# RCRA CORRECTIVE ACTION FACILITY INVESTIGATION WORKPLAN

## FORMER HAYES LEMMERZ SITE
## FERNDALE, OAKLAND COUNTY, MICHIGAN
## SITE ID NUMBER: MID 041 803 123
## WASTE DATA SYSTEM NUMBER: 395519

**PREPARED FOR:**

Michigan Department of Environment, Great Lakes, and Energy
Hazardous Waste Section, Materials Management Division
Lansing District Office
525 West Allegan Street
Constitution Hall, 1st Floor, South
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**PREPARED BY:**

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February 17, 2022

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February 17, 2022

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Dear Mr. Rogers:

Atlas Technical Consultants LLC (Atlas), on behalf of Axle Holdings 1, LLC, is pleased to present this Resource Conversation and Recovery Act (RCRA) Corrective Action Facility Investigation (RFI) Workplan for the Former Hayes Lemmerz Site located at the northwestern corner of West Eight Mile Road and Pinecrest Road, Ferndale (Oakland County), Michigan.

If you have any questions, please call us at (248) 669-5140.

Respectfully submitted,
**Atlas Technical Consultants LLC**

Andrew Stuart
National Program Director

Ryann Scott
Project Geologist

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# 1. INTRODUCTION

Atlas Technical Consultants LLC (Atlas), formerly known as ATC Group Services, LLC (ATC), has been retained by Axle Holdings 1, LLC (Client) to prepare a Resources Conservation and Recovery Act (RCRA) Facility Investigation Workplan (RFI Workplan) in accordance with the RCRA Corrective Action Plan (May, 1994) for the former Hayes Lemmerz Site located on West Eight Mile Road, Ferndale, Oakland County, Michigan (Site). Corrective action will occur via a Corrective Action Consent Order that is being drafted by the Michigan Department of Environment, Great Lakes and Energy (EGLE) that will be negotiated between the two parties.

The Site is a former hazardous waste storage facility regulated under Part 111, Hazardous Waste Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, and its administrative rules (Act 451). The Site is identified as Environmental Protection Agency (EPA) ID Number MID 041 803 123. Under Part 111, an owner or operator of such facilities is subject to corrective action to establish environmental protection standards based on zoning and intended land use.

# 2. DESCRIPTION OF CURRENT CONDITIONS

Current Site conditions were identified in ATC's (now known as Atlas) *RCRA Corrective Actions, Description of Current Conditions and Interim Measures Report (CCR)*, prepared on behalf of Axle Holdings 1, LLC, a revised report of which was submitted on September 21, 2021 incorporating EGLE's comments of August 5, 2021.

## 2.1 Site Location Information

The Site is located on West Eight Mile Road in Ferndale, Oakland County, Michigan, on the north side of West Eight Mile Road between Mitchelldale Avenue and Pinecrest Drive. The Site consists of two parcels totaling approximately 34 acres, as shown on Site Details Map (**Figure 1**).

## 2.2 Site and Vicinity General Characteristics

The Site is located in an area characterized by commercial business, light industrial, and residential use within the limits of the City of Ferndale, at the southern border of Oakland County. The Site is zoned light industrial (M-1) according to the City of Ferndale online Zoning Map Application. The adjacent parcels to the west, north and east are zoned light industrial, and predominately residential, with some commercial properties lining the major corridor to the south. Refer to the Site Details Map (**Figure 1**).

## 2.3 Current Use of Site

As described in detail in Section 3.0, the Site was formerly developed and used from the 1930s until 2012, when it was razed from 2012 to 2013. The current use is as partially graded, vacant land.

## 2.4 Intended Future Use of Site

The intended future use of the southern portion of the Site is for the construction of an additional industrial/warehouse/distribution building for the western adjacent Detroit Axle operation. There are no current plans for the remaining portions of the Site.

## 2.5 Topographic Setting

The Site is located in the west ½ of the southeast ¼ of Section 33, Township 1 North, Range 11 East, on the United States Geological Survey (USGS) 7.5 Minute Topographic Map, *Detroit, Michigan Quadrangle,* dated 1985. The Site is approximately 665 feet above mean sea level. The topography across the Site and surrounding area is relatively flat with a gentle slope to the east, as shown on Site Details Map, **Figure 1**.

## 2.6 Hydrogeologic Setting

The Site is located in the Clinton River drainage basin (HUC8: 0409003) of the River Rouge, which discharges to Lake St. Clair. The nearest surface-water body to the Site is a pond on the Woodlawn Cemetery located approximately 5,160 feet east/southeast of the Site. No wetlands were identified on the National Wetlands Inventory in the vicinity of the Site.

The USDA Soil Survey map of the area identifies surficial soils at the Site as primarily Fortress Family loamy sand with 0 to 6 percent slopes, which typically formed in sandy human-transported materials on the near-shore slopes of water-lain moraines and are characterized as moderately well drained with very low runoff potential. The EGLE GeoWebFace database identifies the Site as lying within a lacustrine sand and gravel plain overlying Upper Devonian-aged Antrim Shale. The brown to black pyritic organic-rich shale is identified as 60 to 200 feet thick in the area, with the bedrock surface approximately 100 to 150 feet below surface grade (bsg).

According to prior reports, Oakland County Health Department records indicate that a 560-foot deep well was installed at the Site by Corsault Well Drilling looking for a source of cooling water; however, the well was terminated in dry shale. Atlas has performed a search of the EGLE Wellogic database of historical scanned water well records to obtain a copy of this well log, however a well log was not found. Although the detailed description of bedrock lithology is not currently available for the Site, there are other wells in the general area that confirm the depth to bedrock and general lithology.

The nearest water-supply well identified in the EGLE Wellogic database for the area is a well installed by Consumers Energy approximately one mile northwest (upgradient) of the Site. The well log indicated a shale water bearing zone present at approximately 130 feet bsg, with approximately 129 feet of overburden consisting of a mix of gravel, gray clay and/or sandy clay. The water-bearing shale unit was approximately 140 feet in depth, and was underlain by dolomite at approximately 273 feet, extending to the boring terminus depth of 277 feet bsg.

Based on review of soil boring logs for the Site from current and previous Site investigations, the southern portion of the Site contains native sand of various grain size to approximately 20 feet bsg. The sand layer is followed by a clay layer approximately 115 feet thick that extends to bedrock. Up to five feet of discontinuous fill containing brick, concrete, and glass debris have been observed in various locations, overlying approximately 20 to 23 feet of loose native sand above the clay that then extends to bedrock.

On the northern portion of the property, the native sand is interbedded with clay, silty clay, and sandy clay. Boring logs for the Site can be found in Appendix C of the CCR. Cross sectional maps are presented in Appendix A of the CCR. These cross-sections help form the basis for the conceptual site model (CSM) that will be refined as additional RFI work is completed.

Groundwater generally is encountered between 8 to 11 feet bsg. Groundwater gradient maps completed for the April and June 2020 groundwater sampling events presented in the CCR indicate groundwater flow direction to be toward the east-southeast.

# 3. FACILITY BACKGROUND

## 3.1 General Site Information and History of Ownership

The Site occupies the northwest corner of the intersection of West Eight Mile Road and Pinecrest Drive. The Site was developed as a multi-building research and development facility for chemical additives for gasoline products from the 1930s until the 1980s. Manufacturing operations took over the facility from the 1980s until 2012. Site buildings were demolished in 2012 and 2013.

Various Site historical building plans identified up to 38 buildings or building wings over time. Underground tunnels reportedly linked several of the southern buildings and several of the buildings reportedly were bunkered with earthen mounds as protection in the event of explosions. The locations of known tunnels can be found on **Figure 1**. However, the possibility remains that there are additional unmapped tunnels.

Additional investigation will be required to determine whether additional tunnels may exist on-site. As additional information is identified, the CSM and cross sections will be updated. Buildings were reportedly heated principally by central natural gas steam systems that also reportedly extended along the underground tunnels.

The Site was developed in stages from the 1930s until 2012 when demolition of the entire Site began. A summary of the former ownership at the Site is as follows:

- Ethyl Corporation (Ethyl) from 1936 to 1987;
- CMI purchased the site though a holding company (TC Realty) in 1987;
- TC Realty changed name to HLI Realty (operating as Hayes Lemmerz International) in 1999;
- HLI Realty transferred to Cedan Holdings VI, LLC 2012;
- Cedan Holdings VI transferred to Pinecrest Holdings, LLC purchased May 4, 2016;
- Pinecrest Holdings, LLC entered into a Land Contract with Axle Holdings 1, LLC (for a 6 acre portion of the Site) and a Land Contract with Axle Holdings 2, LLC (for a 28 acre portion of the Site).

## 3.2 Historical Facility Operations

Historical operations at the Site by Ethyl included blending of fuels, foundry, service, and maintenance operations, chemical storage, incineration, and laboratory testing. Subsequent manufacturing operations by CMI-Tech Center (after 1987), TC Realty, Inc. (in the early 1990s), and Hayes Lemmerz International (after 1999) included researching various casting and molding processes, integrity testing automotive parts, computer-aided product assembly and product testing, and other engineering and analysis testing. The Site has been vacant following demolition activities which ended in 2013. A summary of the former buildings and their uses on the Site includes:

| Building ID | Description of Former Building Use |
|---|---|
| A | Executive Offices, Printing, Cafeteria, Library, and Machine Shop |
| B | Experimental Operations, Machine Shop, Vehicle Servicing, and Ref. Technology |
| C | Engine Research and Dynamometer, Fuel Testing, Control Testing |
| DA | Chemical Research, Executive Offices, and Patent Department |
| E | Office, Auto Application Department, and Large Engine Dynamometer Testing |
| F | Maintenance, Pipe Shop, Carpenter Shop, Glass Blower Shop, and Manufacturing |
| H | Fueling and Oil Blending |
| J | Fuel Storage |
| M | Chemical Development Lab, Heavy Equipment and Manufacturing |
| N | Chemical Storage |
| O | Maintenance Storage |
| Q | Guard Shack |
| AL | Vehicle Fueling |
| AN | Emissions Laboratory, Dynamometer Testing Area, Dipping Operations, and Manufacturing |
| AC | Active Metal Storage |
| AH | Chemical Engineering Products |
| L | Bulk Chemicals |
| U | Chemical Res. And Pilot Plant |
| AF | Drum Storage |
| AJ | Can Storage |
| AB | Can Storage |
| R | Fleet Building |
| K | Chemical Supplies Storage |
| P | Chemical Storage |

### 3.2.1 Former Waste Generation

Ethyl submitted an application for a permit for the generation and storage of hazardous waste generated during the research and development activities at the facility. The Part A Hazardous waste permit application listed spent solvent waste codes for the container storage of 6,400 pounds of F002 waste; 5,600 pounds of F004 waste; and 21,000 pounds of F005 waste. These wastes were listed as ignitable (D001), corrosive (D002), reactive (D003), and toxic (D000). During RCRA facility inspections conducted by the Michigan Department of Natural Resources (MDNR) in the early 1980s, it was noted that Ethyl was generating organophosphate waste, 1,800 gallons of waste oil, and 4,500 gallons of waste gasoline.

TC Realty, Inc. (TCR) generated waste primarily from testing and analyzing automotive products. TCR generated mineral spirits wastes (D001) from cleaning machinery that tested automotive parts. TCR also generated hydraulic oil and motor oil wastes from automotive testing.

### 3.2.2 Former Waste Storage

According to a Preliminary Assessment/Visual Site Inspection Report, prepared by PRC Environmental in 1994, there were four former solid waste management units (SWMU) located at the Site. Ethyl submitted a notification of hazardous waste activity to EPA on August 6, 1980. The facility submitted a RCRA Part A Permit application on November 14, 1980. The application listed container storage (S01) of up to 5,000 gallons of hazardous waste with the following waste codes: F002 (6,400 pounds); F004 (5,600 pounds); and F005 (21,000 pounds).

Ethyl submitted a closure plan for its hazardous waste storage area SWMU-1 (former drum storage area) on June 3, 1983, which was approved by the EPA on October 11, 1983. The closure was reportedly completed and certified by the MDEQ on February 14, 1984 as a Clean Closure. A FOIA request was sent to EGLE on September 15, 2021 requesting the correspondence that certifies the Clean Closure. According to an EGLE response of September 24, 2021, "After a search, to the best of this public body's knowledge, information, and belief, the public record(s) do not exist as described by you, or by another name or description reasonably known to the public body; therefore, your request to examine or receive a copy of the documents described above is denied." Ethyl did not file any further permit applications for EPA hazardous waste activity after February 1984. TCR stored mineral spirits waste in a 500-gallon aboveground storage tank and waste oils were stored in 55-gallon drums at the SWMU-1 location.

### 3.2.3 Former Waste Disposal

Ethyl maintained no records for the generation, storage or disposal of waste onsite. However, according to correspondence from Ethyl to the Oakland County Health Department in 1985, laboratory wastes, residues, used glassware, foundry sands, and containers reportedly were buried in pits in the northern, central, and eastern portions of the Site from 1939 to the early 1980s. Oakland County Health Department records identified 11 pits in the vicinity of former Building AE in the northwestern portion of the Site. These locations have not been confirmed with geophysical or sampling investigations. The 11 pits are associated with AOC 2 (previously identified as SWMU 2).

Other disposal pits were reported north of former Building AI and in the vicinity of the eastern parking lot, where Ethyl reported that from about 1948 to 1962 metal pans containing residuals of the reaction of sodium compounds with water were disposed in shallow hand-dug holes. No information exists regarding disposal records or transportation for wastes generated by TCR. However, geophysical anomalies have been identified at several locations across the Site and will be investigated as part of the RFI to assess potential waste disposal pits. Refer to Sections 4.2 through 4.7 for further detail pertaining to proposed investigation activities.

### 3.2.4 Former Permits

Ethyl held a license from the U.S. Atomic Energy Commission (License #21-0064-01) from 1954 to 1957. According to the 2012 RJN Phase I ESA (RJN Environmental, 2012), the license was for the storage of a small amount of nuclear source material in the Soundproofing Room of Building C. A July 9, 1998 U.S. Nuclear Regulatory Commission (NRC) letter to CMI-Tech Center indicated that the license was terminated prior to 1985 and that there was insufficient information to justify closure. NRC requested access to perform an inspection of the Site. Inspection results and current permit status were not identified on available online databases.

Hayes-Lemmerz Technical Center, Inc. was identified as RCRA MID 041 803 123, with additional listings under alternative names as Hayes Lemmerz International Inc., Hayes Lemmerz Tech Svc Inc., Hayes Lemmerz Inc., and Hayes Lemmerz Technical Center Incorporated, Ethyl Corp. R&D Labs, and CMI Tech Center, Inc. The Conditionally Exempt Small Quantity Generator was first identified in 1980 and last reported in 2006 as a generator of ignitable hazardous waste (D001). Violations were identified in 1995, 2001, and 2005 for pre-transport and records/reporting concerns. In 2005, the EPA identified no records of generated waste shipped to off-site facilities, managed on-site, or received from another off-site facility.

The facility was added to the CERCLIS database by March 1986, with Preliminary Assessments performed in March 1986, February 1990, and March 1992 that determined the Site did not qualify for National Priority List (NPL) and deferred further response to RCRA Subtitle C. A CERCLIS NFAP determination was issued in December 1995. The TSDF was identified as potentially subject to Corrective Action in June 1992 and assigned a low corrective action priority. A CORRACTS Stabilization Measures Evaluation performed in June 1992 determined that insufficient information was available relative to the facility to support implementation of stabilization measures or feasibility evaluation.

Hayes-Lemmerz Technical Center, Inc. was identified on the ICIS-AIR database as Facility MI00000000000A4646 and as State Registration Number A4646, having the following operating status listings:

| PROGRAM CODE | PROGRAM DESCRIPTION | OPERATING STATUS |
|---|---|---|
| CAACFC | Stratospheric Ozone Protection | Permanently Closed |
| CAAFESOP | Federally Enforceable State Operating Permit – Non-Title V | Permanently Closed |
| CAAMACT | MACT Standards (40 CFR Part 63, Subpart RRR) | Permanently Closed |
| CAASIP | State Implementation Plan for National Primary and Secondary Ambient Air Quality Standards | Permanently Closed |
| CAATVP | Title V Permits | Permanently Closed |

### 3.2.5 Former Storage Tanks

The Site contained numerous unregistered Underground Storage Tanks (USTs) operated by Ethyl ranging in size from 500 to 10,000 gallons. The USTs were used to store gasoline for research and development. In the mid-1980s the Ferndale Fire Department oversaw the excavation of the USTs. Additionally, CMI operated one-15,000 gallon diesel UST and one-15,000 gallon gasoline UST. However, it is important to note that due to the lack of available documentation pertaining to regulated USTs (USTs which pre-date tank registration regulations) the exact amount of USTs previously located at the Site is currently unknown. A release (C-0185-96) of the CMI USTs was reported in 1996 and granted a Tier I Unrestricted LUST closure granted in 1998. A summary of the former storage tanks (65 USTs as provided to Atlas through historical documentation and/or previous reports) located on the Site is as follows:

**Summary of Former Underground Storage Tanks**

| Number of USTs | Size (gallons) | Contents | Location | Date Installed | Date Removed |
|---|---|---|---|---|---|
| 8 | 2,000 | Gasoline and/or diesel | West of former Building B | Unknown | 1985 |
| 15 | 500 | Unknown | North of former Building H | 1942 | 1985 |
| 11 | 1,000 | Unknown | North of former Building H | 1942 | 1985 |
| 4 | 5,000 | Unknown | North of former Building H | 1942 | 1985 |
| 4 | 10,000 | Unknown | North of former Building H | 1942 | 1985 |
| 14 | 1,000 | Unknown | North of former Building H | 1948 | 1985 |
| 4 | 10,000 | Unknown | North of former Building H | 1948 | 1985 |
| 3 | 1,000 | Unknown | Likely in the vicinity of former Buildings O, M, J, E, and/or L | Unknown | 1985 |
| 1 | 15,000 | Diesel | West of former Building C | 1988 | 2008 |
| 1 | 15,000 | Gasoline | West of former Building C | 1988 | 2008 |

### 3.2.6 Summary of Releases

The Site has previously been identified as a closed LUST site relative to one regulated gasoline UST. A release of gasoline was identified during the refueling of the 15,000-gallon gasoline UST and a secondary containment chamber boot failure occurred in 1996. The gasoline UST was located on the west side of Building C (inclusive to AOC 11). Following removal of 90 cubic yards of gasoline impacted soil, unrestricted Tier I LUST closure was granted by the MDEQ on February 4, 1998.

A release of heating oil from a former UST located near the north end of Building D was identified based on the 1995 presence of non-aqueous phase liquid (NAPL) in a nearby monitoring well. Because the heating oil UST was not registered, the release was not reported as a LUST.

As discussed above, there have been a number of known releases at the Site. It should be noted that presumptively there may have been other historical releases at the Site whose source is unknown. This is evidenced by the presence of contaminants in locations and types of contaminants other than where the known releases occurred. Historical petroleum and fuel additive releases are presumed to have occurred from multiple USTs formerly located in the south-central portion of the Site. This is evidenced by detected concentrations of multiple volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs), including ethylbenzene, naphthalene, methylnaphthalene, xylenes and trimethylbenzenes (TMBs) in soil and/or groundwater, as well as detections of perfluorinated compounds (per- and polyfluoroalkyl substances identified as PFAS) in groundwater within this area.

## 3.3 General Site Lithology/Hydrogeology

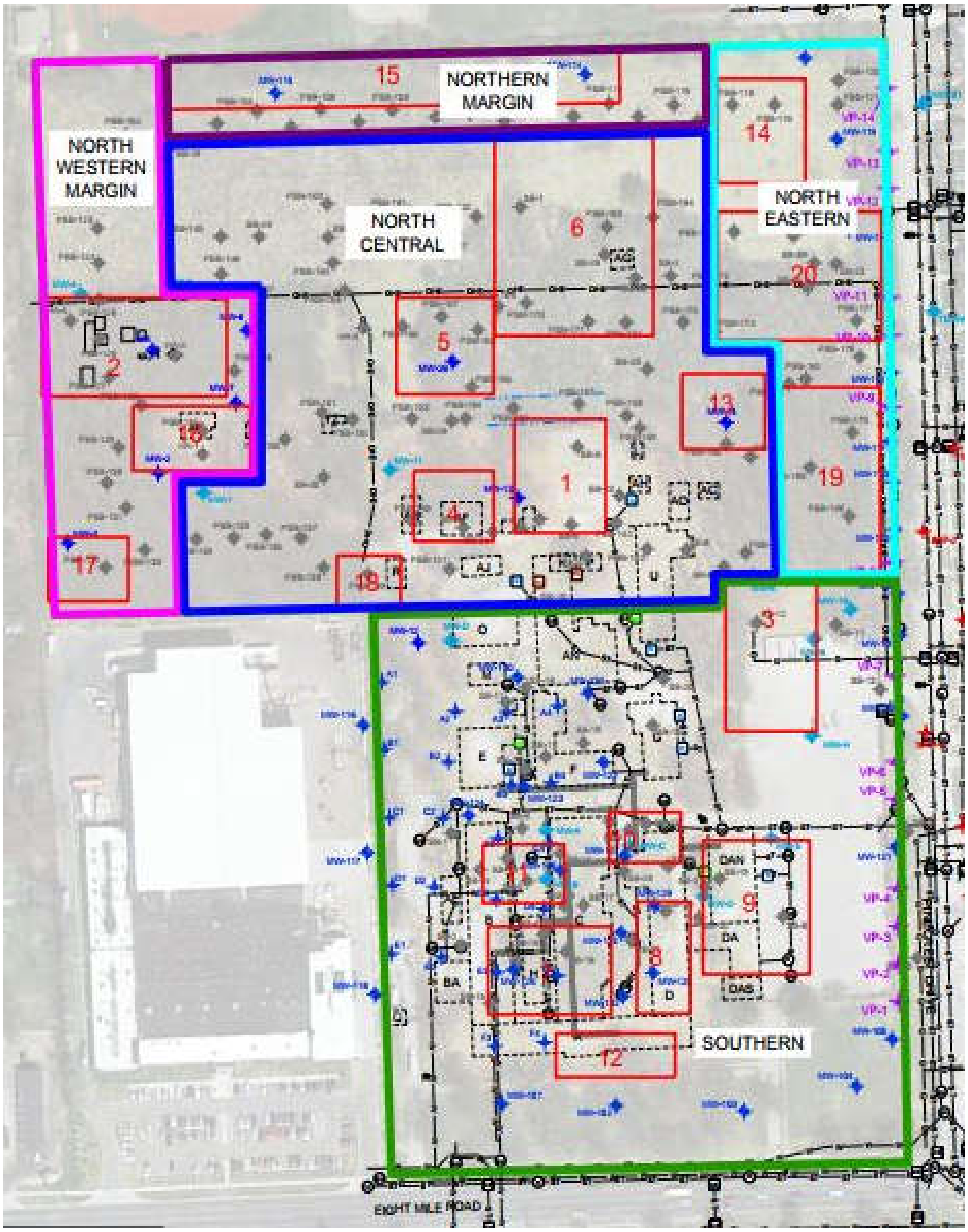
General site lithology derived from the historical and current subsurface investigations at the Site indicate up to five feet of discontinuous fill containing brick, concrete, and glass debris overlying approximately 20 to 23 feet of loose native sand above clay that extends more than 100 feet to bedrock. On the northern portion of the Site, the native sand is interbedded with clay, silty clay, and sandy clay. Groundwater generally is first encountered between 8 to 11 feet bsg and flows in an east-southeasterly direction.

Representative cross-sections are presented in the CCR. These cross sections provide a graphic depiction of general site lithology and form the physical basis of the CSM that will be refined as additional information is gathered as part of the ongoing RFI work. This will include evaluating where tunnels and utilities may be added onto the existing cross sections on a site-wide basis. Additionally, a cross section depicting the lithology/hydrogeology/utility corridors along the eastern boundary of the Site will be generated.

## 4. AREAS OF CONCERN (AOCS) AND INVESTIGATION PLANS

Atlas has divided the Site into twenty (20) areas of concern (AOC), based upon past use, identified SWMUs, geophysical anomalies, EMI survey data and soil, groundwater and soil vapor concentrations within those specific AOCs. For investigation purposes and importance of potential receptor risk, each individual AOC has been placed into the groups listed below. Proposed AOCs by Area is presented as **Figure 2** (a copy of which is pasted below for easy reference). The summarized scope of work for all AOCs is presented by Area/Margin in **Table 1** and soil boring/monitoring well/test pit locations for each AOC are presented in **Figures 3** through **7**.

Note that Axle Holdings 1, LLC has agreed to undertake a request by EGLE to investigate potential exposure issues for residents living along the Site's eastern property boundary prior to work being completed under this RFI. A work plan detailing the planned investigative work was submitted as part of the September 2021 CCR. Starting in November 2021, Atlas began this work at EGLE's direction installing soil vapor points and sampling those and a number of existing monitoring wells placed in close proximity to the eastern property boundary. Results of the Eastern Property Boundary work will be presented in a separate report in 2022 and the findings will subsequently be combined with the findings of other Site-wide RFI work planned for delineation and assessment purposes.



**Southern Area (area proposed for redevelopment for use by Axle Holdings 1 LLC):**

The southern portion of the Site is the first area planned to be investigated as part of the RFI. The Southern Area includes AOCs 3, 7, 8, 9, 10, 11 and 12, which constitutes the majority of the former building and operational areas. The initial RFI work is planned to start within two quarters of when the current Eastern Property Boundary work is completed, likely starting in the Fourth Quarter 2022 and will continue into the First Quarter 2023 including the first round of groundwater sampling for all of the wells in the Southern area (new and intact existing wells). A second round of groundwater sampling will be completed with one calendar quarter between rounds to allow for seasonality.

Depending on findings of the initial RFI in the Southern Area, additional delineation may be necessary. The scope of any additional delineation in the Southern Area will be proposed to EGLE, with work proceeding following approvals through the remainder of 2023.

Once EGLE has accepted Atlas' completed delineation of each phase, the next phase will be implemented. Timelines listed in this RFI Workplan are the best estimates at the time and are subject to change, as necessary. It is anticipated each consecutive RFI phase will begin within two quarters of the prior phase's completion. In the event of material deviations in scheduling or completion, Atlas will notify EGLE.

**Northern Half, which includes the following sub-groups:**

Northwestern Margin:

Work in the Northwestern Margin will begin within two quarters of completed delineation and reporting in the Southern Area. The Northwestern Margin includes AOCs 2, 16 and 17. This second phase of the RFI will likely start in 2024 and with two rounds of segregated groundwater sampling, potential additional delineation, and reporting is estimated to run through the Second or Third Quarter of 2025.

Northcentral Area:

Work in the Northcentral Area will begin within two quarters of completed delineation and reporting in the Northwestern Margin. The Northcentral Area includes AOCs 1, 4, 5, 6, 13 and 18. This third phase of the RFI will likely start in 2026 and with two rounds of segregated groundwater sampling, potential additional delineation, and reporting is estimated to run through the second or third quarter of 2027.

Northeastern Area:

Work in the Northeastern Area will begin within two quarters of completed delineation and reporting for the Northcentral Area. The Northeastern Area comprises the eastern property boundary adjacent to offsite residential areas. The Northeastern Area includes AOCs 14, 19 and 20. This fourth phase of the RFI will likely start in 2028 and with two rounds of segregated groundwater sampling, potential additional delineation, and reporting is estimated to run through the Second or Third Quarter of 2029.

Northern Margin:

Work in the Northern Margin will begin within two quarter of completed delineation and reporting in the Northeastern Area. The Northern Margin includes AOC 15. This fifth phase of the RFI will likely start in 2030 and with two rounds of segregated groundwater sampling, potential additional delineation, and reporting is estimated to be completed in the second or third Quarter of 2031.

**Site-Wide Items for Investigation:**

Atlas has additionally identified the need for a site-wide AOC, to create a holistic, site-wide approach to the investigation of the Site, when that makes logical sense to do so. The site-wide AOC will focus on vertical delineation of the geologic and hydrogeologic understanding of the overburden and the potential effects of areas and potentially preferential pathways may exist related to onsite features such as the former tunnels and utility corridors that are connected to, but not part of any individual AOC. This RFI work is expected to be completed in tandem with the Southern Half AOC Area work.

## 4.1 Site Investigation and Analytical Parameter List

Due to the nature and extent of various chemicals used, stored, managed, and disposed throughout the course of the history of the Site, Atlas has compiled the following **Site-Specific Comprehensive Constituent List (SSCCL)**, which will be utilized, at a minimum, during the analysis of all RFI soil and/or groundwater when indicated in the following sections below.

The **SSCCL** includes, but is not limited to:

- VOCs + tentatively identified compounds (TICs) (73 VOCs including MTBE, tetrahydrofuran, and 1,4-dioxane) plus 3 alcohols (methanol, ethanol, and n-butanol)
- SVOCs + TICs (61 SVOCs)
- Michigan List Part 201 Metals (28 metals including boron, molybdenum and strontium)

The specific list of contaminants of concern (COCs) for each of the categories above are presented in **Table 2**. These COC lists are the same as was analyzed for Site investigative work completed by Atlas in 2020-2022 prior to the implementation of this RFI Workplan with the addition of the TICs. TICs have been added to identify other potential COCs that may be present on-site, but not on the current VOC or SVOC target lists. If during the course of this RFI, specific COCs identified as part of the TICs analyses are prevalent, consideration will be given to modify the SSCCL to add these COCs.

In addition to the SSCCL, where indicated in the sections below, additional parameters may be run, which will include the following, when indicated, based on AOC-specific knowledge as to the AOC's known or suspected prior use:

- Hexavalent chromium
- PCBs (by individual Aroclor)

- Michigan List 28 PFAS
- tetraethyl lead
- dioxins/furans

The list of individual COCs for these additional parameters groups (i.e., PCBs, PFAS, and dioxin/furans) are also presented in **Table 2**. All site RFI media samples will be compared to their respective risk-based screening levels identified as Residential and Non-Residential Risk Based Screening Levels (RBSLs). The exception to this is soil gas and groundwater samples collected from the eastern boundary, which will be compared to Residential RBSLs, based upon the potential for off-site residential receptors. Note that additional discussion relative to Atlas 2021 investigation of the Eastern Property Boundary is discussed in Section 4.3.

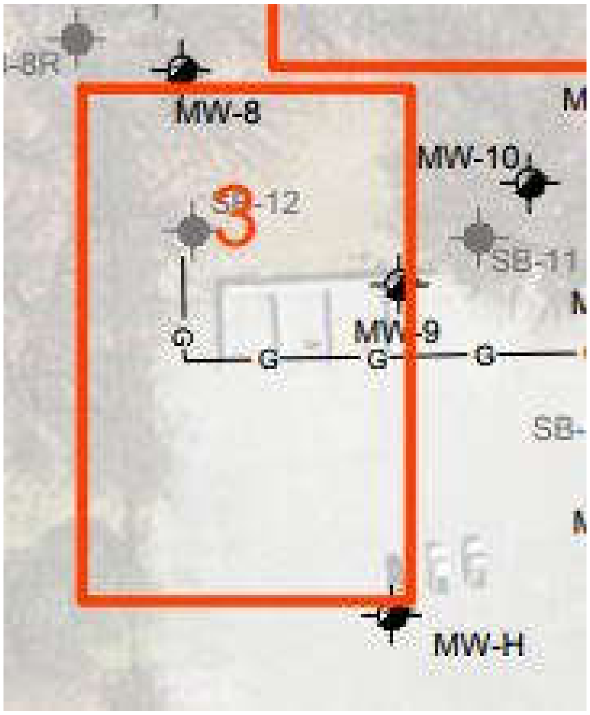
Each of the AOCs within a designated area or margin will be investigated simultaneously. Any additional assessment will be proposed and completed within six months of the reporting of the current RFI scope, as it is deemed necessary.

Groundwater sampling scoped in the AOCs includes two rounds of sampling spread approximately one quarter apart and will include all new and existing uncompromised wells. Well development will be completed prior to the first round of sampling. Some historic wells have not been encountered during recent sampling and any wells whose integrity is suspect prior to or at the time of sampling will not be sampled. Metals samples for groundwater will be field filtered.

## 4.2 Southern Area

AOCs 3, 7, 8, 9, 10, 11 and 12 are all included in the Southern Area that will be the focus of the first phase of the RFI. Description of known uses, investigative work completed so far, and proposed additional sampling scope to address horizontal and vertical delineation of the area is presented below. As stated above, start of the first phase of RFI in the Southern Area is planned to begin in the Third or Fourth Quarter of 2022 and is expected to be completed by the end 2023. Refer to **Figure 3** for a depiction of planned assessment locations pertaining to each AOC in the Southern Area.

### 4.2.1 AOC 3 – SWMU 3 – Former Burial Area



The area designated as SWMU-3 (as originally defined in a Preliminary Assessment/Visual Site Inspection Report (PRC Environmental,1994) is located within the eastern portion of the Site, within the northwest corner of the paved parking lot area. This location was a former burial area for various wastes utilized by Ethyl from approximately 1939 until 1955.

**Constituents of Concern/Objective:**

*Soil -*

A total of six soil borings (with three being converted to temporary monitoring wells) and four permanent monitoring wells were evaluated within and surrounding this AOC. Of the six soil borings installed, five soil samples were analyzed between the years 2012 and 2015: SB/TMW-8 (1-2'), SB-11 (10-12'), SB-12 (10-12'), SB-20 (10-12'), and PSB-144 (8-9'). Soil samples were not analyzed for borings SB/TMW-8R or monitoring wells MW-8, MW-9, MW-10 or MW-H.

The following COCs were detected:

- VOCs: 2-methylnapthalene at SB-11 (10-12') and SB-12 (10-12') and trichloroethylene at SB-12 (10-12').
- PNAs (full scan SVOC analysis was not conducted): none detected at PSB-144 (8-9'). The remainder of the soil samples were not analyzed for PNAs.
- Metals: arsenic, barium, chromium, copper, lead, and zinc at SB/TMW-8 (1-2') and PSB-144 (8-9'). Mercury was also detected at SB/TMW-8 (1-2').

- PCBs: none detected at SB/TMW-8 (1-2’). The remainder of the soil samples were not analyzed for PCBs.

*Groundwater -*

Groundwater analytical data for monitoring well MW-8 has not been disclosed and/or the well was not sampled historically. Groundwater samples collected in 2012 from MW-9, MW-10 and MW-H; as well as groundwater samples collected in 2015/2016 from temporary monitoring wells SB/TMW-8 and SB/TMW-8R, detected the following COCs (only bolded COCs exceeded their lowest respective screening criteria):

- VOCs: **1,2-dichlorobenzene (SB/TMW-8 and SB/TMW-8R)**; **trichloroethylene (MW-9 and MW-10)**; chlorobenzene (MW-9) and 1,4-dichlorobenzene (SB/TMW-8 and SB/TMW-8R).
- SVOCs (full SVOC screening was not completed): none detected.
- Metals: barium, copper and/or zinc (MW-10 and SB/TMW-8). The remainder of the wells were not analyzed for metals.
- PCBs: wells were not analyzed for PCBs.

Further delineation of VOCS and metals detected (in particular, 2-methylnapthalene, trichloroethylene and 1,2-dichlorobenzene) in soil and groundwater for COCs potentially associated with the reported buried laboratory wastes, and physical and chemical characterization and vertical and horizontal delineation of potential groundwater impacts form the objective for this AOC investigation. The unspecified laboratory wastes could be associated with virtually any chemicals used, stored, managed, or disposed onsite. COCs should target a broad spectrum of analysis to ensure current comprehensive analyses are completed.

**Planned Assessment:**

Provided the historical use of this area as a former burial pit for various unidentified wastes, planned assessment includes the completion of up to four test pits and will extend to the reach of the excavator, no less than 10 feet bsg. Soil samples will be collected from each sidewall (default at approximately 5 feet bsg) and the bottom of each test pit, with sampling biased to the most contaminated interval if any are identified.

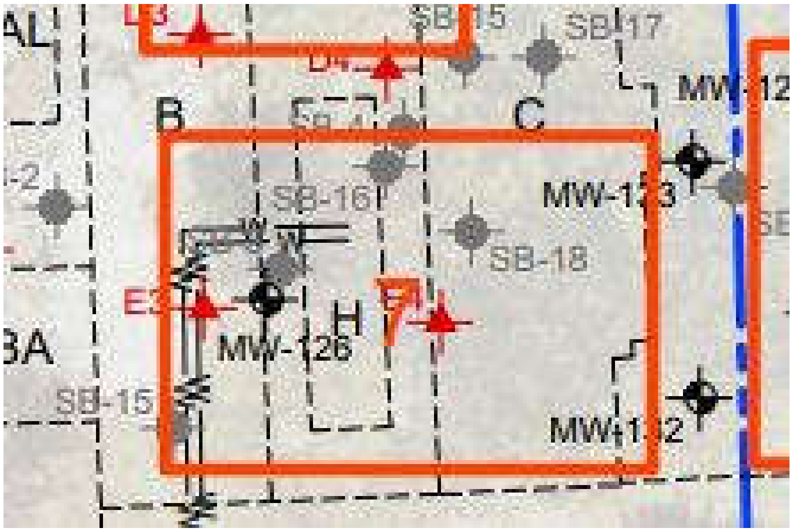
Note that for all RFI work, the test pit depth selected is generally the depth to the water table and the reach of a standard excavator. We believe this should be sufficient to identify at least the tops of anything identified as anomalies during the EMI study. If any signs of anomalies or buried material is encountered that cannot be completely delineated, additional plans may be warranted to fully assess the visual limits of those items.

Additional planned assessment work includes the installation of two permanent monitoring wells within the northwestern and southeastern portions of SWMU-3 to evaluate soil and groundwater conditions in a cross-gradient direction. Wells will be screened to the base of the sand unit ( (at a depth greater than 16 feet bsg, according to historical boring logs for SB-11 and SB-12 completed in this area, which indicate sand extending to this depth with no underlying clay unit identified).

Soil samples collected from each test pit and soil boring/monitoring well will be analyzed for SSCCL parameter list, plus MI PFAS 28 compounds.

Groundwater sampling at newly installed monitoring wells (as well as existing monitoring wells MW-130 and MW-131) will be conducted via low-flow techniques. Groundwater samples will be submitted for the SSCCL parameter list, plus at least one round of MI PFAS 28 compounds. PFAS will be added to the AOC-specific COC list for this AOC if Non-Residential RBSL exceedances are observed.

### 4.2.2 AOC 7 – PCE/TCE



AOC 7 contained historical Building H, which was utilized for fuel and oil blending. This former building was situated in between former Building B, which was utilized for experimental operations, a machine shop, and vehicle servicing and former Building C, which was utilized for engine research and dynamometer, fuel testing and control testing.

**Constituents of Concern/Objective:**

*Soil -*

A total of six soil borings (with three being converted to temporary monitoring wells and one converted to a permanent monitoring well) were evaluated within and surrounding this AOC. Of the six soil borings installed, seven soil samples were analyzed between the years 2012 and 2020: SB-3 (10-12'), SB-4 (10-12'), SB/TMW-15 (1-2'), SB/TMW-16 (1-2'), SB/TMW-18 (7-8') and MW-126 (4-5') and (7.5-8.5'). Additionally two temporary soil vapor points, E-3 and E-4 were installed in 2019.

The following COCs were detected (only bolded COCs exceeded their lowest respective screening criteria):

- VOCs: **naphthalene**, 2-methylnapthalene and trichlorofluoromethane at **TMW/SB-18 (7-8').** Not detected in remaining samples analyzed.

- PNAs/SVOCs: Full scan SVOCs was only completed at MW-126 location. **Up to 14 PNAs were detected at SB/TMW-18 (7-8') with multiple constituents exceeding the lowest respective screening criteria**. Select PNAs/SVOCs were also detected at SB-3 (10-12'), SB/TMW-16 (1-2'), SB/TMW-18 (7-8') and MW-126 (4-5'), however below respective screening levels.

- Metals: multiple metals (including arsenic, barium, cadmium, chromium etc.) were detected at all samples analyzed. **Mercury was detected at SB/TMW-16 (1-2') and SB/TMW-18 (7-8') above default background levels** and at SB-3 (10-12'), however below default background levels.

- PCBs: not detected.

*<u>Groundwater –</u>*

Groundwater samples were not collected from temporary monitoring well SB/TMW-15. Groundwater samples collected in 2016 from temporary monitoring well SB/TMW-16 and SB/TMW-18, as well as groundwater samples collected in 2020 from monitoring well MW-126, detected the following COCs (only bolded COCs exceeded their lowest respective screening criteria:

- VOCs: **tetrachloroethylene** at **SB/TMW-16, SB/TMW-18 and MW-126**; **trichloroethylene at MW-126**; trichlorofluoromethane at SB/TMW-16 and SB/TMW-18; and 1,1-dichloroethylene at SB/TMW-18.

- SVOCs: none detected.

- Metals: up to 10 metals were detected in each sample collected, including **aluminum, boron, iron, manganese, and vanadium at MW-126.**

- PCBs: none detected at MW-126. SB/TMW-16 and SB/TMW-18 were not analyzed for PCBs.

*<u>Soil Gas –</u>*

Soil gas samples collected from temporary soil gas points E-4 and E-5, set at a depth of 5 feet bsg, detected multiple VOCs and/or SVOCs, however the concentrations were below their respective VIAP criteria, with the exception of **trichloroethylene at E-4.**

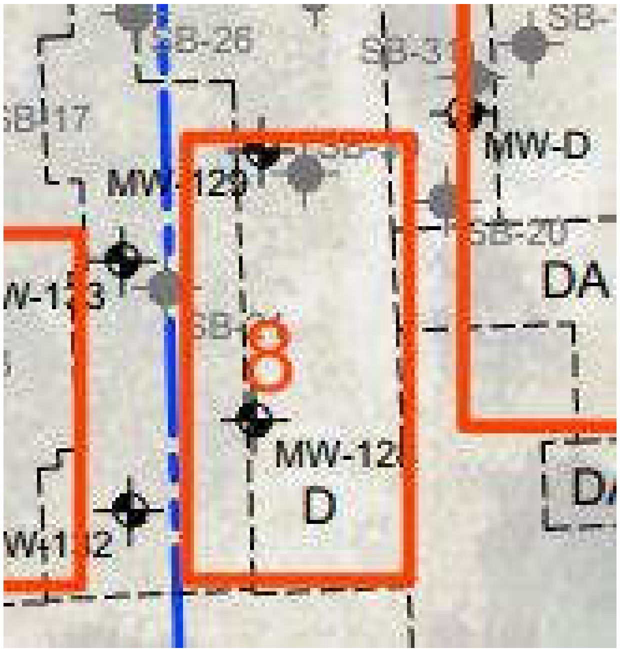
**<u>Planned Assessment:</u>**

Installation of two monitoring wells located within the central and northwestern portions of the AOC, which will be screened to the base of the sand unit (at a depth to exceed approximately 16 feet bsg, according to monitoring wells MW-126 and MW-132 installed within this area). Soil samples will be collected from both shallow (within the first 5 feet bsg) and deep intervals exhibiting the highest PID readings and/or which exhibit visual evidence of contamination to attempt to identify whether the source of soil gas vapors previously detected in soil gas samples collected is in this area.

