Groundwater Monitoring Plan
RCRA Corrective Action
IND 980 700 801

2915 Dr. Martin Luther King Jr. Boulevard, Anderson, IN
Revitalizing Auto Communities Environmental Response Trust

Indiana Department of Environmental Management

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→ **The Power of Commitment**

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List of Acronyms/Short Forms

AOC	Area of Concern
AOI	Areas of Interest
bgs	below ground surface
cis-1,2-DCE	cis-1,2-dichloroethene
CMP	Corrective Measures Proposal
CRA	Conestoga-Rovers & Associates
DO	dissolved oxygen
ENVIRON	ENVIRON International Corporation
EPA	United States Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GMC	General Motors Corporation
IDEM	Indiana Department of Environmental Management
MCL	Maximum Contaminant Level
MLK	Martin Luther King Junior
NAVD	North American Vertical Datum

ORP	oxidation reduction potential
RACER	Revitalizing Auto Communities Environmental Response
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SWMU	Solid Waste Management Unit
TCE	trichloroethene
TCL	target compound list
TOC	top-of-casing
trans-1,2-DCE	trans-1,2-dichloroethene
U.S.	United States
VOC	volatile organic compound
WWTP	wastewater treatment plant

1. Introduction

GHD Services Inc. (GHD), on behalf of the Revitalizing Auto Communities Environmental Response (RACER) Trust, has prepared this Resource Conservation and Recovery Act (RCRA) Groundwater Monitoring Plan (Plan) for the former General Motors Corporation (GMC) facility located at 2915 Dr. Martin Luther King Junior (MLK) Boulevard in Anderson, Indiana (Site or Facility).

This Plan has been prepared and submitted to the Indiana Department of Environmental Management (IDEM) as part of the final corrective measures detailed in the Final Corrective Measures Proposal (GHD, July 7, 2020) which was approved by IDEM on December 30, 2020.

1.1 Groundwater Monitoring Plan Objective

The primary objective of the Site-wide groundwater monitoring plan is to:

1. Monitor the stability of the two volatile organic compound (VOC) groundwater plumes

1.2 Report Organization

This Plan is organized in the following Sections.

- Section 1 provides an introduction and the objective of the Groundwater Monitoring Plan
- Section 2 includes the Site description, Site history, hydrologic Site setting, a summary of previous groundwater monitoring activities, and the current status of groundwater monitoring
- Section 3 details the proposed Groundwater Monitoring Plan
- Section 4 describes the statistical data evaluation procedures
- Section 5 describes data reporting requirements

2. Background

2.1 Site Description

The Site is located in the northwest quarter of Section 23, T19N, R7E, on the southwest side of Anderson, Madison County, Indiana. Formerly the Site was comprised of approximately 3,000,000 square feet of manufacturing operations situated on 234 acres. A Site location map is provided on **Figure 1**.

MLK Boulevard divides the Site in a north-south direction. The former east manufacturing areas (Plants 6 and 9) and the Wastewater Treatment Plant (WWTP) are bounded by active railroad tracks to the south, by 29th Street to the north, and Madison Avenue to the east. The former manufacturing facilities west of MLK Boulevard, referred to as the Main Plant, are bounded to the west and south by active railroad tracks, and to the north by 25th street. Facility parking areas were located west of the westernmost railroad, and north of 25th street. A small public-access park is located in the northernmost portion of the Site. A Site plan is provided on **Figure 2**.

Land use surrounding the Site varies from residential and commercial to the north and east, residential and recreational (Meadowbrook Golf Course) to the south, and residential and agricultural to the west.

2.2 Site History

Operations began at the MLK Boulevard facility in 1929. Primary manufacturing operations at the Site included injection molding, stamping, assembly and wastewater treatment. Manufacturing plants were expanded several times, generally proceeding from the north end of the Main Plant southward and eastward through 1989.

The former Plant 6 and 9 properties and a lot east of Madison Avenue were sold soon after related manufacturing operations ceased in 1997. All manufacturing operations at the Site ceased in 2006. Facilities west of MLK Boulevard were demolished during the period of late 2007 to early 2009. The demolition included the removal of all concrete building slabs and many areas of pavement around the immediate Main Plant building area. Following demolition, the area was regraded and covered with varying thickness of crushed concrete. A soil and vegetative cover were applied during the summer of 2009.

