mutagenic IURs for trichloroethylene apply (see footnote (4) above).

Yellow highlighting indicates site-specific parameters that may be edited by the user.

Blue highlighting indicates exposure factors that are based on Risk Assessment Guidance for Superfund (RAGS) or EPA vapor intrusion guidance, which generally should not be changed.

**Lower explosive limit is the minimum concentration of the compound in air (% by volume) that is needed for the gas to ignite and explode.

<http://www.epa.gov/iris/subst/index.html>

<http://hhpprtv.ornl.gov/pprtv.shtml>

<http://www.atsdr.cdc.gov/mrls/index.html>

<http://www.oshha.ca.gov/risk/ChemicalDB/index.asp>

<http://epa-heast.ornl.gov/heast.shtml>

<http://www.cdc.gov/niosh/npg/default.html>

<http://www.cdc.gov/niosh/npg/default.html>

Summary of Proposed Commercial/Industrial Target Levels Indoor Air, Soil Gas, and Groundwater*					
Parameter	Toxicity Basis ⁺	Target Indoor Air Concentration (µg/m ³)	Target Soil Gas Concentration (µg/m ³)		Target Ground Water Concentration (µg/L)
Acetone	NC	1.4E+05	4.5E+06		1.8E+08
Benzene	C	1.6E+01	5.2E+02		1.4E+02
Carbon Tetrachloride	C	2.0E+01	6.8E+02		3.5E+01
Chlorobenzene	NC	2.2E+02	7.3E+03		3.9E+03
Chloroform	C	5.3E+00	1.8E+02		6.7E+01
Chloromethane	NC	3.9E+02	1.3E+04		1.6E+03
1,1-Dichloroethane	C	7.7E+01	2.6E+03		6.2E+02
1,2-Dichloroethane	C	4.7E+00	1.6E+02		2.0E+02
1,1-Dichloroethylene	NC	8.8E+02	2.9E+04		1.4E+03
Methylene Chloride	NC	2.6E+03	8.8E+04		3.5E+04
Tetrachloroethylene	NC	1.8E+02	5.8E+03		5.4E+02
Toluene	NC	2.2E+04	7.3E+05		1.7E+05
1,1,1-Trichloroethane	NC	2.2E+04	7.3E+05		6.0E+04
Trichloroethylene	NC	8.8E+00	2.9E+02		4.4E+01
Vinyl Chloride	C	2.8E+01	9.3E+02		3.7E+01
1,2-cis-Dichloroethylene			No Inhal. Tox. Info		No Inhal. Tox. Info
1,2-trans-Dichloroethylene			No Inhal. Tox. Info		No Inhal. Tox. Info

Notes

* Target oncentrations are based on HI=1 and excess cancer risk of 1.0E-05.

+ Calculated value based on cancer (C) or non-cancer risk (NC) risk.

EPA-OLEM VAPOR INTRUSION ASSESSMENT

Vapor Intrusion Screening Level (VISL) Calculator Version 3.5.1 (May 2016 RSLs)

The primary objective of risk-based screening is to identify sites or buildings unlikely to pose a health concern through the vapor intrusion pathway. Generally, at properties where subsurface concentrations of vapor-forming chemicals (e.g., groundwater or "near source" soil gas concentrations) fall below screening levels (i.e., VISLs), no further action or study is warranted, so long as the exposure assumptions match those taken into account by the calculations and the site fulfills the conditions and assumptions of the generic conceptual model underlying the screening levels. In a similar fashion, the results of risk-based screening can help the data review team identify areas, buildings, and/or chemicals that can be eliminated from further assessment. The generic conceptual model underlying these screening levels is described in OSWER Publication 9200.2-154 (OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway From Subsurface Vapor Sources to Indoor Air) (EPA 2015; Section 6.5)

Parameter	Symbol	Value	Instructions
Exposure Scenario	Scenario	Residential	Select residential or commercial scenario from pull down list
Target Risk for Carcinogens	TCR	1.00E-05	Enter target risk for carcinogens
Target Hazard Quotient for Non-Carcinogens	THQ	1	Enter target hazard quotient for non-carcinogens
Average Groundwater Temperature (°C)	Tgw	11	Enter average of the stabilized groundwater temperature to correct Henry's Law Constant for groundwater target concentrations