Soil samples collected from each soil boring/monitoring well will be analyzed for SSCCL parameter list, plus MI PFAS 28 compounds and tetraethyl lead.

Groundwater samples will be collected via low-flow techniques from newly installed monitoring wells (as well as existing monitoring well MW-126). Groundwater samples will be submitted for SSCCL parameter list plus MI 28 PFAS compounds and tetraethyl lead.

### 4.2.3 AOC 8 – PFOA/PFOS



AOC 8 contained historical Building D, of which the former operations occurring at this building are unknown. This former building was situated in between former Building DA, which was utilized for chemical research and former Building C, which was utilized for engine research and dynamometer, fuel testing and control testing.

**<u>Constituents of Concern/Objective:</u>**

*<u>Soil -</u>*

A total of seven soil borings (with two being converted to temporary monitoring wells and four converted to a permanent monitoring well) were evaluated within and surrounding this AOC. Of the seven soil borings installed, nine soil samples were analyzed between the years 2012 and 2020: SB/TMW-20 (1-2'), SB-21 (10-12'), SB/TMW-30 (8-9'), MW-128 (4-5') and (8-9'), MW-129 (3-4'), MW-132 (5.5-6.5') and MW-133 (3-4') and (10-11').

The following COCs were detected (only bolded COCs exceeded their lowest respective screening criteria):

- VOCs: none detected.
- PNAs/SVOCs: Full scan SVOCs were only completed at MW-128, MW-129, MW-132 and MW-133 locations. Multiple SVOCs were detected with **benzo(b)pyrene, carbazole, dibenzofuran, fluoranthene, naphthalene and/or phenanthrene exceeding lowest respective screening criteria at each sample.** PNAs were not detected in remaining samples analyzed.
- Metals: multiple metals (including arsenic, barium, cadmium, chromium etc.) were detected at all samples analyzed, with the exception of SB-20 and SB/TMW-30, which were not analyzed for metals. **Mercury was detected at MW-129 (3-4'), MW-132 (5.5-6.5'), MW-133 (3-4') and (10-11') above default background levels and VIAP screening levels.**
- PCBs: not detected.

*Groundwater –*

Groundwater samples collected in 2016 from temporary monitoring wells SB/TMW-20 and SB/TMW-30, as well as groundwater samples collected in 2020 from monitoring wells MW-128, MW-129, MW-132 and MW-133, detected the following COCs (only bolded COCs exceeded their lowest respective screening criteria):

- VOCs: trichlorofluoromethane at SB/TMW-20 and SB/TMW-30; and 1,1-dichloroethylene at SB/TMW-20; **tetrachloroethylene at MW-128; trichloroethylene at MW-129;** acetone, chloromethane, 1,4-dioxane, **ethylbenzene, naphthalene,** toluene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, xylene and **methanol at MW-132;** and chloromethane and **naphthalene at MW-133.**
- SVOCs: **carbazole,** fluoranthene, **naphthalene**, 2-nitrophenol, 4-nitrophenol, **phenanthrene** and phenol at **MW-132; carbazole,** fluoranthene**,** naphthalene and **phenanthrene at MW-133.**
- Metals: multiple metals (including arsenic, barium, cadmium, chromium etc.) were detected at all samples analyzed, with the exception of SB/TMW-30, which was not analyzed for metals. **Boron was detected in MW-128, MW-129 and MW-133.**
- PCBs: none detected.
- PFAS: A total of ten PFAS compounds were detected at MW-128, MW-129, MW-132 and MW-133 with **PFOA, PFNA and/or PFOS** exceeding lowest respective screening levels.

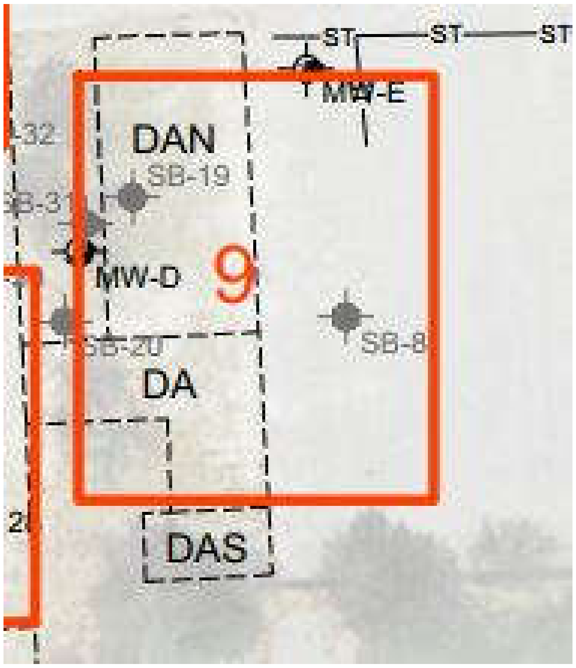
**Planned Assessment:**

Installation of two additional monitoring wells along the eastern/southeastern border of this area to determine if PFAS concentrations are migrating in a horizontal downgradient direction. Monitoring wells will be screened at the same depth interval as existing monitoring wells MW-128 and MW-129 (approximately 8 to 13 feet bsg) across the water table interface in the overburden. Soil samples will be collected at up to three depth intervals in each of the well boings following the rational described above. Attempting to identify the source of PFAS concentrations will also be included in the assessment activities.

Soil samples collected from each soil boring/monitoring well will be analyzed for SSCCL parameter list, plus MI PFAS 28 compounds.

Groundwater samples will be collected via low-flow techniques from newly installed monitoring wells (as well as existing monitoring wells MW-128, MW-129, MW-132 and MW-133). Groundwater samples will be submitted for SSCCL parameter list, plus MI PFAS 28 compounds.

### 4.2.4 AOC 9 – Neutralization Basin/Former UST Area



The area of a former neutralization basin and former underground storage tank (UST) is located along the southeastern portion of the Southern Area.

**Constituents of Concern/Objective:**

*Soil -*

A total of five soil borings (with three being converted to temporary monitoring wells and two permanent monitoring wells) were evaluated within and surrounding this AOC. Of the soil borings installed, four soil samples were analyzed between the years 2012 and 2016: SB-8 (10-12'), SB/TMW-19 (1-2'), SB/TMW-20 (1-2') and SB/TMW-31 (7-8'). Soil samples were not collected during the installation of monitoring wells MW-D and MW-E.

The following COCs were detected:

- VOCs: trichloroethylene at SB/TMW-19 (1-2'); 2-methylnaphthalene, naphthalene and 1,2,4-trimethylbenzene at SB-8 (10-12'). VOCs were not detected in the remaining samples analyzed.
- PNAs (full SVOC scan was not conducted): none detected.
- Metals: arsenic, barium, chromium, copper, lead and zinc at SB/TMW-19 (1-2') and SB/TMW-20 (1-2'). Remaining soil samples were not analyzed for metals.
- PCBs: none detected.

*Groundwater –*

Groundwater samples collected in 2012 from monitoring wells MW-D and MW-E, as well as groundwater samples collected from temporary monitoring wells SB/TMW-19, SB/TMW-20 and SB/TMW-31 in 2015 and 2016, detected the following COCs:

- VOCs: chlorobenzene, 1,1-dichloroethylene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene and/or trichlorofluoromethane at SB/TMW-19, SB/TMW-20 and SB/TMW-31. Tetrachloroethylene at MW-E. No detections at MW-D.
- PNAs (full SVOC scan was not completed): Diethyl phthalate at MW-E. None detected at remaining wells.
- Metals: arsenic, barium, copper and/or zinc at SB/TMW-19 and SB/TMW-20. SB/TWM-31, MW-D and MW-E were not analyzed for metals.
- PCBs: wells were not analyzed for PCBs.

**Planned Assessment:**

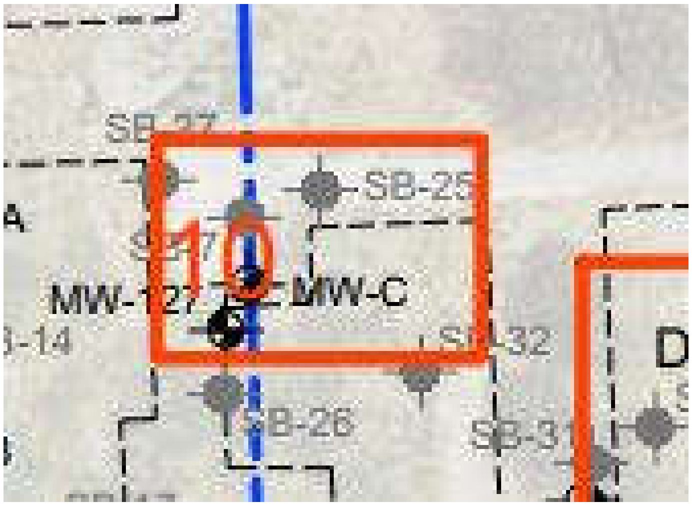
Completion of two soil borings, within the area of the identified electromagnetic anomalies present in the central-southern/southeastern portions of the area, which coincide with the location of the former USTs. The soil borings will extend to an approximate depth of 25 feet bsg to properly evaluate for the presence of buried orphaned tanks/sumps/vaults. If subsurface structures are identified, soil samples will be collected from a depth immediately below the base of the structure, with samples biased toward any visual evidence of contamination and/or PID readings present. Additionally, other soil depth intervals will be collected following the rationale described above for a maximum of three per boring.

Additional planned assessment work includes the installation of three monitoring wells within the northern, eastern, southeastern and western portions of the AOC to evaluate soil and groundwater conditions in a cross-gradient direction. Wells will be screened from approximately 8 to 13 feet bsg. Soil samples will also be collected from the well borings following the depth selection rationale described above.

Soil samples collected from each soil boring/monitoring well will be analyzed for SSCCL parameter list, plus MI PFAS 28 compounds and tetraethyl lead.

Groundwater sampling will be conducted via low-flow techniques at newly installed monitoring wells. Groundwater samples will be submitted for SSCCL parameter list, plus MI PFAS 28 compounds and tetraethyl lead.

### 4.2.5 AOC 10 – Former Heating Oil UST/EMI Interference – GPR Anomaly



Electromagnetic induction conducted indicated the presence of deep and shallow voids within the subsurface of this area, which is located within the southern-central portion of the Southern Area. Furthermore, a GPR survey conducted within this area indicated an anomaly within the subsurface. According to historical documentation, a former heating oil UST was located within this area.

**<u>Constituents of Concern/Objective:</u>**

*<u>Soil -</u>*

A total of seven soil borings (with one being converted to a temporary monitoring well and two permanent monitoring wells) were evaluated within and surrounding this AOC. Of the seven soil borings installed, seven soil samples were analyzed between the years 2012 and 2020: SB-7 (10-12'), SB-25 (10-12'), SB-26 (12-14'), SB-27 (10-12'), SB/TMW-32 (8-9') and MW-127 (6-7') and (10-11'). Soil samples were not collected during the installation of monitoring well MW-C.

The following COCs were detected (only bolded COCs exceeded their lowest respective screening criteria):

- VOCs: A total of 26 VOCs were detected from samples collected at SB-7 (10-12'), SB-25 (10-12'), SB-26 (12-14') and SB-27 (10-12'). Specifically, **benzene, chlorobenzene, ethylbenzene, 2-methylnapthalene, naphthalene, toluene, 1,2,3-, 1,2,4- and 1,3,5-trimethylbenzene, xylenes, and/or 1,2-, 1,3- and 1,4-dicholobenzene were detected in excess of screening criteria at these sample locations.** Samples collected from SB/TMW-32 (8-9') and MW-127 (6-7') and (10-11') did not have VOCs detected.

- PNAs/SVOCs: Full scan SVOCs was only completed at MW-127 location. Up to 10 PNAs were detected at the SB-7 (10-12'), SB-25 (10-12'), SB-27 (7-8') and MW-127 (10-11') with **acenaphthene, acenapthylene, anthracene, chrysene, fluorene and/or phenanthrene exceeding the lowest respective screening criteria.** SB/TMW-32 (8-9') did not have any PNA detections. SB-26 (12-14') was not analyzed for PNAs.

- Metals: arsenic, barium, chromium, copper, lead, selenium and/or zinc at SB-7 (10-12'), SB-25 (10-12') and SB-27 (10-12'). Mercury was also detected at SB-27 (10-12') below default background levels. Expanded metal analysis was completed at MW-127 (6-7') and (10-11') which indicated 16 metals including **aluminum, cobalt, iron and manganese above their lowest respective screening criteria.** SB-26 (12-14') was not analyzed for metals.

- PCBs: none detected.

*<u>Groundwater –</u>*

Groundwater samples collected in 2016 from temporary monitoring well SB/TMW-32, as well as groundwater samples collected in 2020 from monitoring well MW-127, detected the following COCs (only bolded COCs exceeded their lowest respective screening criteria):

- VOCs: **chlorobenzene, 2-methylnapthalene and naphthalene** at SB/TMW-32; chlorobenzene, 2-methylnapthalene, **naphthalene,** trichlorofluoromethane, 1,2,4- and 1,3,5-trimethylbenzene, and xylenes at MW-127.

- PNAs/SVOCs (full SVOC scan was only completed at MW-127): acenapthylene, fluorene, **naphthalene, phenanthrene** and **2-methylnapthalene** at SB/TMW-32; benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, **fluoranthene** and **phenanthrene** at MW-127.

- Metals: A total of 11 metals were detected at MW-127. Specifically, **aluminum, iron, manganese and vanadium** exceeded lowest respective screening levels at MW-127. SB/TMW-32 was not analyzed for metals.

- PCBs: none detected at MW-127. SB/TMW-32 was not analyzed for PCBs.

- PFAS: Seven PFAS compounds were detected at MW-127 with **PFOA and PFOS** exceeding lowest respective screening levels.

**Planned Assessment:**

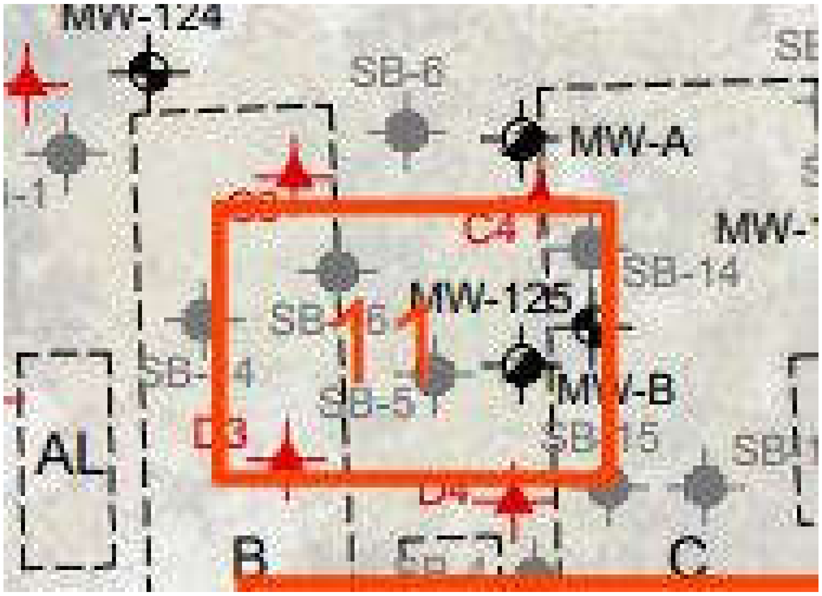
Provided the historical use of this area as a location for heating oil USTs, planned assessment includes the completion of two test pits, within the area of the identified electromagnetic anomalies present in the near monitoring well MW-127. The test pits will extend to the reach of the excavator, no less than 10 feet bsg, to properly evaluate for the presence of potential buried materials. Soil samples will be collected from each sidewall (default at approximately 5 feet bsg) and the bottom of each test pit, with sampling biased to the most contaminated interval, if appropriate.

Additional planned assessment includes installation of two monitoring wells. Specifically, monitoring wells that are vertically screened to the base of the sand unit (at a depth exceeding 15 feet bsg, which indicates sand extending to this depth with no clay interface encountered) will be installed in the northwestern and southeastern portions of this area.

Soil samples collected from each test pit and soil boring/monitoring well will be analyzed for the SSCCL parameter list.

Groundwater samples will be collected via low-flow techniques from newly installed monitoring wells (as well as existing monitoring wells MW-122, MW-123 and MW-127). Groundwater samples will be submitted for the SSCCL parameter list.

### 4.2.6 AOC 11 – Former UST Area/EMI Interference



Electromagnetic induction conducted indicated the presence of deep and shallow voids within the subsurface of this area, which is located within the southern-central portion of the Southern AOC Area. According to historical documentation, USTs were formerly located within this area.

**Constituents of Concern/Objective:**

*Soil -*

A total of nine soil borings (with one being converted to a temporary monitoring well and five permanent monitoring wells) were evaluated within and surrounding this AOC. Of the nine soil borings installed, six soil samples were analyzed between the years 2012 and 2020: SB-5 (10-12'), SB-6 (10-12'), SB-14 (10-12), SB/TMW-14 (1-2'), MW-124 (4-5') and MW-125 (4-5'). Soil samples were not collected during the installation of monitoring wells MW-A or MW-B. Additionally four temporary soil vapor points, C-3, C-4, D-3 and D-4 were installed in 2019.

The following COCs were detected (only bolded COCs exceeded their lowest respective screening criteria):

- VOCs: 2-methylnapthalene, naphthalene, n-propylbenzene, 1,2,3- 1,2,4- and 1,3,5-trimethylbenzene at SB-6 (10-12'); n-butylbenzene, sec-butylbenzene, chlorobenzene at SB-14 (10-12'); **n-butylbenzene, sec-butylbenzene**, **isopropylbenzene**, **ethylbenzene, 2-methylnapthalene, naphthalene,** p-isopropyltoluene, **n-propylbenzene, 1,2,3- 1,2,4- and 1,3,5-trimethylbezene, xylenes at SB-5 (10-12').** None detected in remaining samples analyzed.

- PNAs/SVOCs: Full scan SVOCs was only completed at MW-124 and MW-125 locations. Up to nine PNAs were detected at the SB/TMW-14 (1-2') location with none exceeding lowest respective screening criteria. Eleven SVOCs were detected at the MW-125 (4-5') sample with **phenanthrene exceeding the lowest respective screening criteria.** SVOCs were not detected in MW-124 (4-5'). Samples collected from SB-5 (10-12'), SB-6 (10-12') and SB-14 (10-12') were not analyzed for PNAs.

- Metals: arsenic, barium, cadmium, chromium, copper, lead and zinc were detected at SB/TMW-14 (1-2'), along with **mercury which was detected in exceedance of its default background level**. Expanded metal analysis was completed at MW-124 (4-5') and MW-125 (4-5') which indicated 21 metals detected, of which **aluminum, cobalt, iron, manganese and/or silver above their lowest respective screening criteria.** Additionally, **mercury was detected exceeding VIAP screening levels at MW-125 (4-5').** SB-5 (10-12'), SB-6 (10-12') and SB-14 (10-12') were not analyzed for metals.

- PCBs: none detected.

*Groundwater –*

Groundwater samples were not collected from MW-B. Groundwater samples collected in 2012 from monitoring well MW-A, groundwater samples collected in 2015 from temporary monitoring well SB/TMW-14, as well as groundwater samples collected in 2020 from monitoring wells MW-124 and MW-125, detected the following COCs (only bolded COCs exceeded their lowest respective screening criteria):

- VOCs: 1,2-dichlorobenzene at MW-A; and chloroethane, trichlorofluoromethane and **vinyl chloride at SB/TMW-14**. VOCs were not detected in MW-124 or MW-125.
- PNAs/SVOCs (full SVOC scan was only completed at MW-124 and MW-125): none detected at SB/TMW-14, MW-124 and MW-125. MW-A was not analyzed for PNAs/SVOCs.
- Metals: arsenic and barium at SB/TMW-14. A total of nine metals, of which **aluminum, iron and manganese were detected at levels exceeding lowest screening criteria at MW-124 and MW-125.** MW-A was not analyzed for metals.
- PCBs: none detected at MW-125. SB/TMW-14, MW-A and MW-124 were not analyzed for PCBs.

*Soil Gas –*

Soil gas samples collected from temporary soil gas points C-3, C-4, D-3 and D-4, set at a depth of 5 feet bsg detected multiple VOCs and/or SVOCs. However, all concentrations were below respective VIAP criteria, with the exception of **trichloroethylene at C-3.**

**Planned Assessment:**

Provided the historical use of this area as a former location of multiple USTs, planned assessment includes the completion of four test pits, within the area of the former UST locations. The test pits will extend to the reach of the excavator, no less than 10 feet bsg, to properly evaluate for the presence of orphaned and/or closed-in-place USTs, should they exist. Soil samples will be collected from each sidewall (default at approximately 5 feet bsg) and the bottom of each test pit, with sampling biased to the most contaminated interval, as appropriate.

Additional planned assessment includes installation of two monitoring wells. Specifically, monitoring wells that are vertically screened to the base of the sand unit (at a depth exceeding 15 feet bsg, which indicates sand extending to this depth with no clay interface encountered at monitoring well MW-125) will be installed in the northwestern and southeastern portions of this area. Soil samples will be collected from both shallow (within the first 5 feet bsg) and deep intervals exhibiting the highest PID readings and/or which exhibit visual evidence of contamination to determine the source of soil gas vapors previously detected in soil gas samples collected from this area. Additionally, other soil depth intervals will be collected following the rationale described above for a maximum of three per boring.

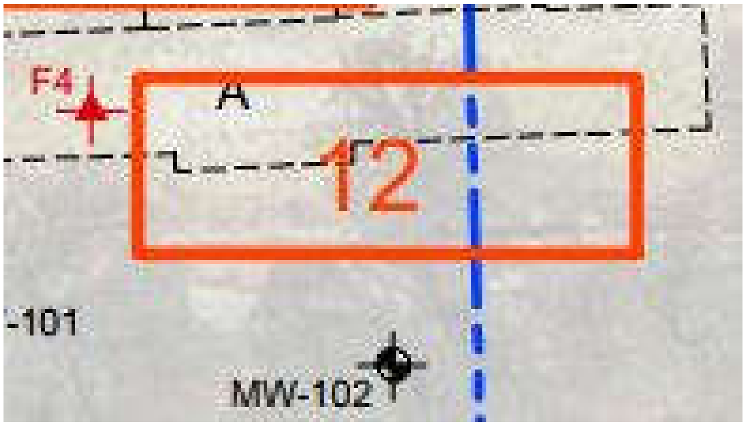
If the source of soil gas vapors has been identified, three soil gas vapor points will be installed within the subsurface (one upgradient and two downgradient) targeting that location. If it is not identified, the same sequence will be placed around the perimeter of the former USTs.

Soil samples collected from each test pit and soil boring/monitoring well will be analyzed for SSCCL parameter list, plus MI PFAS 28 compounds and tetraethyl lead.

Groundwater samples will be collected via low-flow techniques from newly installed monitoring wells (as well as existing monitoring wells MW-124 and MW-125) and. Groundwater samples will be submitted for SSCCL parameter list, plus MI 28 PFAS compounds and tetraethyl lead.

Soil gas samples will be analyzed for TO-15 analysis for VOCs.

### 4.2.7 AOC 12 – EMI Interference – GPR Anomaly



Electromagnetic induction conducted indicated the presence of a large deep void within the subsurface of this area, which is located within the southern portion of the Southern AOC Area. Furthermore, a GPR survey conducted within this area indicated an anomaly within the subsurface.

**Constituents of Concern/Objective:**

*Soil -*

A total of three soil borings (all of which were converted to permanent monitoring wells) were evaluated surrounding this AOC. Of the three soil borings installed, three soil samples were analyzed in 2020: MW-101 (2-3’), MW-102 (2-3’) and MW-132 (5.5-6.5’). Additionally two temporary soil vapor points, F-3 and F-4 were installed in 2019.

The following COCs were detected (only bolded COCs exceeded their lowest respective screening criteria):

- VOCs: none detected at MW-132 (5.5-6.5’). MW-101 (2-3’) and MW-102 (2-3’) were not analyzed for VOCs.
- PNAs/SVOCs: Multiple SVOCs were detected with **naphthalene and phenanthrene exceeding lowest respective screening criteria at MW-132 (5.5-6.5’).** MW-101 (2-3’) and MW-102 (2-3’) were not analyzed for SVOCs.
- Metals: arsenic, barium and/or chromium were detected at MW-101 (2-3’) and MW-102 (2-3’). Multiple metals were detected at **MW-132 (5.5-6.5’) with arsenic, boron, iron, magnesium, manganese and molybdenum exceeding lowest respective screening**

**criteria.** Additionally, **mercury was detected exceeding VIAP screening levels at MW-102 (2-3') and MW-132 (5.5-6.5').**

- PCBs: none detected at MW-132 (5.5-6.5'). MW-101 (2-3') and MW-102 (2-3') were not analyzed for PCBs.

*Groundwater –*

Groundwater samples collected in 2020 from monitoring wells MW-101, MW-102 and MW-132, detected the following COCs (only bolded COCs exceeded their lowest respective screening criteria):

- VOCs: acetone, chloromethane, 1,4-dioxane, **ethylbenzene**, **naphthalene,** toluene, 1,2,4- and 1,3,5-trimethylbenzene, xylene and **methanol** were detected at **MW-132**. VOCs were not detected at MW-101 or MW-102.
- SVOCs: **carbazole,** fluoranthene, **naphthalene**, 2- and 4-nitrophenol, **phenanthrene** and phenol were detected at MW-132. SVOCs were not detected at MW-101 or MW-102.
- Metals: a total of ten metals, of which **aluminum and lead were detected at levels exceeding lowest screening criteria at MW-132.** MW-101 and MW-102 had no detections for select metals analyzed.
- PCBs: none detected at MW-132. MW-101 and MW-102 were not analyzed for PCBs.
- PFAS: Nine PFAS compounds were detected between MW-101, MW-102 and MW-132, with **PFOA and PFOS** exceeding lowest respective screening levels at **MW-132**.

*Soil Gas –*

Soil gas samples collected from temporary soil gas points F-3 and F-4, set at a depth of 5 feet bsg, detected multiple VOCs and/or SVOCs, however all detections were below respective VIAP criteria.

**Planned Assessment:**

Provided the presence of a large deep void within the subsurface, planned assessment includes the completion of three test pits within the area of the void. The test pits will extend to the reach of the excavator, no less than 10 feet bsg, to properly evaluate the deep void and assess for potential orphaned USTs/buried material. Soil samples will be collected from each sidewall (default at approximately 5 feet bsg) and the bottom of each test pit, with sampling biased to the most contaminated interval, as appropriate.

Additional planned assessment includes installation of two monitoring wells. Specifically, monitoring wells that are vertically screened to the base of the sand unit (at a depth exceeding 15 feet bsg, which indicates sand extending to this depth with no clay interface encountered at monitoring well MW-102) will be installed in the eastern and western portions of this area. Soil samples will be collected following the rationale for selecting depth intervals as described above to determine if this is a potential source area for contamination observed at this AOC.

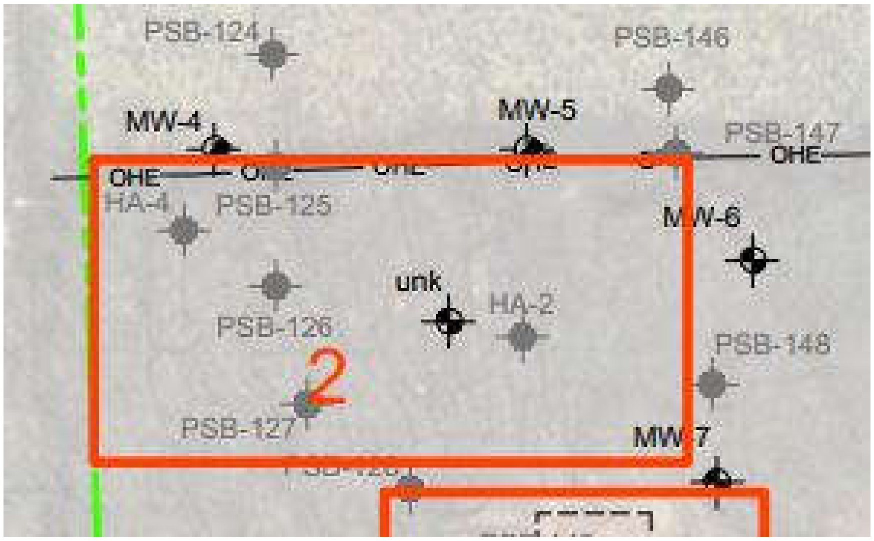
Soil samples collected from each test pit and soil boring/monitoring well will be analyzed for SSCCL parameter list plus MI PFAS 28 compounds to horizontally and vertically delineate previous detections.

Groundwater samples will be collected via low-flow techniques from newly installed monitoring wells (as well as existing monitoring wells MW-101, MW-102 and MW-103). Groundwater samples will be submitted for SSCCL parameter list plus MI PFAS 28 compounds.

## 4.3 Northwestern Margin

AOCs 2, 16 and 17 are all included in the Northwestern Margin that will be the focus of the third phase of the RFI. Description of known uses, investigative work completed so far, and proposed additional sampling scope to address horizontal and vertical delineation of the area is presented below. As stated above, start of the second phase of RFI in the Northwestern Margin is planned to begin in 2024 and be completed Second or Third Quarter 2025. Refer to **Figure 4** for a depiction of planned assessment locations pertaining to each AOC in the Northwestern Margin.

### 4.3.1 AOC 2 – SWMU 2 – Former Burial Area



The area designated as SWMU-2 (as originally defined in a Preliminary Assessment/Visual Site Inspection Report (PRC Environmental, 1994) is located within the northwestern portion of the Site, along the northwestern property boundary, in a vacant wooded area. This location was reportedly a former burial area for various laboratory wastes utilized by Ethyl from approximately 1962 until 1983.

## Constituents of Concern/Objective:

*Soil -*

A total of twelve soil borings (and four permanent monitoring wells) were evaluated within and surrounding this AOC. Of the twelve soil borings installed, seven soil samples were analyzed between the years 2012 and 2016: HA-2 (8'), HA-4 (8'), PSB-127 (6.5-7.5'), PSB-146 (2-3'), PSB-147 (5-6'), PSB-148 (2-3'), and SB-28 (3-4'). Soil samples were not analyzed for soil borings PSB-123, PSB-124, PSB-125, PSB-126, PSB-145 or monitoring wells MW-1, MW-5, MW-6 or MW-7.

The following COCs were detected (only bolded COCs exceeded their lowest respective screening criteria):

- VOCs: none detected.
- PNAs (full scan SVOC analysis was not conducted): anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene and pyrene at HA-4 (8').
- Metals: arsenic, barium, cadmium, chromium, copper, lead, selenium and/or zinc. Mercury was detected at PSB-146 (2-3'), PSB-147 (5-6'), HA-4 (8'), HA-2 (8'), and SB-28 (3-4'). **Mercury was detected exceeding state default background levels at PSB-148 (2-3').**
- PCBs: none detected.

*Groundwater -*

Groundwater samples collected in 2012 from MW-7, as well as groundwater samples collected in 1985 from MW-4 and MW-5 (collected from the deeper water bearing unit of from approximately 20-25 feet) detected the following COCs (only bolded COCs exceeded their lowest respective screening criteria):

- VOCs: tetrahydrofuran (MW-4 and MW-5).
- SVOCs: **1,2-dicholorethane (MW-7).**
- Metals: **lead (MW-7).**

Further delineation of SVOCS (e.g., PNAs and tetrahydrofuran) in soil, testing for COCs potentially associated with the reported buried laboratory wastes, and physical and chemical characterization and vertical and horizontal delineation of potential groundwater impacts in the form the objective for this AOC investigation. The unspecified laboratory wastes could be associated with virtually any chemicals used, stored, managed, or disposed onsite. COCs should target a broad spectrum of analysis to ensure current comprehensive analyses are completed.

**Planned Assessment:**

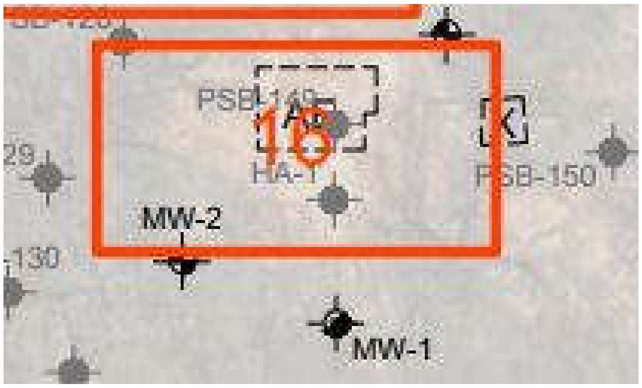
Provided the historical use of this area as a former burial pit for various unknown wastes, planned assessment includes the completion of up to four test pits to be conducted within each of the areas corresponding with previously identified magnetic anomalies detected within the SWMU. Soil samples will be collected from each sidewall and the bottom of each test pit, with sampling biased to the most contaminated interval based on PID and/or visual impacts.

Additional planned assessment work includes the installation of a nested pair of monitoring wells (one set within the shallow overburden and one set within the deeper section of the overburden) at the down-gradient edge of the AOC to vertically profile the groundwater within this area. Screened interval for each well is anticipated at approximately 8-13 feet bsg for shallow and 20 - 25 feet bsg for deep. Soil samples will also be collected from well borings.

Soil samples collected from each test pit and soil boring/monitoring well will be analyzed for SSCCL parameter list plus MI PFAS 28 compounds and tetraethyl lead.

Groundwater samples will be collected via low-flow techniques from the newly installed monitoring wells (as well as existing monitoring wells MW-6 and MW-7). Groundwater samples will be submitted for SSCCL parameter list plus MI PFAS 28 compounds, with select samples submitted for tetraethyl lead.

### 4.3.2 AOC 16 – Former Heating Oil UST



Historical documentation indicated the presence of a former heating oil UST within the southern portion of the northwestern corner of the Site, however electromagnetic induction conducted did not indicate the presence of any voids within this area.

**Constituents of Concern/Objective:**

*Soil -*

A total of eight soil borings (three of which were permanent monitoring wells) were evaluated within and surrounding this AOC. Of the eight soil borings installed, three soil samples were analyzed between 2012 and 2016: HA-1 (8'), PSB-149 (6-7') and PSB-150 (8.5-9.5').

The following COCs were detected:

- VOCs: none detected.
- PNAs/SVOCs (a full SVOC scan was not completed): benzo(a)anthracene, chrysene and fluoranthene at HA-1 (8'). None detected in remaining samples analyzed.
- Metals: multiple metals (including arsenic, barium, cadmium, etc.) in all samples analyzed. Mercury was also detected at HA-1 (8') and PSB-149 (6-7'), however below default background levels.
- PCBs: samples were not analyzed for PCBs.

*Groundwater –*

Groundwater sampling data for MW-1 and MW-2 was not disclosed and/or sampling was not completed. Groundwater samples collected in 2012 from monitoring well MW-7 detected the following COCs (only bolded COCs exceeded their lowest respective screening criteria):

- VOCs: **1,2-dicholorethane** and 1,1,2-trichlorethane.
- PNAs/SVOCs: none detected.
- Metals: arsenic, barium, chromium, copper, **lead**, selenium and zinc.
- PCBs: well was not sampled for PCBs.

**Planned Assessment:**

Planned assessment includes the advancement of two soil borings, with conversion of at least one soil boring into a permanent monitoring well, within the location of the former heating oil UST and vertically screened to the base of the sand unit (estimated at a depth exceeding 10 feet bsg, based on historical soil boring PSB-140 completed in this area, exhibiting sand to a maximum depth explored of 10 feet bsg, with no clay interface encountered). If subsurface structures are identified, soil samples will be collected from a depth immediately below the base of the structure, with samples biased toward any visual evidence of contamination and/or PID readings present. Additionally, other soil depth intervals will be collected following the rationale described above for a maximum of three per boring.

Soil samples collected from each soil boring/monitoring well will be analyzed for SSCCL parameter list.

Groundwater samples will be collected via low-flow techniques from the newly installed monitoring well (as well as existing monitoring well MW-2). Groundwater samples will be submitted for SSCCL parameter list.

### 4.3.3 AOC 17 – EMI Interference

Electromagnetic induction conducted indicated the presence of one deep void within the subsurface of this area, which is located within the southern portion of the northwestern corner of the Site. The presence of a deep void indicates the potential for buried material, disturbed subsurface soils and/or orphaned underground tanks.

**Constituents of Concern/Objective:**

*Soil -*

A total of four soil borings (one of which was converted to a monitoring well) were evaluated within and surrounding this AOC. Of the four soil borings installed, no soil samples were collected and submitted for analysis. Therefore, the presence of soil COCs need to be determined for this area.

*Groundwater –*

Groundwater sampling data for MW-3 was not disclosed and/or was sampling was not completed. Therefore, the presence of groundwater COCs need to be determined for this area.

**Planned Assessment:**

Provided the presence of a deep void within the subsurface, planned assessment includes the completion of two test pits. The test pits will extend to the reach of the excavator, no less than 10 feet bsg, to properly evaluate the deep voids and assess for potential orphaned USTs/buried material. Soil samples will be collected from each sidewall (default at approximately 5 feet bsg) and the bottom of each test pit, with sampling biased to the most contaminated interval, as appropriate.

Additional planned assessment includes installation of two monitoring wells. Specifically, monitoring wells that are vertically screened to the base of the sand unit (at a depth exceeding 10 feet bsg, which indicates sand extending to this depth with no clay interface encountered at soil borings PSB-132) will be installed in the central and southeastern portions of this area. If subsurface structures are identified, soil samples will be collected from a depth immediately below the base of the structure, with samples biased toward any visual evidence of contamination and/or PID readings present. Additionally, other soil depth intervals will be collected following the rationale described above for a maximum of three per boring.

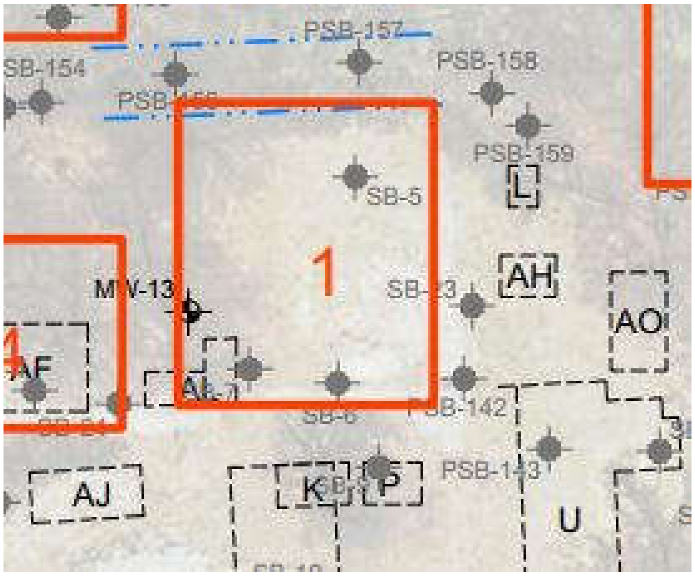
Soil samples collected from each test pit and soil boring/monitoring well will be analyzed for SSCCL parameter list compounds to determine if any site-related contamination exists.

Groundwater samples will be collected via low-flow techniques from the newly installed monitoring wells (as well as existing monitoring well MW-3). Groundwater samples will be submitted for SSCCL parameter list to determine if any site-related contamination exists.

## 4.4 Northcentral Area

AOCs 1, 4, 5, 6, 13 and 18 are all included in the Northcentral Area that will be the focus of the third phase of the RFI. Description of known uses, investigative work completed so far, and proposed additional sampling scope to address horizontal and vertical delineation of the area is presented below. As stated above, start of the third phase of RFI in the Northcentral Area is planned to begin in the 2026 and be completed by the second or third quarter 2027. Refer to **Figure 5** for a depiction of planned assessment locations pertaining to each AOC in the Northcentral Area.

### 4.4.1 AOC 1 – SWMU 1 – Former Drum Storage Area



The area designated as SWMU-1 (as originally defined in a Preliminary Assessment/Visual Site Inspection Report (PRC Environmental, 1994) is a former drum storage area and is located within the north-central portion of the Site, in a sparsely wooded area. The area formerly consisted of an approximately 12,000 square foot exterior concrete pad.

**Constituents of Concern/Objective:**

*Soil -*

A total of eight soil borings (with three being converted to temporary monitoring wells) were evaluated within and surrounding this AOC. Of the eight soil borings installed, seven soil samples were analyzed between the years 2012 and 2015: SB/TMW-5 (1-2’), SB/TMW-7 (8-9’), SB/TMW-9 (1-2’), SB-23 (8-10’), PSB-142 (8-9’), PSB-156 (4-5’) and PSB-157 (4-5’). Soil samples were not analyzed for soil boring SB-6 or monitoring well MW-13.

The following COCs were detected (only bolded COCs exceeded their lowest respective screening criteria):

- VOCs: sec-butylbenzene, p-isopropyltoluene, 1,2-dichlorobenzene, and **1,3-dichlorobenzene** at SB-33 (8-10’).
- PNAs (full scan SVOC analysis was not conducted): none detected.
- Metals: arsenic, barium, chromium copper, lead, selenium and/or zinc at each soil sample. Mercury was also detected at SB-9 (1-2’).
- PCBs: none detected.

*Groundwater -*

Groundwater sampling data for MW-13 was not disclosed and/or this well was historically never sampled. Groundwater samples collected in 2015 from temporary monitoring wells SB/TMW-5 and SB/TMW-6 detected the following COCs:

- VOCs: none detected.
- SVOCs: none detected.
- Metals: barium and zinc.