GMC declared bankruptcy in June 2009. The RACER Trust was created in March 2011 by the U.S. Bankruptcy Court to clean up and position for redevelopment certain properties and other facilities owned by former GMC before the 2009 bankruptcy, including this Site.

RACER Trust sold the northern portion of the former Main Plant building (Tract B North) on April 1, 2015. Tract B (North) was redeveloped as a plastic injection molding plant later in 2015. RACER Trust donated Tracts C and F and Crawford Field, north of the former main plant building, to the City of Anderson on September 14, 2015. Lot 1, east of MLK Boulevard, was sold on July 6, 2016. RACER Trust sold the central portion of the former Main Plant building (Tract B Central) on September 14, 2019 for expansion to the plastic injection molding plant. The remaining portions of the Site that were held by GMC until its bankruptcy in June 2009 are currently owned by RACER Trust. The Site boundary and historical operational areas are shown on **Figure 3**.

2.3 Hydrologic Setting

2.3.1 Physiography

The Site is situated in the New Castle Till Plains and Drainage ways Section of the Central Till Plain Region as described by Gray (2000). This area was affected by multiple continental glaciations that deposited a thick blanket of glacial sediments over the bedrock. The New Castle Till Plains and Drainage ways Section is primarily underlain by complexly stratified glacial diamict deposits, glaciofluvial sand and gravel deposits and glaciolacustrial silt and clay deposits. The area is characterized by broad plains of low relief crossed by relict glacial meltwater valleys (2011 Annual Groundwater Monitoring Report, AECOM, January 31, 2012).

2.3.2 Stormwater/Surface Water Drainage

The Site area is nearly level with elevations ranging from 860 to 880 feet North American Vertical Datum (NAVD) 88. East of MLK Boulevard the elevation is lowest, and the surface elevation descends into a relict glacial meltwater valley. Former Plant 9, Plant 6, and the Meadowbrook Golf Course are all located in the relict meltwater valley, the western border of which roughly follows the alignment of MLK Boulevard. This valley trends south-southwest from Anderson, Indiana several miles towards Pendleton, Indiana (Brown and others, 2003). A small channelized stream, Stanley Ditch, occupies the north end of the relict meltwater valley and drains westward along the south boundary of the Meadowbrook Golf Course. Stanley Ditch originally flowed to the north between former Plant 6 and Plant 9 but was diverted southward in 1963 to provide stormwater relief for the City of Anderson combined sewer system. As a result, Stanley Ditch is now tributary to Prairie Creek and flows to the south down the trend of the valley to Pendleton, Indiana where it joins Fall Creek, a tributary to the West Fork White River.

Stormwater run-off from paved areas of the property either infiltrates the ground surface or is directed to the combined sewer system that discharges north to the City of Anderson Publicly Owned Treatment Works on the West Fork White River. The combined sewer system flows northward across the Meadowbrook Golf Course property and beneath former Plant 9 up the trend of the relict meltwater channel. Stormwater on the northern portion of the Meadowbrook

Golf course property is directed through piping, and discharges to ponds. Stormwater in the southern portion of the Meadowbrook property drains southward toward Stanley Ditch that flows along the southern and eastern property boundaries of the golf course.

A drainage divide between Stanley Ditch and Prairie Creek, draining to the south, and the combined sewer system, draining north to West Fork White River, appears to occur near the south side of former Plant 9, perhaps near and along the South Anderson Cutoff railroad embankment. Areas to the south of the railroad embankment, including most of the Meadowbrook Golf Course, are floodway and floodway fringe areas subject to flooding (Federal Emergency Management Agency [FEMA], February 18, 1994). (2011 Annual Groundwater Monitoring Report, AECOM, January 31, 2012).