CAS		Does the chemical meet the definition for volatility?	Does chemical have inhalation toxicity data?	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Soil Source?	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Groundwater Source?	Target Indoor Air Conc. @ TCR = 10E-06 or THQ = 1	Toxicity Basis	Target Sub-Slab and Exterior Soil Gas Conc. @ TCR = 10E-06 or THQ = 1	Target Ground Water Conc. @ TCR = 10E-06 or THQ = 1	Is Target Ground Water Conc. < MCL?	Pure Phase Vapor Conc. @ 25°C	Maximum Groundwater Vapor Conc.	Temperature for Max. Groundwater Vapor Conc.	Lower Explosive Limit**	LEL Source	Inhalation Unit Risk	IUR Source*	Reference Concentration	RFC Source*	Mutagenic Indicator	Target Indoor Air Conc. for Carcinogens @ TCR = 10E-06	Target Indoor Air Conc. for Non-Carcinogens @ THQ = 1	
				Cvp > Cia,target?	Chc > Cia,target?	MIN(Cia,c,Cia,nc)		Csq	Cqw	Cpw<MCL?	Cvp	Chc	Tgw or 25	LEL							Cia,c	Cia,nc	
				Yes/No	Yes/No	(ug/m³)		C/NC	(ug/m³)	(ug/L)	(MCL ug/L)	(ug/m³)	C	(% by vol)							(ug/m³) ⁻¹	(mg/m³)	(ug/m³)
x	67-64-1	Acetone	Yes	Yes	Yes	3.2E+04	NC	1.1E+06	4.2E+07	–	7.23E+08	7.64E+08	11	2.6	E			3.10E+01	A			3.2E+04	
x	71-43-2	Benzene	Yes	Yes	Yes	3.1E+00	C	1.0E+02	2.7E+01	No (5)	3.98E+08	2.07E+08	11	1.2	N		I	3.00E-02	I		3.1E+00	3.1E+01	
x	56-23-5	Carbon Tetrachloride	Yes	Yes	Yes	4.1E+00	C	1.4E+02	6.9E+00	No (5)	9.52E+08	4.66E+08	11				I	1.00E-01	I		4.1E+00	1.0E+02	
x	108-90-7	Chlorobenzene	Yes	Yes	Yes	5.2E+01	NC	1.7E+03	9.3E+02	No (100)	7.25E+07	2.80E+07	11	1.3	N			5.00E-02	P			5.2E+01	
x	67-66-3	Chloroform	Yes	Yes	Yes	1.1E+00	C	3.5E+01	1.3E+01	Yes (8.0E+01(F)	1.27E+09	6.37E+08	11				I	9.80E-02	A		1.1E+00	1.0E+02	
x	74-87-3	Chloromethane	Yes	Yes	Yes	9.4E+01	NC	3.1E+03	3.9E+02	–	1.17E+10	1.29E+09	11	8.1	N			9.00E-02	I			9.4E+01	
x	75-34-3	Dichloroethane, 1,1-	Yes	Yes	Yes	1.5E+01	C	5.1E+02	1.2E+02	–	1.21E+09	6.23E+08	11	5.4	N		CA				1.5E+01		
x	107-06-2	Dichloroethane, 1,2-	Yes	Yes	Yes	9.4E-01	C	3.1E+01	3.9E+01	No (5)	4.20E+08	2.04E+08	11	6.2	N		I	7.00E-03	P		9.4E-01	7.3E+00	
x	75-35-4	Dichloroethylene, 1,1-	Yes	Yes	Yes	2.1E+02	NC	7.0E+03	3.3E+02	No (7)	3.13E+09	1.52E+09	11	6.5	N			2.00E-01	I			2.1E+02	
x	156-59-2	Dichloroethylene, 1,2-cis-	Yes	No	No Inhal. Tox. Info										M								
x	156-60-5	Dichloroethylene, 1,2-trans-	Yes	No	No Inhal. Tox. Info						1.73E+09	9.49E+08	11	9.7	M								
x	75-09-2	Methylene Chloride	Yes	Yes	Yes	6.3E+02	NC	2.1E+04	8.5E+03	No (5)	1.99E+09	9.63E+08	11	13	N		I	6.00E-01		I	Mut	1.0E+03	6.3E+02
x	127-18-4	Tetrachloroethylene	Yes	Yes	Yes	4.2E+01	NC	1.4E+03	1.3E+02	No (5)	1.65E+08	6.74E+07	11				I	4.00E-02	I		9.4E+01	4.2E+01	
x	108-88-3	Toluene	Yes	Yes	Yes	5.2E+03	NC	1.7E+05	4.1E+04	No (1000)	1.41E+08	6.67E+07	11	1.1	N			5.00E+00	I			5.2E+03	
x	71-55-6	Trichloroethane, 1,1,1-	Yes	Yes	Yes	5.2E+03	NC	1.7E+05	1.4E+04	No (200)	8.90E+08	4.71E+08	11	7.5	N			5.00E+00	I			5.2E+03	
x	79-01-6	Trichloroethylene	Yes	Yes	Yes	2.1E+00	NC	7.0E+01	1.1E+01	No (5)	4.88E+08	2.53E+08	11	8	N		I	2.00E-03	I	TCE	4.4E+00	2.1E+00	
x	75-01-4	Vinyl Chloride	Yes	Yes	Yes	1.6E+00	C	5.4E+01	2.1E+00	No (2)	1.00E+10	6.60E+09	11	3.6	N		I	1.00E-01	I	VC	1.6E+00	1.0E+02	