Based on limited previous sampling in this AOC, COCs cannot be refined, so a more comprehensive COC list will be analyzed. This AOC is still in a discovery phase of investigation. The objective of additional sampling will be to detect COCs and vertically and horizontally delineate any potential COCs in this AOC.

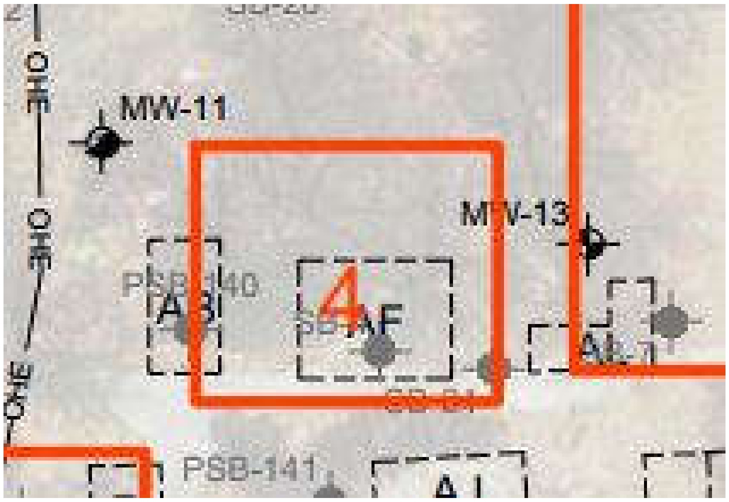
**Planned Assessment:**

Provided the historical use of this area as a former drum storage area for various unknown chemicals, planned assessment includes the installation of three permanent monitoring wells, placed within the northwestern, central and southeastern portions of the former drum storage area to evaluate soil and groundwater conditions in a cross-gradient direction.

Soil samples collected from each soil boring/monitoring well will be analyzed for SSCCL list parameters plus PCBs, tetraethyl lead and MI PFAS 28 compounds. A minimum of two and maximum of three soil sample depth intervals will be collected per boring. The surface depth immediately below ground cover (if present) and bottom of boring 0-6 inch interval should be collected. If elevated photoionization detector (PID) levels or visibly impacted intervals are observed, particularly at the depth immediately above the water table interface, then that depth interval will also be collected.

Groundwater samples will be collected via low-flow sampling techniques from newly installed monitoring wells (as well as existing monitoring well MW-13). Groundwater samples will be submitted for SSCCL list parameters plus PCBs, tetraethyl lead and MI PFAS 28 compounds.

### 4.4.2 AOC 4 – SWMU 4



The area designated as solid waste management unit (SWMU) SWMU-4 (as originally defined in a Preliminary Assessment/Visual Site Inspection Report (PRC Environmental, 1994) is located in the north-central portion of the Site, within a heavily wooded area. This area was formerly utilized as a container and tank storage area that consisted of an approximately 1,500 square foot concrete pad with a curb, which was covered with a roof and secured with a chain linked fence. This area became active in 1987 for the staging of waste prior to disposal.

**Constituents of Concern/Objective:**

*Soil -*

A total of four soil borings (with one being converted to a temporary monitoring well) and one permanent monitoring well were evaluated within and surrounding this AOC. Of the four soil borings installed, four soil samples were analyzed between the years 2012 and 2015: SB/TMW-4 (1-2’), SB-24 (8-10’), PSB-140 (3-4’) and PSB-141 (7-8’). Soil samples were not analyzed for monitoring well MW-11.

The following COCs were detected:

- VOCs: none detected.
- PNAs (full scan SVOC analysis was not conducted): none detected.
- Metals: arsenic, barium, cadmium, chromium, copper, lead, selenium and/or zinc at all soil sample locations. Mercury was also detected at SB/TMW-4 (1-2').
- PCBs: none detected at all of the sample locations. PSB-141 (7-8') was not analyzed for PCBs.

*Groundwater –*

Groundwater samples collected in 2012 from MW-11; as well as groundwater samples collected in 2015 from temporary monitoring well SB/TMW-4, detected the following COCs (only bolded COCs exceeded their lowest respective screening criteria):

- VOCs: **1,1 and 1,2-dicholorethane** (MW-11).
- SVOCs: none detected.
- Metals: barium, selenium and/or zinc (MW-11 and SB/TMW-4).
- PCBs: wells were not analyzed for PCBs.

Further delineation of VOCS (e.g., 1,1 and 1,2-dicholorethane) in groundwater for COCs potentially associated with the historical chemical storage area, and physical and chemical characterization and vertical and horizontal delineation of potential groundwater impacts in the overburden form the objective for this AOC investigation. The unspecified laboratory wastes could be associated with virtually any chemicals used, stored, managed, or disposed onsite. COCs should target a broad spectrum of analysis to ensure current comprehensive analyses are completed.

**Planned Assessment:**

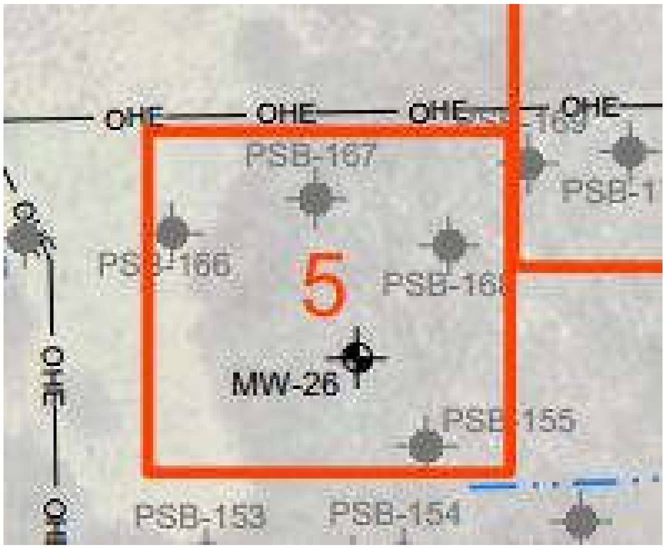
Provided the historical use of this area as a former container and tank storage area, planned assessment includes the completion of two soil borings, within the area of the identified electromagnetic anomaly present in the south/southwestern portion of the former SWMU. The soil borings will be conducted within the southern/southwestern portion of the former SWMU and extend to an approximate depth of 25 feet bsg to properly evaluate for the presence of buried orphaned tanks/sumps/vaults. If subsurface structures are identified, soil samples will be collected from a depth immediately below the base of the structure, with samples biased toward any visual evidence of contamination and/or PID readings present. Additionally, other soil depth intervals will be collected following the rationale described above for a maximum of three per boring.

Additional planned assessment work includes the installation of two permanent monitoring wells within the central and southeastern portions of the AOC to evaluate soil and groundwater conditions in a cross-gradient direction.

Soil samples collected from each soil boring/monitoring well will be analyzed for SSCCL parameter list plus tetraethyl lead and MI PFAS 28 compounds.

Groundwater samples will be collected via low-flow techniques from the newly installed monitoring wells. Groundwater samples will be submitted for SSCCL parameter list, with specific wells analyzed for tetraethyl lead, and MI PFAS 28 compounds.

### 4.4.3 AOC 5 – Former Disposal Pit Area



This location was a former burial area for various unknown wastes utilized by Ethyl from approximately 1948 until 1962. Specifically, reactive sodium compounds were reacted with water and the resultant residue was buried within this area.

**<u>Constituents of Concern/Objective:</u>**

*<u>Soil -</u>*

A total of nine soil borings (with one being converted to a temporary monitoring well) were evaluated within and surrounding this AOC. Of the nine soil borings installed, five soil samples were analyzed between the years 2012 and 2016: HA-3 (8'), SB/TMW-26 (2-3'), PSB-153 (7-8'), PSB-165 (6-7') and PSB-168 (2-3'). Soil samples were not collected from soil borings PSB-154, PSB-155, PSB-166 or PSB-167.

The following COCs were detected (only bolded COCs exceeded their lowest respective screening criteria):

- VOCs: **trichloroethylene at PSB-168 (2-3').** Not detected at remaining samples analyzed.

- PNAs (full scan SVOC analysis was not conducted): benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene at HA-3 (8'). Not detected at remaining samples analyzed.
- Metals: arsenic, barium, cadmium, chromium, copper, lead, selenium and/or zinc. **Mercury was also detected at PSB-168 (2-3') above default background levels** and also at HA-3 (8'), however below default background levels.
- PCBs: none detected at the sample locations amalyzedPSB-168 (2-3') and SB/TMW-26 (2-3') were not analyzed for PCBs.

*Groundwater –*

Groundwater samples collected in 2016 from temporary monitoring well SB/TMW-26, detected the following COCs (only bolded COCs exceeded their lowest respective screening criteria):

- VOCs: **trichloroethylene, 1,1,2-trichloroethane,** 1,2-dichloroethane and 1,1,2,2-tetrachloroethane**.**
- SVOCs: none detected.
- Metals: none detected.
- PCBs: well was not analyzed for PCBs.

**Planned Assessment:**

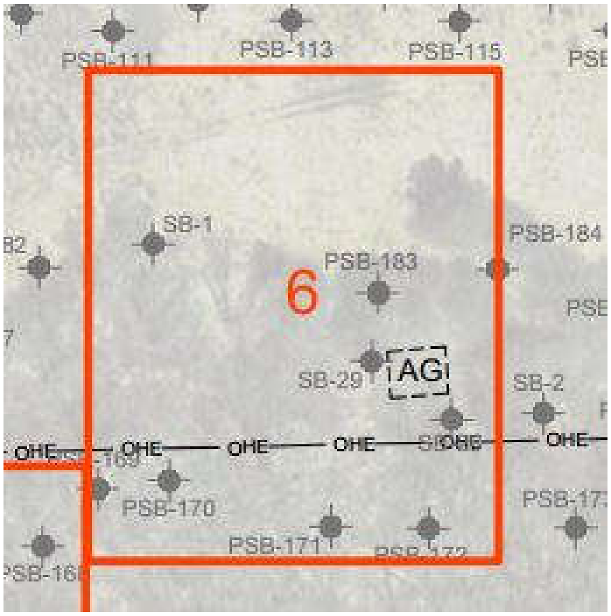
Provided the historical use of this area as a former disposal pit, planned assessment includes the completion of four test pits, within the area of the identified electromagnetic anomalies. The test pits will extend to the reach of the excavator, no less than 10 feet bsg, to properly evaluate for the presence of buried materials. Soil samples will be collected from each sidewall (default at approximately 5 feet bsg) and the bottom of each test pit, with sampling biased to the most contaminated interval, as appropriate.

Additional planned assessment includes installation of three monitoring wells within the former disposal pit area. Specifically, monitoring wells will be installed that are vertically screened to the base of the sand unit (at a depth greater than 15 feet bsg, according to historical boring logs completed for this area) and located within the southwestern, northern and eastern/southeastern portions of the former disposal pit area. One shallow surface sample (1–2 feet bsg) and one sample at depth (to be determined based on visual/PID readings) will be collected from each of the soil borings/monitoring wells during installation, with the collection of soil sample intervals not to exceed six inches.

Soil samples collected from each test pit and soil boring/monitoring well will be analyzed for SSCCL parameter list, tetraethyl lead and MI PFAS 28 compounds.

Groundwater samples will be collected via low-flow techniques from the newly installed monitoring wells (as well as existing monitoring well MW-26). Groundwater samples will be submitted for SSCCL parameter list, tetraethyl lead and MI PFAS 28 compounds.

### 4.4.4 AOC 6 – EMI Interference – GPR Anomaly Area/Concrete Pad Burn Pit



Electromagnetic induction conducted across the Site indicated the presence of deep and shallow voids within the subsurface of this area, which is located within the northern-central portion of the Site. The presence of deep and shallow voids indicate the potential for buried material, disturbed subsurface soils and/or orphaned underground tanks. Furthermore, GPR surveys conducted within this area indicated anomalies within the subsurface, which may also indicate the presence of orphaned underground tanks. According to historical documents, a burn pit, consisting of a concrete pad, was historically located within this area as well as a depression pond and notable ground disturbance/soil stockpiles.

**Constituents of Concern/Objective:**

*Soil -*

A total of twelve soil borings (with three being converted to temporary monitoring wells) were evaluated within and surrounding this AOC. Of the twelve soil borings installed, twelve soil samples were analyzed between the years 2012 and 2016: SB/TMW-1 (5-6'), SB/TMW-2 (3-4'), SB/TMW-27 (4-5'), SB-28 (10-12'), SB-29 (10-12'), PSB-169 (2-3'), PSB-170 (2-3'), PSB-171 (2-3'), PSB-172 (1-2'), PSB-182 (4-5'), PSB-183 (3-4') and PSB-184 (4-5').

The following COCs were detected (only bolded COCs exceeded their lowest respective screening criteria)

- VOCs**: trichloroethylene at PSB-170 (2-3') and PSB-171 (2-3'); tetrachloroethylene at PSB-171 (2-3');** toluene at PSB-170 (2-3'); and **naphthalene at SB/TMW-27 (4-5')**. Not detected at remaining samples analyzed.
- PNAs (full scan SVOC analysis was not conducted): **up to 18 PNAs were detected at SB/TMW-27 (4-5') and PSB-170 (2-3') with multiple constituents exceeding the lowest respective screening criteri**a. Multiple PNAs were also detected at and PSB-182 (4-5'), however concentrations were below respective screening levels. Fluoranthene was detected at SB-29 (10-12').
- Metals: arsenic, barium, cadmium, chromium, copper, lead, selenium, silver and/or zinc. **Mercury was also detected at SB/TMW-27 (4-5') and PSB-170 (2-3') above default background levels** and at SB/TMW-2 (3-4'), SB-29 (10-12'), PSB-169 (2-3'), PSB-171 (2-3') and PSB-172 (1-2'), however below default background levels.
- PCBs: detected at PSB-171 (2-3'). Not detected at remaining samples analyzed.

*Groundwater –*

Groundwater samples were not collected from temporary monitoring wells SB/TMW-1 or SB/TMW-2. Groundwater samples collected in 2016 from temporary monitoring well SB/TMW-27, detected the following COCs:

- VOCs: none detected.
- SVOCs: none detected.
- Metals: arsenic.
- PCBs: not analyzed for PCBs.

**Planned Assessment:**

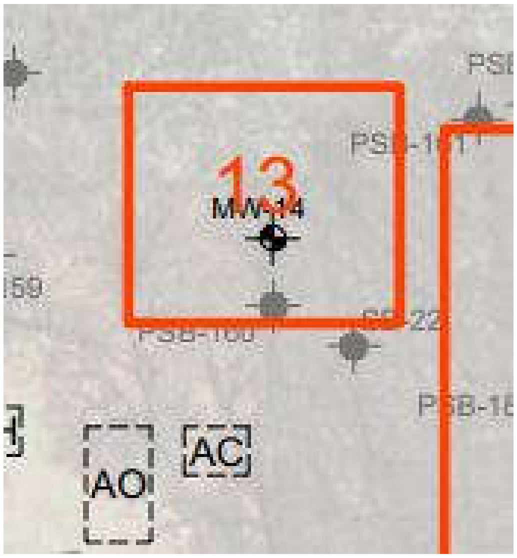
Provided the historical use of this area as a former burn pit, planned assessment includes the completion of four test pits, within the area of the identified electromagnetic anomalies. The test pits will extend to the reach of the excavator, no less than 10 feet bsg, to properly evaluate for the presence of buried materials. Soil samples will be collected from each sidewall (default at approximately 5 feet bsg) and the bottom of each test pit, with sampling biased to the most contaminated interval, as appropriate.

Additional planned assessment includes installation of four monitoring wells. Specifically, monitoring wells that are vertically screened to the base of the sand unit (at a depth of approximately 23 feet bsg, according to historical boring log SB-1 completed within the central-western portion of this AOC) will be installed in the northwestern, central, eastern and southeastern portions of this area. However, depth of sand layer was also encountered at historical boring PSB-183 (located within the central-eastern portion of the AOC) at a depth of approximately 7 feet bsg. Therefore, wells will be screened based upon field observations of encountered sand/clay interface depth, which may result in differential depth intervals to properly characterize the sand unit. Additionally, other soil depth intervals will be collected following the rationale described above for a maximum of three per boring.

Soil samples collected from each test pit and soil boring/monitoring well will be analyzed for SSCCL parameter list, PCBs, dioxins/furans and MI PFAS 28 compounds.

Groundwater samples will be collected via low-flow techniques from the newly installed monitoring wells.  Groundwater samples will be submitted for SSCCL parameter list, PCBs, dioxins/furans and MI PFAS 28 compounds.

### 4.4.5 AOC 13 – EMI Interference



Electromagnetic induction conducted indicated the presence of approximately four deep voids within the subsurface of this area, which is located within the northeastern portion of the Site.

**Constituents of Concern/Objective:**

*Soil -*

A total of seven soil borings (one of which was converted to a monitoring well) were evaluated within and surrounding this AOC. Of the seven soil borings installed, six soil samples were analyzed between 2012 and 2016: SB-22 (8-10’), PSB-158 (4-5’), PSB-159 (6-7’), PSB-160 (2-3’), PSB-161 (4-5’) and PSB-178 (3-4’). No soil samples were collected during the installation of MW-14 (also known as MW-C).

The following COCs were detected:

- VOCs: none detected.
- PNAs/SVOCs (a full SVOC scan was not completed): none detected.

- Metals: arsenic, barium chromium, copper, lead, selenium and/or zinc at all samples collected. Mercury was also detected at SB-22 (8-10'), however below default background levels.
- PCBs: none detected at SB-22 (8-10'), PSB-159 (6-7'), PSB-160 (2-3'). PSB-158 (4-5'), PSB-161 (4-5') and PSB-178 (3-4') were not analyzed for PCBs.

*Groundwater –*

Groundwater samples collected in 2015 from monitoring well MW-14 (also referred to as MW-C) detected the following COCs:

- VOCs: trichloroethylene, however below lowest screening level criteria.
- SVOCs: not sampled for PNAs/SVOCs.
- Metals: not sampled for metals.
- PCBs: not sampled for PCBs.

**Planned Assessment:**

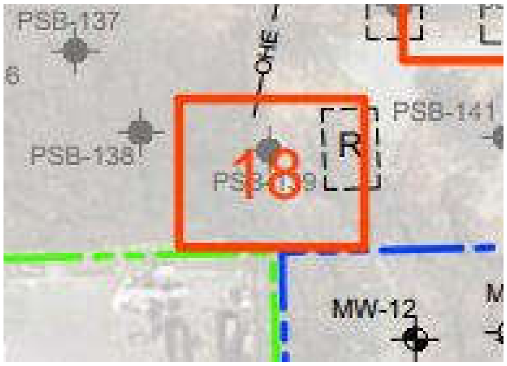
Provided the presence of a large deep void within the subsurface, planned assessment includes the completion of two test pits, within the area of the void. The test pits will extend to the reach of the excavator, no less than 10 feet bsg, to properly evaluate the deep void and assess for potential orphaned USTs/buried material. Soil samples will be collected from each sidewall (default at approximately 5 feet bsg) and the bottom of each test pit, with sampling biased to the most contaminated interval, as appropriate.

Additional planned assessment includes installation of two monitoring wells. Specifically, monitoring wells that are vertically screened to the base of the sand unit (at a depth exceeding 12 feet bsg, which indicates sand extending to this depth with no clay interface encountered at soil boring SB-22) will be installed in the northeastern and southwestern portions of this area. If subsurface structures are identified, soil samples will be collected from a depth immediately below the base of the structure, with samples biased toward any visual evidence of contamination and/or PID readings present. Additionally, other soil depth intervals will be collected following the rationale described above for a maximum of three per boring.

Soil samples collected from each test pit and soil boring/monitoring well will be analyzed for SSCCL parameter list.

Groundwater samples will be collected via low-flow techniques from the newly installed monitoring wells (as well as existing monitoring well MW-14). Groundwater samples will be submitted for SSCCL parameter list.

### 4.4.6 AOC 18 – EMI Interference – GPR Anomaly



Electromagnetic induction conducted indicated the presence of one large deep void within the subsurface of this area, which is located within the central northwestern portion of the Site. Historical documentation indicates the presence of a former UST within this AOC as well.

**Constituents of Concern/Objective:**

*Soil -*

A total of five soil borings (one of which was converted to a monitoring well) were evaluated within and surrounding this AOC. Of the five soil borings installed, two soil samples were analyzed in 2016: PSB-139 (6.5-7.5’) and PSB-141 (7-8’).

The following COCs were detected:

- VOCs: none detected.
- PNAs/SVOCs (a full SVOC scan was not completed): none detected.
- Metals: arsenic, barium, chromium, copper, lead and zinc.
- PCBs: samples were not analyzed for PCBs.

*Groundwater –*

Groundwater samples collected in 2012 from monitoring well MW-12 detected the following COCs:

- VOCs: none detected.
- PNAs/SVOCs: none detected.
- Metals: barium.
- PCBs: well was not sampled for PCBs.

**Planned Assessment:**

Provided the presence of a deep void within the subsurface as well as the former UST pit, planned assessment includes the completion of three test pits to assess the deep void and one within the southeastern corner to assess the former UST pit. The test pits will extend to the reach of the excavator, no less than 10 feet bsg, to properly evaluate the deep void and assess for potential orphaned USTs/buried material. Soil samples will be collected from each sidewall (default at approximately 5 feet bsg) and the bottom of each test pit, with sampling biased to the most contaminated interval, as appropriate.

Additional planned assessment includes installation of two monitoring wells. Specifically, monitoring wells that are vertically screened to the base of the sand unit (at a depth exceeding 15 feet bsg, which indicates sand extending to this depth with no clay interface encountered at soil borings PSB-139) will be installed in the central and southeastern portions of this area. If subsurface structures are identified, soil samples will be collected from a depth immediately below the base of the structure, with samples biased toward any visual evidence of contamination and/or PID readings present. Additionally, other soil depth intervals will be collected following the rationale described above for a maximum of three per boring.

Soil samples collected from each test pit and soil boring/monitoring well will be analyzed for SSCCL parameter list, PCBs and tetraethyl lead.

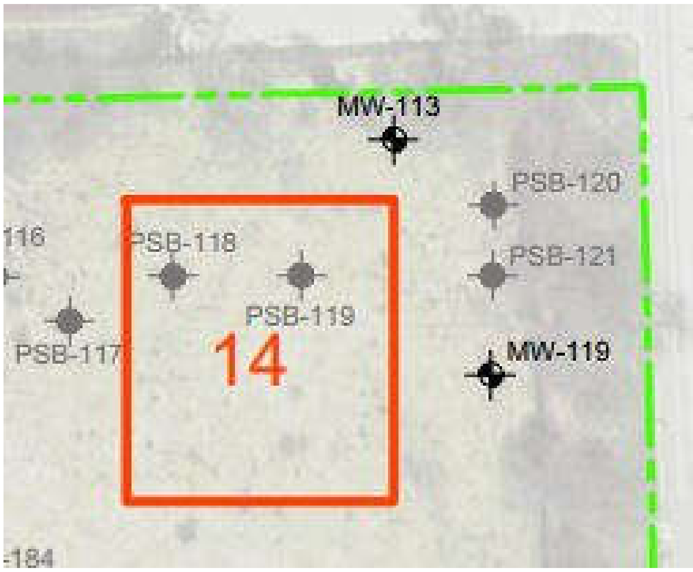
Groundwater samples will be collected via low-flow techniques from the newly installed monitoring wells. Groundwater samples will be submitted for SSCCL parameter list, PCBs and tetraethyl lead.

## 4.5 Northeastern Area

AOCs 14, 19 and 20 are all included in the Northeastern Area that will be the focus of the fourth phase of the RFI. Description of known uses, investigative work completed so far, and proposed additional sampling scope to address horizontal and vertical delineation of the area is presented below.

As stated above, start of the fourth phase of RFI in the Northeastern Area is planned to begin in 2028 and be completed by the Second or Third Quarter 2029. However, as this Area lies within the eastern boundary of the Site, groundwater and soil gas investigations are currently proceeding to determine if off-site migration of VOCs is occurring. Atlas' work completed to address the eastern boundary concerns are further described in Sections 4.3. Refer to **Figure 6** for a depiction of planned assessment locations pertaining to each AOC in the Northeastern Area.

### 4.5.1 AOC 14 – EMI Interference



Electromagnetic induction conducted indicated the presence of a large area of deep and shallow voids within the subsurface of this area, which is located within the northeastern-most portion of the Site. This large subsurface void area may be attributed to disturbed soil/non-native material fill and/or the presence of buried material.

**Constituents of Concern/Objective:**

*Soil -*

A total of eight soil borings (two of which were converted to permanent monitoring wells) were evaluated within and surrounding this AOC. Of the eight soil borings installed, six soil samples were analyzed between 2016 and 2020: PSB-116 (3-4'), PSB-117 (2-3'), MW-113 (2-3') and (7-8') and MW-119 (2-3') and (6-7').

The following COCs were detected (only bolded COCs exceeded their lowest respective screening criteria):

- VOCs: 2-methynapthalene at PSB-116 (3-4') and **methanol at MW-113 (2-3')** and (7-8') and MW-119 (6-7').
- PNAs/SVOCs (a full SVOC scan was not completed): multiple PNAs detected at SB-116 (3-4') and SB-117 (2-3') with **benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene and naphthalene detected at SB-117 (2-3').** PNAs were not detected at other sample locations.
- Metals: multiple metals were detected in all samples collected. **Specifically, mercury was detected above default background levels and VIAP criteria at PSB-117 (2-3') and arsenic and selenium in excess of lowest screening levels at MW-119 (2-3').**

- PCBs:  no samples were analyzed for PCBs.

*Groundwater –*

Groundwater samples collected in 2020 from monitoring wells MW-113 and MW-119 detected the following COCs:

- VOCs: methanol at MW-119.
- SVOCs: none detected.
- Metals: none detected.
- PCBs: no samples were analyzed for PCBs.
- PFAs: none detected.

**Planned Assessment:**

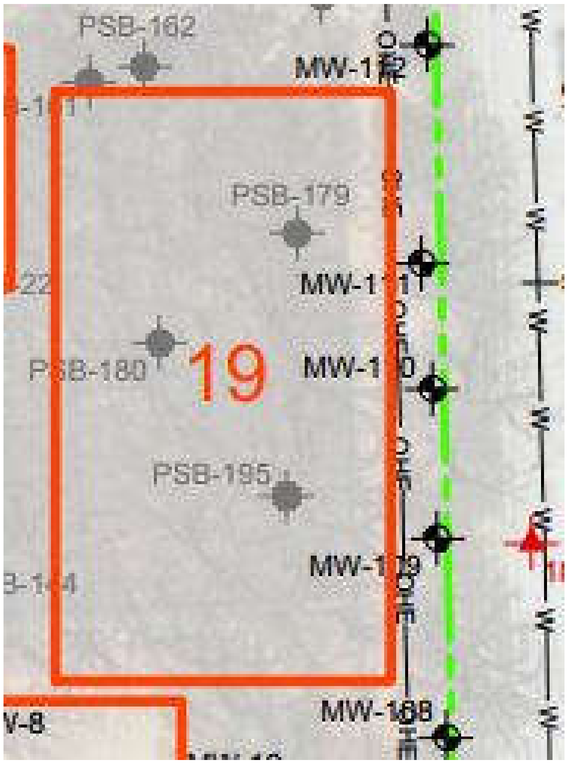
Provided the presence of shallow and deep voids within the subsurface and previous exceedances in soil, planned assessment includes the completion of four test pits. The test pits will extend to the reach of the excavator, no less than 10 feet bsg,  to properly evaluate the deep voids and assess for potential orphaned USTs/buried material. Soil samples will be collected from each sidewall (default at approximately 5 feet bsg) and the bottom of each test pit, with sampling biased to the most contaminated interval, as appropriate.

Additional planned assessment includes installation of two monitoring wells. Specifically, monitoring wells that are vertically screened to the base of the sand unit (at a depth exceeding 15 feet bsg, which indicates sand extending to this depth with no clay interface encountered at soil borings PSB-118 and PSB-119) will be installed in the central-northern and southeastern portions of this area. If subsurface structures are identified, soil samples will be collected from a depth immediately below the base of the structure, with samples biased toward any visual evidence of contamination and/or PID readings present. Additionally, other soil depth intervals will be collected following the rationale described above for a maximum of three per boring.

Soil samples collected from each test pit and soil boring/monitoring well will be analyzed for SSCCL parameter list.

Groundwater samples will be collected via low-flow techniques from the newly installed monitoring wells (as well as existing monitoring wells MW-113 and MW-119).  Groundwater samples will be submitted for SSCCL parameter list.

### 4.5.2 AOC 19 – TCE



**Constituents of Concern/Objective:**

*<u>Soil -</u>*

A total of eleven soil borings (five of which were converted to permanent monitoring wells) were evaluated within and surrounding this AOC. Of the eleven soil borings installed, five soil samples were analyzed between 2016 and 2020: PSB-144 (8-9'), PSB-161 (4-5'), MW-108 (4-5'), MW-109 (4-5') and MW-110 (4-5').

The following COCs were detected:

- VOCs: methanol at MW-108 (4-5'), MW-109 (4-5') and MW-110 (4-5').
- PNAs/SVOCs (a full SVOC scan was not completed): none detected.
- Metals: barium and chromium at MW-108 (4-5'), MW-109 (4-5') and MW-110 (4-5').
- PCBs: samples were not analyzed for PCBs.

*Groundwater –*

Groundwater samples collected in 2020 from monitoring wells MW-109, MW-110, MW-111 and MW-112 detected the following COCs (only bolded COCs exceeded their lowest respective screening criteria):

- VOCs: **trichloroethylene at MW-111** exceeding VIAP screening levels and trichlorofluoromethane at MW-108.
- SVOCs (a full SVOC scan was not completed): none detected.
- Metals: **arsenic at MW-114**.
- PCBs: no samples were analyzed for PCBs.
- PFAs: a total of seven PFAS compounds were detected between samples collected from MW-109, MW-110, MW-111 and MW-112, with **PFOA exceeding lowest screening criteria at MW-109 and MW-112**.

*Soil Gas –*

Temporary soil vapor points 18VP-1, 18VP-2 and 18VP-3 (each set at 5 feet bsg) installed by EGLE in August 2018, to the east of AOC 19 across Pinecrest Drive, exhibited trichloroethylene and tetrachloroethylene concentrations in 18VP-1 and 18VP-2. **Trichloroethylene exceeded VIAP screening levels at 18VP-1 and 18VP-2.**

**Planned Assessment:**

As part of Atlas' RCRA CCR September 2021 submittal, the installation of 14 soil vapor points traversing north-south along the eastern boundary of the Site was proposed to monitor trichloroethylene concentrations along this boundary. Atlas completed the installation of the soil vapor points (named VP-1 through VP-14) in November 2021. Additionally, collection of groundwater samples via low-flow methodology was conducted at thirteen existing monitoring wells (MW-104 through MW-113 and MW-119 through MW-121) along the eastern boundary of the Site to assess for the potential of off-site COC migration through the groundwater media. Data obtained from the soil vapor sampling and groundwater sample collection will be disseminated and reported to EGLE under separate cover.

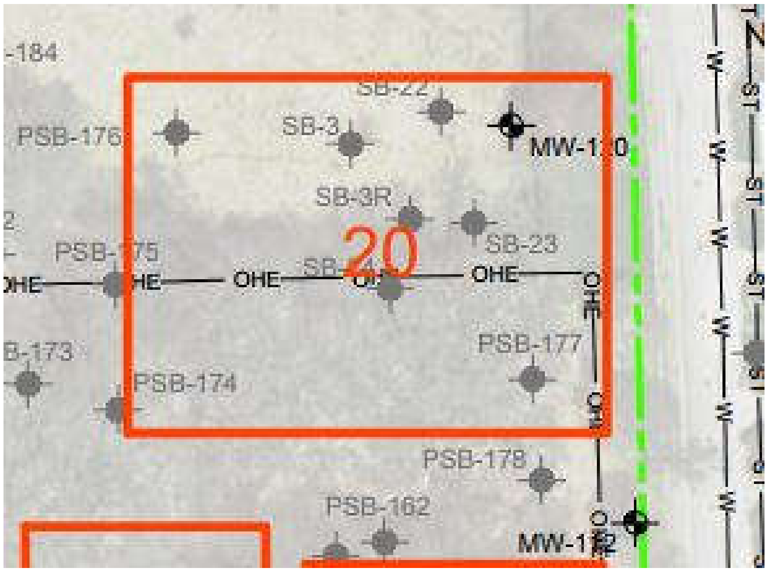
The planned assessment of this AOC will incorporate the data obtained from the soil vapor sampling and groundwater sampling conducted along the eastern boundary. To accomplish this RFI goal, the installation of three monitoring wells will be conducted. Specifically, monitoring wells that are vertically screened to the base of the sand unit (at a depth exceeding 10 feet bsg, which indicates sand extending to this depth with no clay interface encountered at soil borings PSB-179, PSB-180 and PSB-195) will be installed in the northwestern, central and southeastern portions of this area. Soil samples will be biased toward any visual evidence of contamination and/or photoionization (PID) readings present following sample depth selection rationale described above.

Soil samples collected from each soil boring/monitoring well will be analyzed for SSCCL parameter list plus MI PFAS 28 compounds.

Groundwater samples will be collected via low-flow techniques from newly installed monitoring wells (as well as existing monitoring wells MW-109, MW-110, MW-111 and MW-112). Groundwater samples will be submitted for SSCCL parameter list plus MI PFAS 28 compounds.

Soil gas samples will be analyzed for TO-15 analysis.

### 4.5.3 AOC 20 – TCE/SVOC/VOCs



<u>**Constituents of Concern/Objective:**</u>

<u>*Soil -*</u>

A total of eleven soil borings (five of which were converted to temporary monitoring wells and one completed as a permanent monitoring well) were evaluated within and surrounding this AOC. Of the eleven soil borings installed, ten soil samples were analyzed between 2015 and 2020: SB/TMW-3R (3-4'), SB/TMW-22 (3-4'), SB/TMW-23 (4-5'), SB/TMW-24 (3-4'), PSB-174 (5-6'), PSB-175 (2-3'), PSB-177 (5.5-6.5'), PSB-178 (3-4') and MW-120 (2-3') and (4-5').

The following COCs were detected:

- VOCs: **methanol** at MW-120 (4-5').
- PNAs/SVOCs (a full SVOC scan was not completed): multiple SVOCs were detected at SB/TMW-3R (3-4'), SB/TMW-22 (3-4'), SB/TMW-23 (4-5') and SB/TMW-24 (3-4'), however only fluoranthene and phenanthrene at SB/TMW-3R (3-4') exceeded lowest respective screening levels.

- Metals: multiple metals detected at each sampling location with arsenic at PSB-178 (3-4'). Additionally, mercury was detected at SB/TMW-22 (3-4') and at PSB-175 (2-3'), however below default background levels.
- PCBs: none detected at SB/TMW-3R (3-4'), SB/TMW-22 (3-4'), SB/TMW-23 (4-5'), SB/TMW-24 (3-4') and PSB-175 (2-3'). Remaining samples were not analyzed for PCBs.

*Groundwater –*

Groundwater samples collected in 2015 and/or 2016 from temporary monitoring wells SB/TMW-3, SB/TMW-3R, SB/TMW-22, SB/TMW-23 and SB/TMW-24 and in 2020 from monitoring well MW-120 detected the following COCs (only bolded COCs exceeded their lowest respective screening criteria):

- VOCs: benzene**, chlorobenzene (exceedance only at SB/TMW-3),** trichloroethylene (SB/TMW-22 only) and methanol (MW-120 only).
- SVOCs (a full SVOC scan was not completed): none detected.
- Metals: **arsenic**, barium and/or zinc at SB/TMW-3 and SB/TMW-24.
- PCBs: no samples were analyzed for PCBs.
- PFAs: a total of three PFAS compounds were detected at MW-120, however all were below lowest screening criteria.

**Planned Assessment:**

As part of Atlas' RCRA CCR September 2021 submittal, the installation of 14 soil vapor points traversing north-south along the eastern boundary of the Site was proposed to monitor trichloroethylene concentrations along this boundary. Atlas completed the installation of the soil vapor points (named VP-1 through VP-14) in November 2021. Additionally, collection of groundwater samples via low-flow methodology was conducted at thirteen existing monitoring wells (MW-104 through MW-113 and MW-119 through MW-121) along the eastern boundary of the Site to assess for the potential of off-site COC migration through the groundwater media. Data obtained from the soil vapor sampling and groundwater sample collection will be disseminated and reported to EGLE under separate cover.

The planned assessment of this AOC will incorporate the data obtained from the soil vapor sampling and groundwater sampling conducted along the eastern boundary. To accomplish this RFI goal, and provided the presence of a large shallow void identified within the subsurface along the central portion of the area, planned assessment includes the completion of three test pits to assess the shallow void. The test pits will extend the reach of the excavator, no less than 10 feet bsg, to properly evaluate the shallow void and assess for potential orphaned USTs/buried material. Soil samples will be collected from each sidewall (at approximately 5 feet bsg) and the bottom of each test pit, with sampling biased to the most contaminated interval, as appropriate.

Additional planned assessment includes installation of two monitoring wells. Specifically, monitoring wells that are vertically screened to the base of the sand unit (at a depth exceeding 12 feet bsg, which indicates sand extending to this depth with no clay interface encountered at soil borings SB-22, SB-23 and PSB-177) will be installed in the northwestern and central-southern portions of this area. If subsurface structures are identified, soil samples will be collected from a depth immediately below the base of the structure, with samples biased toward any visual evidence of contamination and/or PID readings present. Additionally, other soil depth intervals will be collected following the rationale described above for a maximum of three per boring.

Soil samples collected from each test pit and soil boring/monitoring well will be analyzed for SSCCL parameter list plus MI 28 PFAS compounds.

Groundwater samples will be collected via low-flow techniques from newly installed monitoring wells (as well as existing monitoring well MW-120). Groundwater samples will be submitted for SSCCL parameter list plus MI PFAS 28 compounds.

Soil gas samples will be submitted for TO-15 analysis.

## 4.6 Northern Margin

AOC 15 is included in the Northern Margin that will be the focus of the final phase of the RFI. Description of known uses, investigative work completed so far, and proposed additional sampling scope to address horizontal and vertical delineation of the area is presented below. As stated above, start of the fifth phase of RFI in the Northern Margin is planned to begin in 2030 and be completed by the second or third quarter 2031. Refer to **Figure 7** for a depiction of planned assessment locations pertaining to each AOC.

### 4.6.1 AOC 15 – Historical Ground Disturbances

Historical aerial photographs (particularly from the 1930s to the 1960s) identified areas of disturbance on the sparsely developed northern portion of the property. Indications of disturbed soil including a depression pond and soil stockpiles have been documented within this area.

**Constituents of Concern/Objective:**

*Soil -*

A total of sixteen soil borings (two of which were converted to permanent monitoring wells) were evaluated within and surrounding this AOC. Of the sixteen soil borings installed, fifteen soil samples were analyzed between 2016 and 2020: PSB-102 (2.5-3.5'), PSB-103 (12-13'), PSB-104 (9-10'), PSB-106 (8-9'), PSB-109 (12-13'), PSB-110 (3-4'), PSB-111 (7-8'), PSB-112 (8-9'), PSB-113 (8-9'), PSB-114 (3-4'), PSB-115 (3.5-4.5), MW-114 (3-4') and (8-9') and MW-115 (2-3') and (7-8').

The following COCs were detected (only bolded COCs exceeded their lowest respective screening criteria)

- VOCs: multiple VOCs including **benzene, n-butylbenzene, sec-butylbenzene, 2-methylnapthalene, naphthalene, n-propylbenzene, toluene, 1,2,3- 1,2,4- and 1,3,5-TMBs and/or xylenes** at PSB-103 (12-13'), PSB-104 (9-10'), PSB-110 (3-4'), PSB-111 (7-8'), PSB-112 (8-9'), PSB-113 (8-9'), PSB-114 (3-4') and PSB-115 (3.5-4.5'). Methanol at MW-114 (3-4') and (8-9') and MW-115 (7-8').
- PNAs/SVOCs (a full SVOC scan was not completed): multiple PNAs detected including **benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, fluoranthene and/or phenanthrene** at PSB-111 (7-8'), PSB-113 (8-9'), PSB-114 (3-4'), PSB-115 (3.5-4.5') and MW-114 (3-4').
- Metals: multiple metals were detected in all samples collected. **Specifically, mercury in excess of default background levels and/or VIAP criteria was detected** at PSB-103 (12-13'), PSB-104 (9-10'), PSB-109 (12-13'), PSB-112 (8-9'), PSB-113 (8-9'), PSB-115 (3.5-4.5'), MW-114 (3-4') and MW-115 (7-8'). Mercury was also detected at PSB-106 (8-9'), however below default background levels.
- PCBs: detected at PSB-103 (12-13'), however below lowest screening criteria.

*Groundwater –*

Groundwater samples collected in 2020 from monitoring wells MW-114 and MW-115 detected the following COCs (only bolded COCs exceeded their lowest respective screening criteria):

- VOCs: **benzene, 1,2-dicholorethane** (including cis- and trans-), **naphthalene, trichloroethylene (MW-114 only), vinyl chloride (MW-114 only)** and xylenes.
- SVOCs: naphthalene and **phenanthrene** at MW-115.
- Metals: **arsenic** at MW-114.
- PCBs: no samples were analyzed for PCBs.

- PFAs: a total of six PFAS compounds were detected in MW-114 and MW-115, however none exceed lowest screening criteria.

**Planned Assessment:**

Provided the nature of the AOC (land disturbance), planned assessment is focused determining the extent of material contributing to groundwater impact, with the goal of designing a potential source removal or ground coverage effort. Investigation includes the completion of six test pits. The test pits will extend to the extent of the excavator, to at least 10 feet bsg, to properly assess for buried material, which may include buried containers. Soil samples will be collected from each sidewall (default at approximately 5 feet bsg) and the bottom of each test pit, with sampling biased to the most contaminated interval, as appropriate.