2.3.3 Hydrogeology

Figure 4 presents a generalized, schematic east-west hydrogeologic cross-section of the unconsolidated materials at the Site showing monitoring well completion intervals. The unconsolidated deposits range from less than 20 feet to over 160 feet in thickness and overlie an irregular bedrock surface. Bedrock beneath the Site consists of carbonate rocks of Silurian age. The bedrock topography beneath the Site slopes to the northwest into a pre-glacial bedrock valley. The bedrock is high (above 840 foot elevation) in the southern portion of the former Plant 9 area and at the Meadowbrook Golf Course. Bedrock is generally only about 20 feet below ground surface (bgs) in this area as a result of both the high bedrock elevation and low ground surface elevation in the relict meltwater valley area east of MLK Boulevard. To the northwest, the bedrock elevation descends to below 730 foot elevation at former groundwater production well 11 and the bedrock in this area is in excess of 158 feet bgs.

Detailed hydrogeologic cross-sections are presented in both the Stage II RCRA Facility Investigation (RFI) Data Report (Earth Tech, March 30, 2005) and the RFI Final Report (Earth Tech and ENVIRON International Corporation [ENVIRON], September 28, 2007). Five distinct geologic units are recognized in the unconsolidated surficial soil materials. These units are identified from top to bottom as Units 1 to 5.

Unit 1 is a heterogeneous fill material consisting of silty clay loam, silty clay, sandy clay, sandy clay loam, and loam texture soil intermixed, in places, with debris consisting of wood, brick, glass, brick, concrete, coal fragments, and cinders. The unit consists of fill material placed at various times during the developmental history of the property and is generally no more than a few feet in thickness. In places, the lower portion of the Unit 1 fill is saturated and a localized perched groundwater zone occurs. The clayey diamicts in the underlying Unit 2 confining unit cause this perched groundwater condition. Saturated conditions have been observed in the basal portion of Unit 1 in several shallow Area of Concern (AOC) 1 – South Court Area soil borings.

Unit 2 is a glacial diamict of silty clay loam, silty clay, and loam texture with occasional thin, interbedded sand and gravel deposits. Sand and gravel lithologies make up a small percentage of the unit. Unit 2 is thin in southern and eastern parts of the Site, but thickens to the north and west.

Unit 3 consists of stratified sand and gravel and forms the uppermost aquifer beneath the Site. In places, a diamict occurs within Unit 3 and is identified as the Unit 3 Confining Bed. At some locations the confining bed is represented by a distinctive silty texture and laminated structure. The confining bed is hydrologically significant because it separates the Unit 3 aquifer into an upper portion (Unit 3S) and lower portion (Unit 3D). Unit 3 is generally only 10 to 20 feet thick in the eastern part of the Site beneath the meltwater valley. The unit thickens appreciably in the western part of the area where it forms the major portion of the unconsolidated deposits.

Unit 3 is almost entirely within the phreatic zone and is the uppermost aquifer unit at the Site. Groundwater may exist in the unit under both confined and unconfined conditions. Where the base of Unit 2 is relatively high in elevation, the upper few feet of Unit 3 are unsaturated, and unconfined conditions occur. At locations where the base of Unit 2 is relatively low in elevation the top of Unit 3 is saturated, and confined conditions occur.

Conceptually, Unit 3 may be divided into an upper (Unit 3S) and lower (Unit 3D) part. In those places where there is no physical separation between the upper and lower parts of the unit provided by the Unit 3 Confining Bed, the designations 3S and 3D merely provide a convenient way to refer to the upper and lower portions of the Unit 3 aquifer, and the monitoring wells completed therein. Where a physical separation occurs due to the presence of the Unit 3 Confining Bed, Unit 3S refers to that portion of the aquifer above the confining layer and Unit 3D refers to that portion below the confining layer. Locally, the Unit 3 Confining Bed induces a downward vertical gradient within the Unit 3 aquifer. Where the confining bed is absent, water levels in Units 3S and 3D are comparable.

The lateral groundwater gradient in Unit 3S is directed to the east-northeast in AOC 1 - South Court Area. Locally there are significant variations in the magnitude and direction of the gradient related, in part, to the presence or absence of the Unit 3 Confining Bed. An east-southeast oriented potentiometric trough in Unit 3S persistently occurs in the vicinity of MW 40 and MW 42 where the confining bed is absent. In this area groundwater flow in Unit 3S appears to be directed easterly into the relict meltwater valley.