Notes:

(1) Inhalation Pathway Exposure Parameters (RME):

Exposure Scenario
Averaging time for carcinogens
Averaging time for non-carcinogens
Exposure duration
Exposure frequency
Exposure time

Units

(yrs)
(yrs)
(yrs)
(days/yr)
(hr/day)

Residential

Symbol Value
ATc_R 70
ATnc_R 30
ED_R 30
EF_R 350
ET_R 24

Commercial

Symbol Value
ATc_C 70
ATnc_C 25
ED_C 25
EF_C 250
ET_C 8

Selected (based on scenario in cell G10)

Symbol Value
ATc 70
ATnc 30
ED 30
EF 350
ET 24

(2) Generic Attenuation Factors:

Source Medium of Vapors
Groundwater
Sub-Slab and Exterior Soil Gas

(-)
(-)

Residential

Symbol Value
AFgw_R 0.001
AFss_R 0.03

Commercial

Symbol Value
AFgw_C 0.001
AFss_C 0.03

Selected (based on scenario in cell G10)

Symbol Value
AFgw 0.001
AFss 0.03

(3) Formulas

Cia, target = MIN(Cia,c; Cia,nc)
Cia,c (ug/m3) = TCR x ATc x (365 days/yr) x (24 hrs/day) / (ED x EF x ET x IUR)
Cia,nc (ug/m3) = THQ x ATnc x (365 days/yr) x (24 hrs/day) x RfC x (1000 ug/mg) / (ED x EF x ET)

(4) Special Case Chemicals

Trichloroethylene

Residential

Symbol Value
mIURTCE_R 1.00E-06
IURTCE_R 3.10E-06

Commercial

Symbol Value
mIURTCE_C 0.00E+00
IURTCE_C 4.10E-06

Selected (based on scenario in cell G10)

Symbol Value
mIURTCE 1.00E-06
IURTCE 3.10E-06

Mutagenic Chemicals

The exposure durations and age-dependent adjustment factors for mutagenic-mode-of-action are listed in the table below:

Age Cohort	Exposure Duration (years)	Age-dependent adjustment factor
0 - 2 years	2	10
2 - 6 years	4	3
6 - 16 years	10	3
16 - 26 years	10	1

Mutagenic-mode-of-action (MMOA) adjustment factor

72

This factor is used in the equations for mutagenic chemicals.

See the Navigation Guide equation for Cia,c for vinyl chloride.

Notation:

NVT = Not sufficiently volatile and/or toxic to pose inhalation risk in selected exposure scenario for the indicated medium

C = Carcinogenic

NC = Non-carcinogenic

I = IRIS: EPA Integrated Risk Information System (IRIS). Available online at:

P = PPRTV: EPA Provisional Peer Reviewed Toxicity Values (PPRTVs). Available online at:

A = Agency for Toxic Substances and Disease Registry (ATSDR) Minimum Risk Levels (MRLs). Available online at:

CA = California Environmental Protection Agency/Office of Environmental Health Hazard Assessment assessments. Available online at:

H = HEAST. EPA Superfund Health Effects Assessment Summary Tables (HEAST) database. Available online at:

S = See RSL User Guide, Section 5

X = PPRTV Appendix

E = The Engineering ToolBox. Available online at http://www.engineeringtoolbox.com/explosive-concentration-limits-d_423.html

N = Centers for Disease Control and Prevention (CDC) National Institute for Occupational Safety and Health (NIOSH). Pocket Guide to Chemical Hazards. Available online at:

M = Chemical-specific MSDS

Mut = Chemical acts according to the mutagenic-mode-of-action, special exposure parameters apply (see footnote (4) above).