Additional planned assessment includes installation of four monitoring wells. Specifically, monitoring wells that are vertically screened to the base of the sand unit (at a depth of approximately 13 feet bsg, which indicates sand/sandy clay extending to this depth with a clay interface encountered beneath at soil borings/monitoring wells advanced in this area) will be installed in the northern, eastern, southern and western margins. If subsurface structures are identified, soil samples will be collected from a depth immediately below the base of the structure, with samples biased toward any visual evidence of contamination and/or PID readings present. Additionally, other soil depth intervals will be collected following the rationale described above for a maximum of three per boring. Specifically for this AOC, all of the soil depth intervals with detections and exceedances were collected at depth. The future land use of this space is expected to remain wooded and be used for green space/walking trails, so surface depth intervals will be critical for risk-based evaluations of this AOC Area.

Soil samples collected from each test pit and soil boring/monitoring well will be analyzed for SSCCL parameter list plus PCBs (since PCBs have been historically detected in soil).

Groundwater samples will be collected via low-flow techniques from the newly installed monitoring wells (as well as existing monitoring wells MW-114 and MW-115). Groundwater samples will be submitted for SSCCL parameter list, plus PCBs (since PCBs in groundwater has not been evaluated to date).

## 4.7 Site Wide Investigation

As stated in Section 4.0, the purpose of the Site Wide Investigation is to create a holistic, site-wide approach to the investigation of the Site. Activities to be performed during the Site Wide Investigation include 1) the vertical delineation of overburden to provide a better understanding of the overall deep lithology (greater than the current maximum explored depth of 30 feet bsg); and 2) assess potential preferential pathways created by utility corridors and/or known underground tunnels on the Site.

Although the Site Wide Investigation will run in tandem with the proposed assessment of the remaining areas on the site (Southern Area, Northeastern Area, Northwestern Margin, Northern Margin and Northcentral Area); the majority of the assessment will be completed during the Southern Area RFI activities, as all tunnels and the majority of the utilities are located within this Area as well as the planned deep well. Locations of the proposed sampling Site Wide is shown primarily on **Figure 3**.

**Planned Assessment:**

**Vertical delineation of overburden -**

Based on the data collected to date, there is reasonable knowledge of site-related COCs present in the overburden, particularly at the water table interface. The scope of proposed RFI work in various individual AOCs will supplement knowledge base regarding the presence of the presumed continuous shallow clay surface across the Site and how that affects migration potential in this water-bearing zone. Additional RFI work scoped will supplement knowledge of the continuity of the presumed clay by tagging the sand/clay interface at a number of locations within individual AOCs allowing horizontal delineation to be better assessed and understanding more complete. However, without penetrating deeper through the shallow clay surface, interpretation on vertical delineation of COCs below the clay cannot be determined.

One deep well (likely to be set at approximately 130-150 feet bsg) will be installed within the Southern Area of the Site. Based upon Wellogic records obtained from EGLE's online database, a well installed by Consumers Energy approximately one mile northwest (upgradient) of the Site indicated a water bearing zone within the shale present at approximately 130 feet bsg. The purpose of the deep, water bearing well on-site will be to vertically profile the underlying lithologic and hydrogeologic conditions beneath the Site.

A deep, double-cased monitoring well will be installed for vertical delineation purposes targeting the next water-bearing zone below the overburden. The proposed total depth of the well is approximately 130 feet bsg, just above the interface of the gray clay and the black and gray shale, as identified in the Consumers Energy well installed approximately one mile northwest of the Site. A drill rig will be used to advance the borehole to a depth of 150 feet bsg. Two-inch inner diameter Schedule 40 PVC surface casing will be installed and the annular space will be sealed using a neat cement grout placed using a tremie pipe. The annular seal will be allowed to cure overnight. The drilling method will be used to advance the borehole to the target total depth.

A monitoring well will be constructed using Schedule 40 PVC threaded riser and 10 to 20 feet of factory machine-slotted threaded, 2-inch diameter screen (0.010 slot size). Centralizers will be installed on the riser at maximum intervals of 30 feet. A clean silica sand pack will be placed opposite the screen and to a height of at least 5.0 feet above the top of the screen. Above the screen, a 5.0 foot seal will be constructed with hydrated sodium bentonite. A locking, flush mounted steel, traffic rated manway and cement apron will be installed. The monitoring well will be developed approximately 24 hours after completion using a pump and surge method until suspended solids are significantly reduced. All development water will be collected and contained for proper disposal. All other associated procedures for well installation, decontamination, and screening will follow Standard Operating Procedures as presented in Section 6.0.

**Underground Tunnels and Subsurface Utility Corridors -**

Multiple utility corridors and historical underground pedestrian tunnels on-site connecting former buildings will be investigated. The initial focus of the site wide assessment of these former and current features is to identify and map their locations for delineation purposes. Secondarily, risks associated with the presence of utility corridors (which are typically shallow, set at an average of 3-5 feet bsg) can exacerbate impacts to soil, groundwater and/or soil gas through migration of COCs along preferential pathways provided by the surrounding fill material of the utility line or through residual void space of the crushed tunnels.

Although it has been demonstrated that overburden within the Site is typically sand, fill material surrounding utility lines may present a preferential pathway concern. Therefore, the termination of on-site utility corridors into off-site mains within both Pinecrest Drive and 8 Mile Road will be evaluated within the right-of-way of each respective roadway and along the locations of the tunnels and the paths of the underground utility corridors.

Historical underground pedestrian tunnels, will be evaluated during assessment of the Southern Area. These tunnels were reported to have been crushed and compacted with fill during demolition activities in 2012/2013. Specifically, during test pit evaluation and soil boring/monitoring well boring advancement in the Southern Area, subsurface investigations will extend at least to the terminus depth of approximately 10 feet bsg which is the approximate depth of the tunnels.

Migration of VOCs and/or SVOCs as well as mercury vapor (likely occurring from confirmed presence of an unknown source of mercury onsite) in soil and groundwater has been identified at the Site, particularly within the Southern Area. Trichloroethylene specifically has been identified in soil gas samples collected within the eastern right-of-way of Pinecrest Drive, within a residential area. As such, identification and delineation of the location of the tunnels and utility corridors and the effect these may contribute to COCs within soil/groundwater/soil gas will also be completed as part of the site-wide AOC as well as in individual AOCs. If potential evidence of off-site migration issues are identified during this RFI, additional delineation measurements may be needed to protect these sensitive offsite receptors.

# 5. PROJECT MANAGEMENT PLAN

## 5.1 Technical Approach

As noted in Section 4.0, the Site has been divided into 20 areas of concern (AOC) contained within five groupings called Margins (**Figure 2**) (Southern, Northern, North-Western, North-Central, and North-Eastern Margins), based upon previously identified SWMUs, historical uses or specific subareas, geophysical anomalies, EMI survey data and/or soil, groundwater and/or soil gas concentrations within those specific areas. The technical RFI approach for each AOC has been described in Section 4.0. Details of how the RFI will proceed, including standard operating procedures (SOPs) for undertaking field investigative activities, are further discussed in Section 6.0.

## 5.2 Schedules

Schedules for each Area and Margin's RFI are also included in Section 4.0. The projected investigation timeline is 2022 through 2030.

## 5.3 Personnel

Investigations performed by Atlas, on behalf of Axle Holdings 1, LLC, will be conducted under the direction of an Atlas Program Director, Project Manager/Field Operations Manager, and a Staff Geologist/Field Task Leader. Additional experienced and qualified field personnel will be assigned to the project, as necessary. Contractor personnel will be determined at the time of investigation scheduling for each specific AOC.

# 6. STANDARD OPERATING PROCEDURES

To ensure RFI goals are achieved and decisions are technically sound, statistically valid and properly documented, Atlas will conduct the field investigative activities following standard operating procedures (SOPs) as referenced and attached herein, during each investigation phase. Details pertaining to specific depths, number and location of soil borings/monitoring wells, test pits, as well as specific COCs for each AOC is outlined in Section 4.0.

SOPs pertaining to field activities for this RFI are presented in **Appendix A**. A summary of the referenced SOPs include:

| SOP # | Title |
|---|---|
| 01 | Sampling for Perfluorinated Compounds |
| 02 | Field Soil Sample Headspace Screening |
| 03 | Soil Boring Subsurface Sample Collection |
| 04 | Direct Push Subsurface Sample Collection |
| 05 | Groundwater Gauging |
| 06 | Soil Vapor Point Installation and Sample Collection |
| 07 | Decontamination Procedures |
| 08 | Monitoring Well Installation |
| 09 | Slug Test |
| 10 | Groundwater Sampling Low Flow Method |
| 11 | Groundwater Sampling Three Volume Method |
| 12 | Test Pit Installation |

Supplemental site-specific instructions and details for implementing select field activities referenced in Section 4.0 are as summarized below. A summary of proposed sampling numbers, proposed analyses associated with each AOC, and estimated numbers of QA/QC samples with the investigative scope are presented in **Table 1**.

## 6.1 Test Pits

Test pit activities will be completed following instructions in SOPs No. 02, 07, and 12 biased towards GPR and EMI anomalies and historically identified reported waste locations. Based on the age of any buried containers, if remnants of containers are encountered, the number, description, location, and description of the encountered containers will be documented and the remnants will be carefully recovered returning cuttings to the hole in the reverse order then when excavated.

Under no circumstances will the containers be attempted to be moved or removed over concerns for loss of former material contained. There is no way to predict the hazardous characteristics or reactive possibilities of buried waste. If exposed containers with visible waste can be safely sampled without disturbing the remnants, then samples will be collected. Analytical laboratory analysis will include VOCs, SVOCs, PCBs and metals to properly characterize the contents as Hazardous or Non-Hazardous materials. If solids are present within the containers, they will be additionally extracted for toxicity characterization leaching procedure (TCLP) analysis of these same parameters to determine their suitability for landfill disposal. The Atlas Program Manager will be contacted and EGLE representatives will be informed within 24 hours. A plan will be developed to identify and characterize the visible material upon receipt of the analytical results for safely removing the materials for proper disposal.

Per the SOP, visible uncontainerized materials discovered during test pit excavations will be targeted for biased sampling during test pit activities and RFI characterization.

## 6.2 Soil Boring/Monitoring Well Installation

Soil samples will be collected from soil borings and well borings specific to each AOC, as detailed in Section 4.0 following general instructions and guidance presented in SOPs No. 01, 02, 03, 07, 08, and 09.

The monitoring wells will be installed to allow for the collection of groundwater samples and will be screened at depths specific to each AOC, as further discussed in Section 4.0. Some wells will be nested to specifically target the bottom of the overburden at the clay interface to evaluate COCs that tend to sink and accumulate on a semi-confining layer. These wells will be constructed with a small sump to allow for potential NAPL.

## 6.3 Groundwater Sampling

Atlas will conduct low-flow groundwater sampling at installed monitoring wells depending on the needs of the investigation following SOPs No. 01, 05, 07 and 10. Groundwater samples will be analyzed for the presence of select COCs, specific to each AOC, as detailed in Section 4.0.

## 6.4 Soil Vapor Sampling

Soil vapor samples will be collected in select AOCs as described in Section 4.0 following SOPs No, 06 and 07 for soil gas point installation and soil vapor point installation and sampling, respectively. Historical environmental samples have reported detections of VOCs in soil and groundwater and preliminary soil vapor sampling, particularly in the southern and eastern margins of the Site.

# 7. DATA COLLECTION QUALITY ASSURANCE PROJECT PLAN

## 7.1 Data Quality

Data quality objectives (DQOs) are to obtain data that are sufficiently accurate and representative of site media that reliable assessment of exposure pathways and risks may be identified. Field data will be obtained in a consistent manner using standard protocols developed by the USEPA, EGLE, ASTM, or other appropriate developer of scientific methods. Laboratory data will be obtained in accordance with standard protocols similarly developed, targeting analytical method detection limits less than the lowest applicable regulatory standards and levels of toxicological risk to the extent possible and data that are reproducible and verifiable, such as documented in EGLE's March 2016 *Application of Target Detection Limits and Designated Analytical Methods*. Where analytical results cannot be determined to the target levels, such as because of analytical interference, documentation of data limitations and effect on assessment conclusions will be evaluated. Data accuracy, reproducibility, and absence of cross-contamination will be evaluated using field and laboratory quality assurance and quality control (QA/QC) measures including the use of sample blanks, replicates, and comparative standards.

## 7.2 Analysis and Testing

Field screening for total VOCs will be performed following SOP No. 02. Laboratory analysis will be performed in accordance with EGLE's March 2016 *Application of Target Detection Limits and Designated Analytical Methods*, where applicable. Analytical methods will follow RCRA Test Methods for Evaluating Solid Waste SW-846. The COC list for the various methods for VOCs (8260B), alcohols (8015B), SVOCs (8270C), metals (6020/7470), PCBs (8082), PFAS (8327), and dioxins and furans (8290A) along with their associated reporting limits (RLs) and method detection limits (MDLs) are presented in **Table 2**. As additionally shown in **Table 2**, tetraethyl lead and hexavalent chromium will individually be analyzed by SW-846 Methods (8270D Organo Lead by GC/MS) and (7196A), respectively, when applicable. The VOC 1,4-dioxane will be separately analyzed using 8270C with Selective Ion Monitoring to be able to have RLs low enough to screen against RBSLs for undiluted water samples.

Vapor samples will be analyzed for the site-specific target list VOCs by Method TO-15.

If new site-specific COCs are identified as part of the TIC analysis as part of the VOC or SVOC GC/MS analyses or if analytical reporting limits are not achievable by their identified analytical method, alternate analytical methods will be selected in cooperation with the analyzing laboratory and documented as an addendum to this RFI.

## 7.3 Quality Assurance/Quality Control

QA/QC samples of all media will be collected as measures of the precision, accuracy, and representativeness of the DQOs for this project. Trip blanks will be collected daily. Trip blanks are prepared by the laboratory and accompany empty sample containers and any coolers containing water samples for VOC analyses.

If reusable sampling equipment is utilized rather than single-use disposable or if the sampling media comes into contact with any decontaminated field equipment, an equipment field blank will be collected by running deionized water over the equipment once cleaned. Field blanks, if needed, will be analyzed at a frequency one per 20 samples per equipment type cleaned.

Field duplicate (or split samples for soil vapor) samples will be collected every ten samples per media. The estimated number of QA/QC samples to be collected per AOC Area are presented in **Table 1**.

Sample containers are pre-preserved by the analytical laboratory, when necessary. Soil VOC samples will be collected using methanol preservation, as recommended by EGLE.

Laboratory reagent blanks (method blanks) will be prepared and analyzed at the appropriate frequency; surrogate, lab control sample, and matrix spiked recoveries will be performed by the laboratory at appropriate frequencies and specifications stipulated by the associated SW-846 analytical methods, as identified by EGLE's March 2016 *Application of Target Detection Limits and Designated Analytical Methods*.

Reagents, preservation chemicals, and analytical standards will be prepared freshly, as appropriate, by the analyzing laboratory. Reagent transfer will employ clean transfer devices such as sanitizer pipets sealed in plastic following decontamination.

## 7.4 Project Documentation

Data will be fully documented at the time of collection, using prepared forms, including those for field observations, boring and well logs, photo-documentation, instrument calibration and use logs, and analytical forms. All field and analytical forms will be scanned to a project server and evaluated by the Project Manager daily to determine if modifications or additional sampling is required. Ongoing data tabulation, including comparison to applicable risk standards, and graphical representation will be used to assist with data evaluation.

Soil sample locations will be flagged and those locations and well top of casing and ground surface coordinates and elevations will be obtained by a certified land-surveyor using high resolution equipment. Geospatial coordinates for the Site will be tied into State Plane Coordinates by establishing on-site benchmarks and working from that demarcation.

Investigative reports will be prepared and confirmed by the Project Manager, reviewed by the Program Manager, undergo in-house technical and administrative review, client review, stepwise revisions, and submittal for regulatory review and approval.

## 7.5 Organization Performing Field or Laboratory Operations

Field data will be recorded on standard forms and scanned to electronic databases immediately upon return from the field. Laboratory oversight will be provided by the Project Manager.

Laboratory analyses primarily will be performed by Pace Analytical (Pace) located in Mt. Juliet, Tennessee. PFAS analyses will be performed by the PACE West Columbia, South Carolina laboratory, the alcohol VOC analyses by the PACE Indianapolis, Indiana laboratory, and the dioxin/furans analyses by the PACE Minneapolis, Minnesota laboratory. All analytical laboratories are in good standing and hold relevant NELAP certifications plus Michigan Drinking Water certifications, although that does not necessarily apply in this case.

## 7.6 Performance Evaluation

The Project Manager will be responsible for verifying that field crews and other individuals and contractors conduct their work in accordance with prescribed SOPs and document all data necessary to verify sampling and analysis methods are followed to generate a robust and complete data set of reliable, precise, and accurate data.

## 7.7 Field Activities

All field equipment and instrumentation will be calibrated and used in accordance with manufacturer’s recommendations and applicable regulatory guidelines. Standard and blank samples will be used, as appropriate, to verify the validity of data collected, and the efficacy of decontamination procedures employed.

When evaluating areas previously identified as contaminated, investigations will be performed from areas anticipated to be least contaminated to those expected to be more contaminated. Decontamination protocols will be implemented between each location following the SOP No. 7 (**Appendix A**).

Field records will be thoroughly documented on prepared forms and in field logbooks using permanent pen or marker, scanned onto the Atlas server, and evaluated for inconsistencies or indications of possible error. All entries will be legible, with dates and people present annotated, and corrections made with a single line through, initialed and dated by the corrector.

## 7.8 Laboratory Activities

Laboratory sample handling, analysis, and QA/QC evaluation will be performed in accordance with the PACE Laboratory Quality Assurance Manual prepared for each of the four facilities.

Analytical data will be evaluated by the laboratory prior to reporting relative to holding times, preservation methods and proper temperature and/or pH, laboratory blanks, surrogate recoveries, laboratory control sample recoveries, matrix spike recoveries, duplicate analyses, and method detection limit reporting. Data relative to periodic QA sample analyses, performance evaluation testing, and calibration time relative to analytical determinations also will be provided and evaluated by the laboratory.

Internal laboratory QA evaluations will be documented in each laboratory data report. The outcome is typically provided in the case narrative so the data user can understand any complications in sample handling or analyses, determine the effect on data quality, and make an independent determination of the data’s utility. Independent data validation outside the laboratory is discussed below.

# 8. FIELD OPERATIONS / DATA MANAGEMENT AND REPORTING

Field operations subject to QA/QC oversight by the Project Manager include all field activities – subsurface drilling and soil classification, sampling of each media, geophysical investigations for subsurface structures and features, physiochemical monitoring with various field meters, data logging, and field crew and contractor performance and decontamination. Field logistics will conform to Atlas' SOPs and EGLE guidelines, as appropriate, as discussed in Section 6.0.

## 8.1 Sample Management

Samples will be collected directly into laboratory-prepared containers suitable for the media, preserved consistent with analytical guidelines, and maintained in an appropriate container (such as an iced cooler) for transport at a temperature consistent with preservation guidelines. Samples will be labeled with unique numbers keyed to location, media, and depth; with date and time of collection; preservation; and intended analyses. Samples will be delivered under completed chain-of-custody form to the analyzing laboratory within appropriate holding times for analysis.

Samples will be identified using a standardized sample naming nomenclature for all RFI samples for ease of sorting as described below. To facilitate quick identification as RFI samples, soil borings will begin sequentially counting using the naming structure SB-200, SB-201, etc. with soil depth intervals in feet to feet format. For example, a surface sample from soil boring SB-201 would be identified as SB-201(0-0.5').

Similarly, newly installed monitoring wells will start sequentially counting using the naming nomenclature MW-200, MW-201, etc. Groundwater samples from monitoring wells will be named the same as the well identification (ID) with a differentiator between samples from the same well as the date sampled. A depth for a groundwater sample is superfluous as the well screen depth is static and intuitively known. Groundwater samples from existing wells will follow suit and be named the same as their existing well ID such as MW-1. Note that existing wells may be renamed as duplicate IDs have been used through multiple pre-RFI phases of Site investigations.

Soil gas sample vapor points will be similarly labeled like monitoring wells to permit multiple samples to be collected from the same point in the form VP-100, VP-101, etc. Multiple samples from the same vapor point location will be differentiated based on the date sampled.

## 8.2 Field Measurements

Field measurements using geophysical and survey equipment will be performed in accordance with manufacturers' guidelines. Principal field measurements will include total VOC screening using a properly calibrated PID and physiochemical measurements using a multi-parameter meter during low-stress groundwater sampling.

## 8.3 Data Reduction and Validation

Soil and groundwater concentrations will be compared to applicable residential and non-residential RBSLs. All soil data will be determined in parts per billion by dry weight and groundwater data will be determined in parts per billion by volume, except for PFAS analysis results which are reported in units of parts per trillion by volume and dioxin/furan analysis results which are reported in units of parts per quadrillion. Soil vapor data will be reported in units of parts per billion by volume and converted micrograms per cubic meter. Concentrations will be verified for precision by evaluation of field duplicate samples collected and analyzed every tenth sample by media.

Qualifications of the data based on laboratory and field QA/QC results associated with the sample analyses and interpretations of usability of the data quality will be incorporated into the data summaries. Limitations of potential utility based on the data validation findings and resulting data qualifications will be examined prior to their use in any risk assessment or remedial design.

## 8.4 Reporting

Progress reports will be prepared upon the completion of each investigative phase. An RFI Report will be prepared upon completion of each AOC Area investigation phase and the cumulative RFI Report will serve as the basis for preparing the Corrective Measures Study, evaluating remedial alternatives. Each additional RFI phase will be used to build expectation, clarifications and modifications, as applicable or appropriate, for subsequent phases.

## 8.5 Records Management

Field records and boring logs will be maintained on standard forms, scanned secured server locations, and maintained in notebooks. Laboratory analytical reports will be electronically maintained in a similar fashion. Electronic databases will be manipulated to evaluate concentrations of individual contaminants spatially and temporally. Spatial evaluations will be performed by overlying contaminant concentrations on a surveyed base map in AutoCAD, with surveyed locations of sampling points, potential contaminant source structures, and potential conduits for contaminant migration. Spatial evaluations also will be performed using cross-sections to visualize migration pathways, stratigraphic controls, and vertical contaminant spread by media. Figures presenting contaminant distributions focusing on risk-based exceedances in on-site media will be incorporated in the RFI Reports.

## 8.6 Waste Disposal

Investigative-derived wastes (IDW) generated by field sampling, including used PPE, soil cuttings, well development and purge water, will be drummed for appropriate off-site disposal. IDW will be labeled as “Hazardous Waste Pending Analysis” and stored in a secured singular onsite location will it will not be disturbed and will not interfere with investigations or other onsite operations. IDW characterization samples will be collected and analyzed to guide disposal protocols. Waste manifests will maintained in project records and included for documentation proof in the RFI Reports.

Wastes generated by laboratory analytical procedures will be managed and disposed by the contract laboratory including residual sample material following aliquots needed for analyses.

## 9. COMMUNITY RELATIONS PLAN

This Public Involvement Plan (PIP) was prepared in general accordance with RCRA Public Involvement Manual (EPA/530-R-93-006, September 1993). Atlas' goal is to provide access to neighbors and other interested and involved parties to review available existing site reports and investigative plans and provide opportunity for questions and comments, as it pertains to COCs at the Site, with special emphasis on PFAS. Due to PFAS concentrations detected at the Site, the Site has been considered a candidate for EGLE's Michigan PFAS Action Response Team (MPART) Program.

However, because of limitations on public meetings and other gatherings imposed by the Michigan Governor's Executive Order (EO) 2020-21 and its amendments intended to help mitigate the spread of the COVID-19 virus, public meetings and other activities involving direct contact between the involved parties, regulators, and the public are deemed generally undesirable at the present time. Accordingly, this PIP envisions public involvement as consisting of the following activities until applicable measures available to control the COVID-19 virus are established:

- Atlas will work with EGLE to present tabular PFAS data obtained from the Site to the general public, utilizing EGLE's MPART Program web portal. EGLE's MPART web portal is utilized for public access to relevant available documents for review and for submittal of comments and questions.

- Atlas will work with EGLE to provide to the public body a Public Fact Sheet to present a summary of the following: historical operations at the Site; a generalized overview of proposed/ongoing activities being conducted at the Site by Atlas to mitigate the threat of any potential contamination migration to off-site receptors; and a link to EGLE's FOIA web-based portal so the general public may request to review reports/information for the Site, should they so desire. Atlas will approach the City of Ferndale to discuss the best way to provide this Fact Sheet to the general public and citizens within the community.

# 10. REFERENCES

Applied EcoSystems, Inc. (AE), November 26, 2019, *Proposal & Eastern Area Investigation Work Plan, Hayes Lemmerz (Former Ethyl Corp.) Site, 1600 West Eight Mile Road, Ferndale, Michigan:* Prepared for Pinecrest Holdings, LLC.

Applied EcoSystems, Inc. (AE), November 27, 2019, *RCRA Corrective Action Description of Current* Conditions *Report; Hayes Lemmerz (Former Ethyl Corp.) Site, 1600 West Eight Mile Road, Ferndale, Michigan:* Prepared for Pinecrest Holdings, LLC.

Atlas Technical Consultants (Atlas), April 5, 2021, *RCRA Corrective Action Description of Current Conditions and Interim Measures Report, Hayes Lemmerz (Former Ethyl Corp.) Site, 1600 West Eight Mile Road, Ferndale, Michigan:* Prepared for Michigan Department of Environment. Great Lakes, and Energy

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Neyer, Tiseo & Hindo Ltd., December 26, 1985, *Preliminary Site Assessment Investigation, Ethyl Corporation, Ferndale, Michigan*: Prepared for Oakland County Michigan Economic Development Group.

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PM Environmental, November 3, 2015, *Phase I Environmental Site Assessment of the Vacant Industrial Property Located at 1600 West 8 Mile Road, Ferndale, Michigan*: Prepared for CG Emerson Real Estate Group.

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PM Environmental, May 24, 2019, *Phase I Environmental Site Assessment; 1600 West Eight Mile Road and Identified as Parcel ID 24-25-33-451-005, Ferndale, Michigan*: Prepared for Axle of Dearborn.

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RJN Environmental, December 5, 2012, *Baseline Environmental Assessment, 1600 West Eight Mile Road, City of Ferndale, Oakland County, Michigan*: Prepared for Cedan Holdings VI, LLC.

RJN Environmental, December 18, 2012, *Phase II Environmental Site Assessment, Former Ethyl Corporation Laboratories, 1600 West Eight Mile Road, City of Ferndale, Oakland County, Michigan*: Prepared for Cedan Holdings VI, LLC.

RJN Environmental, Inc., November 1, 2013, *Phase II Environmental Site Assessment, North Half Former Ethyl Corporation Laboratories, 1600 West Eight Mile Road, City of Ferndale, Oakland County, Michigan*: Prepared for Cedan Holdings VI, LLC.

City of Ferndale Zoning Map (ArcGIS) https://www.ferndalemi.gov/services/planning-zoning

City of Ferndale Master Plan, updated January 2017 https://www.ferndalemi.gov/resources/project-3

U.S.D.A. Web Soil Survey http://websoilsurvey.nrcs.usda.gov/app/

USFWS on-line Wetland Mapper: http://www.fws.gov/wetlands/data/Mapper.html

EGLE Water Well Viewer: https://www.mcgi.state.mi.us/waterwellviewer/

Wellogic Water Well Record Search:
https://www.egle.state.mi.us/wellogic/Login.aspx?ReturnUrl=%2fwellogic%2fdefault.aspx

## 11. SIGNATURES

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Ryann Scott

February 17, 2022

Ryann Scott
Project Geologist

Keith M. Stang

February 17, 2022

Keith Stang
Project Manager

February 17, 2022

Andrew Stuart
National Program Director

# TABLES

# TABLE 1
# PROPOSED SAMPLE LOCATIONS AND PARAMETERS BY AREA OF CONCERN

| | SOIL | | | | | | | GROUNDWATER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | VOCS + TICS | SVOCS + TICS | Metals | PCBS | Tetraethyl Lead | Dioxins/Furans | PFAS | VOCS + TICS | SVOCS + TICS | Metals | PCBs | Tetraethyl lead | Dioxins/Furans | PFAS |
| **Southern / Site Wide** | | | | | | | | | | | | | | |
| AOC 3 | 24 | 24 | 24 | | | | | 4 | 4 | 4 | | | | 4 |
| AOC 7 | 4 | 4 | 4 | | 4 | | 4 | 5 | 5 | 5 | | 5 | | 5 |
| AOC 8 | 4 | 4 | 4 | | | | 4 | 8 | 8 | 8 | | | | 8 |
| AOC 9 | 6 | 6 | 6 | | 6 | | 6 | 3 | 3 | 3 | | 3 | | 3 |
| AOC 10 | 14 | 14 | 14 | | | | | 6 | 6 | 6 | | | | |
| AOC 11 | 24 | 24 | 24 | | 24 | | 24 | 5 | 5 | 5 | | 5 | | 5 |
| AOC 12 | 19 | 19 | 19 | | | | 19 | 5 | 5 | 5 | | | | 5 |
| **Northeastern** | | | | | | | | | | | | | | |
| AOC 14 | 24 | 24 | 24 | | | | | 6 | 6 | 6 | | | | |
| AOC 19 | 6 | 6 | 6 | | | | 6 | 10 | 10 | 10 | | | | 10 |
| AOC 20 | 19 | 19 | 19 | | | | 19 | 4 | 4 | 4 | | | | 4 |
| **Northwestern** | | | | | | | | | | | | | | |
| AOC 2 | 24 | 24 | 24 | | 24 | | 24 | 4 | 4 | 4 | | 4 | | 4 |
| AOC 16 | 4 | 4 | 4 | | | | | 2 | 2 | 2 | | | | |
| AOC 17 | 14 | 14 | 14 | | | | | 3 | 3 | 3 | | | | |

# TABLE 1
# PROPOSED SAMPLE LOCATIONS AND PARAMETERS BY AREA OF CONCERN

| | SOIL | | | | | | | GROUNDWATER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | VOCS + TICS | SVOCS + TICS | Metals | PCBS | Tetraethyl Lead | Dioxins/Furans | PFAS | VOCS + TICS | SVOCS + TICS | Metals | PCBs | Tetraethyl lead | Dioxins/Furans | PFAS |
| **Northern** | | | | | | | | | | | | | | |
| AOC 15 | 38 | 38 | 38 | 38 | | | | 6 | 6 | 6 | 6 | | | |
| **North Central** | | | | | | | | | | | | | | |
| AOC 1 | 9 | 9 | 9 | 9 | 9 | | 9 | 4 | 4 | 4 | 4 | 4 | | 4 |
| AOC 4 | 8 | 8 | 8 | | 8 | | 8 | 4 | 4 | 4 | | 4 | | 4 |
| AOC 5 | 26 | 26 | 26 | | 26 | | 26 | 4 | 4 | 4 | | 4 | | 4 |
| AOC 6 | 28 | 28 | 28 | 28 | | 28 | 28 | 4 | 4 | 4 | 4 | | 4 | 4 |
| AOC 13 | 14 | 14 | 14 | | | | | 3 | 3 | 3 | | | | |
| AOC 18 | 19 | 19 | 19 | 19 | 19 | | | 2 | 2 | 2 | 2 | 2 | | |

QA/QC Samples:

One duplicate sample collected every 10 samples, per media.

One field blank, trip blank and equipment blank per day, per media.

# TABLE 2
# GROUNDWATER - MDL/RDL

## METALS

| Parameter | Units | MDL | RDL |
|---|---|---|---|
| **GFAA Metals by 6020** | | | |
| ALUMINUM | mg/l | 0.005150 | 0.100000 |
| ALUMINUM,DISSOLVED | mg/l | 0.005150 | 0.100000 |
| ANTIMONY | mg/l | 0.000754 | 0.002000 |
| ANTIMONY,DISSOLVED | mg/l | 0.000754 | 0.002000 |
| ARSENIC | mg/l | 0.000250 | 0.002000 |
| ARSENIC,DISSOLVED | mg/l | 0.000250 | 0.002000 |
| BARIUM | mg/l | 0.000360 | 0.005000 |
| BARIUM,DISSOLVED | mg/l | 0.000360 | 0.005000 |
| BERYLLIUM | mg/l | 0.000120 | 0.002000 |
| BERYLLIUM,DISSOLVED | mg/l | 0.000120 | 0.002000 |
| BORON | mg/l | 0.001500 | 0.020000 |
| BORON,DISSOLVED | mg/l | 0.001500 | 0.020000 |
| CADMIUM | mg/l | 0.000160 | 0.001000 |
| CADMIUM,DISSOLVED | mg/l | 0.000160 | 0.001000 |
| CALCIUM | mg/l | 0.046000 | 1.000000 |
| CALCIUM,DISSOLVED | mg/l | 0.046000 | 1.000000 |
| CHROMIUM | mg/l | 0.000540 | 0.002000 |
| CHROMIUM,DISSOLVED | mg/l | 0.000540 | 0.002000 |
| COPPER | mg/l | 0.000520 | 0.005000 |
| COPPER,DISSOLVED | mg/l | 0.000520 | 0.005000 |
| COBALT | mg/l | 0.000260 | 0.002000 |
| COBALT,DISSOLVED | mg/l | 0.000260 | 0.002000 |
| IRON | mg/l | 0.015000 | 0.100000 |
| IRON,DISSOLVED | mg/l | 0.015000 | 0.100000 |
| LEAD | mg/l | 0.000240 | 0.002000 |
| LEAD,DISSOLVED | mg/l | 0.000240 | 0.002000 |
| MAGNESIUM | mg/l | 0.100000 | 1.000000 |
| MAGNESIUM,DISSOLVED | mg/l | 0.100000 | 1.000000 |
| MANGANESE | mg/l | 0.000250 | 0.005000 |
| MANGANESE,DISSOLVED | mg/l | 0.000250 | 0.005000 |
| MOLYBDENUM | mg/l | 0.000140 | 0.005000 |
| MOLYBDENUM,DISSOLVED | mg/l | 0.000140 | 0.005000 |
| NICKEL | mg/l | 0.000350 | 0.002000 |
| NICKEL,DISSOLVED | mg/l | 0.000350 | 0.002000 |
| POTASSIUM | mg/l | 0.037000 | 1.000000 |
| POTASSIUM,DISSOLVED | mg/l | 0.037000 | 1.000000 |
| SELENIUM | mg/l | 0.000380 | 0.002000 |
| SELENIUM,DISSOLVED | mg/l | 0.000380 | 0.002000 |
| SILVER | mg/l | 0.000310 | 0.002000 |
| SILVER,DISSOLVED | mg/l | 0.000310 | 0.002000 |
| SODIUM | mg/l | 0.110000 | 1.000000 |
| SODIUM,DISSOLVED | mg/l | 0.110000 | 1.000000 |
| STRONTIUM | mg/l | 0.000160 | 0.010000 |
| STRONTIUM,DISSOLVED | mg/l | 0.000160 | 0.010000 |
| THALLIUM | mg/l | 0.000190 | 0.002000 |
| THALLIUM,DISSOLVED | mg/l | 0.000190 | 0.002000 |
| THORIUM | mg/l | 0.000450 | 0.010000 |
| THORIUM,DISSOLVED | mg/l | 0.000450 | 0.010000 |
| TIN | mg/l | 0.000300 | 0.002000 |
| TIN,DISSOLVED | mg/l | 0.000300 | 0.002000 |
| TITANIUM | mg/l | 0.000420 | 0.010000 |
| TITANIUM,DISSOLVED | mg/l | 0.000420 | 0.010000 |
| VANADIUM | mg/l | 0.000180 | 0.005000 |
| VANADIUM,DISSOLVED | mg/l | 0.000180 | 0.005000 |
| ZINC | mg/l | 0.002560 | 0.025000 |
| ZINC,DISSOLVED | mg/l | 0.002560 | 0.025000 |
| **Mercury by 7470** | | | |
| MERCURY | mg/l | 0.0000490 | 0.000200 |
| MERCURY,DISSOLVED | mg/l | 0.0000490 | 0.000200 |
| **Tetraethyl Lead by PAH SIM** | | | |
| TETRAETHYL LEAD | mg/l | 0.000025 | 0.00005 |
| **Cyanide by 9012B** | | | |
| CYANIDE | mg/l | 0.0018 | 0.005 |
| **Hexavalent Chromium by 7199** | | | |
| HEXAVALENT CHROMIUM | mg/l | 0.0002 | 0.001 |

## TPH

| | | | |
|---|---|---|---|
| **8015 Diesel and Oil Ranges by 3511** | | | |
| C10-C28 DIESEL RANGE | mg/l | 0.022200 | 0.100000 |
| C28-C40 OIL RANGE | mg/l | 0.011800 | 0.100000 |
| **GRO by 8015** | | | |
| TPH (GC/FID) | mg/l | 0.031400 | 0.100000 |

## VOCS

| Parameter | Units | MDL | RDL |
|---|---|---|---|
| **VOCs by 8260** | | | |
| ACETONE | mg/l | 0.010000 | 0.050000 |
| ACROLEIN | mg/l | 0.008870 | 0.050000 |
| ACRYLONITRILE | mg/l | 0.001870 | 0.010000 |
| BENZENE | mg/l | 0.000331 | 0.001000 |
| BROMOBENZENE | mg/l | 0.000352 | 0.001000 |
| BROMODICHLOROMETHANE | mg/l | 0.000380 | 0.001000 |
| BROMOFORM | mg/l | 0.000469 | 0.001000 |
| BROMOMETHANE | mg/l | 0.000866 | 0.005000 |
| N-BUTYLBENZENE | mg/l | 0.000361 | 0.001000 |
| SEC-BUTYLBENZENE | mg/l | 0.000365 | 0.001000 |
| TERT-BUTYLBENZENE | mg/l | 0.000399 | 0.001000 |
| CARBON TETRACHLORIDE | mg/l | 0.000379 | 0.001000 |
| CHLOROBENZENE | mg/l | 0.000348 | 0.001000 |
| CHLORODIBROMOMETHANE | mg/l | 0.000327 | 0.001000 |
| CHLOROETHANE | mg/l | 0.000453 | 0.005000 |
| CHLOROFORM | mg/l | 0.000324 | 0.005000 |
| CHLOROMETHANE | mg/l | 0.000276 | 0.002500 |
| 2-CHLOROTOLUENE | mg/l | 0.000375 | 0.001000 |
| 4-CHLOROTOLUENE | mg/l | 0.000351 | 0.001000 |
| 1,2-DIBROMO-3-CHLOROPROPANE | mg/l | 0.001330 | 0.005000 |
| 1,2-DIBROMOETHANE | mg/l | 0.000381 | 0.001000 |
| DIBROMOMETHANE | mg/l | 0.000346 | 0.001000 |
| 1,2-DICHLOROBENZENE | mg/l | 0.000349 | 0.001000 |
| 1,3-DICHLOROBENZENE | mg/l | 0.000220 | 0.001000 |
| 1,4-DICHLOROBENZENE | mg/l | 0.000274 | 0.001000 |
| DICHLORODIFLUOROMETHANE | mg/l | 0.000551 | 0.005000 |
| 1,1-DICHLOROETHANE | mg/l | 0.000259 | 0.001000 |
| 1,2-DICHLOROETHANE | mg/l | 0.000361 | 0.001000 |
| 1,1-DICHLOROETHENE | mg/l | 0.000398 | 0.001000 |
| CIS-1,2-DICHLOROETHENE | mg/l | 0.000260 | 0.001000 |
| TRANS-1,2-DICHLOROETHENE | mg/l | 0.000396 | 0.001000 |
| 1,2-DICHLOROPROPANE | mg/l | 0.000306 | 0.001000 |
| 1,1-DICHLOROPROPENE | mg/l | 0.000352 | 0.001000 |
| 1,3-DICHLOROPROPANE | mg/l | 0.000366 | 0.001000 |
| CIS-1,3-DICHLOROPROPENE | mg/l | 0.000418 | 0.001000 |
| TRANS-1,3-DICHLOROPROPENE | mg/l | 0.000419 | 0.001000 |
| 2,2-DICHLOROPROPANE | mg/l | 0.000321 | 0.001000 |
| DI-ISOPROPYL ETHER | mg/l | 0.000320 | 0.001000 |
| ETHYLBENZENE | mg/l | 0.000384 | 0.001000 |
| HEXACHLORO-1,3-BUTADIENE | mg/l | 0.000256 | 0.001000 |
| ISOPROPYLBENZENE | mg/l | 0.000326 | 0.001000 |
| P-ISOPROPYLTOLUENE | mg/l | 0.000350 | 0.001000 |
| 2-BUTANONE (MEK) | mg/l | 0.003930 | 0.010000 |
| METHYLENE CHLORIDE | mg/l | 0.001000 | 0.005000 |
| 4-METHYL-2-PENTANONE (MIBK) | mg/l | 0.002140 | 0.010000 |
| METHYL TERT-BUTYL ETHER | mg/l | 0.000367 | 0.001000 |
| NAPHTHALENE | mg/l | 0.001000 | 0.005000 |
| N-PROPYLBENZENE | mg/l | 0.000349 | 0.001000 |
| STYRENE | mg/l | 0.000307 | 0.001000 |
| 1,1,1,2-TETRACHLOROETHANE | mg/l | 0.000385 | 0.001000 |
| 1,1,2,2-TETRACHLOROETHANE | mg/l | 0.000130 | 0.001000 |
| 1,1,2-TRICHLOROTRIFLUOROETHANE | mg/l | 0.000303 | 0.001000 |
| TETRACHLOROETHENE | mg/l | 0.000372 | 0.001000 |
| TOLUENE | mg/l | 0.000412 | 0.001000 |
| 1,2,3-TRICHLOROBENZENE | mg/l | 0.000230 | 0.001000 |
| 1,2,4-TRICHLOROBENZENE | mg/l | 0.000355 | 0.001000 |
| 1,1,1-TRICHLOROETHANE | mg/l | 0.000319 | 0.001000 |
| 1,1,2-TRICHLOROETHANE | mg/l | 0.000383 | 0.001000 |
| TRICHLOROETHENE | mg/l | 0.000398 | 0.001000 |
| TRICHLOROFLUOROMETHANE | mg/l | 0.001200 | 0.005000 |
| 1,2,3-TRICHLOROPROPANE | mg/l | 0.000807 | 0.002500 |
| 1,2,4-TRIMETHYLBENZENE | mg/l | 0.000373 | 0.001000 |
| 1,2,3-TRIMETHYLBENZENE | mg/l | 0.000321 | 0.001000 |
| 1,3,5-TRIMETHYLBENZENE | mg/l | 0.000387 | 0.001000 |
| VINYL CHLORIDE | mg/l | 0.000259 | 0.001000 |
| XYLENES, TOTAL | mg/l | 0.001060 | 0.003000 |

| **SVOC SIM 8270D** | **UNITS** | **RL** | **MDL** |
|---|---|---|---|
| 1,4 - Dioxane (p-Dioxane) | ug/L | 3 | 0.58 |
| **Alcohols by 8015** | | | |
| METHANOL | ug/L | 5000 | 480 |
| ETHANOL | ug/L | 5000 | 277 |
| N-BUTANOL | ug/L | 5000 | 130 |