The hydraulic gradient for Unit 3D is more consistent and the potentiometric surface for this unit suggests an eastward gradient in the South Court Area and along MLK Boulevard and a predominantly western gradient across the east portion of the Site into the meltwater valley.

Unit 4 consists of hard diamict of loam or clay loam texture. The unit forms a confining bed between Unit 3 and Silurian carbonate bedrock. The unit is absent from the eastern part of the area at Plant 9 and portions of the adjacent Meadowbrook Golf Course.

Two deep bedrock borings at the north end of the Site (MW 62 and MW 71) encountered a bed of cobbles above the bedrock surface. This zone is referred to as Unit 5. The unit was encountered at no other locations. (2011 Annual Groundwater Monitoring Report, AECOM, January 31, 2012).

2.4 Previous Groundwater Investigations

The following sections summarize groundwater investigations that have been conducted at the Site. Monitoring wells on and adjacent to the Site have been installed at various times. The earliest Site wells (MW 1 to MW 17) were installed in 1992 and 1993 for the purposes of evaluating a suspected waste oil leak at Area 1 – Former Waste Oil Tank [Solid Waste Management Unit (SWMU) 16]. The longest monitoring history exists for these wells. Most of the 1992 / 1993 wells were installed in Unit 3S. No evidence of a significant waste oil leak was found at SWMU 16, but elevated concentrations of VOCs, primarily trichloroethene (TCE), cis 1,2 dichloroethene (cis-1,2-DCE) and vinyl chloride were detected in several wells in this area. These wells are now known to be located in and around a source area for the Area 1 – South Court VOC plume.

Work associated with RFI Stage I in 2000 to 2001 included installation of 20 new monitoring wells (MW 18 to MW 37) and collection of 85 groundwater samples from new and existing wells. The new wells were completed in Units 1, 3S, and 3D. The Stage I investigations partially delineated a groundwater VOC plume extending north and east from AOC 1 - South Court. This plume was found to lie underneath several previously-defined Areas of Interest (AOIs) and was referred to as Area 1. The Stage I RFI investigations identified concentrations of TCE, cis 1,2 DCE, and vinyl chloride above screening criteria based on state and federal Maximum Contaminant Levels (MCLs). A Stage I RFI report was completed in 2001, and this report included a work plan for additional groundwater delineation work in both on and off-Site areas (Earth Tech and ENVIRON, July 31, 2001).

In 2001 a Phase II Environmental Site Assessment was conducted in the north parking area and three monitoring wells (MW1 01 to MW3 01) were installed. Groundwater concentrations, where detected, were detected below IDEM's criteria. TCE, cis-1,2-DCE and vinyl chloride were not detected in groundwater samples collected.

Stage II RFI investigations began in late 2003. Work associated with the Stage II RFI in 2003 to 2005 included installation of 47 monitoring wells (MW 38 to MW 84) and collection of 182 groundwater samples from both new and existing wells. Area 1 was expanded to include Plant 9 as well as off Site areas including Meadowbrook Golf Course. Seven wells (MW-1 to MW-7) were installed on the golf course by others in 2003. Sampling of MW-4 in October 2003 indicated that high concentrations of cis 1,2 DCE and vinyl chloride were present. Additional wells (MW 56, MW 57, MW 58, MW 77, and MW 85) were installed by GMC on the golf course in 2004 and 2007 to delineate the VOC plume southeast of MW-4. These and other RFI Stage II monitoring wells delineated the concentrations of TCE, cis 1,2 DCE, and vinyl chloride above MCLs both on and off Site (Earth Tech and ENVIRON, September 28, 2007).

Three additional monitoring wells (MW 86, MW 87, and MW 88) were installed on the Plant 9 property in October 2010 to provide additional downgradient plume delineation. One well was installed downgradient of MW49 (MW89-11) in 2011 to provide additional downgradient plume delineation in proximity to nearby residential land use. In 2012 and 2013, three monitoring wells (MW90-12, MW91-12, and MW92-13) were installed near a recently identified AOI referred to as former Bay M26/M27 to assess groundwater quality in the vicinity of the AOI, not previously investigated. In 2013, four monitoring wells (MW 93-13 to MW 96-13) were installed to delineate the lateral extent of groundwater impacts at the perceived source area for the former WWTP Area plume.