VC = Special exposure equation for vinyl chloride applies (see Navigation Guide for equation).

TCE = Special mutagenic and non-mutagenic IURs for trichloroethylene apply (see footnote (4) above).

Yellow highlighting indicates site-specific parameters that may be edited by the user.

Blue highlighting indicates exposure factors that are based on Risk Assessment Guidance for Superfund (RAGS) or EPA vapor intrusion guidance, which generally should not be changed.

**Lower explosive limit is the minimum concentration of the compound in air (% by volume) that is needed for the gas to ignite and explode.

Summary of Proposed Residential Target Levels Indoor Air, Soil Gas, and Groundwater*					
Parameter	Toxicity Basis ⁺	Target Indoor Air Concentration (µg/m ³)	Target Soil Gas Concentration (µg/m ³)		Target Ground Water Concentration (µg/L)
Acetone	NC	3.2E+04	1.1E+06		4.2E+07
Benzene	C	3.1E+00	1.2E+02		3.1E+01
Carbon Tetrachloride	C	4.1E+00	1.4E+02		6.9E+00
Chlorobenzene	NC	5.2E+01	1.7E+03		9.3E+02
Chloroform	C	1.1E+00	3.5E+01		1.3E+01
Chloromethane	NC	9.4E+01	3.1E+03		3.9E+02
1,1-Dichloroethane	C	1.5E+01	5.1E+02		1.2E+02
1,2-Dichloroethane	C	9.4E-01	3.1E+01		3.9E+01
1,1-Dichloroethylene	NC	2.1E+02	7.0E+03		3.3E+02
Methylene Chloride	NC	6.3E+02	2.1E+04		8.5E+03
Tetrachloroethylene	NC	4.2E+01	1.4E+03		1.3E+02
Toluene	NC	5.2E+03	1.7E+05		4.1E+04
1,1,1-Trichloroethane	NC	5.2E+03	1.7E+05		1.4E+04
Trichloroethylene	NC	2.1E+00	7.0E+01		1.1E+01
Vinyl Chloride	C	1.6E+00	5.4E+01		2.1E+00
1,2-cis-Dichloroethylene			No Inhal. Tox. Info		No Inhal. Tox. Info
1,2-trans-Dichloroethylene			No Inhal. Tox. Info		No Inhal. Tox. Info

Notes

* Target oncentrations are based on HI=1 and excess cancer risk of 1.0E-05.

+ Calculated value based on cancer (C) or non-cancer risk (NC) risk.

APPENDIX E

VERIFICATION OF LAND USE



HZW
Environmental
Consultants

**Former ODOT District 5 Headquarters Facility Unit C
115½ Maholm Street, Newark, Licking County, Ohio**

**Post-Closure Plan
Appendix E
Land Use Verification of Properties Where Monitoring Is Conducted**

A tabular summary of the land uses for the properties monitored or included as part of the Former Ohio Department of Transportation District 5 Headquarters Facility Unit C Post-Closure Plan is presented as **Attachment 1**. As indicated in Attachment 1, 14 properties are comprised of vacant land with no structures present and the remaining five (5) properties are used for commercial or industrial purposes. One (1) industrial property that is developed with an industrial warehouse building, 99 James Street, is currently vacant. The second industrial property is occupied by the Modern Welding Company for the manufacture of underground and aboveground storage tanks. The commercial properties, 100 James Street and 107 South Pine Street, are occupied by Consumer Support Services, an adult day habilitation facility. Specific information on the use and operations of the buildings occupied by Consumer Support Services is presented below. A copy of an electronic mail correspondence between HZW and Consumer Support Services verifying use and operations of Consumer Support Services is presented as **Attachment 2**.

- The Consumer Support Services facilities located at 100 James Street and 107 South Pine Street are open weekdays (Monday through Friday) between the hours of 8:00 a.m. and 4:00 p.m.
- The Consumer Support Services facilities are not open on weekends or legal holidays.
- Full-time and part-time Consumer Support Services employees are at the facilities during the hours of 8:00 a.m. to 4:00 p.m.
- Clients (adults) are at the facilities for five-hour periods Monday through Friday. Clients arrive in two (2) shifts: the first in early morning; the second in late morning.