# TABLE 2
# GROUNDWATER - MDL/RDL

## PCBS/SVOCS

| Parameter | Units | MDL | RDL |
|---|---|---|---|
| **PCBs by 8082** | | | |
| PCB 1016 | mg/l | 0.000100 | 0.000500 |
| PCB 1221 | mg/l | 0.000073 | 0.000500 |
| PCB 1232 | mg/l | 0.000042 | 0.000500 |
| PCB 1242 | mg/l | 0.000047 | 0.000500 |
| PCB 1248 | mg/l | 0.000086 | 0.000500 |
| PCB 1254 | mg/l | 0.000047 | 0.000500 |
| PCB 1260 | mg/l | 0.000120 | 0.000500 |
| **SVOCs by 8270** | | | |
| ACENAPHTHENE | mg/l | 0.000316 | 0.001000 |
| ACENAPHTHYLENE | mg/l | 0.000309 | 0.001000 |
| ANTHRACENE | mg/l | 0.000291 | 0.001000 |
| BENZIDINE | mg/l | 0.004320 | 0.010000 |
| BENZO(A)ANTHRACENE | mg/l | 0.000098 | 0.001000 |
| BENZO(B)FLUORANTHENE | mg/l | 0.000090 | 0.001000 |
| BENZO(K)FLUORANTHENE | mg/l | 0.000355 | 0.001000 |
| BENZO(G,H,I)PERYLENE | mg/l | 0.000161 | 0.001000 |
| BENZO(A)PYRENE | mg/l | 0.000340 | 0.001000 |
| BIS(2-CHLORETHOXY)METHANE | mg/l | 0.000329 | 0.010000 |
| BIS(2-CHLOROETHYL)ETHER | mg/l | 0.001620 | 0.010000 |
| BIS(2-CHLOROISOPROPYL)ETHER | mg/l | 0.000445 | 0.010000 |
| 4-BROMOPHENYL-PHENYLETHER | mg/l | 0.000335 | 0.010000 |
| 2-CHLORONAPHTHALENE | mg/l | 0.000330 | 0.001000 |
| 4-CHLOROPHENYL-PHENYLETHER | mg/l | 0.000303 | 0.010000 |
| CHRYSENE | mg/l | 0.000332 | 0.001000 |
| DIBENZ(A,H)ANTHRACENE | mg/l | 0.000279 | 0.001000 |
| 3,3-DICHLOROBENZIDINE | mg/l | 0.002020 | 0.010000 |
| 2,4-DINITROTOLUENE | mg/l | 0.001650 | 0.010000 |
| 2,6-DINITROTOLUENE | mg/l | 0.000279 | 0.010000 |
| FLUORANTHENE | mg/l | 0.000310 | 0.001000 |
| FLUORENE | mg/l | 0.000323 | 0.001000 |
| HEXACHLOROBENZENE | mg/l | 0.000341 | 0.001000 |
| HEXACHLORO-1,3-BUTADIENE | mg/l | 0.000329 | 0.010000 |
| HEXACHLOROCYCLOPENTADIENE | mg/l | 0.002330 | 0.010000 |
| HEXACHLOROETHANE | mg/l | 0.000365 | 0.010000 |
| INDENO(1,2,3-CD)PYRENE | mg/l | 0.000279 | 0.001000 |
| ISOPHORONE | mg/l | 0.000272 | 0.010000 |
| NAPHTHALENE | mg/l | 0.000372 | 0.001000 |
| NITROBENZENE | mg/l | 0.000367 | 0.010000 |
| N-NITROSODIMETHYLAMINE | mg/l | 0.001260 | 0.010000 |
| N-NITROSODIPHENYLAMINE | mg/l | 0.000304 | 0.010000 |
| N-NITROSODI-N-PROPYLAMINE | mg/l | 0.000403 | 0.010000 |
| PHENANTHRENE | mg/l | 0.000366 | 0.001000 |
| BENZYLBUTYL PHTHALATE | mg/l | 0.000275 | 0.003000 |
| BIS(2-ETHYLHEXYL)PHTHALATE | mg/l | 0.000709 | 0.003000 |
| DI-N-BUTYL PHTHALATE | mg/l | 0.000266 | 0.003000 |
| DIETHYL PHTHALATE | mg/l | 0.000282 | 0.003000 |
| DIMETHYL PHTHALATE | mg/l | 0.000283 | 0.003000 |
| DI-N-OCTYL PHTHALATE | mg/l | 0.000278 | 0.003000 |
| PYRENE | mg/l | 0.000330 | 0.001000 |
| 1,2,4-TRICHLOROBENZENE | mg/l | 0.000355 | 0.010000 |
| 4-CHLORO-3-METHYLPHENOL | mg/l | 0.000263 | 0.010000 |
| 2-CHLOROPHENOL | mg/l | 0.000283 | 0.010000 |
| 2,4-DICHLOROPHENOL | mg/l | 0.000284 | 0.010000 |
| 2,4-DIMETHYLPHENOL | mg/l | 0.000624 | 0.010000 |
| 4,6-DINITRO-2-METHYLPHENOL | mg/l | 0.002620 | 0.010000 |
| 2,4-DINITROPHENOL | mg/l | 0.003250 | 0.010000 |
| 2-NITROPHENOL | mg/l | 0.000320 | 0.010000 |
| 4-NITROPHENOL | mg/l | 0.002010 | 0.010000 |
| PENTACHLOROPHENOL | mg/l | 0.000313 | 0.010000 |
| PHENOL | mg/l | 0.000334 | 0.010000 |
| 2,4,6-TRICHLOROPHENOL | mg/l | 0.000297 | 0.010000 |

## GASES

| | | | |
|---|---|---|---|
| **RSK 175/3810** | | | |
| METHANE | mg/l | 0.002910 | 0.010000 |
| ETHANE | mg/l | 0.004070 | 0.013000 |
| ETHENE | mg/l | 0.004260 | 0.013000 |

## OTHER

| Parameter | Units | MDL | RDL |
|---|---|---|---|
| **Total Organic Carbon by 9060A** | | | |
| TOC | mg/l | 0.1020 | 1.000 |

## DIOXINS/FURANS

**PCDD/PCDF BY 8290A**

| Parameter | Units | MDL | RDL |
|---|---|---|---|
| 2,3,7,8-TCDF | pg/L | 2.16 | 10 |
| 2,3,7,8-TCDD | pg/L | 2.34 | 10 |
| 1,2,3,7,8-PeCDF | pg/L | 2.73 | 50 |
| 2,3,4,7,8-PeCDF | pg/L | 2.45 | 50 |
| 1,2,3,7,8-PeCDD | pg/L | 2.55 | 50 |
| 1,2,3,4,7,8-HxCDF | pg/L | 5.01 | 50 |
| 1,2,3,6,7,8-HxCDF | pg/L | 4.45 | 50 |
| 2,3,4,6,7,8-HxCDF | pg/L | 4.25 | 50 |
| 1,2,3,7,8,9-HxCDF | pg/L | 4.61 | 50 |
| 1,2,3,4,7,8-HxCDD | pg/L | 4.77 | 50 |
| 1,2,3,6,7,8-HxCDD | pg/L | 4.70 | 50 |
| 1,2,3,7,8,9-HxCDD | pg/L | 5.44 | 50 |
| 1,2,3,4,6,7,8-HpCDF | pg/L | 4.66 | 50 |
| 1,2,3,4,7,8,9-HpCDF | pg/L | 5.06 | 50 |
| 1,2,3,4,6,7,8-HpCDD | pg/L | 4.62 | 50 |
| OCDF | pg/L | 12.0 | 100 |
| OCDD | pg/L | 13.2 | 100 |
| Total TCDF | pg/L | 2.16 | 10 |
| Total TCDD | pg/L | 2.34 | 10 |
| Total PeCDF | pg/L | 2.45 | 100 |
| Total PeCDD | pg/L | 2.55 | 50 |
| Total HxCDF | pg/L | 4.25 | 200 |
| Total HxCDD | pg/L | 4.70 | 150 |
| Total HpCDF | pg/L | 4.66 | 100 |
| Total HpCDD | pg/L | 4.62 | 50 |

## PFAS

| | | | |
|---|---|---|---|
| **PFAS by ID (AQ)** | | | |
| PFBA | ng/L | 0.441 | 2 |
| PFPeA | ng/L | 0.438 | 2 |
| PFHxA | ng/L | 0.438 | 2 |
| PFHpA | ng/L | 0.55 | 2 |
| PFOA | ng/L | 0.585 | 2 |
| PFNA | ng/L | 0.74 | 2 |
| PFDA | ng/L | 0.564 | 2 |
| PFUnA (PFUnDA) | ng/L | 0.54 | 2 |
| PFDoA | ng/L | 0.483 | 2 |
| PFTrDA | ng/L | 0.622 | 2 |
| PFTA (PFTDA) | ng/L | 0.476 | 2 |
| PFBS | ng/L | 0.473 | 2 |
| PFPeS | ng/L | 0.475 | 2 |
| PFHxS | ng/L | 0.508 | 2 |
| PFHpS | ng/L | 0.411 | 2 |
| PFOS | ng/L | 0.548 | 2 |
| PFNS | ng/L | 0.446 | 2 |
| PFDS | ng/L | 0.450 | 2 |
| PFOSA | ng/L | 0.818 | 2 |
| NEtFOSAA | ng/L | 0.555 | 2 |
| NMeFOSAA | ng/L | 0.434 | 2 |
| 4:2 FTS | ng/L | 0.558 | 2 |
| 6:2 FTS | ng/L | 0.645 | 2 |
| 8:2 FTS | ng/L | 0.653 | 2 |
| HFPO-DA | ng/L | 0.529 | 2 |
| ADONA | ng/L | 0.514 | 2 |

## SOIL - METALS

| PARM STORED | UNITS | MDL | RDL |
|---|---|---|---|
| **Mercury by 7471** | | | |
| MERCURY | mg/kg | 0.0028 | 0.0200 |
| **GFAA Metals by 6020** | | | |
| ALUMINUM | mg/kg | 0.4600 | 10.0000 |
| ANTIMONY | mg/kg | 0.0316 | 0.1000 |
| ARSENIC | mg/kg | 0.0025 | 0.1000 |
| BARIUM | mg/kg | 0.0320 | 0.2000 |
| BERYLLIUM | mg/kg | 0.0120 | 0.1000 |
| BORON | mg/kg | 0.0760 | 2.0000 |
| CADMIUM | mg/kg | 0.0160 | 0.1000 |
| CALCIUM | mg/kg | 2.3000 | 100.0000 |
| CHROMIUM | mg/kg | 0.0540 | 0.1000 |
| COBALT | mg/kg | 0.0260 | 0.1000 |
| COPPER | mg/kg | 0.0520 | 0.1000 |
| IRON | mg/kg | 2.4000 | 10.0000 |
| LEAD | mg/kg | 0.0240 | 0.1000 |
| MAGNESIUM | mg/kg | 5.0000 | 100.0000 |
| MANGANESE | mg/kg | 0.0250 | 0.2000 |
| MOLYBDENUM | mg/kg | 0.0140 | 0.2000 |
| NICKEL | mg/kg | 0.0350 | 0.1000 |
| POTASSIUM | mg/kg | 1.8000 | 100.0000 |
| SELENIUM | mg/kg | 0.0380 | 0.1000 |
| SILVER | mg/kg | 0.0310 | 0.1000 |
| SODIUM | mg/kg | 6.1000 | 100.0000 |
| STRONTIUM | mg/kg | 0.0081 | 1.0000 |
| THALLIUM | mg/kg | 0.0190 | 0.1000 |
| THORIUM | mg/kg | 0.0450 | 1.0000 |
| TIN | mg/kg | 0.0300 | 0.1000 |
| TITANIUM | mg/kg | 0.0211 | 1.0000 |
| VANADIUM | mg/kg | 0.0180 | 0.2000 |
| ZINC | mg/kg | 0.2560 | 1.0000 |

## SOIL - PFAS

| | | | |
|---|---|---|---|
| **PFAS by ID (Solid)** | | | |
| PFBA | ug/kg | 0.0237 | 0.100 |
| PFPeA | ug/kg | 0.0263 | 0.100 |
| PFHxA | ug/kg | 0.03 | 0.100 |
| PFHpA | ug/kg | 0.0225 | 0.100 |
| PFOA | ug/kg | 0.0226 | 0.100 |
| PFNA | ug/kg | 0.0286 | 0.100 |
| PFDA | ug/kg | 0.0217 | 0.100 |
| PFUnA (PFUnDA) | ug/kg | 0.0281 | 0.100 |
| PFDoA | ug/kg | 0.0266 | 0.100 |
| PFTrDA | ug/kg | 0.0214 | 0.100 |
| PFTA (PFTDA) | ug/kg | 0.0321 | 0.100 |
| PFBS | ug/kg | 0.022 | 0.0885 |
| PFPeS | ug/kg | 0.0186 | 0.094 |
| PFHxS | ug/kg | 0.0222 | 0.091 |
| PFHpS | ug/kg | 0.0250 | 0.095 |
| PFOS | ug/kg | 0.0278 | 0.0925 |
| PFNS | ug/kg | 0.0179 | 0.096 |
| PFDS | ug/kg | 0.0252 | 0.0965 |
| PFOSA | ug/kg | 0.0235 | 0.100 |
| NEtFOSAA | ug/kg | 0.0247 | 0.100 |
| NMeFOSAA | ug/kg | 0.0233 | 0.100 |
| 4:2 FTS | ug/kg | 0.0318 | 0.0935 |
| 6:2 FTS | ug/kg | 0.032 | 0.095 |
| 8:2 FTS | ug/kg | 0.0259 | 0.0965 |
| HFPO-DA | ug/kg | 0.0297 | 0.100 |
| ADONA | ug/kg | 0.0384 | 0.0945 |

## SOIL - VOCS

| PARM STORED | UNITS | MDL | RDL |
|---|---|---|---|
| **VOCs by 8260/5035** | | | |
| ACETONE | mg/kg | 0.01000 | 0.05000 |
| ACRYLONITRILE | mg/kg | 0.00179 | 0.01000 |
| BENZENE | mg/kg | 0.00027 | 0.00100 |
| BROMOBENZENE | mg/kg | 0.00028 | 0.00100 |
| BROMODICHLOROMETHANE | mg/kg | 0.00025 | 0.00100 |
| BROMOFORM | mg/kg | 0.00042 | 0.00100 |
| BROMOMETHANE | mg/kg | 0.00134 | 0.00500 |
| N-BUTYLBENZENE | mg/kg | 0.00026 | 0.00100 |
| SEC-BUTYLBENZENE | mg/kg | 0.00020 | 0.00100 |
| TERT-BUTYLBENZENE | mg/kg | 0.00021 | 0.00100 |
| CARBON TETRACHLORIDE | mg/kg | 0.00033 | 0.00100 |
| CHLOROBENZENE | mg/kg | 0.00021 | 0.00100 |
| CHLORODIBROMOMETHANE | mg/kg | 0.00037 | 0.00100 |
| CHLOROETHANE | mg/kg | 0.00095 | 0.00500 |
| CHLOROFORM | mg/kg | 0.00023 | 0.00500 |
| CHLOROMETHANE | mg/kg | 0.00038 | 0.00250 |
| 2-CHLOROTOLUENE | mg/kg | 0.00030 | 0.00100 |
| 4-CHLOROTOLUENE | mg/kg | 0.00024 | 0.00100 |
| 1,2-DIBROMO-3-CHLOROPROPANE | mg/kg | 0.00105 | 0.00500 |
| 1,2-DIBROMOETHANE | mg/kg | 0.00034 | 0.00100 |
| DIBROMOMETHANE | mg/kg | 0.00038 | 0.00100 |
| 1,2-DICHLOROBENZENE | mg/kg | 0.00031 | 0.00100 |
| 1,3-DICHLOROBENZENE | mg/kg | 0.00024 | 0.00100 |
| 1,4-DICHLOROBENZENE | mg/kg | 0.00023 | 0.00100 |
| DICHLORODIFLUOROMETHANE | mg/kg | 0.00071 | 0.00500 |
| 1,1-DICHLOROETHANE | mg/kg | 0.00020 | 0.00100 |
| 1,2-DICHLOROETHANE | mg/kg | 0.00027 | 0.00100 |
| 1,1-DICHLOROETHENE | mg/kg | 0.00030 | 0.00100 |
| CIS-1,2-DICHLOROETHENE | mg/kg | 0.00024 | 0.00100 |
| TRANS-1,2-DICHLOROETHENE | mg/kg | 0.00026 | 0.00100 |
| 1,2-DICHLOROPROPANE | mg/kg | 0.00036 | 0.00100 |
| 1,1-DICHLOROPROPENE | mg/kg | 0.00032 | 0.00100 |
| 1,3-DICHLOROPROPANE | mg/kg | 0.00021 | 0.00100 |
| CIS-1,3-DICHLOROPROPENE | mg/kg | 0.00026 | 0.00100 |
| TRANS-1,3-DICHLOROPROPENE | mg/kg | 0.00027 | 0.00100 |
| 2,2-DICHLOROPROPANE | mg/kg | 0.00028 | 0.00100 |
| DI-ISOPROPYL ETHER | mg/kg | 0.00025 | 0.00100 |
| ETHYLBENZENE | mg/kg | 0.00030 | 0.00100 |
| HEXACHLORO-1,3-BUTADIENE | mg/kg | 0.00034 | 0.00100 |
| ISOPROPYLBENZENE | mg/kg | 0.00024 | 0.00100 |
| P-ISOPROPYLTOLUENE | mg/kg | 0.00020 | 0.00100 |
| 2-BUTANONE (MEK) | mg/kg | 0.00468 | 0.01000 |
| METHYLENE CHLORIDE | mg/kg | 0.00100 | 0.00500 |
| 4-METHYL-2-PENTANONE (MIBK) | mg/kg | 0.00188 | 0.01000 |
| METHYL TERT-BUTYL ETHER | mg/kg | 0.00021 | 0.00100 |
| NAPHTHALENE | mg/kg | 0.00100 | 0.00500 |
| N-PROPYLBENZENE | mg/kg | 0.00021 | 0.00100 |
| STYRENE | mg/kg | 0.00023 | 0.00100 |
| 1,1,1,2-TETRACHLOROETHANE | mg/kg | 0.00026 | 0.00100 |
| 1,1,2,2-TETRACHLOROETHANE | mg/kg | 0.00037 | 0.00100 |
| 1,1,2-TRICHLOROTRIFLUOROETHANE | mg/kg | 0.00037 | 0.00100 |
| TETRACHLOROETHENE | mg/kg | 0.00028 | 0.00100 |
| TOLUENE | mg/kg | 0.00043 | 0.00500 |
| 1,2,3-TRICHLOROBENZENE | mg/kg | 0.00031 | 0.00100 |
| 1,2,4-TRICHLOROBENZENE | mg/kg | 0.00039 | 0.00100 |
| 1,1,1-TRICHLOROETHANE | mg/kg | 0.00029 | 0.00100 |
| 1,1,2-TRICHLOROETHANE | mg/kg | 0.00028 | 0.00100 |
| TRICHLOROETHENE | mg/kg | 0.00028 | 0.00100 |
| TRICHLOROFLUOROMETHANE | mg/kg | 0.00038 | 0.00500 |
| 1,2,3-TRICHLOROPROPANE | mg/kg | 0.00074 | 0.00250 |
| 1,2,4-TRIMETHYLBENZENE | mg/kg | 0.00021 | 0.00100 |
| 1,2,3-TRIMETHYLBENZENE | mg/kg | 0.00029 | 0.00100 |
| 1,3,5-TRIMETHYLBENZENE | mg/kg | 0.00027 | 0.00100 |
| VINYL CHLORIDE | mg/kg | 0.00029 | 0.00100 |
| XYLENES, TOTAL | mg/kg | 0.00070 | 0.00300 |

## SOIL- SVOC

| PARM STORED | UNITS | MDL | RDL |
|---|---|---|---|
| **SVOCs by 8270** | | | |
| ACENAPHTHENE | mg/kg | 0.00642 | 0.03300 |
| ACENAPHTHYLENE | mg/kg | 0.00671 | 0.03300 |
| ANTHRACENE | mg/kg | 0.00632 | 0.03300 |
| BENZIDINE | mg/kg | 0.06370 | 0.33300 |
| BENZO(A)ANTHRACENE | mg/kg | 0.00428 | 0.03300 |
| BENZO(B)FLUORANTHENE | mg/kg | 0.00695 | 0.03300 |
| BENZO(K)FLUORANTHENE | mg/kg | 0.00582 | 0.03300 |
| BENZO(G,H,I)PERYLENE | mg/kg | 0.00721 | 0.03300 |
| BENZO(A)PYRENE | mg/kg | 0.00548 | 0.03300 |
| BIS(2-CHLORETHOXY)METHANE | mg/kg | 0.00770 | 0.33300 |
| BIS(2-CHLOROETHYL)ETHER | mg/kg | 0.00896 | 0.33300 |
| BIS(2-CHLOROISOPROPYL)ETHER | mg/kg | 0.00760 | 0.33300 |
| 4-BROMOPHENYL-PHENYLETHER | mg/kg | 0.01140 | 0.33300 |
| 2-CHLORONAPHTHALENE | mg/kg | 0.00639 | 0.03300 |
| 4-CHLOROPHENYL-PHENYLETHER | mg/kg | 0.00627 | 0.33300 |
| CHRYSENE | mg/kg | 0.00555 | 0.03300 |
| DIBENZ(A,H)ANTHRACENE | mg/kg | 0.00821 | 0.03300 |
| 3,3-DICHLOROBENZIDINE | mg/kg | 0.07940 | 0.33300 |
| 2,4-DINITROTOLUENE | mg/kg | 0.00607 | 0.33300 |
| 2,6-DINITROTOLUENE | mg/kg | 0.00737 | 0.33300 |
| FLUORANTHENE | mg/kg | 0.00496 | 0.03300 |
| FLUORENE | mg/kg | 0.00682 | 0.03300 |
| HEXACHLOROBENZENE | mg/kg | 0.00856 | 0.33300 |
| HEXACHLORO-1,3-BUTADIENE | mg/kg | 0.01000 | 0.33300 |
| HEXACHLOROCYCLOPENTADIENE | mg/kg | 0.05870 | 0.33300 |
| HEXACHLOROETHANE | mg/kg | 0.01340 | 0.33300 |
| INDENO(1,2,3-CD)PYRENE | mg/kg | 0.00772 | 0.03300 |
| ISOPHORONE | mg/kg | 0.00522 | 0.33300 |
| NAPHTHALENE | mg/kg | 0.00889 | 0.03300 |
| NITROBENZENE | mg/kg | 0.00695 | 0.33300 |
| N-NITROSODIMETHYLAMINE | mg/kg | 0.06470 | 0.33300 |
| N-NITROSODIPHENYLAMINE | mg/kg | 0.00594 | 0.33300 |
| N-NITROSODI-N-PROPYLAMINE | mg/kg | 0.00906 | 0.33300 |
| PHENANTHRENE | mg/kg | 0.00528 | 0.03300 |
| BENZYLBUTYL PHTHALATE | mg/kg | 0.01030 | 0.33300 |
| BIS(2-ETHYLHEXYL)PHTHALATE | mg/kg | 0.01200 | 0.33300 |
| DI-N-BUTYL PHTHALATE | mg/kg | 0.01090 | 0.33300 |
| DIETHYL PHTHALATE | mg/kg | 0.00691 | 0.33300 |
| DIMETHYL PHTHALATE | mg/kg | 0.00540 | 0.33300 |
| DI-N-OCTYL PHTHALATE | mg/kg | 0.00907 | 0.33300 |
| PYRENE | mg/kg | 0.01230 | 0.03300 |
| 1,2,4-TRICHLOROBENZENE | mg/kg | 0.00876 | 0.33300 |
| 4-CHLORO-3-METHYLPHENOL | mg/kg | 0.00477 | 0.33300 |
| 2-CHLOROPHENOL | mg/kg | 0.00831 | 0.33300 |
| 2,4-DICHLOROPHENOL | mg/kg | 0.00746 | 0.33300 |
| 2,4-DIMETHYLPHENOL | mg/kg | 0.04710 | 0.33300 |
| 4,6-DINITRO-2-METHYLPHENOL | mg/kg | 0.12400 | 0.33300 |
| 2,4-DINITROPHENOL | mg/kg | 0.09800 | 0.33300 |
| 2-NITROPHENOL | mg/kg | 0.01300 | 0.33300 |
| 4-NITROPHENOL | mg/kg | 0.05250 | 0.33300 |
| PENTACHLOROPHENOL | mg/kg | 0.04800 | 0.33300 |
| PHENOL | mg/kg | 0.00695 | 0.33300 |
| 2,4,6-TRICHLOROPHENOL | mg/kg | 0.00779 | 0.33300 |
| | | | |
| **Diesel and Oil Ranges by 8015** | | | |
| C10-C28 DIESEL RANGE | mg/kg | 1.61000 | 4.00000 |
| C28-C40 OIL RANGE | mg/kg | 0.27400 | 4.00000 |
| | | | |
| **GRO by 8015** | | | |
| TPH (GC/FID) LOW FRACTION | mg/kg | 0.02170 | 0.10000 |

## SOIL - OTHER

| PARM STORED | UNITS | MDL | RDL |
|---|---|---|---|
| **Total Organic Carbon by USDA LOI** | | | |
| TOC (TOTAL ORGANIC CARBON) | mg/kg | 3.3300 | 10.0000 |
| **TKN by 4500NOrg C-2011** | | | |
| KJELDAHL NITROGEN, TKN | mg/kg | 4.4800 | 20.0000 |
| **Hexavalent Chromium by 9060A/7196A** | | | |
| CHROMIUM,HEXAVALENT | mg/kg | 0.6400 | 2.0000 |
| **Ammonia Nitrogen by 350.1** | | | |
| AMMONIA NITROGEN | mg/kg | 1.5700 | 5.0000 |
| **Hexavalent Chromium by 7199** | | | |
| HEXAVALENT CHROMIUM | mg/kg | 0.2550 | 1.0000 |
| **Sulfide by 9030B** | | | |
| SULFIDE | mg/kg | 7.6300 | 25.0000 |
| **Oil & Grease by 9071B** | | | |
| OIL & GREASE (HEXANE EXTR) | mg/kg | 33.0000 | 100.0000 |
| **Cyanide by 9012B** | | | |
| CYANIDE | mg/kg | 0.0390 | 0.2500 |

## SOIL - DIOXINS/FURANS

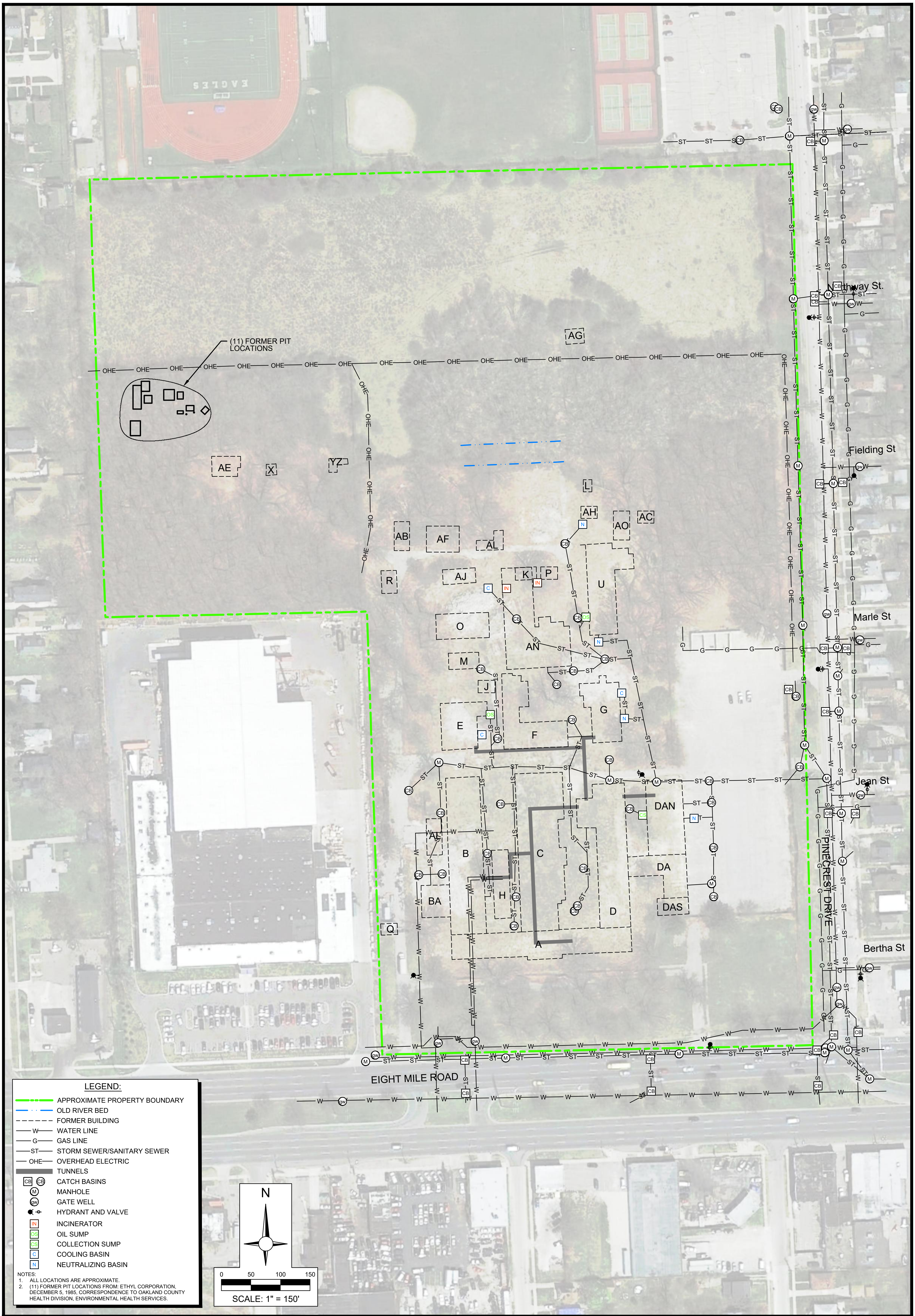
| | | | |
|---|---|---|---|
| **Dioxins/Furans by 8290A** | | | |
| 2,3,7,8-TCDF | ng/Kg | 0.215 | 1.0 |
| 2,3,7,8-TCDD | ng/Kg | 0.195 | 1.0 |
| 1,2,3,7,8-PeCDF | ng/Kg | 0.218 | 5.0 |
| 2,3,4,7,8-PeCDF | ng/Kg | 0.226 | 5.0 |
| 1,2,3,7,8-PeCDD | ng/Kg | 0.209 | 5.0 |
| 1,2,3,4,7,8-HxCDF | ng/Kg | 0.421 | 5.0 |
| 1,2,3,6,7,8-HxCDF | ng/Kg | 0.391 | 5.0 |
| 2,3,4,6,7,8-HxCDF | ng/Kg | 0.420 | 5.0 |
| 1,2,3,7,8,9-HxCDF | ng/Kg | 0.487 | 5.0 |
| 1,2,3,4,7,8-HxCDD | ng/Kg | 0.426 | 5.0 |
| 1,2,3,6,7,8-HxCDD | ng/Kg | 0.471 | 5.0 |
| 1,2,3,7,8,9-HxCDD | ng/Kg | 0.405 | 5.0 |
| 1,2,3,4,6,7,8-HpCDF | ng/Kg | 0.653 | 5.0 |
| 1,2,3,4,7,8,9-HpCDF | ng/Kg | 0.448 | 5.0 |
| 1,2,3,4,6,7,8-HpCDD | ng/Kg | 0.520 | 5.0 |
| OCDF | ng/Kg | 1.46 | 10.0 |
| OCDD | ng/Kg | 2.00 | 10.0 |
| Total TCDF | ng/Kg | 0.215 | 1.0 |
| Total TCDD | ng/Kg | 0.195 | 1.0 |
| Total PeCDF | ng/Kg | 0.218 | 10.0 |
| Total PeCDD | ng/Kg | 0.209 | 5.0 |
| Total HxCDF | ng/Kg | 0.391 | 20.0 |
| Total HxCDD | ng/Kg | 0.405 | 15.0 |
| Total HpCDF | ng/Kg | 0.448 | 10.0 |
| Total HpCDD | ng/Kg | 0.52 | 5.0 |

## SOIL - PCBS

| | | | |
|---|---|---|---|
| **PCBs by 8082** | | | |
| PCB 1016 | mg/kg | 0.00350 | 0.01700 |
| PCB 1221 | mg/kg | 0.00537 | 0.01700 |
| PCB 1232 | mg/kg | 0.00417 | 0.01700 |
| PCB 1242 | mg/kg | 0.00318 | 0.01700 |
| PCB 1248 | mg/kg | 0.00315 | 0.01700 |
| PCB 1254 | mg/kg | 0.00472 | 0.01700 |
| PCB 1260 | mg/kg | 0.00494 | 0.01700 |

# FIGURES

H:\2022\1 OTHER OFFICES\MICHIGAN\CASH CLIENT-CENTRAL REGION\DETRIOT AXLE\RFI WORK PLAN\1-NPDAX19001-SITE.DWG, FIG1



NOTES:
1. ALL LOCATIONS ARE APPROXIMATE.
2. (11) FORMER PIT LOCATIONS FROM: ETHYL CORPORATION, DECEMBER 5, 1985, CORRESPONDENCE TO OAKLAND COUNTY HEALTH DIVISION, ENVIRONMENTAL HEALTH SERVICES.

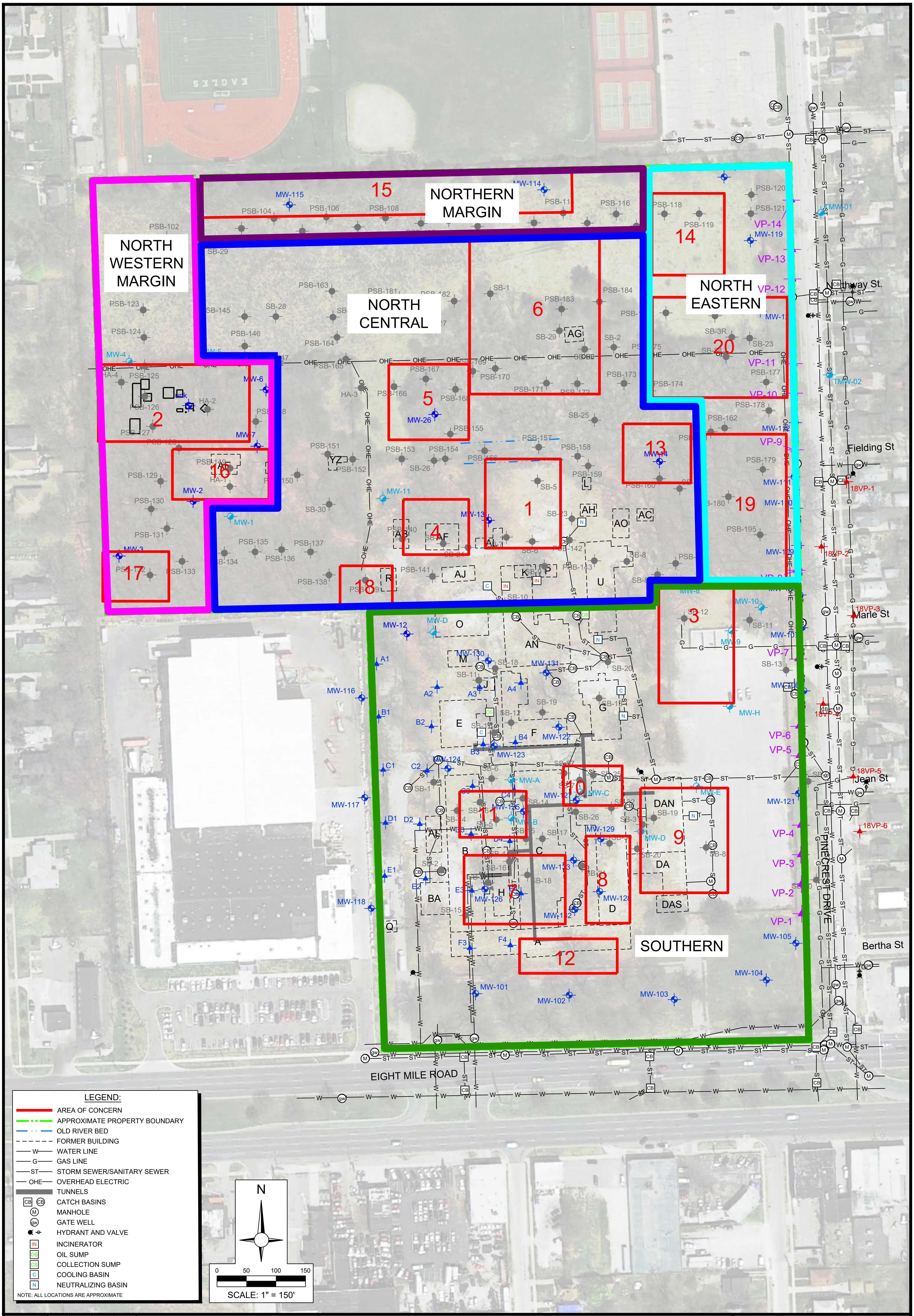
Project Number: NPDAX19001
Date: 02/04/2022
Drn. By: PH
Ckd. By: RS
Scale: AS SHOWN
Figure: 1

# SITE DETAILS MAP

## FORMER HAYES LEMMERZ SITE
WEST EIGHT MILE ROAD
FERNDALE, MICHIGAN

ATLAS

H:\2022\1 OTHER OFFICES\MICHIGAN\CASH CLIENT-CENTRAL REGION\DETRIOT AXLE\RFI WORK PLAN\2-NPDAX19001-AOC-REGIONS.DWG, FIG2



LEGEND:

- 🟥 AREA OF CONCERN
- APPROXIMATE PROPERTY BOUNDARY
- OLD RIVER BED
- FORMER BUILDING
- —W— WATER LINE
- —G— GAS LINE
- —ST— STORM SEWER/SANITARY SEWER
- —OHE— OVERHEAD ELECTRIC
- TUNNELS
- CB CB CATCH BASINS
- M MANHOLE
- gw GATE WELL
- HYDRANT AND VALVE
- IN INCINERATOR
- OS OIL SUMP
- CS COLLECTION SUMP
- C COOLING BASIN
- N NEUTRALIZING BASIN

NOTE: ALL LOCATIONS ARE APPROXIMATE

Figure: 2

Scale: AS SHOWN

Drn. By: PH

Ckd. By: RS

Date: 02/04/2022

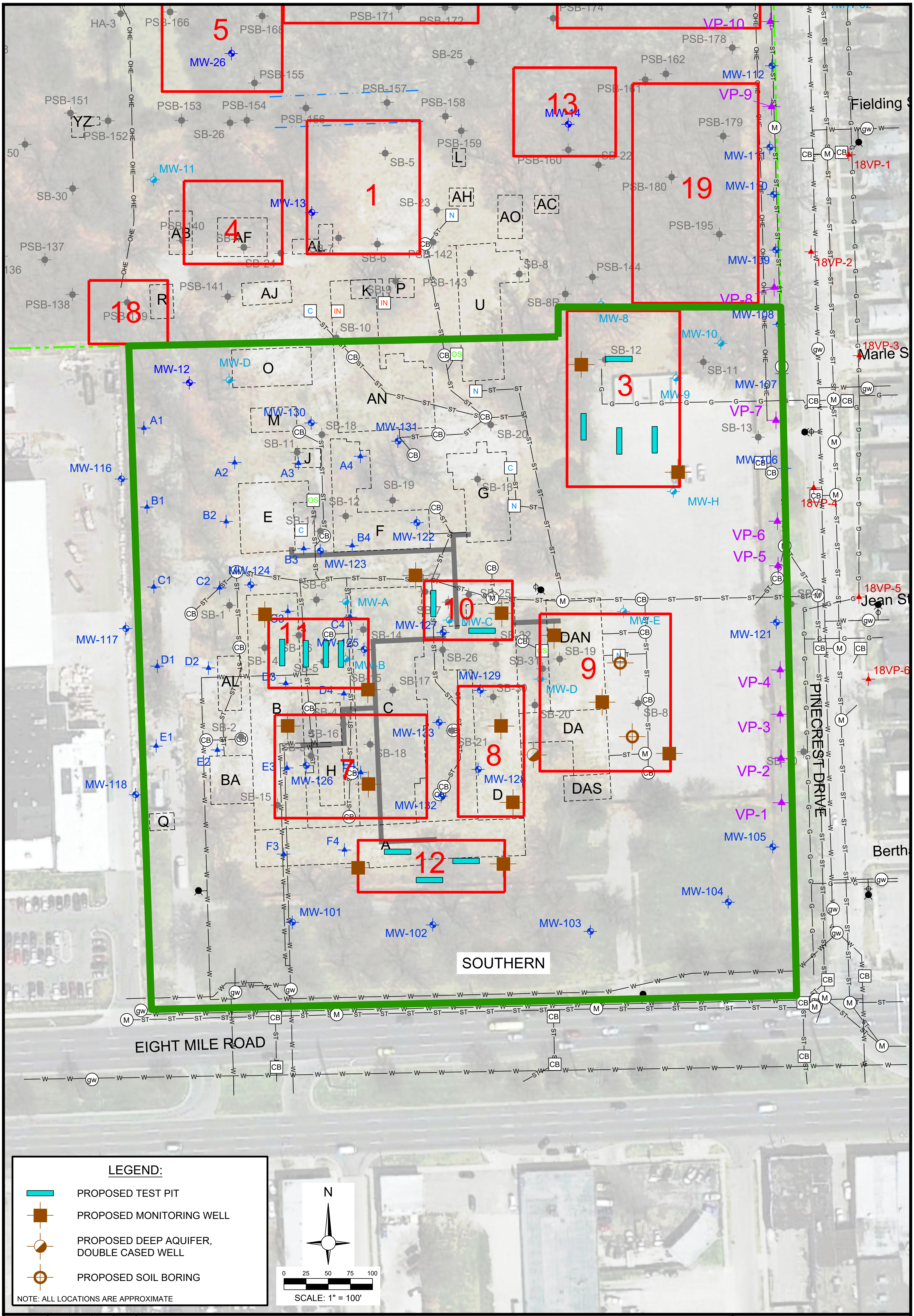
Project Number: NPAX19001

# AREAS OF CONCERN MAP

FORMER HAYES LEMMERZ SITE
WEST EIGHT MILE ROAD
FERNDALE, MICHIGAN

ATLAS

H:\2022\1 OTHER OFFICES\MICHIGAN\CASH CLIENT-CENTRAL REGION\DETRIOT AXLE\RFI WORK PLAN\3-NPDAX19001-SOUTHERN WORK PLAN.DWG, FIG3