In 2014, one monitoring well (MW97-14) was installed to delineate groundwater impacts beneath the Meadowbrook Golf Course. However, MW 97-14 was decommissioned and replaced in May 2016 (MW 97R-16) at a nearby location to facilitate easier lawn maintenance at the request of the property owner.

Seventeen monitoring wells (MW 1-01, MW2-01, MW3-01, MW 11, MW 24, MW 25, MW 34, MW35, MW 52, MW 53, MW 54, MW 55, MW 69, MW 70, MW 71, MW 72, and MW 73) north and west of the former main manufacturing areas, upgradient of the VOC plumes, and not a part of the IDEM approved groundwater monitoring plan were abandoned in March and April 2014 following approval from IDEM (VFC # 69789483).

In October 2018, two monitoring wells (MW98-18 and MW99-18) were advanced and installed to further delineate bedrock groundwater impacts on-Site, east of MLK Boulevard.

During construction activities at the Tract B (Central) property in October and November 2019, monitoring wells MW 50 and MW 51 were decommissioned as they were in the area of a proposed building.

From October 2005 until October 2007 GMC conducted quarterly monitoring of a selected group of monitoring wells according to an interim Site-wide groundwater monitoring plan (Conestoga-Rovers & Associates [CRA], September 20, 2005). This work was conducted for nine consecutive quarters ending in October 2007. Summary results from this monitoring were provided in the 2006 and 2007 Annual Groundwater Monitoring Reports (Earth Tech and ENVIRON, January 31, 2007, January 31, 2008) and an additional round of groundwater monitoring was conducted in February 2008.

The interim monitoring program was replaced by a Site-wide Groundwater Monitoring Plan associated with the draft Corrective Measures Proposal for the Facility. This program consisted of semiannual sampling at a modified well list with sampling of two surface water monitoring points on the Meadowbrook Golf Course conducted three times per year. The sampling plan for this program (AECOM, October 28, 2010) was approved by the IDEM on November 24, 2010. Sampling under this program was conducted since June 2008 until April 2019 (2011 Annual Groundwater Monitoring Report, AECOM, January 31, 2012). On June 10, 2019, IDEM provided comments on the 2018 Annual Groundwater Monitoring Report recommending that groundwater monitoring shift from semi-annual to sampling every 18 months.

This updated Groundwater Monitoring Plan has been prepared as part of the final corrective measures and will replace the previous Site-wide Groundwater Monitoring Plan.

2.5 Potentiometric Surface Mapping

Based on the November 2020 groundwater elevations, GHD developed potentiometric groundwater contours for Unit 3S, Unit 3D, and the bedrock units as shown on **Figures 5 to 7**, respectively. Water levels measured during the November 2020 events were generally consistent with the previous years' water levels.

The groundwater contours representative of the November 2020 Unit 3S data are provided on **Figure 5**. The November 2020 potentiometric groundwater elevation contour map indicates that there is a general northeasterly gradient beneath the central and northern portions of the former Main Plant building. Beneath the southern portion of the former Main Plant, groundwater flow is variable. Data from the November 2020 event again indicates the presence of a groundwater mound, or ridge in Unit 3S that extends in a north-south arc from the MW 46 area on the south to about MW 59 on the north. As discussed in previous reports, this groundwater high, sometimes extending to MW 29 on the north, appeared to separate the AOC 1 South Court and WWTP Area plumes historically. The AOC-1 South Court plume extends beneath the former Main Plant building and affects several monitoring wells including, from south to north, MW 79, MW 60, MW 51, and MW 76R-17. In contrast, historically the Unit 3S monitoring wells along the arc including MW 46, MW 84, MW 59, and MW 29 have not shown any significant VOC contamination.

The groundwater contours representative of November 2020 Unit 3D data are provided on **Figure 6**. The November 2020 potentiometric groundwater elevation contour map indicates that there is a general easterly gradient across the west portion of the Site and a predominantly western gradient across the east portion of the Site into the meltwater valley.