ATTACHMENT 1

TABULAR SUMMARY OF LAND USES



**Summary of Land Use Associated with the Former ODOT District 5 Headquarters Facility
Newark, Ohio**

Street Address	Parcel Number(s)	Owner	Zoning	Current Use
115½ Maholm Street	054-186854-00.000	Ohio Department of Transportation	Limited Industrial District	Vacant land (no structures)
115½ Maholm Street	054-186860-00.000	Ohio Department of Transportation	Limited Industrial District	Vacant land (no structures)
75 James Street	054-223590-00.000	Ohio Department of Transportation	High Density Single Family Residence	Vacant land (no structures)
79 James Street	054-223938-00.000	Ohio Department of Transportation	High Density Single Family Residence	Vacant land (no structures)
83 James Street	054-228720-00.000	Ohio Department of Transportation	High Density Single Family Residence	Vacant land (no structures)
85 James Street	054-229584-00.000	Ohio Department of Transportation	High Density Single Family Residence	Vacant land (no structures)
84 James Street	054-226560-00.000	Ohio Department of Transportation	General Commercial District	Vacant land (no structures)
88 James Street	054-217932-00.000	Ohio Department of Transportation	General Commercial District	Vacant land (no structures)
121 South Pine Street	054-217944-00.000	Ohio Department of Transportation	High Density Single Family Residence	Vacant land (no structures)
123 South Pine Street	054-221784-00.000	Ohio Department of Transportation	High Density Single Family Residence	Vacant land (no structures)
133 South Pine Street	054-230238-00.000	Ohio Department of Transportation	High Density Single Family Residence	Vacant land (no structures)
133 South Pine Street	054-221154-00.000	Ohio Department of Transportation	High Density Single Family Residence	Vacant land (no structures)
143 South Pine Street	054-220626-00.000	Ohio Department of Transportation	Limited Industrial District	Vacant land (no structures)
South Pine Street	054-228810-00.000	Ohio Department of Transportation	Limited Industrial District	Vacant land (no structures)
99 James Street	054-216756-00.000	99 James Partners, Ltd.	Limited Industrial District	Vacant industrial warehouse building (vacant as of 8/28/2017)
100 James Street	054-216762-00.000	SN Properties, LLC	General Commercial District	Adult day habilitation (Consumer Support Services)
92 James Street	054-227982-00.000	SN Properties, LLC	General Commercial District	Parking lot associated with 100 James Street (no structures)
107 South Pine Street	054-216750-00.000	99 James Partners, Ltd.	Limited Industrial District	Adult day habilitation (Consumer Support Services)
Waldo Street/68 Waldo Street	054-216864-00.000	Modern Welding Company of Ohio, Inc.	Limited Industrial District	Manufacture of underground and aboveground storage tanks

ATTACHMENT 2

COPY OF ELECTRONIC MAIL CORRESPONDENCE



Doug Wetzel

From: Steve Daye <Steve.Daye@cssohio.org>
Sent: Wednesday, July 26, 2017 6:14 AM
To: Doug Wetzel
Subject: Re: 100 James Street & 107 South Pine Street Facilities, Newark

The conversation I had with Doug about 100 James st.
and 107 pine st.the information is all correct. I hope that we can continue work together and keeping me up to date and
what is going on our property.thank Steve Daye. Call or email me if you need anything.

Steve daye

On Jul 25, 2017, at 3:26 PM, Doug Wetzel <DWetzel@hzwenv.com> wrote:

Steve,

Thanks for your time on the phone last week regarding Consumer Support Services' facilities located at 100 James Street and 107 South Pine Street in Newark. Below is a summary of our conversation that I would appreciate if you could review and confirm that the summary is correct or indicate the areas where I am mistaken.

- The facilities at 100 James Street and 107 South Pine Street are open weekdays (Monday through Friday) between the hours of 8:00 a.m. and 4:00 p.m.
- The facilities are not open on weekends or legal holidays.
- Full-time and part-time employees are at the facilities during the hours of 8:00 a.m. to 4:00 p.m.
- Clients are at the facilities for five-hour periods Monday through Friday. Clients arrive in two (2) shifts: one in the early morning and one in the late morning.

Let me know if you have any questions. I appreciate your help!