LEGEND:

| | |
|---|---|
| ▬ | PROPOSED TEST PIT |
| ■ | PROPOSED MONITORING WELL |
| ◐ | PROPOSED DEEP AQUIFER, DOUBLE CASED WELL |
| ○ | PROPOSED SOIL BORING |

NOTE: ALL LOCATIONS ARE APPROXIMATE

N

0 25 50 75 100

SCALE: 1" = 100'

Figure:
3

Scale:
AS SHOWN

Drn. By:
PH

Ckd. By:
RS

Date:
02/07/2022

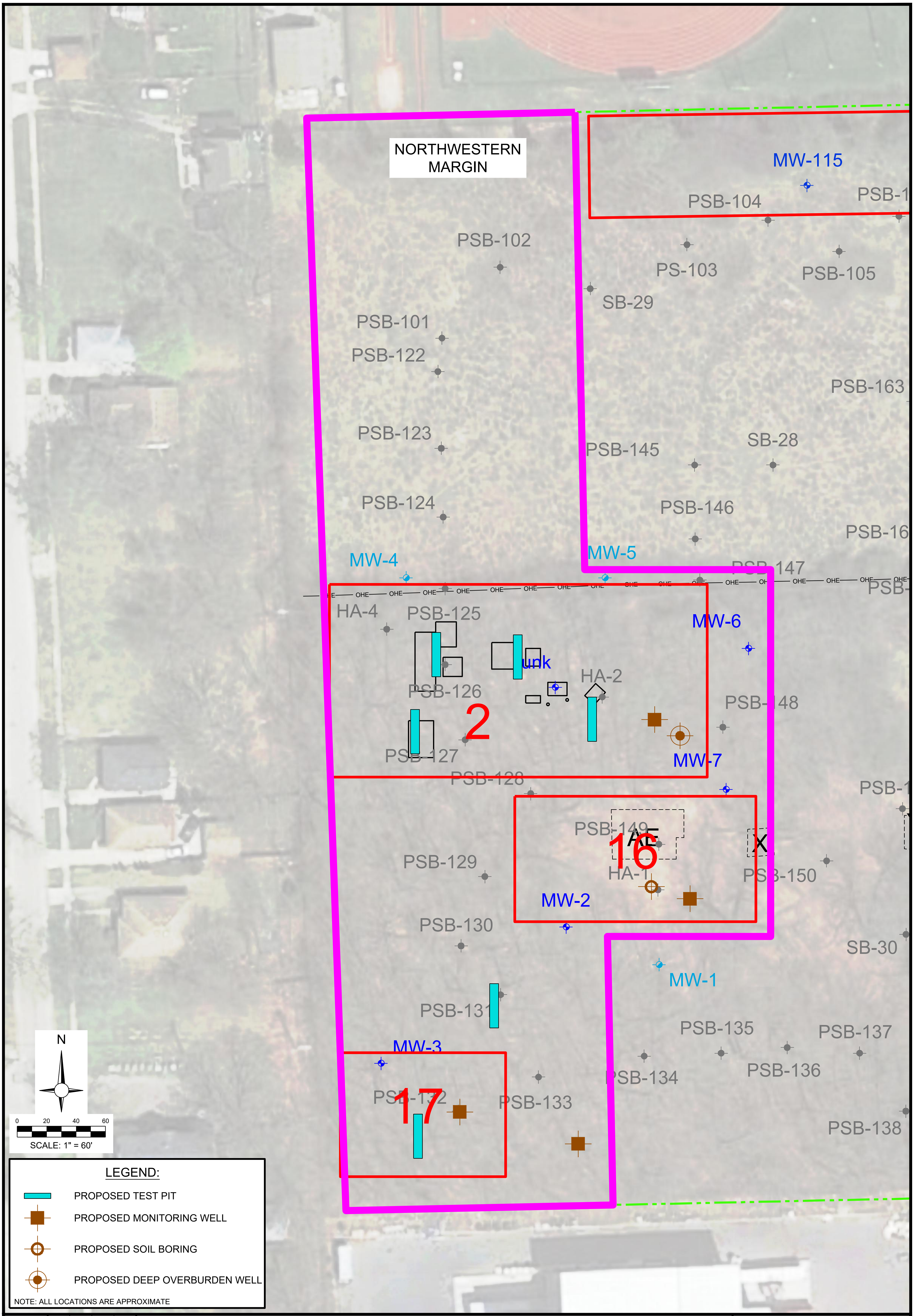
Project Number:
NPAX19001

# SOUTHERN WORK PLAN - PROPOSED LOCATIONS

FORMER HAYES LEMMERZ SITE
WEST EIGHT MILE ROAD
FERNDALE, MICHIGAN

ATLAS

H:\2022\1 OTHER OFFICES\MICHIGAN\CASH CLIENT-CENTRAL REGION\DETRIOT AXLE\RFI WORK PLAN\4-NPDAX19001-NW WORK PLAN.DWG, FIG5



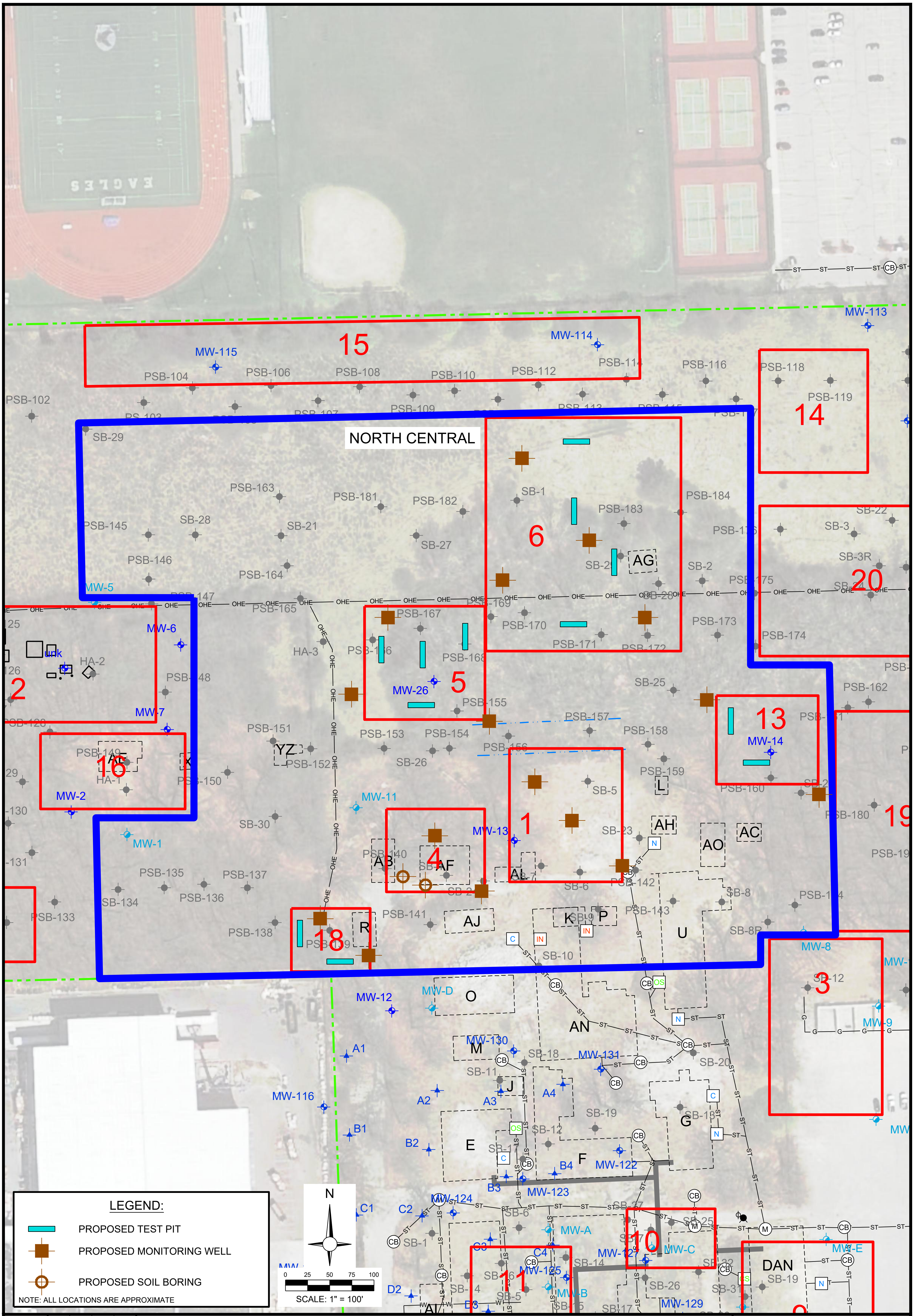
Project Number: NPAX19001
Date: 02/17/2022
Drn. By: PH
Ckd. By: RS
Scale: AS SHOWN
Figure: 4

# NORTHWESTERN MARGIN WORK PLAN - PROPOSED LOCATIONS

FORMER HAYES LEMMERZ SITE
WEST EIGHT MILE ROAD
FERNDALE, MICHIGAN

ATLAS

H:\2022\1 OTHER OFFICES\MICHIGAN\CASH CLIENT-CENTRAL REGION\DETRIOT AXLE\RFI WORK PLAN\5-NPDAX19001-NC WORK PLAN.DWG, FIG7



LEGEND:

🟦 PROPOSED TEST PIT

■ PROPOSED MONITORING WELL

○ PROPOSED SOIL BORING

NOTE: ALL LOCATIONS ARE APPROXIMATE

Figure: 5

Scale: AS SHOWN

Drn. By: PH

Ckd. By: RS

Date: 02/17/2022

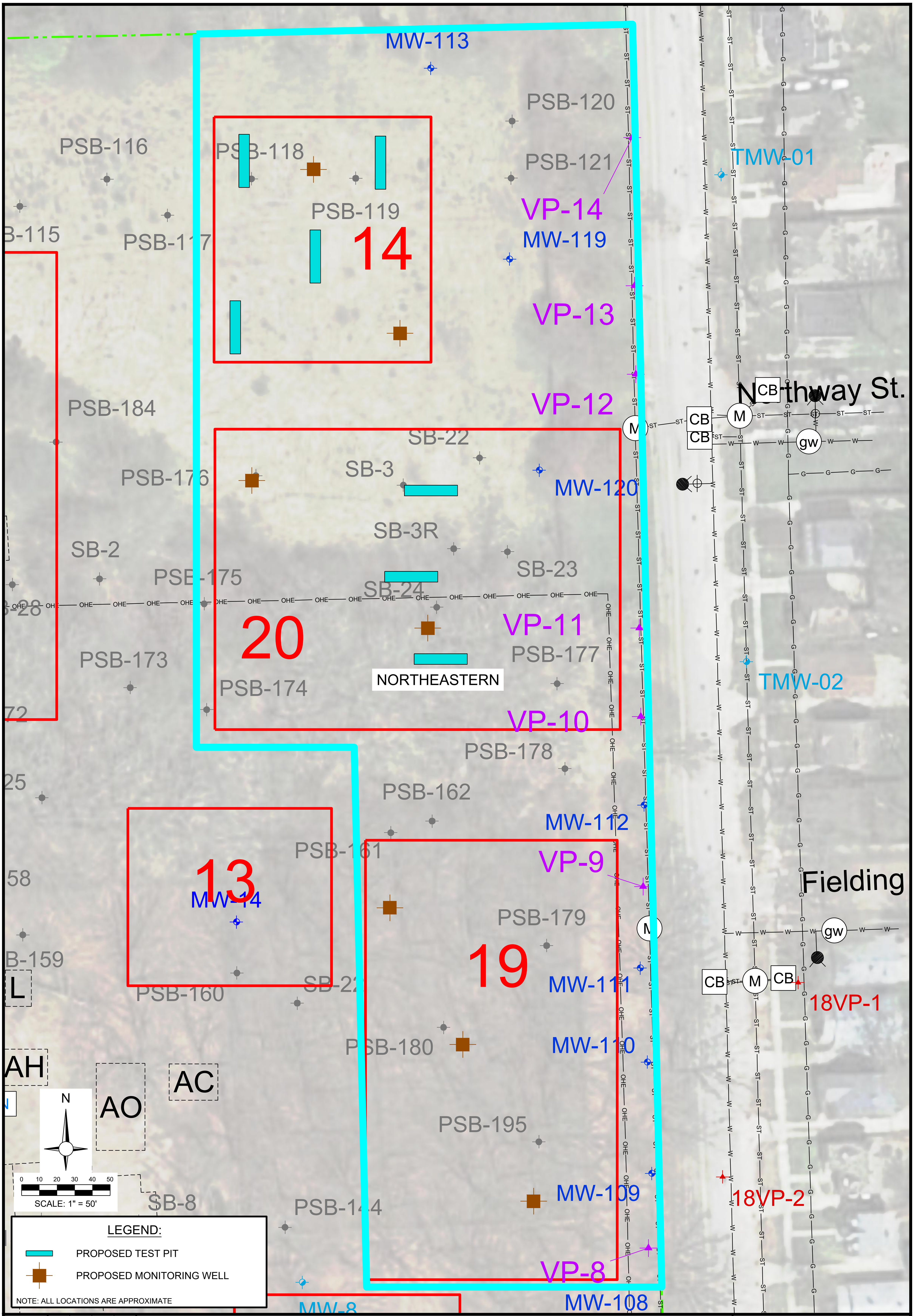
Project Number: NPAX19001

# NORTH CENTRAL WORK PLAN - PROPOSED LOCATIONS

FORMER HAYES LEMMERZ SITE
WEST EIGHT MILE ROAD
FERNDALE, MICHIGAN

ATLAS

H:\2022\1 OTHER OFFICES\MICHIGAN\CASH CLIENT-CENTRAL REGION\DETRIOT AXLE\RFI WORK PLAN\6-NPDAX19001-NE WORK PLAN.DWG, NE



LEGEND:

- ▬ PROPOSED TEST PIT
- ■ PROPOSED MONITORING WELL

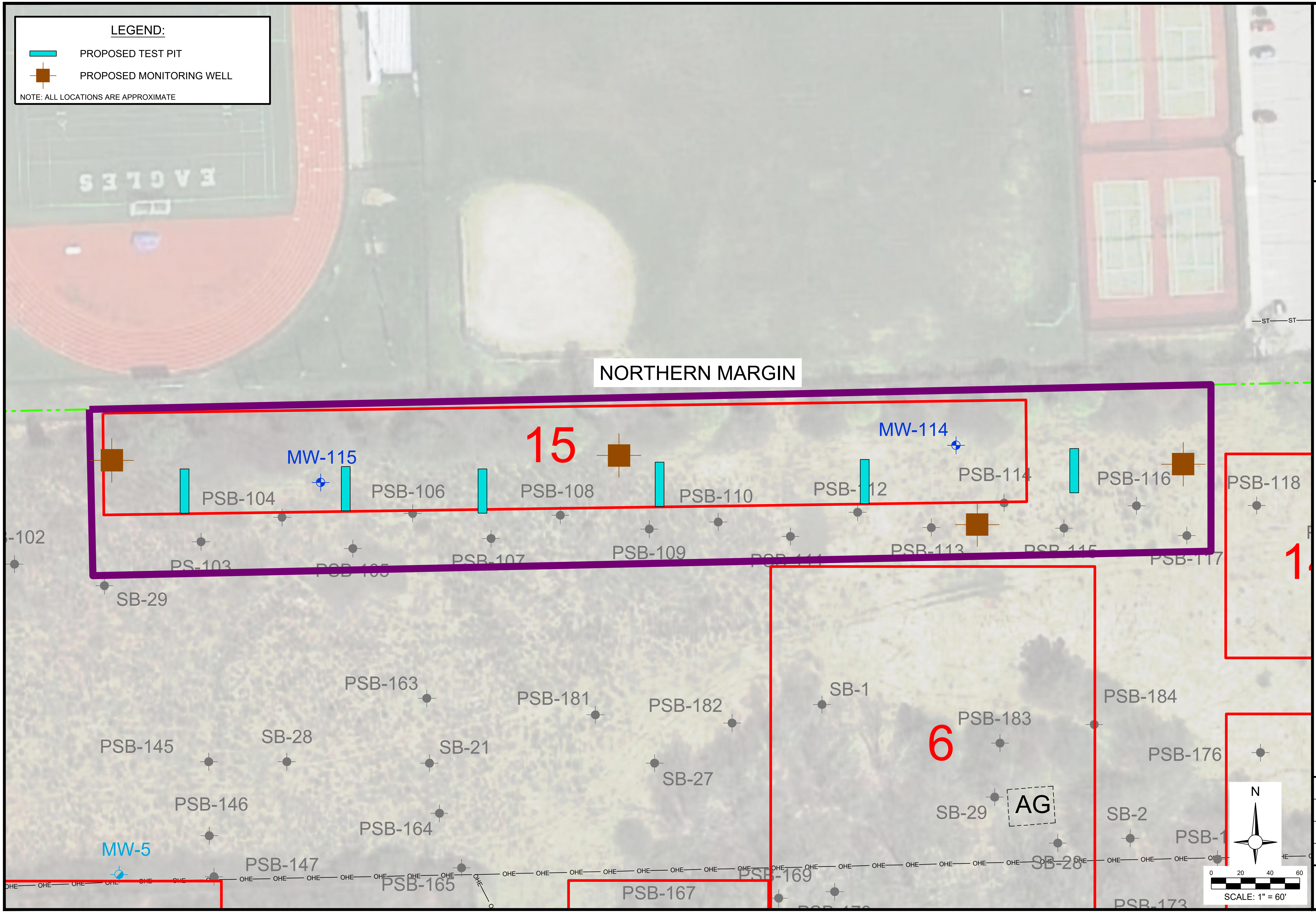
NOTE: ALL LOCATIONS ARE APPROXIMATE

| | |
|---|---|
| Project Number: | NPAX19001 |
| Date: | 02/17/2022 |
| Drn. By: | PH |
| Ckd. By: | RS |
| Scale: | AS SHOWN |
| Figure: | 6 |

## NORTHEASTERN WORK PLAN - PROPOSED LOCATIONS

FORMER HAYES LEMMERZ SITE
WEST EIGHT MILE ROAD
FERNDALE, MICHIGAN

ATLAS



LEGEND:

| | |
|---|---|
| ▬ | PROPOSED TEST PIT |
| ■ | PROPOSED MONITORING WELL |

NOTE: ALL LOCATIONS ARE APPROXIMATE

ATLAS

# NORTHERN MARGIN WORK PLAN - PROPOSED LOCATIONS

FORMER HAYES KEMMERZ SITE
WEST EIGHT MILE ROAD
FERNDALE, MICHIGAN

| | |
|---|---|
| Project Number: NPAX19001 | |
| Date: 02/17/2022 | |
| Drn. By: PH | Ckd. By: RS |
| Scale: AS SHOWN | |
| Figure: 7 | |

H:\2022\1 OTHER OFFICES\MICHIGAN\CASH CLIENT-CENTRAL REGION\DETRIOT AXLE\RFI WORK PLAN\7-NPDAX19001-NORTHERN WORK PLAN.DWG, FIG6

# APPENDIX A

## SAMPLING FOR PER- AND POLY-FLUOROALKYL SUBSTANCES
## (Standard Operating Procedure No. 1)

### 1.0 PURPOSE

The following operating procedures are for sampling for the laboratory analysis of per- and polyfluoroalkyl substances (PFAS). The following procedures are applicable for groundwater, soil, surface water and sediment sampling.

### 2.0 MATERIALS

The following materials will be available during sampling for PFAS:

- Sampling plan;
- Field notebook (non-waterproof only);
- Ball-point pen or pencil;
- Sample log sheets;
- Nitrile gloves;
- 5-gallon bucket;
- Stopwatch;
- Laboratory supplied sample kit including bottles and field blanks, to conduct analysis of PFAS via EPA Method 537 or 8327;
- Sample labels;
- Sample cooler;
- Ice; and,
- Chain-of-custody forms.

### 3.0 PRECAUTIONS FOR PFAS SAMPLING

Due to the widespread use of PFAS in consumer products, it is difficult to eliminate all potential sources of cross-contamination. However, the following special precautions should be taken to minimize sample contamination during sample collection:

- PFAS may be used in the manufacture of polytetrafluoroethylene (PTFE) or Teflon® (DuPont brand name). Therefore, products containing PTFE or Teflon® should not be used during sample handling or mobilization/demobilization. Such products could include carpet squares, car /upholstery cleaning supplies, as well as some rain-resistant work gear.
- Many food and snack products are packaged in wrappers treated with PFAS. Therefore, pre-wrapped food or snacks (e.g. candy bars, microwave popcorn, etc.) must not be in the possession of the sampling personnel during sampling.
- Personnel involved with sample collection and handling should avoid wearing new clothing due to the possible treating of fabric with PFAS. Clothing should be washed at least six times since purchase, prior to use during sampling and fabric softener should not be used in laundering clothing prior to sampling.

- Personnel involved with sample collection and handling should not wear water-resistant (e.g. Gore-Tex® material) clothing or footwear immediately prior to or during sample collection.
- Cosmetics, shampoos, moisturizers, or other similar personal hygiene products should not be used on the day of the sampling activities.
- Only sunscreen and insect repellants with 100% natural ingredients should be used prior to sample collection. Waterproof versions of these items should not be used.
- Personnel involved with sample collection and handling should not wear Tyvek® suits.
- Personnel involved with sample collection and handling should wear new nitrile gloves at all times during sample collection and handling.
- Waterproof field books (e.g. Rite in the Rain®) and waterproof paper should not be used during PFAS sampling activities. Non-waterproof paper or notebooks are acceptable. Similarly, plastic clipboards or spiral hardcover notebooks should not be used; masonite or aluminum clipboards are acceptable to use.
- Post-it® or similar paper note products should not be used during sampling activities. Sharpies® or similar markers are also not to be used. Standard ball-point pens or pencils should be used for note taking and sample labeling.
- Samples should be collected in laboratory-supplied plastic bottles only. Sample bottles should be high-density polyethylene (HDPE). Unlined or polypropylene sample bottle caps should be used.
- Samples should be cooled using regular ice; Blue Ice® must not be used to cool samples in sample coolers.

## 4.0 PROTOCOL FOR GROUNDWATER SAMPLING

Groundwater samples for PFAS analysis may be collected in accordance with regulatory SOPs and/or project or client-specific requirements. The recommendations identified above should be observed for groundwater sample collection for PFAS analysis.

Groundwater sampling equipment should not be constructed of or contain Teflon® or LDPE materials. Acceptable materials for groundwater sampling include HDPE, stainless steel, silicone, or polypropylene. If non-dedicated, non-disposable equipment is used between sample locations, it should be decontaminated with Alconox® or Liquinox®. Groundwater samples should be collected in laboratory-supplied bottleware specifically designated for PFAS analysis, no Teflon® or low-density polyethylene (LDPE)-containing materials.

- Sampler must ensure that no potentially PFAS-containing materials are utilized during sample collection activities (see Section 3.0 above).
- Purge monitoring well in accordance with regulatory SOPs and/or project or client-specific Requirements.
- Prior to handling sample bottles, sampler must don nitrile gloves.
- For collection of afield blank sample, open sample kit provided by the laboratory. Locate full bottle labeled “blank water” and empty bottle labeled “field blank.” Carefully uncap each bottle and empty the contents of the full “blank water” bottle into the empty “field blank” bottle. Recap both bottles and return both bottles to the sample kit before

proceeding. Refer to project or client-specific requirements for the number of field blanks to be collected.

- Adjust flow rate to ensure slow, constant flow of less than $^1/_2$ gallon per minute. Label each of the remaining sample bottles with the sample location descriptor (i.e. MW-1) using a ball-point pen. Fill one of the sample bottles to near top; do not overflow the bottles during sample collection. Securely recap the bottle and return the bottle to the sample kit before repeating this process for the remaining sample bottles. Confirm all sample bottles have been filled and returned to the sample kit and cooler before continuing to the next sample location.
- Record all sample information and relevant observations including any potential PFAS-containing items in the vicinity of the sample location, if present. See the attached list of common PFC-containing products.
- Complete chain-of-custody form.
- Place all sample kit bags into shipping cooler, add ice and packing materials sufficient to keep samples cool and protected during shipping.
- Place chain-of-custody in a sealable plastic bag (Ziploc® or equivalent) and place on top of samples within sample cooler.
- Ship samples within 48 hours to an EPA-approved laboratory for PFAS analysis via EPA Method 537 or 8327.

## 5.0 PROTOCOL FOR SOIL SAMPLING

Soil samples for PFAS analysis may be collected in accordance with project or client-specific requirements. The recommendations identified in Section 3.0 should be observed for soil sample collection for PFAS analysis.

Soil sampling equipment should not be constructed of or contain Teflon®. Acceptable materials for soil sampling include stainless steel, acetate, or polypropylene (i.e. stainless steel hand auger, acetate liner). If non-dedicated, non-disposable equipment is used between sample locations, it should be decontaminated with Alconox® or Liquinox®. Soil samples should be collected in laboratory-supplied bottleware specifically designated for PFAS analysis, i.e. no Teflon® or low- density polyethylene (LDPE)-containing materials.

- Sampler must ensure that no potentially PFAS-containing materials are utilized during sample collection activities (see Section 3.0 above).
- Prior to handling sample bottles, sampler must don nitrile gloves.
- For collection of field blank sample, open sample kit provided by the laboratory. Locate full bottle labeled "blank water" and empty bottle labeled "field blank." Carefully uncap each bottle and empty the contents of the full "blank water" bottle into the empty "field blank" bottle. Recap both bottles and return both bottles to the sample kit before proceeding. Refer to project or client-specific requirements for the number of field blanks to be collected.
- Collect soil sample using stainless steel, acetate, or polypropylene materials. Label each of the remaining sample bottles with the sample location descriptor (i.e. SO-01) using a ball-point pen. Fill the sample bottle to near top. Securely recap the bottle and return the bottle to the sample kit before repeating this process for the remaining sample bottles. Confirm all sample bottles have been filled and returned to the sample kit and cooler before continuing

to the next sample location.

- Record all sample information and relevant observations including any potential PFAS containing items in the vicinity of the sample location, if present. See the attached list of common PFAS-containing products.
- Complete chain-of-custody form.
- Place all sample kit bags into shipping cooler, add ice and packing materials sufficient to keep samples cool and protected during shipping.
- Place chain-of-custody in a sealable plastic bag (Ziploc® or equivalent) and place on top of samples within sample cooler.
- Ship samples within 48 hours to an EPA-approved laboratory for PFAS analysis via EPA Method 537 or 8327.

## 6.0 PROTOCOL FOR SURFACE WATER AND SEDIMENT SAMPLING

Surface water and sediment samples for PFAS analysis may be collected in accordance with regulatory SOPs for surface water and sediment sampling and/or project or client-specific requirements. The recommendations identified in Section 3.0 should be observed for surface water and sediment sample collection for PFAS analysis.

Surface water and sediment sampling equipment should not be constructed of or contain Teflon® or LDPE materials. Acceptable materials for surface water and sediment sampling include HDPE, stainless steel, acetate, or polypropylene (i.e. unpreserved HDPE container, stainless steel hand auger or trowel). If non-dedicated, non-disposable equipment is used between sample locations, it should be decontaminated with Alconox® or Liquinox®.

Surface water and sediment samples should be collected in laboratory-supplied bottleware specifically designated for PFAS analysis, i.e. no Teflon® or LDPE-containing materials. If transfer bottles are required for collection of surface water samples, the transfer bottles used should be the same material as designated for submission to the laboratory (i.e. unpreserved HDPE or glass container).

- Sampler must ensure that no potentially PFAS-containing materials are utilized during sample collection activities (see Section 3.0 above).
- Prior to handling sample bottles, sampler must don nitrile gloves.
- For collection of a field blank sample, open sample kit provided by the laboratory. Locate full bottle labeled “blank water” and empty bottle labeled “field blank.” Carefully uncap each bottle and empty the contents of the full “blank water” bottle into the empty “field blank” bottle. Recap both bottles and return both bottles to the sample kit before proceeding. Refer to project or client-specific requirements for the number of field blanks to be collected.
- Collect surface water sample first using HDPE, stainless steel, acetate, or polypropylene materials. Label each of the remaining sample bottles with the sample location descriptor (i.e. SW-01) using a ball-point pen. Fill the sample bottle to near top. Securely recap the bottle and return the bottle to the sample kit before repeating this process for the remaining sample bottles. Confirm all sample bottles have been filled and returned to the sample kit and cooler before collecting a co-located sediment sample, if applicable.

- Collect sediment sample using HDPE, stainless steel, acetate, or polypropylene materials. Label each of the remaining sample bottles with the sample location descriptor (i.e. SD-01) using a ball-point pen. Fill the sample bottle to near top. Securely recap the bottle and return the bottle to the sample kit before repeating this process for the remaining sample bottles. Confirm all sample bottles have been filled and returned to the sample kit and cooler before continuing to the next sample location.
- Record all sample information and relevant observations including any potential PFAS containing items in the vicinity of the sample location, if present. See the attached list of common PFAS-containing products.
- Complete chain-of-custody form.
- Place all sample kit bags into shipping cooler, add ice and packing materials sufficient to keep samples cool and protected during shipping.
- Place chain-of-custody in a sealable plastic bag (Ziploc® or equivalent) and place on top of samples within sample cooler.
- Ship samples within 48 hours to an EPA-approved laboratory for PFAS analysis via EPA Method 537 or 8327.

## 7.0 REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR), Perfluorinated Chemicals (PFCs) Frequently Asked Questions, CS260189-A

United States Environmental Protection Agency (U.S. EPA). Emerging Contaminants – Perfluorooctane Sulfonate (PFOS) and Perfluorooactanoic Acid (PFOA), Emerging Contaminants Fact Sheet – PFOS and PFOA. March, 2014.

Weston & Sampson Engineers, Inc. (Weston & Sampson). Perfluorinated Compound Sampling Plan, Former ChemFab North Bennington, VT (SMS Site # 2016-4630). February, 2016.

U.S. EPA, 2015. Perfluoroctanoic Acid (PFOA) and Fluorinated Telomers – Frequent Questions. http://www.epa/gov/oppt/pfoa/pubs/faq.html. Accessed April 27, 2015.

## FIELD SOIL VAPOR MONITORING
## (Standard Operating Procedure No. 02)

### 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe field methods for screening soil and residual materials.

### 2.0 REFERENCES

- Quality Assurance Project Plan, if applicable.
- Health and Safety Plan (HASP).
- Soil Boring Subsurface Sample Collection SOP (No. 03).
- Direct Push Subsurface Sample Collection SOP (No. 04).

### 3.0 PROCEDURES

The MiniRAE 2000 photoionization detector (PID) or equivalent organic vapor meter (OVM) will be charged using the recharging cord (e.g., overnight) immediately prior to use. A PID equipped with a 10.6 eV lamp is capable of detecting many non-chlorinated VOCs at concentrations of 0.1 to 2,000 ppm. If chlorinated VOCs ae likely to be present, a PID equipped with an 11+ eV lamp must be utilized.

The PID will be calibrated on-site at the commencement of each work day to zero and to 100-parts per million (ppm) using isobutylene-in-air span gas (equivalent to benzene in instrument response).

A representative soil sample will be collected from each sample location and placed in a Ziplock® plastic bag. The soil sample identifier will be marked on the bag above the top of the bag seal. The bag will be sealed and the soil disaggregated. At least ten minutes will be allowed for the soil to be heated by direct sunlight and for any volatile organic compounds in the soil to accumulate in the headspace of the bag. In cool weather (i.e. under 70° F) or darkness, the soil sample bag will be warmed for at least ten minutes inside a heated vehicle.

Volatile gases will then be monitored by inserting the probe of the OVM into the bag being careful not to touch the probe to the sampling media. The OVM probe will remain inside the bag for a period of time sufficient to allow the reading to peak and stabilize.

### 4.0 DOCUMENTATION

Daily calibration information will be recorded in the field logbook. The peak OVM reading will be recorded on the soil boring log and/or field logbook as appropriate.

# SOIL BORING AND SUBSURFACE SAMPLE COLLECTION
## (Standard Operating Procedure No. 03)

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe soil boring and subsurface sample collection techniques using hollow stem augers or other conventional drilling techniques and to ensure that acceptable, consistent subsurface samples are collected for chemical analysis and physical characterization. Sample collection procedures using Geoprobe® or other direct push type equipment are detailed separately in SOP No. 04. The requirements of this procedure are applicable to project activities involving soil boring, sample collection, sample logging, examination, and classification.

## 2.0 REFERENCES

- Quality Assurance Project Plan (QAPP), if applicable.
- Health and Safety Plan (HASP).
- Field Soil Vapor Monitoring SOP (No. 02)
- Equipment Decontamination SOP (No. 07)

## 3.0 PROCEDURES

### Office Preparation

The field personnel are responsible for ensuring that the following items have been completed prior to leaving for the site:

- Obtain equipment necessary for completing the sampling activities.
- Ensure that the appropriate sample containers are available for the required analytes and additional QA/QC sample requirements. Also, confirm that the analytical laboratory has been notified and is prepared to receive samples being wary of sample transport logistics and ability to receive on a Saturday, if applicable.
- Review the Quality Assurance Program Plan (QAPP), Field Task Order (FTO) or Statement of Work (SOW), Health and Safety Plan (HASP), and appropriate SOPs with the Project Manager to determine the specific sampling requirements.
- Obtain the appropriate site maps with soil boring/monitoring well locations.
- Verify that legal right-of-entry has been obtained, where required.
- Initiate public (and private, if appropriate) utilities clearance in sufficient lead time.
- Verify with the Project Manager/Technical Lead that the locations are appropriately labeled on a site map.
- Verify sample identification protocols for field samples and associated QA/QC samples. Check identification for each boring and for each depth within that boring.

- In advance of drilling activities, provide state agency and site representatives with the schedule for all on- and off-site work. Contact all appropriate representatives for off-site sampling.
- Verify that the appropriate number of clean, empty, solid and liquid 55-gallon drums and drum liners are on-site, or that other suitable containers will be available for containing drill cuttings and decontamination solids and liquids.

### Field Preparation

The field personnel will:

- Introduce themselves to any site representative.
- Discuss the planned scope of work, work schedule, and HASP protocols, and document this site meeting in the field notebook.
- Confirm that all equipment has been decontaminated or pre-cleaned before sampling.
- Verify that the appropriate number of clean and empty 55-gallon drums and drum liners are on-site, or that other suitable containers will be available to contain drill cuttings and decontamination solids and liquids (i.e., residuals or investigation derived waste [IDW]).
- Identify and locate all soil boring/monitoring well locations.
- Ensure that the field team members and any visitors to areas of field activity read, acknowledge acceptance to requirements of, and sign the HASP.
- Obtain potable water for decontamination, if needed. Record the source of water in the field logbook.

## SOIL BORING AND SUBSURFACE SAMPLE COLLECTION (OPERATION)

### Site Mobilization and Setup

- The drilling rig and associated equipment and materials must arrive on-site in a clean condition and should be free of oil, grease, and debris. The Field Team Leader will inspect the rig for any significant fluid leaks. If leaking fluids are present, the equipment will be repaired before any drilling activities begin. Document the drilling rig, drilling services company name, make and model and driller's (and any helper's) name(s) on the boring log or field notebook.
- Ensure that the drill rods, tools, and drill-bits are steam cleaned prior to the start of drilling. Inspect the cleaned materials for residues such as machine oils. If residues are observed, the equipment will be steam cleaned until such residues are removed.
- Set up the decontamination area for the drill rig and associated equipment and materials such that all liquids will be collected for proper disposal. To the extent practical, perform initial decontamination away from marked boring locations and existing monitoring wells, preferably at a location away from and downgradient of proposed boring locations and existing wells.

- Perform decontamination procedures between boreholes in the assigned decontamination area in accordance with the Equipment Decontamination SOP (No. 07) and dispose of the wastes generated in accordance with the work plan.
- Use potable water for decontamination.

**Soil Boring**

- Mobilize the drilling rig to the proposed location and prepare the exclusion or safety zone.
- If required, the proposed locations may be adjusted based on site access, property boundaries, and/or surface obstructions. All changes to boring locations will be documented in the field logbook and checked in regard to buried utilities.
- The safety level for soil borings and related activities is specified in the HASP.
- Throughout the soil boring activities, an organic vapor monitoring (OVM) instrument will be used to monitor the vapors in the worker breathing zone as specified in the HASP. This instrument may also be used to screen soil samples for organic vapors. Refer to the instrument manual for operating instructions.
- Soil borings will be advanced using the drilling method(s) specified in the FTO or SOW.

For borings using hollow stem augering or other similar drilling technique, use the following sampling techniques:

- Soil samples will be collected with a split-barrel sampler also referred to as a split spoon, usually at a frequency specified in the project work plan (or FTO or SOW) to characterize subsurface conditions. Samples will be collected continuously unless otherwise specified in the project work plan. The soil samples will be examined and classified by the on-site geologist. Descriptive drilling logs will be completed for each soil boring using the soil classification system specified in American Society for Testing and Materials (ASTM) Method D-2488. Soil classifications include characterization of soil texture (percentages of sand, silt, clay, etc.), color, moisture content, evidence of contamination (stain, sheen, odor, and instrument readings), and other pertinent information. Sample recovery, moisture, odor, staining will be documented.
- ASTM Method D1586-99: Standard Method for Penetration Test and Split-Barrel Sampling of Soil will be used to collect samples for laboratory analysis of the underlying material.
- Drilling will continue to the depth specified in the site-specific work plan.
- The drilling rig and all downhole tools (e.g., augers, rods, drilling bits, etc.) will be decontaminated between boreholes.

**Soil Sampling Using Hollow Stem Augering (or Similar) Drilling**

- To collect intact subsurface soil samples, augers will be used to advance the borehole to the top of consecutive 2-foot sample intervals or other intervals as specified in the project work plan (or FTO or SOW). The split-spoon will be driven, in 6-inch increments, the length of the split spoon past the bottom of the auger into the underlying material and withdrawn. Record the number of blows ("blow counts") required to advance the spoon for each six-inch increment (standard penetration test method).

- For each sample, the field team will record the following in the field logbook:
    - Date and time of collection.
    - Depth of sample collection.
    - Sample recovery (%).
    - Diameter of the split spoon.
    - The number of blows required to advance the split-spoon sampler for each 6-inch interval of the sample.
    - A qualitative description of the soil sample, expressed in a uniform, consistent manner for each interval, including the following parameters:
        - Color (Dark brown, light brown, etc.);
        - Moisture (dry/unsaturated, moist, or saturated)
        - Grain size expressed as clay, silt, sand, or gravel matrix (largest fraction by volume), with a preceding qualifier to indicate secondary fraction (if present), such as "sandy clay" where clay comprises the primary fraction, and sand comprises the secondary fraction;
        - Presence/absence of free phase product,
        - Depth of stratigraphic contacts; and,
        - Classification as native soil or fill material.
        - For rock, specify the rock quality designation (RQD) and fracture frequency, if feasible. Wireline rock coring methods are addressed in a separate SOP.
- As specified in the work plan, a representative sample will be collected and placed in the appropriate glass sample bottles. The soil samples for volatile organic compound analyses will be collected directly from the split spoon first to minimize volatilization of such compounds and will be placed directly into the sampling bottles or collected directly using sampler device like a TerraCore. The remainder of the split spoon/core (the entire sampling interval) will be homogenized in a stainless steel, tempered glass, or aluminum container. Samples will be placed in sample bottles with a stainless steel implement.
- Outer gloves (latex) worn by sampling personnel will be removed and discarded between samples to minimize the potential for cross-contamination of samples by contact with gloves.
- The sampling equipment will be decontaminated between each sampling interval.

### Sealing the Borehole

The borehole will be abandoned according to state regulations/guidelines. Surface restoration will be performed as specified in the FTO or SOW.

## 4.0 DOCUMENTATION

All boring and sampling information should be recorded in the field logbook, on the chain-of-custody and on sampling logs, if applicable.

# DIRECT PUSH SUBSURFACE SAMPLE COLLECTION
## (Standard Operating Procedure No. 04)

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe soil boring and subsurface sample collection using a hydraulically-powered, soil probing machine which utilizes static force and percussion to advance small diameter sampling tools into the subsurface techniques. Additionally the SOP's purpose is to ensure that acceptable, consistent subsurface samples are collected for chemical analysis and physical characterization. Sample collection procedures using hollow stem augers or other conventional drilling techniques are detailed separately in SOP No. 03. The requirements of this procedure are applicable to project activities involving soil boring, sample collection, sample logging, examination, and classification.

## 2.0 REFERENCES

- Quality Assurance Project Plan (QAPP), if applicable.
- Health and Safety Plan (HASP).
- Field Soil Vapor Monitoring SOP (No. 02)
- Equipment Decontamination SOP (No. 07)

## 3.0 PROCEDURES

### Office Preparation

The field personnel are responsible for ensuring that the following items have been completed prior to leaving for the site:

- Obtain equipment necessary for completing the sampling activities.
- Ensure that the appropriate sample containers are available for the required analytes and additional QA/QC sample requirements. Also, confirm that the analytical laboratory has been notified and is prepared to receive samples being wary of sample transport logistics and ability to receive on a Saturday, if applicable.
- Review the Quality Assurance Program Plan (QAPP), Field Task Order (FTO) or Statement of Work (SOW), Health and Safety Plan (HASP), and appropriate SOPs with the Project Manager to determine the specific sampling requirements.
- Obtain the appropriate site maps with soil boring/monitoring well locations.
- Verify that legal right-of-entry has been obtained, where required.
- Initiate public (and private, if appropriate) utilities clearance in sufficient lead time.
- Verify with the Project Manager/Technical Lead that the locations are appropriately labeled on a site map.
- Verify sample identification protocols for field samples and associated QA/QC samples. Check identification for each boring and for each depth within that boring.