The groundwater contours representative of the November 2020 bedrock unit data are provided on **Figure 7**. The November 2020 potentiometric groundwater elevation contour map indicates that there is a general easterly gradient across the west portion of the Site and a predominantly western gradient across the east portion of the Site into the meltwater valley.

2.6 Current Status of Groundwater Monitoring

The groundwater contaminant plumes at the Site are associated with Area 1 – South Court and Related Areas. Isoconcentration maps for Unit 3 suggest there are two separate VOC plumes. One plume is associated with Area 1 – South Court. The AOC 1 – South Court plume extends in a northeast direction from the South Court beneath several SWMUs in the former Main Plant building area. The predominant VOC contaminants detected in this area are TCE, cis-1,2-DCE, and vinyl chloride. The highest reported concentrations of TCE in this plume are found in the South Court at MW 3 (Unit 3S) and MW 15 (Unit 3S). Perched groundwater in Unit 1 appears to serve as a source area for VOC contaminants in Unit 3. These VOC contaminants are present in both the 3S and 3D portions of Unit 3, but concentrations are generally higher in the upper portion of the unit.

A separate plume is located along and east of MLK Boulevard. Historically the primary evidence for separation of this plume from the AOC 1 – South Court plume comes from four Unit 3S wells located between the plumes where VOCs have not been detected, or detected at only very low levels (MW 29, MW 46, MW 59 and MW 84). The VOC plume east of MLK Boulevard extends from an apparent source near MW 68 and the former WWTP along MLK Boulevard eastward toward former Plant 9 and the Meadowbrook Golf Course. The plume has migrated to the south to at least MW 57 and MW 85 on the golf course. This plume is referred to as the former WWTP Area plume. The predominant VOC constituents detected in this area are cis-1,2-DCE and vinyl chloride. TCE is only a minor plume component.

2.6.1 AOC 1 – South Court Plume

The AOC 1 – South Court plume contains elevated concentrations of TCE, cis-1,2-DCE, and vinyl chloride with the greatest TCE concentrations in monitoring wells near the AOC 1 – South Court source area (i.e., MW 3 and MW 15).

In November 2020, the extent of the AOC 1 – South Court remained defined on the east side with non-detect results for all VOC constituents at monitoring wells MW 37, MW 46, and MW 84. Cis-1,2-DCE and vinyl chloride were detected at east boundary monitoring well MW 16. At the north perimeter boundary of the AOC 1 – South Court plume, Unit 3D monitoring well MW 75 is free of detected VOC concentration. The Unit 3S monitoring well in this area (MW 76R-17) exhibits very low concentrations of cis-1,2-DCE and vinyl chloride. In 2020, MW 49 south of the AOC 1 – South Court area had an estimated detection of TCE above the screening level. Samples from this well have had elevated reporting limits since the October 2014 monitoring event. Downgradient of MW 49 (east-northeast and east), TCE was not detected in the sample collected from MW 89-11, and the sample only exhibited very low concentrations of other VOCs consistent with historical monitoring events. At the south perimeter of the AOC 1 – South Court plume, Unit 3S monitoring well MW 21 is free of all detected VOC concentration.

2.6.2 Former WWTP Area Plume

Monitoring wells in the former WWTP Area plume area contain elevated concentrations of primarily cis-1,2-DCE and vinyl chloride.

Historically increasing trends have been identified in several monitoring wells in the former WWTP Area plume. Most of the increasing trends relate to cis-1,2-DCE and vinyl chloride however, an increasing trend in the concentration of TCE has historically been observed at the perceived source area (MW 68) and downgradient monitoring wells MW-4 and MW 40. Cis-1,2-DCE concentrations are increasing at perimeter monitoring wells MW 28, MW 66 and MW 85 and bedrock monitoring well MW 41, northeast of the source area, perimeter monitoring wells MW 28, MW 58, MW 64, MW 66, MW 88 and bedrock monitoring wells MW 81 and MW 83

In November 2020, the southern extent of the WWTP plume remained defined with perimeter monitoring wells MW-2, MW 56, and MW 97R-16 that were free of detected concentrations of VOCs.