Thanks,
Doug

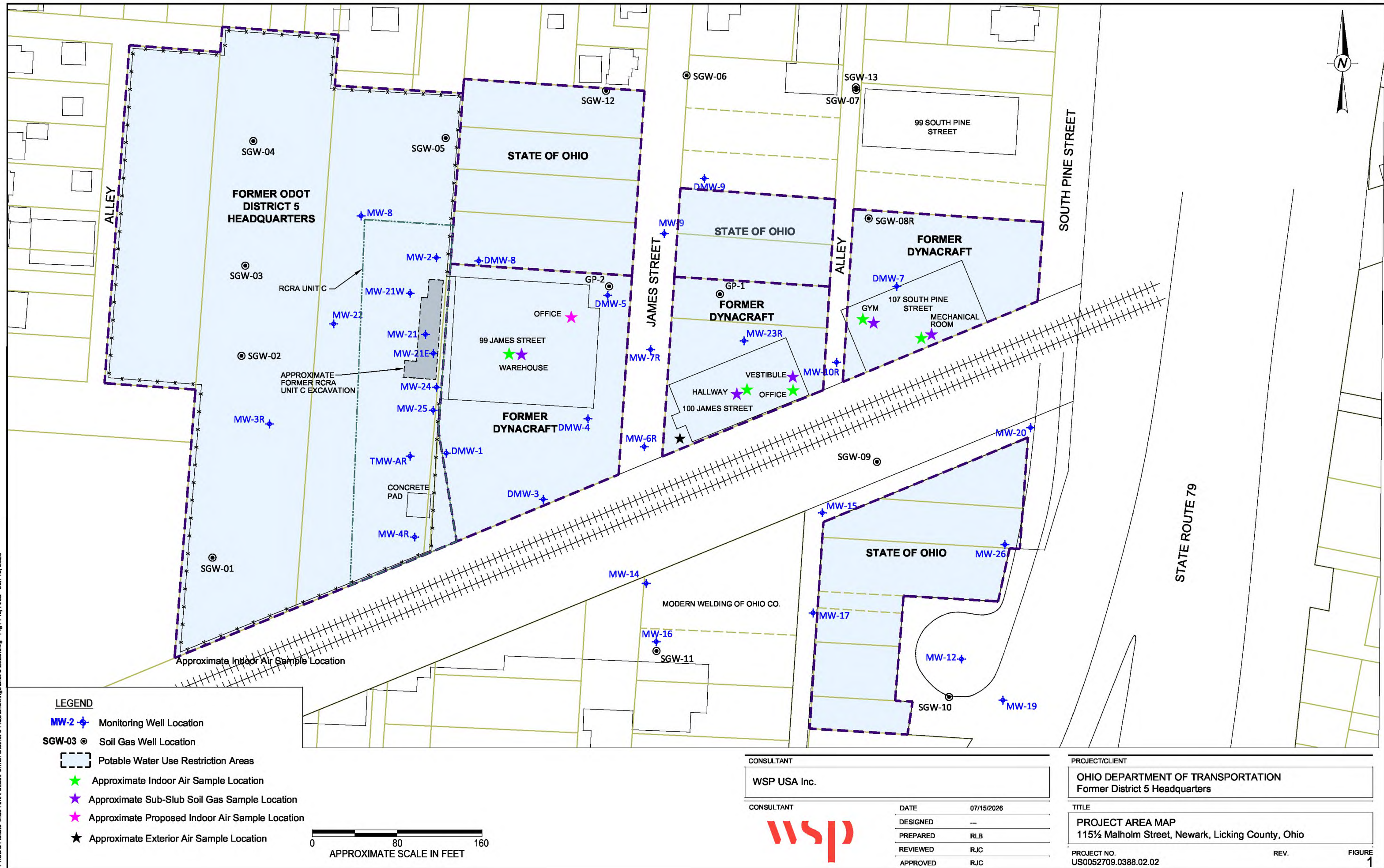
Douglas M. Wetzel
Group Leader, Phase II ESA
HZW Environmental Consultants, LLC
6105 Heisley Road
Mentor, Ohio 44060
440.357.1260 (phone)
800.804.8484 (toll free)
440.357.1510 (fax)
dwetzel@hzwenv.com
<image002.jpg>

ATTACHMENTS

ATTACHMENT C

FIGURE 1

P:\ODOT\State-wide RMR Sites\Former District 5 HQs\Drawings\Dist 5 2025.dwg - Fig1 Proj Area - Jul. 15, 2026



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