- In advance of sampling activities, provide state agency and site representatives with the schedule for all on- and off-site work. Contact all appropriate representatives for off-site sampling.
- Verify that the appropriate number of clean, empty, solid and liquid 55-gallon drums and drum liners are on-site, or that other suitable containers will be available for containing drill cuttings and decontamination solids and liquids.

### Field Preparation

The field personnel will:

- Introduce themselves to any site representative.
- Discuss the planned scope of work, work schedule, and HASP protocols, and document this site meeting in the field notebook.
- Confirm that all equipment has been decontaminated or pre-cleaned before sampling.
- Verify that the appropriate number of clean and empty 55-gallon drums and drum liners are on-site, or that other suitable containers will be available to contain drill cuttings and decontamination solids and liquids (i.e., residuals or investigation derived waste [IDW]).
- Identify and locate all soil boring/monitoring well locations.
- Ensure that the field team members and any visitors to areas of field activity read, acknowledge acceptance to requirements of, and sign the HASP.
- Obtain potable water for decontamination, if needed. Record the source of water in the field logbook.

## DIRECT PUSH SUBSURFACE SAMPLE COLLECTION (OPERATION)

### Site Mobilization and Setup

- The sampling unit and associated equipment and materials must arrive on-site in a clean condition and should be free of oil, grease, and debris. The Field Team Leader will inspect the rig for any significant fluid leaks. If leaking fluids are present, the equipment will be repaired before any drilling activities begin.
- Ensure that the direct push components are steam cleaned prior to the start of drilling. Inspect the cleaned materials for residues such as machine oils. If residues are observed, the equipment will be steam cleaned until such residues are removed.
- Set up the decontamination area for the sampling unit and associated equipment and materials such that all liquids will be collected for proper disposal. To the extent practical, perform initial decontamination away from marked boring locations and existing monitoring wells, preferably at a location away from and downgradient of proposed boring locations and existing wells.
- Perform decontamination procedures between boreholes in the assigned decontamination area in accordance with the Equipment Decontamination SOP (No. 07) and dispose of the wastes generated in accordance with the work plan.
- Use potable water for decontamination.

## Soil Boring

- Mobilize the sampling unit to the proposed location and prepare the exclusion or safety zone.
- If required, the proposed locations may be adjusted based on site access, property boundaries, and/or surface obstructions. All changes to boring locations will be documented in the field logbook and checked in regard to buried utilities.
- The safety level for soil borings and related activities is specified in the HASP.
- Throughout the sampling activities, an organic vapor monitoring (OVM) instrument will be used to monitor the vapors in the worker breathing zone as specified in the HASP. This instrument may also be used to screen soil samples for organic vapors. Refer to the instrument manual for operating instructions.
- Soil borings will be advanced using a Geoprobe® unit or other appropriate direct push unit.

For borings using direct push, use the following sampling techniques:

- Soil samples are collected continuously in a four-foot by 1.5-inch O.D. core sampler lined with an acetate liner. (Note: Check the site-specific work plan (or FTO or SOW) for additional requirements or exceptions). The soil samples will be examined and classified by the on-site geologist. Descriptive drilling logs will be completed for each soil boring using the soil classification system specified in American Society for Testing and Materials (ASTM) Method D-2488. Soil classifications include characterization of soil texture (percentages of sand, silt, clay, etc.), color, moisture content, evidence of contamination (stain, sheen, odor, and instrument readings), and other pertinent information.
- Boring advancement will continue to the depth specified in the site-specific work plan.
- The sampling unit and all downhole tools (e.g., core sampler, etc.) will be decontaminated between boreholes.

## Soil Sampling Using Direct Push

- To collect intact subsurface soil samples, the borehole will advanced to the top of consecutive four-foot sample interval or other intervals as specified in the project work plan (or FTO or SOW). The sampling device will be driven, the length of the sampling device into the underlying material and withdrawn.
- For each sample, the field team will record the following in the field logbook:
    - Date and time of collection.
    - Depth of sample collection.
    - Sample recovery (%).
    - A qualitative description of the soil sample.
- As specified in the work plan, a representative sample will be collected and placed in the appropriate glass sample bottles. The soil samples for volatile organic analyses will be

collected directly from the split spoon first to minimize volatilization of such compounds and will be placed directly into the sampling bottles or collected directly using sampler device like a TerraCore. The remainder of the split spoon/core (the entire sampling interval) will be homogenized in a stainless steel, tempered glass, or aluminum container. Samples will be placed in sample bottles with a stainless steel implement.
- Outer gloves (latex) worn by sampling personnel will be removed and discarded between samples to minimize the potential for cross-contamination of samples by contact with gloves.
- The sampling equipment will be decontaminated between each sampling interval.

### Sealing the Borehole

The borehole will be abandoned according to state regulations/guidelines. Surface restoration will be performed as specified in the FTO or SOW.

## 4.0 DOCUMENTATION

All boring and sampling information should be recorded in the field logbook, on the chain-of-custody and on sampling logs, if applicable.

# GROUNDWATER GAUGING
## (Standard Operating Procedure No. 05)

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe groundwater gauging activities used to collect depth to water, depth to product and product thickness. The requirements of this procedure are applicable to project activities involving monitoring well installation, monitoring well development, groundwater sampling, free product recovery, and slug tests.

## 2.0 REFERENCES

- Quality Assurance Project Plan (QAPP), if applicable.
- Health and Safety Plan (HASP).
- Equipment Decontamination SOP (No. 07).

## 3.0 PROCEDURES

### Office Preparation

The field personnel are responsible for ensuring that the following items have been completed prior to leaving for the site:

- Obtain equipment necessary for completing the groundwater gauging activities.
- Review the QAPP, Field Task Order (FTO) or Statement of Work (SOW), HASP, and appropriate SOPs with the Project Manager to determine the specific sampling requirements.
- Obtain the appropriate site maps with soil boring/monitoring well locations.
- Verify that legal right-of-entry has been obtained, where required.
- Verify with the Project Manager/Technical Lead that the locations are appropriately labeled on a site map.

### Field Preparation

The field personnel will:

- Introduce themselves to any site representative.
- Confirm that all equipment has been decontaminated or pre-cleaned before groundwater gauging.
- Verify that the appropriate number of clean and empty 55-gallon drums and drum liners are on-site, or that other suitable containers will be available to contain drill cuttings and decontamination solids and liquids (i.e., residuals or investigation derived waste).

- Identify and locate all soil boring/monitoring well locations.
- Ensure that the field team members and any visitors to areas of field activity read, acknowledge acceptance to requirements of, and sign the HASP.
- Obtain potable water for decontamination, if needed. Record the source of water in the field logbook.

## GROUNDWATER GAUGING (OPERATION)

- Groundwater gauging locations must begin at the monitoring well with the least contamination, generally up-gradient or furthest from the site or suspected source. Then proceed systematically to the monitoring wells with the most contaminated groundwater based on historical data.
- Check and record the condition of the monitoring well for damage or evidence of tampering.
- Unlock well head. Record location, time, date and appropriate information in a field logbook.
- Remove inner casing cap.
- Monitor the headspace of the monitoring well at the rim of the casing for volatile organic compounds with an Organic Vapor Monitor and record in the field logbook. If the existing monitoring well has a history of positive readings in the headspace, then the gauging must be conducted in accordance with the HASP.
- Allow 10-15 minutes for the depth to water level to stabilize after removing the inner casing cap. Measure the depth to water/product (liquid level must be measured to nearest 0.01 feet) relative to a reference measuring point on the well casing with an groundwater product interface probe and record in logbook or groundwater sampling log. If no reference point is found, measure relative to the top of the inner casing on the north side, then mark that reference point and note that location in the field logbook. Record depth to groundwater information in the field logbook and/or ground water sampling log. Measure the depth to water a second time to confirm initial measurement; measurement should agree within 0.01 feet or re-measure twice.

# SOIL VAPOR PIN/POINT INSTALLATION AND SAMPLING
## (Standard Operating Procedure No. 06)

## 1.0 PURPOSE

This document describes general and specific procedures, methods and considerations to be used and observed when collecting soil gas samples for field screening or laboratory analysis.

The procedures contained in this document are to be used by field personnel when collecting and handling soil gas samples in the field. On the occasion that Atlas field personnel determine that any of the procedures described in this section are inappropriate, inadequate or impractical and that another procedure must be used to obtain a soil gas sample, the variant procedure will be documented in the field logbook, along with a description of the circumstances requiring its use.

### 1.1 General Precautions

Proper safety precautions must be observed when collecting soil gas samples. Refer to the site-specific Health and Safety Plan (HASP) for guidelines on safety precautions. The following precautions should be considered when collecting soil gas samples.

- Special care must be taken not to contaminate samples. This includes storing samples in a secure location to preclude conditions which could alter the properties of the sample.
- Samples shall be custody sealed during long-term storage or shipment.
- Custody seals should not be placed on the canisters due to volatile organic compounds (VOCs) that may out-gas from the adhesives. Custody seals should be placed on the outside of canister shipping containers.
- Sample identification tags shall be attached to the canister using wire, cable tie, or string. Adhesive labels should be affixed to the tag and not be placed directly on the canister.
- Collected samples are in the custody of the sampler or sample custodian until the samples are relinquished to another party.
- If samples are transported by the sampler, they will remain under his/her custody or be secured until they are relinquished.
- Shipped samples shall conform to all U.S. Department of Transportation (DOT) and/or International Air Transportation Association (IATA) hazardous materials shipping requirements.
- Documentation of field sampling is done in a bound logbook.
- Chain-of-custody (COC) documents shall be filled out and remain with the samples until custody is relinquished. Canister Sample Identification Tags and COC and field logbook

should list the unique canister serial number and the starting time that the sample was collected.

- All shipping documents, such as air bills, bills of lading etc., shall be retained by the project leader and stored in a secure place.

## 1.2 Special Considerations for Sampling

The tubing used as part of either of the described sampling systems should be Teflon® or stainless steel. As most soil gas sampling will be conducted to investigate the presence or extent of organic compounds (not including PFAS compounds), Teflon® tubing is recommended to ensure the integrity of the sample.

Extreme care should be taken to protect all VOC sampling equipment whose surfaces will come in direct contact with the collection of the sample. For instance, a Geoprobe® or other drilling rig should not be used to carry or transport sampling equipment because of diesel and other VOC emissions. In addition, other field support vehicles should not be operated in the proximity of the sampling site shortly before or during sampling.

## 1.3 Precautions for Soil Gas Sampling

A clean pair of new, non-powdered, disposable gloves will be worn each time a different location is sampled, and the gloves should be donned immediately prior to sampling. The gloves should be changed any time during sample collection when their cleanliness is compromised. If possible, one member of the field sampling team should take all the notes and photographs fill out tags, etc., while the other member(s) collect the samples.

Using O-rings on all Post Run Tubing (PRT) tooling, adapters, and probe rods will ensure that the entire sampling train is air-tight. This will prevent soil gas ingress during installation and to maintain sample integrity by ensuring that no ambient air is introduced into the sample during collection

## 1.4 Sample Handling Requirements

Soil gas samples will typically be collected by directly filling an evacuated, 6-liter passivated stainless-steel canister after sample delivery line purging. The canister will be labeled and identified with sample ID, date, sampler, start vacuum, stop vacuum, project and site.

## 1.5 Quality Control

Quality control sampling for soil gas sampling investigations will consist of collection of the following types of samples, as appropriate.

- Control Sample: If applicable to the study or investigation, a control (or background) sample should be collected from a location not affected by the possible contaminants of concern and submitted with the other samples.

- Trip Blank: A canister trip blank, prepared prior to the investigation by Atlas personnel, should follow alongside the traditional samples and be submitted with the sample set during the investigation.
- Equipment rinsate blank: Equipment rinsate blanks should be collected if equipment, such as PRT adapters, probe rods, or other sampling equipment is field cleaned and re-used in the sample train to document that low-level contaminants were not introduced into the sample by the decontaminated equipment.
- Field Split: Field split samples, at a minimum frequency of one for every ten samples should be collected. Split samples are collected from one single sample port or installation by attaching the center leg of a Swagelok® "Tee" to the end of the sample tubing. The remaining legs of the "Tee" are connected to two sample containers (usually two flow controllers with roughly the same calibrated flow) which are opened and filled simultaneously.

### 1.6 Records

Field notes will document the sampling procedures and will be placed on the server immediately after the sampling event.

## 2.0 Geoprobe® PRT SYSTEM INSTALLATION

Single event or grab sampling may be conducted using the PRT System. Using this system, soil gas samples can be collected quickly and with a high degree of assurance that the samples are representative of the targeted depth.

The downhole components of the PRT system include:

- Sample delivery tubing
- Probe rods
- PRT Adapter
- Expendable point holder
- Expendable point

O-ring seals are used on the PRT Adapter and the expendable point holder. O-rings can also be used at all rod joints, preventing soil gas ingress which can prevent air-tight docking of the PRT adapter.

### 2.1 PRT System Installation Procedures

The following procedures are used to collect soil gas samples using the Geoprobe® PRT system.

The PRT system is available for 1.0-inch, 1.25-inch and 1.5-inch diameter probe rods. In Atlas practice, 1.25-inch rods are typically used. All parts or accessories used in the PRT system must be selected with the appropriate diameter probe rod in mind to ensure compatibility of all components.

Ensure that the sampling location has been cleared using the procedures detailed in the site HASP. The plan should stipulate that prior to site arrival the proposed soil gas sampling locations will be cleared using the One Call utility locating service. Upon arrival at the site, each individual soil gas sampling location will be cleared using a pipe scanner and metal detector.

- Cut a 4-foot by 4-foot section of disposable plastic sheeting and place on the ground next to the sampling location.
- Hand auger a 4-foot deep hole using a clean stainless-steel hand auger emptying the soil cuttings on the plastic sheeting.
- Don a clean set of gloves. To ensure there is no thread damage to the internal threads of the expendable point holder or the PRT adapter, hand screw the PRT adapter counter-clockwise into the expendable point holder using only your fingertips. The two components should screw together smoothly. If they do not, replace them and repeat the test. Note: PRT fittings are left-hand threaded; turn counterclockwise to tighten.
- Place O-ring on PRT expendable point holder and attach to initial section of probe rod.
- Place O-ring on expendable point and press into expendable point holder.
- Add drive cap to probe rod and push PRT system through the augured hole into ground to the bottom of the sampling interval. Take special care to assure that the rods are in line with the push axis of the probe machine.

It is important to leave at least a 2-foot interval of undisturbed native soil between the augured hole and the top of the sampling interval. The native soil layer will be used to support the bentonite/soil layers described below.

At the bottom of the desired sampling depth, attach a point popper to an extension rod and insert the extension rod string into rods so that the point popper rests on the expendable point. Using the rod puller and taking special care to maintain probe alignment with the rods, begin pulling the rods while maintaining pressure on the extension rods. The extension rods should drop when the pull is started, indicating that the expendable point has been ejected. The rods can then be pulled to expose the desired open sampling interval.

Using a properly decontaminated water level sounder, check, if conditions warrant, to make sure groundwater is not present at the bottom of the rod string. If groundwater is present, the sampling location should be properly abandoned, and an alternate sampling location determined. Soil gas samples should never be collected if there is a high possibility that groundwater may enter the sampling equipment. The groundwater will ruin the sampling and analysis equipment and invalidate the soil gas sample.

The drive rods that are contained in the augured hole will be "sealed" by first adding 12 inches of bentonite clay crumbles (not pellets) and hydrating with de-ionized water. Second, the augured hole will be filled with alternating layers of soil cuttings and hydrated bentonite clay crumbles while being hand packed with a clean stainless-steel auger handle or similar device.

Secure the PRT adapter to a length of Teflon® tubing sufficient to reach from the sampling interval to the surface, with several feet of excess tubing extending beyond the top of the probe rod to facilitate sampling. Straighten the first two feet of tubing above the adapter by pulling it between your thumb and forefinger. This will ease the docking of the tubing.

Run the tubing and adapter into the probe rod and, using steady downward pressure turn the tubing counter-clockwise to dock the adapter into the top of the expendable point holder. Tug gently on the tubing to ensure that the adapter engaged with the expendable point holder. Continue rotating the tubing until the adapter is firmly seated. Failure to dock could indicate that soil intruded during the push or that the expendable point was lost during the push.

At this point, the PRT system has been installed and is ready to be helium leak tested (Section 5) before sampling. If the sample cannot be collected immediately, the end of the tubing should be capped with a stainless-steel Swagelok® cap or crimped by bending over and securing with a cable tie. Sampling is conducted using one of the procedures described in Section 4.

### 2.2 Decommissioning PRT Sample Locations

**Because it is impractical to pump grout through the PRT adapter on the lead probe rod, the entire string of rod must be removed before decommissioning can commence. The following methods are available, depending on conditions related to sample depth and post-removal probe hole wall stability:

**Direct Placement of Pellets or Grout** - If the sampling depth was relatively shallow, on the order of ten feet or less, or the bore hole did not penetrate a water table, grouting/sealing the open hole can be accomplished by directly placing bentonite pellets, hydrated in lifts or pouring a 30% solids bentonite grout mixture from the surface. The acceptable maximum depth for this option is somewhat dependent on the stability of the hole and these methods may be used at slightly greater depths if the holes do not collapse after removal of the rod.

**Re-entry Grouting** - For locations where sampling was conducted at somewhat greater depths, where groundwater was penetrated, or where the surficial formations tend to collapse, the only viable option for grout placement may be to re- probe the entire depth with a new expendable point. After reaching the original sample depth, the expendable point is ejected and the hole is grouted by directly injecting grout through the inside of the rod string, as it is removed. Use of this option is dependent on the relative degree of hole stability.

## 3.0 Geoprobe® Permanent Soil Gas Implant Installation

Long-term soil gas sampling may be conducted using permanent soil gas sampling implants installed with the Geoprobe®. Stainless steel implants may be installed at any depth achievable by the Geoprobe® and may be installed using various diameters of probe rod. Commonly, 2.25-inch probe rods are used. The implants may be installed in custom lengths, configured using a wide assortment of available implant lengths and connections. The implant screens are double-woven stainless steel mesh with 0.0057-inch (0.15 mm) pore openings.

Permanent soil gas sampling implants may also be installed using 2.125-inch diameter rods utilizing an advancing thin-walled corer to facilitate placement of the implant (see Geoprobe Systems, Direct Push Installation of Devices for Active Soil Gas Sampling & Monitoring, Technical Bulletin No. MK3098 for details of this application).

### 3.1 Installation of Permanent Soil Gas Sampling Implants (Typical)

The following procedures are used by Atlas to install a permanent soil gas sampling implant using the Geoprobe®. These are the general procedures which are used with 2.25-inch diameter probe rod.

Ensure that the sampling location has been cleared using the procedures detailed in the Site Safety Plan. The plan should stipulate that: prior to site arrival the proposed soil gas sampling locations will be cleared using the One Call utility locating service. Upon arrival at the site each individual soil gas sampling location will be cleared using a pipe scanner and metal locater.

- Cut a 4-foot by 4-foot section of disposable plastic sheeting and place on the ground next to the sampling location.
- Hand auger a 4-foot deep hole using a clean stainless-steel hand auger emptying the soil cuttings on the plastic sheeting.
- Don a clean set of gloves. To ensure there is no thread damage to the internal threads of the expendable implant anchor or the implant, hand screw the implant counter- clockwise into the expendable implant anchor using only your fingertips. The two components should screw together smoothly. If they do not replace them and repeat the test. Note: implant fittings are left-hand threaded; turn counterclockwise to tighten.
- Place o-ring on PRT expendable implant anchor and attach to initial section of probe rod.
- Add drive cap to probe rod and push PRT system through the augured hole into ground to the bottom of the sampling interval. Take special care to assure that the rods are in line with the push axis of the probe machine. Do not retract rod or removed expendable point yet.

Using a properly decontaminated water level sounder, check, if conditions warrant, to make sure groundwater is not present at the bottom of the rod string. If groundwater is present, the sampling location should be properly abandoned, and an alternate sampling location determined. Soil gas samples should never be collected if there is a high possibility that groundwater may enter the sampling equipment. The groundwater will ruin the sampling and analysis equipment and invalidate the soil gas sample.

Install an o-ring on the docking end of the implant. Next, secure the implant to a length of 1/4"Teflon® tubing sufficient to reach from the sampling interval to the surface, with several feet of excess tubing extending beyond the top of the probe rod to facilitate sampling. Use electrical tape or a cable tie to temporarily cap the end of the tubing. Straighten the first two feet of tubing above the adapter by pulling it between your thumb and forefinger. This will ease the docking of the tubing.

Run the tubing and implant into the probe rod and, using steady downward pressure turn the tubing counter-clockwise to dock the adapter into the top of the expendable point holder. Tug gently on the tubing to ensure that the adapter engaged with the expendable point holder. Continue rotating tubing until the adapter is firmly seated. If docking is difficult, try running the implant and tubing thru an appropriate length of 1/2" PVC tremie pipe to better align the implant with the expendable point to facilitate docking. Remove the tremie pipe once docking is achieved. Failure to dock could indicate that soil intruded during the push or that the expendable point was lost during the push. If the implant does not dock, it is possible to salvage the installation by removing the implant and sealing the small hole on the bottom of the implant, if present, with foil or with a small sheet metal screw, then returning the implant to the hole.

After the implant has been docked, use a pull cap and pull the probe rod approximately one foot while applying slight downward pressure on the tubing connected to the implant. This should start to expose the implant in the sampling interval. Take care while moving the rod and observe the tubing to make sure that the anchor and implant remained in place and is not being pulled with the rod.

If the implant remained in place, slowly pour a measured amount of 60-100 mesh glass beads down the inside of the probe rod. The glass beads are used as a filter pack around the implant. The implant should be covered with beads to approximately six inches above the top of the implant. The volume of beads should be calculated based on the length of implant used, alternatively, a water level sounder can be used to measure the top of the bead layer. While pouring the beads, it is advisable to gently shake the tubing to prevent the beads from bridging inside the probe rod.

After placing the beads, the implant is sealed using a flowable mixture of the glass beads and fine-powdered bentonite. To accomplish this, at least 6 inches of rod is pulled, and the mixture is slowly poured into the rod above the bead-packed implant. As with the bead placement, similar care should be taken to avoid bridging of this mixture.

After placement of the seal, the rod string is removed, and the resultant annular space is grouted using the following procedures which are dependent on the depth and stability of the open hole.

If the resultant open hole is shallow (ten feet or less) and the hole walls are stable, the hole may either be filled with bentonite pellets, hydrated in lifts or grouted using a 30% solids bentonite grout, poured from the surface.

If the hole is deeper than ten to fifteen feet, better results may be obtained by using a tremie pipe to place a pumpable grout. One half inch PVC tremie pipe or Geoprobe nylon grout tubing is threaded down the annulus to the top of the bead/bentonite seal. The tremie is pulled off the bottom to prevent jetting out the seal and grout is pumped until the annulus is filled.

For permanent or long-term installations, the tubing should be protected by an appropriate surface completion, such as a flush vault or well protective casing, similar to well protective casings. After the installation of the vault, cut off the end of the tubing with the previously installed electrical tape or cable tie and cap with a stainless-steel capping fitting.

After installation is complete the soil gas implant is sampled using one of the methods described in Section 7.

Helium leak testing is not practical nor required for permanent soil gas installations.

## 4.0 Sub-Slab Soil Vapor Pin Installations

For soil gas samples that need to be collected under a current structure, sub-slab soil vapor pins (also referred to as sample ports) should be installed. Temporary or long-term installations may be installed depending on the project needs Stainless steel screens may be installed if loose or unconsolidated soils lie underneath the slab. Extreme care should be taken in the location of the drilled sample ports.

### 4.1 Installation of Temporary Sub-slab Soil Vapor Pins

The following procedures are used to install a temporary sub-slab soil gas sampling vapor pins.

Ensure that the sampling location has been cleared using the procedures detailed in the Site Safety Plan. As most if not all of these applications will be inside, a One Call utility locating service might not help. Upon arrival at the site, each individual sub-slab sampling location should be cleared verbally and visually with a site engineer or home owner, whoever is available with the most knowledge on the structure.

Don a clean pair of gloves and drill in the desired location with a 1/2” masonry bit. After drilling, make sure the bit is completely through the slab either by running something rigid along the inside of the borehole to feel the slab end or by visually observing soil cuttings on or from the drill bit. Ensure there is no water in the borehole before moving on. Again, soil gas samples should never be collected if there is a high possibility that groundwater may enter the sampling equipment. The groundwater will ruin the sampling and analysis equipment and invalidate the soil gas sample. If so, choose another sample location.

Cut a piece of Teflon® tubing to a length of the slab thickness, plus two feet for room to reach sampling equipment. Straighten the end of the tubing and place it down the borehole to a height just above the bottom of the slab. If there is unconsolidated soil present that could potentially clog the sampling inlet, a clean stainless-steel screen can be fastened to the end of the tubing.

After brushing away concrete dust, a VOC-free clay or putty like media is then used to secure the tubing and create an air tight seal at the slab interface. After a leak test is conducted according to Section 6.3, the end of the sampling tube is then connected to the sampling device or crimped and secured if sampling is to happen later.

After sample collection according to a method described in Section 7, the holes are immediately abandoned by filling the borehole with cement. A slightly thin mixture of cement will ensure no bridging of the mixture as it pours and makes a more solid patch. A small diameter piece of wire is good for working cement into hole. Check the cement patch for effectiveness before leaving the site.

### 4.2 Installation of Permanent Sub-slab Soil Vapor Pins

The following procedures are used to install a permanent sub-slab soil gas sampling port.

Each sample location should be cleared to the best of the sampling team’s ability following step 1 in Section 5.2 above.

Don a clean pair of gloves and drill in the desired location with a 1” masonry bit to a depth needed to just submerge the permanent sample port body into the concrete to have a flush final product. Finish drilling the remainder of the slab thickness with a 1/2” masonry bit. After drilling, make sure the bit is completely through the slab either by running something rigid along the inside of the borehole to feel the slab end or by visually seeing soil cuttings on the drill bit. Ensure there is no water in the borehole before moving on. If so, choose another sample location.

The port should be made of stainless steel with an air tight connection to a length of stainless steel 1/4” tubing long enough to reach down to just above the bottom of the slab and have a cap or plug that can make an air tight seal when left between sampling events. Again, a clean stainless-steel screen can be added to the end of the sample tube if needed to prevent soil from penetrating the sample inlet.

Place the permanent sample port into the drilled borehole with a piece of malleable VOC- free media to seal the hole where it narrows (to keep the cement off the sample inlet). Seal the sample port in place using anchor cement and allow to set overnight.

After port is set, perform a leak test as described in Section 6.3. If the sample port passes the leak test, samples may then be collected by one of the methods described in Section 7. Leak tests should be completed for every sampling event, as torquing the plug can crack the anchor cement over time.

## 5.0 Helium Leak Testing of PRT Soil Gas Sampling Installations

Leak testing of soil gas sampling installations should be conducted if the sampling equipment has a connection that if compromised would emit ambient air into the soil gas sample. For sub-slab soil gas sample ports, it is most important to leak test temporary sample ports as the integrity of the seal made by the malleable VOC-free media used can be easily damaged.

## 5.1 Helium Leak Testing Procedures for PRT Soil Gas Sampling Installations

The sampling system will be leak checked by inserting a 1/8” diameter Teflon® tubing into the drive rod next to the 1/4-inch diameter Teflon® sampling tubing, until it bottoms out a few inches above PRT adaptor. The 1/8” diameter tubing will be connected to a 99.999% pure helium source.

A second length of 1/4” Teflon® tubing will be inserted into the drive rod to a point approximately one foot below the top of the rod. The free end of this tubing will be connected to a helium meter that will monitor the helium content of the drive rod during the leak test.

The top of the drive rod and tubing will be sealed with Parafilm® to retain the helium for the leak test. The drive rod will be filled with helium to a concentration of greater than 90%, while a soil gas sample is collected into a Tedlar® bag through the 1/4” Teflon® sample tube for on-site sample analysis of helium content. When the Tedlar® bag is disconnected from the sample tubing the sample tubing is crimped and held with a rubber band or cable tie, to prevent ambient air from entering the sample tube. The helium concentration in the Tedlar® bag must be less than 10% of the helium concentration in the drive rod to insure integrity of the soil gas sampling well. When the leak test is complete, the Parafilm®, helium supply, and monitoring tubes will be removed, leaving the sample tube.

## 5.2 Helium Leak Testing Procedures for Sub-slab Soil Vapor Pins

The sampling system will be leak checked by covering the sample port with a shroud that can be filled from a 99.999% pure helium source. The shroud will allow two other ports where the leak check sample can be pulled and the helium concentration in the shroud can be testing similar to the set-up in Section 5.2 above.

The shroud will be filled with helium to a concentration of greater than 90%, while a soil gas sample is collected into a Tedlar® bag through the 1/4” Teflon® sample tube for on- site sample analysis of helium content. When the Tedlar® bag is disconnected from the sample tubing the sample tubing is crimped and held with a rubber band or cable tie, to prevent ambient air from entering the sample tube. The helium concentration in the Tedlar® bag must be less than 10% of the helium concentration in the shroud to insure integrity of the soil gas sampling port. When the leak test is complete, the shroud, helium supply, and monitoring tubes will be removed, leaving the sample tube connected to the port.

For temporary sub-slab sample ports, if the leak test fails, the malleable VOC-free media can be reinserted, added to, or shifted and tested again. After the sample port passes, take care in not moving or shifting the seal media before sample collection.

## 6.0 Sampling Soil Gas Installations

Soil gas samples may be collected from PRT and permanent soil gas implant installations using one of several methods, listed below. Canister sampling is the most common method utilized by Atlas.

Canister Sampling for Laboratory Analysis – After installation is complete and immediately prior to sampling, a flow-limiting device, consisting of a Nupro® 7- micron sintered stainless steel filter, a critical orifice and gauge is attached to an evacuated canister for sampling. A sampler leak check is conducted by plugging the inlet of the flow control device and opening the canister valve momentarily. After the valve has been closed the needle on the gauge should not move (remain at full vacuum) indicating that at the sampler is leak free.

Once the PRT installation or the sub-slab sample port has passed the helium leak test as described in Section 5 and the sampler leak check has been completed, the Teflon® sample tube is connected to the flow-limiting device using a Swagelok® or other suitable secure connection. After connection, the rubber band (if used) is cut and the crimp in the Teflon® tubing straightened and the valve on the canister is opened, pulling soil gas from the implant into the canister. Typically, the sample is collected over a one-hour period (depending on soil conditions), at which time the canister valve is closed, and the canister tagged with pertinent sampling information. When using this type of device, it is advisable to check the canister vacuum throughout the sampling period to verify filling. The initial and final gauge pressure/vacuum reading should be recorded in the project logbook.

Real-time Field Analytical Methods – Real-time analytical measurements may be obtained from PRT, soil gas implant, or sub-slab port installations using appropriate instrumentation. The soil gas to be analyzed may be drawn directly into the instrument by the instrument pump or the instrument may be placed in line and the sample drawn into the instrument using a suitable pump connected to the discharge side of the instrument. Results may be qualitative, such as those obtained with flame ionization or photoionization detectors, or they may be quantitative, for instruments which can be calibrated to specific compounds.

# DECONTAMINATION OF EQUIPMENT
## (Standard Operating Procedure No. 07)

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the methods to be used when decontaminating field equipment that will come in contact with investigative medium (including soil, groundwater, surface water, sediment, and other medium) that will be sampled as part of investigation activities.

## 2.0 REFERENCES

- Quality Assurance Project Plan (QAPP), if applicable.
- Health and Safety Plan (HASP).
- Investigative Derived Waste Management SOP (No. 06)

## 3.0 PROCEDURES

### Office Preparation

Prior to leaving for the site, the field personnel will ensure that the following activities have been completed:

- For investigations that involve large equipment requiring decontamination, (e.g., drilling rigs, backhoes/excavators, etc.), verify whether containerizing decontamination fluids will be required. Ensure that the subcontractor will have appropriate equipment on-site to perform decontamination, including:
    - Portable, electric generator.
    - High-pressure steam cleaner or steam jenny.
- Prepare a site-specific plan for containerizing runoffs of decontamination fluids, if required. Ensure that any logistical concerns relative to decontamination of large equipment and containerization of runoff liquids have been resolved.
- Verify that an appropriate source for potable water is available.
- Verify with the Project Manager/Technical Lead that the appropriate number, types, and sizes of liquid drums (or other suitable containers) are available for disposal of decontamination waste fluids.
- Verify that all equipment, solvents, and water (both potable and distilled water) necessary for completing decontamination are available and/or will be shipped to the site.

### Field Preparation

Prior to initiating field activities, set up the decontamination area, preferably upwind from the sampling area(s). Setup for decontamination will vary depending on the type of equipment to be used:

- For decontamination of hand-held, sampling equipment, spread a sheet of Visqueen plastic sheeting on the ground and place the decontamination tubs and/or buckets and rinse bottles on top of the plastic.
- For decontamination of drilling rigs or backhoes/excavators, establish an area for decontamination that will meet the program and site-specific requirements for collection of decontamination fluids. If necessary, set up an area lined with plastic and sloped to accommodate the collection of wastewater by sump pump or other suitable means. Do not allow fluids to runoff.

## GENERAL CONSIDERATIONS

All equipment used for investigative activities should arrive on-site in a clean condition. With the exception of certified laboratory-cleaned equipment, all excavating and drilling equipment, as well as all sampling, testing, or measuring equipment that comes in contact with potentially sampled medium, will be decontaminated prior to use, unless it arrives prepackaged by a manufacturer. Equipment will also be decontaminated between sampling locations. If disposable sampling equipment (clean prepackaged materials) is used, it will not be decontaminated before use and will be disposed of properly after one use.

Dedicated sampling equipment, such as individual sampling/purging pumps that are used to sample one well, will be decontaminated prior to the first use, but do not require decontamination between uses at the same well. Similarly, if dedicated tubing per well location is elected, it will also not require decontamination between uses at the same well.

## DECONTAMINATION OF MANUAL SAMPLING EQUIPMENT (OPERATION)

The following steps for decontamination will be applied to all equipment that will come in contact with the sampling medium:

- Physically remove as much of the visible material as possible from the sampling equipment after use and before submersing it in decontamination fluids. (If contamination of sampling medium is suspected, as determined by visual observation or instrument readings, it will be collected in an appropriate container. Otherwise, it may be returned to the area from which it originated.)
- Scrub with non-phosphate detergent (Liquinox)/potable water solution.
- Potable water rinse.
- Distilled water rinse.
- Air dry, as conditions allow.

The initial detergent/water solution will be changed daily or more frequently if needed.

## DECONTAMINATION OF HEAVY EQUIPMENT (OPERATION)

The following steps for decontamination will be applied to all heavy equipment that does not come in direct contact with the sampling medium:

- Physically remove as much of the visible material as possible from the heavy equipment after use and prior to pressure wash or steam cleaning. If contamination of material is suspected, as determined by visual observations or instrument readings, materials will be collected in an appropriate container. Otherwise, return the material to the area where it originated.
- Place the heavy equipment on the decontamination pad in the decontamination area. If wash water is to be collected, ensure that the collection mechanism functions properly and that the decontamination pad has no leaks.
- Steam clean parts of the heavy machinery that come into contact with the material (tires, bulldozer bucket, augers, back of drill rig, etc.).
- Containerize fluids, if appropriate. Place solids in a drum or other US Department of Transportation (DOT)-approved container.

## DECONTAMINATION OF DOWNHOLE PUMPS AND TRANSDUCERS (OPERATION)

Downhole pumps and transducers will not be used in grossly contaminated wells unless the equipment is to be dedicated. The following steps for decontamination will be applied to downhole pumps, transducers, and other sensitive electronic equipment, except where manufacturer’s recommendations for decontamination exceed these requirements:

- Physically remove as much of the visible material as possible from the equipment after use and prior to decontamination. If contamination of material is suspected, as determined by visual observations, instrument readings, or previous analytical results, materials will be collected in an appropriate container. Otherwise, return the material to the ground surface in the general area where it originated.
- Scrub the outside of the equipment with non-phosphate detergent (Liquinox)/potable water solution. Run this solution through pumps.
- Potable water rinse. Run potable water through pumps.
- Distilled water rinse.
- Air dry in a clean area.
- If done using, return equipment to its protective case.

## DECONTAMINATION OF DIRECT PUSH EQUIPMENT

The following steps for decontamination will be applied to direct push equipment that is used when collecting direct push samples:

- Physically remove as much of the visible material as possible from the heavy equipment after use and prior to pressure wash or steam cleaning. If contamination of material is suspected, as determined by visual observations or instrument readings, materials will be collected in an appropriate container. Otherwise, return the material to the area where it originated.
- Place the Direct Push equipment on the decontamination pad or in an appropriate decontamination area. If wash water is to be collected, ensure that the collection mechanism functions properly and that the decontamination pad has no leaks.

- Steam clean parts of the equipment that come into contact with the material (tires, coring devices, back of DPT rig, etc.) upon arriving at the site and after every boring.
- Containerize fluids, if appropriate. Place solids in a drum or other DOT-approved container.

## 4. DOCUMENTATION

Record the decontamination procedure used (steam cleaning, solvents) in detail in the field logbook. Describe the location used for decontamination in the field logbook and sketch this location on the field map. Record the sampling and decontamination events in order of occurrence. Record the management of residual materials generated during decontamination.

# MONITORING/EXTRACTION WELL INSTALLATION
## (Standard Operating Procedure No. 08)

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe monitoring and extraction well installation procedures, and this SOP is an accompaniment to the Soil Boring and Subsurface Sampling SOP No. 3.

## 2.0 REFERENCES

- Quality Assurance Project Plan (QAPP), if applicable.
- Health and Safety Plan (HASP).
- Field Soil Vapor Monitoring SOP (No. 02)
- Equipment Decontamination SOP (No. 07)

## 3.0 PROCEDURES

### Office Preparation

The field personnel are responsible for ensuring that the following items have been completed prior to leaving for the site:

- Review the Field Task Order (FTO) or Statement of Work (SOW) and ensure you have construction details, or know the decision criteria for these details, including: total depth, screen interval, screen slot size, filter pack, annular seal, and surface completion details. Review depth to water, PID results, lithology, and residual and dissolved phase COC nature and depth at nearby wells or soil borings and ensure this information is on the FTO/SOW. If you do not have this information, obtain it.
- Bring site map and copies of boring and well construction logs from nearby wells to the field, if available.
- Review the QAPP, FTO/SOW, HASP, and appropriate SOPs with the Project Manager to determine the specific sampling requirements.
- Obtain the appropriate site maps with soil boring/monitoring well locations.
- Verify that legal right-of-entry has been obtained for any off-site well installations. Bring a copy of this documentation to the field.
- Verify with the Project Manager/Technical Lead that the locations are appropriately labeled on a site map.
- In advance of field activities, ensure Project Manager or designee has provided state agency and site representatives with the schedule for all on- and off-site work. Contact all appropriate representatives for off-site sampling, if necessary.
- Verify that the appropriate number of clean, empty, solid and liquid 55-gallon steel investigation derived waste drums are on-site, or that other suitable

containers will be available for containing drill cuttings and decontamination solids and liquids, and whom is responsible for bringing them.

**Field Preparation**

The field personnel will perform soil boring advancement pursuant to SOP for Soil Boring and Subsurface Sampling (No. 02) in conjunction with the field activities described in this SOP.

## MW INSTALLATION (OPERATION)

- Advance the soil boring to the target total depth. Determine based on field conditions (heaving sands, etc.) whether the boring should be advanced further to ensure the well depth meets the target depth.
- Determine the depth to upper saturated zone and depth to water in the augers or borehole to ensure the well construction plan will result in a screen that bridges the water table, if that is the objective of the well installation. If the plan must be modified, notify the Project Manager or designee immediately to receive plan modification approval.
- Install riser, screen and bottom cap in the borehole to attain target depth. Use centralizers for total depths exceeding 50 feet, or as specified in the FTO/SOW. Document total feet of screen and riser.
- Slowly place clean silica sand pack to avoid bridging. Extend the sand two feet above the top of the screen, or as specified in the FTO/SOW. Center the screen and riser in the borehole. Document number of bags of sand and type used.
- If hydrated bentonite seal, slowly place bentonite chips and slowly hydrate with sufficient water until water extends no more than 6 inches above the top of the bentonite. Or, place bentonite cement grout (3 to 5% bentonite by weight) by tremie (except for shallow wells) or alternate grout/method specified in FTO/SOW. Document type and number of bentonite and cement (# bags). Document water volume used.
- Install expansion cap and lock keyed alike. Excavate soil and place apron frame. Construct well apron and manway or stick-up, depending on the plan objective. Ensure manway is flush with no more than ¼ inch above) ground surface to avoid surface water pooling and snow removal equipment damage.
- Surface casing for double-cased wells should extend no less than five feet into bedrock, and annular seal should cure overnight before advancing the borehole.
- Document construction with photographs.
- Notify PM as soon as possible if any deviation to the plan is required.
- Perform well development no sooner than 24 to 72 hours (depending on conditions) after well construction, and survey by (preferred method) licensed Professional Surveyor to determine top of casing and ground surface elevations within 0.01 foot. If hand-held GPS and transit must be used, ensure coordinates are tied into local benchmark and cross check elevation to known well locations.

**MW DOCUMENTATION**

- Prepare MW construction log showing screen interval, total depth, silica sand pack extent, annular seal nature and extent, and surface completion details. If available, add survey coordinates and ground surface and top of casing elevations.
- Submit required well construction documentation to regulatory agency, when required to register the well.
- Document all details relative to the well construction in the field logbook.

# SLUG TEST
# (Standard Operating Procedure No. 09)

## 1.0 PURPOSE

This standard operating procedure (SOP) is applicable to determine the horizontal hydraulic conductivity of distinct geologic horizons under in-situ conditions. The hydraulic conductivity (K) is an important parameter for modeling the flow of groundwater in an aquifer.

These are standard (i.e. typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

## 2.0 METHOD SUMMARY

A slug test involves the instantaneous injection or withdrawal of a volume or slug of water or solid cylinder of known volume. This is accomplished by displacing a known volume of water from a well and measuring the artificial fluctuation of the groundwater level.

The primary advantages of using slug tests to estimate hydraulic conductivities are numerous. First, estimates can be made in-situ, thereby avoiding errors incurred in laboratory testing of disturbed soil samples. Second, tests can be performed quickly at relatively low costs because pumping and observation wells are not required. And lastly, the hydraulic conductivity of small discrete portions of an aquifer can be estimated (e.g., sand layers in a clay).

## 3.0 SAFETY

Refer to the site-specific Health and Safety Plan for health and safety guidelines.

## 4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Limitations of slug testing include: 1) only the hydraulic conductivity of the area immediately surrounding the well is estimated which may not be representative of the average hydraulic conductivity of the area, and 2) the storage coefficient, S, usually cannot be determined by this method. Multiple well slug tests are advised to obtain a range of hydraulic conductivity values.

## 5.0 EQUIPMENT/APPARATUS

The following equipment is needed to perform slug tests. All equipment which comes in contact with the well should be decontaminated and tested prior to commencing field activities.

- Tape measure (subdivided into tenths of feet)
- Water pressure transducer
- Electric water level indicator Weighted tapes
- Steel tape (subdivided into tenths of feet)
- Electronic data-logger (if transducer method is used)

- Stainless steel slug of a known volume
- Watch or stopwatch with second hand
- Semi-log graph paper (if required)
- Water proof ink pen and logbook Thermometer
- Appropriate references and calculator
- Electrical tape
- 21X micrologger
- Laptop and power supply or fully charged battery

## 6.0 REAGENTS

No chemical reagents are used in this procedure. However, decontamination solvents may be necessary. If decontamination of the slug or equipment is required, refer to Atlas SOP No. 07 Sampling Equipment Decontamination and the site-specific work plan.

## 7.0 PROCEDURES

The following procedures are typically used to collect and report slug test data. These procedures may be modified to reflect site specific conditions:

- When the slug test is performed using an electronic data-logger and pressure transducer, all data will be stored internally. The information will be transferred directly to the field laptop computer and analyzed. A copy of the data shall be maintained in the files for reference.
- If the slug test data is collected and recorded manually, the slug test data form (Figure 1, Appendix A) will be used to record observations. The slug test data form shall be completed as follows:
    - Site ID - Identification number assigned to the site. Location ID - Identification of location being tested.
    - Date - The date when the test data was collected in this order: year, month, day.
    - Slug volume (ft.$^3$) - Manufacturers specification for the known volume or displacement of the slug device.
    - Logger - identifies the company or person responsible for performing the field measurements.
    - Test method - The slug device is either injected or lowered into the well or withdrawn or pulled-out from the monitor well. Check the method that is applicable to the test situation being run.
    - Comments - Appropriate observations or information for which no other blanks are provided.
    - Elapsed time (min) - Cumulative time readings from beginning of test to end of test, in minutes.
    - Depth to water (ft.) - Depth to water recorded in tenths of feet.
- Decontaminate the transducer and cable.
- Make initial water level measurements on monitoring wells in an upgradient to downgradient

sequence, if possible.

- Before beginning the slug test, information will be recorded and entered into the electronic data-logger. The type of information may vary depending on the model used. When using different models, consult the operator's manual for the proper data entry sequence to be used.
- Test wells from least contaminated to most contaminated, if possible.
- Determine the static water level in the well by measuring the depth to water periodically for several minutes and taking the average of the readings.
- Cover sharp edges of the well casing with duct tape to protect the transducer cables.
- Install the transducer and cable in the well to a depth below the target drawdown estimated for the test but at least two feet from the bottom of the well. Be sure the depth of submergence is within the design range stamped on the transducer. Temporarily tape the transducer cable to the well to keep the transducer at a constant depth.
- Connect the transducer cable to the electronic data-logger.
- Enter the initial water level and transducer design range into the recording device according to manufacturer’s instructions (the transducer design range will be stamped on the side of the transducer). Record the initial water level on the recording device.
- "Instantaneously" introduce or remove a known volume or slug of water to the well. Another method is to introduce a solid inert (e.g., Teflon) cylinder of known volume to displace and raise the water level, allow the water level to restabilize and remove the cylinder. It is important to remove or add the volumes as quickly as possible because the analysis assumes an "instantaneous" change in volume is created in the well.
- At the moment of volume addition or removal assigned time zero, measure and record the depth to water and the time at each reading. Depths should be measured to the nearest 0.01 foot. The number of depth-time measurements necessary to complete the test are variable. It is critical to make as many measurements as possible in the early part of the test. The number and intervals between measurements will be determined from earlier previous aquifer tests or evaluations.
- Continue measuring and recording depth-time measurements until the water level returns to equilibrium conditions or a sufficient number of readings have been made to clearly show a trend on a semi-log plot of time versus depth.
- Retrieve slug (if applicable).

Note: The time required for a slug test to be completed is a function of the volume of the slug, the hydraulic conductivity of the formation and the type of well completion. The slug volume should be large enough that a sufficient number of water level measurements can be made before the water level returns to equilibrium conditions. The length of the test may range from less than a minute to several hours.

If the well is to be used as a monitoring well, precautions should be taken that the wells are not contaminated by material introduced into the well. If water is added to the monitoring well, it should be from an uncontaminated source and transported in a clean container. Bailers or measuring devices should be cleaned prior to the test. If tests are performed on more than one monitor well, care must be taken to avoid cross contamination of the wells.

Slug tests shall be conducted on relatively undisturbed wells. If a test is conducted on a well that has recently been pumped for water sampling purposes, the measured water level must be within 0.1 foot of the water level prior to sampling. At least one week should elapse between the drilling of a well and the performance of a slug test.

Post Operation Procedures

When using an electronic data-logger use the following procedure:

1. Stop logging sequence.
2. Save the data.
3. Save memory and disconnect battery at the end of the day's activities.
4. Review field forms for completeness.

## 8.0 CALCULATIONS

The simplest interpretation of piezometer recovery is that of Hvorslev (1951). The analysis assumes a homogenous, isotropic medium in which soil and water are incompressible. Hvorslev's expression for hydraulic conductivity (K) is included in that reference.

Where:

**K** = hydraulic conductivity [ft/sec]
**r** = casing radius [ft]
**L** = length of open screen (or borehole) [ft]
**R** = filter pack (borehole) radius [ft]
**$T_0$** = Basic Time Lag [sec]; value of t on semi-logarithmic plot of $H-h/H-H_0$ vs. t, where $H-h/H-H_0 = 0.37$
**H** = initial water level prior to removal of slug
**$H_0$** = water level at t = 0
**h** = recorded water level at t > 0 (Hvorslev, 1951; Freeze and Cherry, 1979)

The Bower and Rice method is also commonly used for K calculations. However, it is much more time consuming than the Hvorslev method. Refer to Freeze and Cherry or Applied Hydrogeology (Fetter) for a discussion of these methods.

## 9.0 QUALITY ASSURANCE/QUALITY CONTROL

The following general quality assurance procedures apply:

1. All data must be documented on standard Chain of Custody records, field data sheets, or within personal/site logbooks.

2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

Each well should be tested at least twice in order to compare results.

## 10.0 REFERENCES

Bower, H., 1978. Groundwater Hydrology, McGraw-Hill Book Company, New York, New York.

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# APPENDIX A
# Slug Test Data
# Form

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FIGURE 1. Slug Test Data Form

DATE: ____________________

SITE ID: ____________________

SLUG VOLUME (ft$^3$): ____________________

LOCATION ID: ____________________

LOGGER: ____________________

TEST METHOD: ______SLUG INJECTION ______SLUG WITHDRAWAL

COMMENTS ____________________________________________________________

____________________________________________________________

____________________________________________________________

Time Beginning of Test #1 _______

Time Beginning of Test #2 ____________________

Time End of Test #1 _______

Time End of Test #2 ____________________

| ELAPSED TIME (MIN) | DEPTH TO WATER (FT) | ELAPSED TIME (MIN) | DEPTH TO WATER (FT) |
|---|---|---|---|

# LOW FLOW GROUNDWATER SAMPLING
## Standard Operating Procedure No. 10

## 1.0 SCOPE

Water quality samples are taken to establish the groundwater quality at a well location. This standard operating procedure (SOP) is dedicated to collecting groundwater samples from monitoring wells using low flow purge and sampling procedures using a peristaltic, centrifugal or submersible pumps capable of flow rates at or below 200 milliliters per minute.

## 2.0 REFERENCES

American Society for Testing and Materials (ASTM); "Annual Book of Standards, Section 11: Water".

Driscoll, Fletcher G., Ph.D.; "Groundwater and Wells"; Second Edition; Johnson Division; St. Paul, Minnesota; 1986.

Kablanow, R.I., Andersson, K.A. and McDonald, T.J.; "Hydropunch Sampling Techniques for Multi-level Sampling of an Unconfined Alluvial Aquifer--Central Valley, California: A Case Study"; Proceedings of the Sixth National Outdoor Action Conference on Aquifer Restoration Groundwater Monitoring Geophysical Methods, NGWA; May 11-13, 1992; pp. 315-325.

USEPA; "Procedures Manual for Ground Water Monitoring at Solid Waste Disposal Facilities"; SW-611; Cincinnati, Ohio; 1977.

## 3.0 DEFINITIONS

Potable Well: A public or private well which is used for drinking water supply.

Static Water Level: The vertical distance measured from the ground surface to the surface of the water table in a well. For an accurate measure, the well cannot be subject to pumping or flowing under artesian pressure.

Teflon: Trade name for fluoro-polymer material.

Water Table: The upper surface in an unconfined groundwater body at which the pressure is atmospheric.

## 4.0 GENERAL

Sampling equipment and methods should be chosen which minimize the potential for altering the water quality of the sample. Most pumps expose the sample to pressure gradients and cannot be used to collect samples for volatile organic analysis. Preferably, samples should be collected using a peristaltic pump/vacuum jug procedure.

Pumps and tubing should not be used for sampling, unless the interior and exterior portions of the pump, tubing, and discharge hoses can be thoroughly cleaned, or a dedicated pump and tubing/hose is utilized.

## 4.1 Safety

Information on personal protective equipment (PPE) and contamination reduction should be obtained from the Atlas Health and Safety Policy Manual and the site-specific health and safety plan (HASP). If any doubt exists, check with your office's safety officer or the Corporate Director of Health and Safety.

The following are general safety procedures:

- Monitor for volatile organic compounds (VOCs) inside the well and within the breathing zone before sampling with an appropriate screening instrument (ex. photoionization detector or explosimeter).

- Consult health and safety policy for safety precautions if the pump is hooked up to a power source (i.e. 120 voltage, or 220 voltage).

## 4.2 Equipment and Materials

- Field notebook, pencil, ballpoint, and waterproof pen or fine-tipped marker;
- Map of well locations;
- Keys for the well locks;
- Water level and/or interface probe;
- Paper towels or clean rags;
- Multi-meter capable of measuring temperature, conductivity, dissolved oxygen and ORP and flow-through cell;
- Calibration solutions;
- Polyethylene squirt bottle of 50% hydrochloric (HCL) acid;
- Narrow range pH paper (1.0 - 2.5 pH range);
- Dissolved oxygen meter;
- Graduated container;
- Pump, tubing, Power source, i.e. portable generator;
- Buckets and/or plastic bags to contain disposable contaminated material;
- Containers for purged water;

- Chain-of-custody forms, sample identification labels;
- New sample containers (bring 20% more than needed, sealed, cleaned, and labeled);
- Quality control samples;
- Monitoring instruments;
- Operation manuals for field equipment;
- Filtration apparatus and filters;
- Preservatives;
- Chest or 6-pack cooler with ice ;
- Decontamination vessels or buckets;
- Alconox detergent solution
- Deionized (DI) and/or distilled water (1 1/2 gallons per well)
- Decontamination solvents methanol;
- Toolbox (wrench, screwdriver, scissors or knife);
- Flashlight; and
- Calculator.

### 4.3 Calibration

Calibrate all field instruments per the manufacturer's recommendations.

### 4.4 Reporting

Data which should be recorded (at a minimum) in addition to the information required on the sample label include:

- Depth of well;
- Source of the water (ex. groundwater, water supply, etc.);
- Method of collection and the time since pumping or bailing started;
- Volume purged or evacuated removed from the well prior to sampling;
- Pumping rate;
- Depth or interval from which samples were taken;
- Appearance, color or odor at time of collection (clear, milky, colorless, etc. – do not attempt to quantify or identify source of odors); and
- Field parameters (ex. pH, conductivity, temperature, dissolved oxygen, etc.).

## 5.0 PROCEDURE

## 5.1 General

- Monitoring wells should be allowed to stabilize and return to equilibrium for a minimum of 48 to 72 hours after installation prior to sampling. Wells should also be properly developed prior to sampling to ensure proper communication with the surrounding strata.
- Sample from the least to the most contaminated wells last (i.e., sample in increasing order of contamination, if known and possible). If the degree of contamination is unknown, sample from the upgradient to the downgradient wells.
- Do not sample during rain, unless sample exposure can be minimized, for example, park vehicle near the well and shelter the well with plastic sheeting.
- Do not sample when dust, wind blown particles and/or exhaust from vehicles or industrial amazons can contaminate the sample or sample equipment.
- Unless specifically directed by the project work directives, do not obtain water samples for groundwater quality if well contains free-phase contaminants. Samples may be obtained of the product to determine the chemical characteristics and properties of the sample.
- Do not obtain samples for groundwater quality, if well appears to be tampered or vandalized. Record the physical evidence of tampering in the field notebook.

## 5.2 Prior to Leaving for Site

- Obtain well diagrams, boring logs, well diameter, depth, and protective cover type, previous pumping rate(s), average volume of water in wells; well and ground elevations and sounding depths.
- Record preliminary information requested on groundwater sampling forms.
- Confirm sampling equipment is appropriately sized to fit into the well.
- Consult equipment check list prior to sampling to ensure the availability of adequate sampling supplies.
- Calibrate pH, conductivity and temperature meters with fresh standards before each sampling event.
- Determine necessary preservatives, containers and amounts of samples to be collected for each laboratory test to be performed.
- Get keys to well locks and arrange for access prior to field work.
- Create/obtain a quick reference nomograph or table to determine the volume of a well.

## 5.3 Initial

- Record wind direction and inspect for unusual hazards.
- Wells should be gauged (water levels should be measured) prior to starting the water sampling, especially when numerous wells are to be sampled, to provide more accurate water-table data, to orient samplers with a new site, to note any unusual circumstances, such as, lost, damaged, dry or inaccessible wells which would or possibly change the sampling plan.
- Evaluate the area around the sampling point prior to sample collection for possible air contamination by VOCs.

## 5.4 Monitoring Well Sampling Procedures

Step 1 Inspect and decontaminate reusable portions of sampling equipment immediately before sampling each well.

Step 2 Inspect the well for damage. Document damage (apron, casing, expansion cap, manway lid, missing dog-ears and bolts) and promptly communicate the damage and repair recommendations to the project manager.

Step 3 Unlock and/or open the protective casing or cover.

Step 4 Clean the outside and top of the well casing with a clean cloth to knock off any debris and to prevent sediment from entering the well.

Step 5 Place plastic sheeting around well casing to protect sampling equipment from potential contamination.

Step 6 Remove well cap.

Step 7 Monitor air immediately above well casing and in the breathing zone using appropriate field screening instruments and record data.

**Warning**: Make any adjustments to personal protective equipment as indicated in HASP.

Step 8 Wear clean disposable gloves.

Step 9 If not previously gauged the same day, measure the water level and the depth of the well.

**Note**: Record the thickness of any product observed. Wells containing free-phase contaminants should not normally be sampled for groundwater quality.

Step 11 If not performed previously, calculate height of standing water column. Subtract water sounding depth from total well depth.

Step 12 If not previously performed, calculate volume of standing water column in well (water to be withdrawn).

Step 13 Purge or evacuate the calculated volume of groundwater from the well by bailing, submersible pump, or purge system.

**Note**: If the well goes dry during pumping or bailing, allow the well to recover, reduce the pumping or bailing rate and continue.

Step 14 Measure (estimate) and record the pumping and recovery rate of the well.

Bucket/Stop Watch Method

Collect the flow of water from a pump with a constant rate (i.e.; gasoline powered or electric submersible pumps) in a bucket of known volume and time how long it takes to accumulate the known volume.

**Note**: Pumping rates cannon be reliably determined by this method for battery powered pumps since as the batteries lose charge, the pump rate decreases.

Recovery Test Method

As the well recovers, periodically gauge the water level. Estimate the volume per unit time.

Step 15 Obtain a representative sample (approximately one-half gallon) in an approximately one-half gallon or one liter, clean, unpreserved glass container. Measure field pH, DO, conductivity, temperature, ORP, and specific conductance immediately following evacuation and prior to sampling, or a subset of parameters if specified in the Field Task Order (FTO) or Statement of Work (SOW). Record values on the sampling data sheet. Three successive readings should be within ± 0.1 for pH, ± 3% for conductivity, ± 10 mv for redox potential, and ± 10% for turbidity and DO. Stabilized purge indicator parameter trends are generally obvious and follow either an exponential or asymptotic change to stable values during purging. Dissolved oxygen and turbidity usually require the longest time for stabilization.

Step 16 Record qualitative field observations of color, turbidity and odor.

Step 17 Manage purge water according to protocol outlined in the FTO or SOW, and applicable regulatory management of purge water guidance.

Step 18 Inspect sample containers to confirm clean and unbroken.

**Note**: Keep the sample vials or containers capped until immediately before obtaining the sample.

Step 19 Withdraw sample from within or just above the screened section of the well immediately after purging or as soon as possible after the well has recovered sufficiently to obtain a sample. For sites with heavier than water constituents of concern and/or a known zone of relatively higher transmissivity near the base of the monitoring well, withdraw near the bottom of the well but no less than 2 ft from the well bottom.

**Note**: Wells with a slow recovery period should be purged dry and then sampled within 24 hours. If enough sample cannot be obtained within 24 hours, then well sampling is not performed and record that the well is "dry".

Rinse the pump and associated apparatus with reagent grade water.

Carefully lower the pump into the well, trailing a discharge hose, electrical cables, and a stainless steel security cable. The security cable should bare most of the weight of the pump. These items can be bundled together at 10 foot intervals with plastic electrician's ties. Duct or electrical tape should not be used at a level that will be submerged into the water column.

Turn on and evacuate the proper volume.

**Note**: Locate portable gasoline generator away from the well where the fumes will not affect sample quality.

Position the pump inlet in the well such that water is removed from the same portion of the well each time.

Turn off the generator while the sample is being collected.

Set the discharge of the pump at a slow rate.

When the peristaltic pump is used, samples for purgable organic compounds analyses should be collected using a bailer or by allowing the Teflon tube to fill and then allowing the water to drain into the sample vials.

Step 20 Open one vial or sample jar/container at a time.

**Caution**: Do NOT touch the rim of the sample container or the sample container top with your fingers or with the bailer.

Step 21 Thoroughly rinse the sample containers with the water to be sampled.

Step 22 Gently and carefully pour the sample into the sample container in a steady stream to avoid aeration of the sample which would reduce the possibility of oxidation of the sample.

Step 23 Fill sample container slowly, overfilling container prior to capping to eliminate all head space.

1) Slowly pour an unfiltered portion into sample containers for volatile organics analyses (as necessary) as it is brought to the surface.

2) Slowly pour a portion into the sample containers for all other unfiltered analyses as necessary. Preserve and cap quickly.

3) Slowly pour a portion of the sample into a transfer bottle for analyses requiring field filtering. Draw the sample through the filter into the collection bottles.

Step 24 Properly label each container.

Step 25 Store sample in a cooler immediately on ice.

Step 26 Complete Chain of Custody

Step 27 Replace slip cap and protective cover.

Step 28 Decontaminate all sampling equipment which contacted the water in the well to avoid cross-contamination from site to site and sample to sample. The sampling equipment should be cleaned before each well sampling, between each sampling, and at the end of each sampling round.

# THREE VOLUME GROUNDWATER SAMPLING
## Standard Operating Procedure No. 11

## 1.0 SCOPE

Water quality samples are taken to establish the groundwater quality at a well location. This standard operating procedure (SOP) is dedicated to collecting groundwater samples from monitoring wells using three well volumes as a means to establishing proper communication with the well's surrounding strata. Well gauging, well evacuation or purging, chain of custody, quality control, and decontamination requirements are provided in other SOPs.

## 2.0 REFERENCES

American Society for Testing and Materials (ASTM); "Annual Book of Standards, Section 11: Water".

Driscoll, Fletcher G., Ph.D.; "Groundwater and Wells"; Second Edition; Johnson Division; St. Paul, Minnesota; 1986.

Kablanow, R.I., Andersson, K.A. and McDonald, T.J.; "Hydropunch Sampling Techniques for Multi-level Sampling of an Unconfined Alluvial Aquifer--Central Valley, California: A Case Study"; Proceedings of the Sixth National Outdoor Action Conference on Aquifer Restoration Groundwater Monitoring Geophysical Methods, NGWA; May 11-13, 1992; pp. 315-325.

USEPA; "Procedures Manual for Ground Water Monitoring at Solid Waste Disposal Facilities"; SW-611; Cincinnati, Ohio; 1977.

## 3.0 DEFINITIONS

<u>Air-Lift Method</u>: A gas is introduced into a well by a hand pump, air compressor or pressurized air bottles to "lift" the water to the surface by reducing the specific gravity of the water. The water is generally forced up a smaller diameter, discharge pipe or tube inserted into the well. Groundwater is aerated when air is introduced into the well; therefore this method is not acceptable in obtaining samples for all chemical analysis.

<u>Bailer</u>: A long, narrow tube-like device with an open top and open check valve (ball) or closed top used to remove water from a well.

<u>Bladder or Gas Squeeze Pump Method</u>: Water enters a membrane encased by stainless steel housing through a lower check valve. Compressed gas from either bottled gas or air compressor is injected between the housing and bladder. The groundwater enters through an upper check valve, which prevents flow from reversing into the bladder, and then into the discharge line. Although similar to a submersible pump; no electrical lines are lowered down the well. Bladder pumps

generally need large volumes of gas. Bladders can potentially rupture and the pump may be difficult to clean.

Gas Displacement Method: Water is pumped to the surface without extensive mixing of the pressurizing gas and water. Correct chamber pressurization minimizes the gas-water interface, the degree of mixing, and sample degassing during transport. Generally, gas displacement pumps are easy to disassemble and clean.

Gas Piston Pump Method: Pistons within a stainless steel housing are activated by alternating the pressurization which allows groundwater to enter during the suction stroke and forces the water to the surface during the pressure stroke. The gas piston pump provides continuous sample withdrawal at depths greater than is possible with most other pump techniques.

Packer Method: Two expandable parts that isolate a sampling unit deflate for vertical movement within the well and inflate when the desired depth is reached. The packers are constructed of rubber and can be used with submersible, gas lift, and suction pumps. However, the rubber may deteriorate with time and undesirable organic material may enter the water.

Suction Lift, Peristaltic, Centrifugal, and Diaphragm Pump Methods: These method utilize a vacuum and/or impellers to obtain a sample. The pumps should be equipped with a check valve to prevent aerated groundwater from falling back into the well.

Water may lose dissolved gases as it moves through impellers, and may gain gases from the atmosphere (carbon dioxide or oxygen during its passage through the suction line if all connections are not absolutely airtight. These gases may change not only the carbon dioxide/bicarbonate concentrations and pH, but also concentrations of oxidizable ions such as iron or manganese. Air-tight connections on the suction line are not only needed to minimize chemical changes, but are also needed to maximize pump efficiency.

Potable Well: A public or private well which is used for drinking water supply.

Static Water Level: The vertical distance measured from the ground surface to the surface of the water table in a well. For an accurate measure, the well cannot be subject to pumping or flowing under artesian pressure.

Teflon: Trade name for fluoro-polymer material.

Water Table: The upper surface in an unconfined groundwater body at which the pressure is atmospheric.

## 4.0 GENERAL

Sampling equipment and methods should be chosen which minimizes the potential for altering the water quality of the sample. Most pumps expose the sample to pressure gradients and cannot be used to collect samples for volatile organic analysis. Preferably, samples should be collected using a peristaltic pump/vacuum jug procedure.

Pumps should not be used for sampling, unless the interior and exterior portions of the pump and discharge hoses can be thoroughly cleaned.

Although sampling from inline flow from pumps is more preferable, sampling with closed-top, Teflon, stainless steel, or glass bailers is often performed due lower associated costs. Teflon bailers are to be used to sample chlorinated compounds or for obtaining bacteriological samples. PVC bailers can be used if dedicated to a one-time sampling event to reduce the possibility for cross-contamination.

Cords used to lower bailers into wells should be made of non-porous material compatible with the material being sampled preferably, stainless steel cable or Teflon coated stainless steel. Either stainless steel cable or a new Teflon-coated cord is preferred. Other materials, such as polypropylene or nylon, may be compatible with the material being sampled. However, some bailer strings are treated with a fungicide which may be detected in priority pollutant analysis. It is acceptable to use a line made of a leader of the preferred material attached to a less costly material, provided that the other material does not contact the water and is discarded after use.

Additional clean bailers should be taken to the site in the possibility that one becomes contaminated due to touching the ground, etc. New dedicated string should be utilized for each bailer (bailer string should not be reused) to avoid cross-contamination.

## 4.1 Safety

Information on personal protective equipment (PPE) and contamination reduction should be obtained from the Atlas Health and Safety Policy Manual and the site-specific health and safety plan (HASP). If any doubt exists, check with your office's safety officer or the Corporate Director of Health and Safety.

The following are general safety procedures:

- Monitor for volatile organic compounds (VOCs) inside the well and within the breathing zone before sampling with an appropriate screening instrument (ex. photoionization detector or explosimeter).

- Consult health and safety policy for safety precautions if the pump is hooked up to a power source (i.e. 120 voltage, or 220 voltage).

## 4.2 Equipment and Materials

- Field notebook, pencil, ballpoint, and waterproof pen or fine-tipped marker;
- Map of well locations;
- Keys for the well locks;
- Water level and/or interface probe;
- Paper towels or clean rags;
- Multi-meter capable of measuring temperature, conductivity, dissolved oxygen and ORP and flow-through cell;
- Calibration solutions;
- Polyethylene squirt bottle of 50% hydrochloric (HCL) acid;
- Narrow range pH paper (1.0 - 2.5 pH range);
- Dissolved oxygen meter;
- Graduated container;
- Pump, tubing, Power source, i.e. portable generator;
- Buckets and/or plastic bags to contain disposable contaminated material;
- Twine (Teflon, nylon, etc.);
- Purge and/or sampling bailers (clear);
- Graduated container;
- Containers for purged water;
- Chain-of-custody forms, sample identification labels;
- New sample containers (bring 20% more than needed, sealed, cleaned, and labeled);
- Quality control samples;
- Monitoring instruments;
- Operation manuals for field equipment;
- Filtration apparatus and filters;
- Preservatives;
- Chest or 6-pack cooler with ice ;
- Decontamination vessels or buckets;
- Alconox detergent solution
- Deionized (DI) and/or distilled water (1 1/2 gallons per well)
- Decontamination solvents methanol;
- Toolbox (wrench, screwdriver, scissors or knife);
- Flashlight; and
- Calculator.

## 4.3 Calibration

Calibrate all field instruments per the manufacturer's recommendations.

### 4.4 Reporting

Data which should be recorded (at a minimum) in addition to the information required on the sample label include:

- Depth of well;
- Source of the water (ex. groundwater, water supply, etc.);
- Method of collection and the time since pumping or bailing started;
- Volume purged or evacuated removed from the well prior to sampling;
- Pumping rate;
- Depth or interval from which samples were taken;
- Appearance, color or odor at time of collection (clear, milky, colorless, etc. – do not attempt to quantify or identify source of odors); and
- Field parameters (ex. pH, conductivity, temperature, dissolved oxygen, etc.).

The pumping rate should be in gallons per minute.

## 5.0 PROCEDURE

### 5.1 General

- Monitoring wells should be allowed to stabilize and return to equilibrium for a minimum of 48 to 72 hours after installation prior to sampling. Wells should also be properly developed prior to sampling to ensure proper communication with the surrounding strata.
- Sample from the least to the most contaminated wells last (i.e., sample in increasing order of contamination, if known and possible). If the degree of contamination is unknown, sample from the upgradient to the downgradient wells.
- Do not sample during rain, unless sample exposure can be minimized, for example, park vehicle near the well and shelter the well with plastic sheeting.
- Do not sample when dust, windblown particles and/or exhaust from vehicles or industrial amazons can contaminate the sample or sample equipment.
- Unless specifically directed by the project work directives, do not obtain water samples for groundwater quality if well contains free-phase contaminants. Samples may be obtained of the product to determine the chemical characteristics and properties of the sample.
- Do not obtain samples for groundwater quality, if well appears to be tampered or vandalized. Record the physical evidence of tampering in the field notebook.

## 5.2 Prior to Leaving for Site

- Obtain well diagrams, boring logs, well diameter, depth, and protective cover type, previous pumping rate(s), average volume of water in wells; well and ground elevations and sounding depths.
- Record preliminary information requested on groundwater sampling forms.
- Confirm sampling equipment is appropriately sized to fit into the well.
- Consult equipment check list prior to sampling to ensure the availability of adequate sampling supplies.
- Calibrate pH, conductivity and temperature meters with fresh standards before each sampling event.
- Determine necessary preservatives, containers and amounts of samples to be collected for each laboratory test to be performed.
- Get keys to well locks and arrange for access prior to field work.
- Create/obtain a quick reference nomograph or table to determine the volume of a well.

## 5.3 Initial

- Record wind direction and inspect for unusual hazards.
- Wells should be gauged (water levels should be measured) prior to starting the water sampling, especially when numerous wells are to be sampled, to provide more accurate water-table data, to orient samplers with a new site, to note any unusual circumstances, such as, lost, damaged, dry or inaccessible wells which would or possibly change the sampling plan.
- Evaluate the area around the sampling point prior to sample collection for possible air contamination by VOCs.

## 5.4 Monitoring Well Sampling Procedures

Step 1 Inspect and decontaminate reusable portions of sampling equipment immediately before sampling each well.

Step 2 Inspect the well for damage. Document damage (apron, casing, expansion cap, manway lid, missing dog-ears and bolts) and promptly communicate the damage and repair recommendations to the project manager.

Step 3 Unlock and/or open the protective casing or cover.

**Note**: WD-40 can be used to open rusted locks, if needed.

Step 4 Clean the outside and top of the well casing with a clean cloth to knock off any debris and to prevent sediment from entering the well.

Step 5 Place plastic sheeting around well casing to protect sampling equipment from potential contamination.

Step 6 Remove well cap.

Step 7 Monitor air immediately above well casing and in the breathing zone using appropriate field screening instruments and record data.

**Warning**: Make any adjustments to personal protective equipment as indicated in HASP.

Step 8 Wear clean disposable gloves.

Step 9 If not previously gauged the same day, measure the water level and the depth of the well.

**Note**: Record the thickness of any product observed. Wells containing free-phase contaminants should not normally be sampled for groundwater quality.

Step 11 If not performed previously, calculate height of standing water column. Subtract water sounding depth from total well depth.

Step 12 If not previously performed, calculate volume of standing water column in well (water to be withdrawn).

Step 13 Purge or evacuate the calculated volume of groundwater from the well by bailing, submersible pump, or purge system.

**Note**: If the well goes dry during pumping or bailing, allow the well to recover, reduce the pumping or bailing rate and continue.

Step 14 Measure (estimate) and record the pumping and recovery rate of the well.

### Bucket/Stop Watch Method

Collect the flow of water from a pump with a constant rate (i.e.; gasoline powered or electric submersible pumps) in a bucket of known volume and time how long it takes to accumulate the known volume.

**Note**: Pumping rates cannon be reliably determined by this method for battery powered pumps since as the batteries lose charge, the pump rate decreases.

Recovery Test Method

As the well recovers, periodically gauge the water level. Estimate the volume per unit time.

Step 15 Obtain a representative sample in an approximately one-half gallon or one liter, clean, unpreserved glass container. Measure field pH, temperature and specific conductance immediately following evacuation and prior to sampling. Record values on the sampling data sheet.

Note: Stabilization of these parameters is generally measured during the purging process to evaluate the adequacy of the purging procedure. The final measurements for these parameters prior to sampling is to be considered the measurement for the well.

Step 16 Record qualitative field observations of color, turbidity and odor.

Step 17 Manage purge water according to protocol outlined in the FTO or SOW, and applicable regulatory management of purge water guidance. Never pour the water back into the well.

Step 18 Inspect sample containers to confirm clean and unbroken.

**Note**: Keep the sample vials or containers capped until immediately before obtaining the sample.

Step 19 Withdraw sample from within or just above the screened section of the well immediately or within 2 hours after purging or as soon as possible after the well has recovered sufficiently to obtain a sample.

Note: Wells with a slow recovery period should be bailed dry and then sampled within 24 hours. If enough sample cannot be obtained within 24 hours, then well sampling is not performed and record that the well is "dry".

Bailer

- Attach the bailer rope or line to the bailer via a Teflon coated stainless steel wire.

Note: Do not allow the bailer or rope to contact the ground by coiling the bailer rope onto plastic sheeting or in a clean bucket.

- Rinse the bailer and line with reagent grade water.
- Slowly lower the bailer into the well to avoid aerating the well water and avoid stirring up any sediments in the well.
- Do not allow the bailer to touch the bottom of the well.

- Lower the bailer to the same depth in the well each time, preferably within or just above the screened interval.
- Retrieve the bailer smoothly (do not allow the bailer rope to touch the ground).

Do NOT pour the sample from the sample bailer over the bailer cord; do not allow the cord to touch the sample container.

Use the sample bailer before retaining the sample from the last bailer to rinse the sample bailer with the water to be sampled to insure a representative sample and reduce cross contamination

- Preserve and cap quickly.
- Remove rope on bailers before going to a new sampling location.

<u>Portable Submersible Pumps</u>

- Rinse the pump and associated apparatus with reagent grade water.
- Carefully lower the pump into the well, trailing a discharge hose, electrical cables, and a stainless steel security cable. The security cable should be bear most of the weight of the pump. These items can be bundled together at 10 foot intervals with plastic electrician's ties. Duct or electrical tape should not be used at a level that will be submerged into the water column.
- Turn on and evacuate the proper volume.

<u>Note</u>: Locate portable gasoline generator away from the well where the fumes will not affect sample quality.

- Position the pump inlet in the well such that water is removed from the same portion of the well each time, preferably within or just above the screened interval.
- Turn off generator while the sample is being collected.
- Set the discharge of the pump at a slow rate.
- Direct the sample into the containers in the same order as with a bailer.
- When the peristaltic pump is used, samples for purgable organic compounds analyses should be collected using a bailer or by allowing the Teflon tube to fill and then allowing

the water to drain into the sample vials.

Step 20 Open one vial or sample jar/container at a time.

**Caution**: Do NOT touch the rim of the sample container or the sample container top with your fingers or with the bailer.

Step 21 Thoroughly rinse the sample containers with the water to be sampled.

Step 22 Gently and carefully pour the sample into the sample container in a steady stream to avoid aeration of the sample which would reduce the possibility of oxidation of the sample.

Step 23 Fill sample container slowly, overfilling container prior to capping to eliminate all head space.

1) Slowly pour an unfiltered portion into sample containers for volatile organics analyses (as necessary) as it is brought to the surface.

2) Slowly pour a portion into the sample containers for all other unfiltered analyses as necessary. Preserve and cap quickly.

3) Slowly pour a portion of the sample into a transfer bottle for analyses requiring field filtering. Draw the sample through the filter into the collection bottles.

Step 24 Properly label each container.

Step 25 Store sample in a cooler immediately on ice.

Step 26 Complete Chain of Custody

Step 27 Replace slip cap and protective cover.

Step 28 Decontaminate all sampling equipment which contacted the water in the well to avoid cross-contamination from site to site and sample to sample. The sampling equipment should be cleaned before each well sampling, between each sampling, and at the end of each sampling round.

# TEST PIT EXCAVATION
## (Standard Operating Procedure No. 12)

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe test pit excavation for subsurface investigation purposes.

## 2.0 REFERENCES

- Quality Assurance Project Plan (QAPP), if applicable.
- Health and Safety Plan (HASP).
- Field Soil Vapor Monitoring SOP (No. 02)
- Equipment Decontamination SOP (No. 07)
- American Society for Testing and Materials (ASTM) Method D-2488

## 3.0 PROCEDURES

### Office Preparation

The field personnel are responsible for ensuring that the following items have been completed prior to leaving for the site:

- Understand test pit excavation objectives and review any historical subsurface investigation findings (pertaining to lithology, stratigraphy, USTs, oil/water separators, underground utilities, anticipated depth to groundwater, and laboratory sampling results. This information will be used for general planning and health and safety purposes.
- Obtain equipment necessary for completing the sampling activities.
- If sampling is planned, ensure that the appropriate sample containers are available for the required analytes and additional QA/QC sample requirements. Also, confirm that the analytical laboratory has been notified and is prepared to receive samples being wary of sample transport logistics and ability to receive on a Saturday, if applicable.
- Review the QAPP, Field Task Order (FTO) or Statement of Work (SOW), HASP, and appropriate SOPs with the Project Manager to determine the specific sampling requirements.
- Review the access agreement for the site, and ensure that the property owner understands the planned activities and schedule.
- Place a One-Call ticket.
- Initiate utilities clearance by conducting a scan of the target test pit locations using non-intrusive geophysical investigation techniques.
- Complete a Pre-Drill Checklist.

- Verify with the Project Manager/Technical Lead that the proposed excavation locations are correct on the site map. Verify that the test pits have been numbered on the site plan for clarity and reference.
- Verify sample identification protocols for field samples and blanks, if any.

## Field Preparation

The field personnel will:

- Introduce themselves to any site representative.
- Discuss the planned scope of work, work schedule, and HASP protocols, and document this site meeting in the field notebook.
- Conduct and document a tailgate safety meeting with all subcontractors.
- Confirm that all equipment has been decontaminated or pre-cleaned before sampling.
- Identify and locate all test pit locations.
- Ensure that the field team members and any visitors read and sign the HASP.
- Obtain potable water for decontamination, if needed. Record the source of water in the field logbook.

## Test Pit Excavation and Data Collection

- The excavator must arrive on-site in a clean condition and should be free of oil, grease, and debris. The Field Team Leader will inspect the rig for any significant fluid leaks. If leaking fluids are present, the equipment will be repaired before any activities begin. Document the equipment make/model, bucket size, and subcontractor name in the field notebook.
- Set up the decontamination area for the equipment and ensure all decontamination liquids (wash and rinse water) will be collected for proper disposal.
- Set up the decontamination area for sampling equipment and decontaminate any non-disposable sampling equipment prior to use.
- Perform decontamination procedures between pits in the assigned decontamination area in accordance with the Equipment Decontamination SOP (007) and dispose of the wastes generated in accordance with the work plan.
- Use potable water for decontamination.
- Mobilize the equipment to the proposed location and prepare the exclusion or safety zone.
- If required, the proposed locations may be adjusted based on site access, property boundaries, and/or surface obstructions. All changes to boring locations will be documented in the field logbook and checked in regard to buried utilities.
- Throughout the field activities, an organic vapor monitoring (OVM) instrument will be used to monitor and record the vapor levels in the worker breathing zone as specified in the HASP. This instrument may also be used to screen soil samples for organic vapors. Refer to the instrument manual for operating instructions.

- Excavate to the specified depth (prescribed in the work plan) and final excavation lateral dimensions (typically a minimum of 6 feet in length, but not intentionally longer than the length of the excavator bucket). Measure depths to stratigraphic contacts, groundwater, native soil, fill material, stained soil, waste, and any anthropogenic features using a weighted tape and/or scaled grade or survey rod.
- Document the depth to the source (e.g., perched zone above a low permeability unit) of groundwater.
- Prepare a scaled field notebook sketch showing the stratigraphy and depth to all contacts/features. Include the scaled grade/survey rod in the photograph for scale/reference.
- Use the excavator bucket to collect samples of each strata for inspection and logging (and sampling, if planned). Do not enter the excavation or stand within 4 feet of the excavation edge.
- Document the following for each strata in your notebook:
    - Lithology
    - Depth interval
    - Moisture content
    - USCS classification
    - Staining/odor presence absence
    - PID result using EPA soil headspace screening procedure and calibrated (day of use)
    - Sheen presence/absence
    - Depth to native soil and presence/absence of fill material
- Record the PID lamp (10.6 eV, etc.) and document calibration process.
- Sketch the lateral and vertical extent of the stained or otherwise impacted soil and waste in your field notebook.
- Document the four walls of the excavation using a camera. Use a whiteboard to show the test pit # in all photos.
- Soil classification will be documented in accord with American Society for Testing and Materials (ASTM) Method D-2488.

- For each soil sample collected, the field team will record the following in the field logbook:
    - Date and time of collection.
    - Depth of sample collection.
    - A qualitative description of the soil sample, expressed in a uniform, consistent manner for each interval, including the following parameters:
        - Color (Dark brown, light brown, etc.);
        - Moisture (dry/unsaturated, moist, or saturated)
        - Grain size expressed as clay, silt, sand, or gravel matrix (largest fraction by volume), with a preceding qualifier to indicate secondary fraction (if present), such as “sandy clay” where clay comprises the primary fraction, and sand comprises the secondary fraction;
        - Presence/absence of SPL (free phase product, or NAPL);

    - Depth of stratigraphic contacts; and,
    - Classification as native soil or fill material.
- As specified in the work plan, a representative sample will be collected and placed in the appropriate glass sample bottles.
- Outer gloves (latex) worn by sampling personnel will be removed and discarded between samples to minimize the potential for cross-contamination of samples by contact with gloves.
- The equipment will be decontaminated between each pit.

Do not remove pipe, tanks, waste or water without PM authorization, since these cannot typically be returned to the excavation and must be managed in accordance with local, state and federal applicable and relevant requirements once removed from the test pit.

Return the excavated soil to the excavation in the same general sequence as it was removed. Compact the soil using the excavator bucket or compaction equipment, as specified in the work plan. Restore the surfacing to match existing conditions.

## 4.0 DOCUMENTATION

All test pit and sampling information should be recorded in the field logbook, on the chain-of-custody and on sampling logs, if applicable. Locations of anything discovered during visual inspection of open pits will be well documented with photographs and descriptions in the field logbook including type, number, and condition of materials encountered. The waste materials locations will be flagged for subsequent later survey.