Along the northern extent of the WWTP plume, monitoring wells MW 88 had a detection of vinyl chloride above the Site-specific Commercial/Industrial Tap Water Use Criteria. Other north perimeter monitoring wells, MW 61 and MW 86, were free of or contained very low concentrations of VOCs.

2.6.3 Extent of Groundwater Contamination

Analytical data from all sampling events between 2016 and 2020 are presented on **Figure 8** (on-Site) and **Figure 9** (off-Site). **Figure 10** to **Figure 12** show the isoconcentrations of the principal VOC constituents TCE, cis-1,2-DCE and vinyl chloride, respectively, in groundwater for hydrogeologic Unit 3. These isoconcentration maps are based on November 2020 data presented in the 2020 Annual Groundwater Monitoring Report (GHD, January 31 2021).

Since the Unit 3S confining unit is absent in the area of former Plant 9 and portions of the Meadowbrook Golf Course, and Unit 3 is relatively thin in these areas, the VOC data from wells in these areas may be shown on the Unit 3S isoconcentration maps. Combining data in this manner provides a useful portrayal of the former WWTP Area plume from its apparent source in the upper part of Unit 3 near MW 68 to its tail area occurrences at former Plant 9 and Meadowbrook Golf Course.

The isoconcentration maps continue to suggest that there are two separate VOC plumes. One plume is associated with AOC 1 – South Court and the second plume is derived from an apparent source area near MW 68. Historically the plumes have been separated by a series of Unit 3S wells where VOCs have not been detected, or have been detected only at very low levels (MW 29, MW 37, MW 46, MW 59 and MW 84). A groundwater ridge in Unit 3S has historically occurred along this line of wells, and this mound appears to have served as a hydraulic barrier separating the two plume areas. In November 2020, cis-1,2-DCE and vinyl chloride were detected at the east boundary monitoring well MW 16. VOC detections at MW 16 (between MW 46 and MW 84) and alterations in the predominance and extent of this ridge suggests changes to the historical hydraulic barrier may be occurring.

The AOC 1 – South Court plume in Unit 3S extends in a northeast direction from AOC 1 – South Court. The eastern extent of the plume appears to be limited by the groundwater mound noted in the preceding paragraph. The plume has historically been bounded to the north by MW 76/MW76R-17 with marginal detections of cis-1,2-DCE and vinyl chloride below the reporting limit and at estimated quantities. In 2020, cis-1,2-DCE and vinyl chloride were detected at MW 76R-17 above but on the same order of magnitude as the reporting limit and three orders of magnitude below the screening level.

In 2015, GHD completed a plume stability analysis (GHD, August 12, 2015) that indicated that the AOC 1- South Court plume has changed little in planar plume area, average concentration, and plume mass, despite the presence of degradation products, which is consentient with recent groundwater monitoring results and indicates that the plume is stable.

The former WWTP Area plume extends eastward from the apparent source area near MW 68 towards former Plant 9 and has migrated to the east to the vicinity of MW 64 and MW 66, to the northeast in the vicinity of MW 88, and to the southeast to Meadowbrook Golf Course irrigation pond in the vicinity of MW 57, MW 58 and MW 85. This VOC plume is composed primarily of cis-1,2-DCE and the highest reported concentrations occur in a series of monitoring wells from the source area (MW 68) southeast to the Meadowbrook Golf Course irrigation pond (MW 40, MW-4, and MW 85).

Prior to July 2006, MW 68, located just west of MLK Boulevard generally had the highest cis-1,2-DCE concentration in this plume and is inferred to be closest to the VOC source area. From December 2006 until April 2009 the highest cis-1,2-DCE concentration was generally found downgradient at MW 40. From December 2009 until October 2015, the highest cis-1,2-DCE concentration has generally been found at MW-4 downgradient of MW 40. In 2016 and 2017 the highest cis-1,2-DCE concentration was found at MW 85 downgradient of MW-4. In 2018 and 2020 the highest cis-1,2-DCE concentration was found at MW-4, as indicated on the current isoconcentration map. This trend is consistent with the findings in the plume stability analysis completed as part of the Supplemental Analysis in Support of the Corrective Measures Proposal (CMP) (GHD, August 12, 2015). The plume stability analysis concluded that TCE equivalent is decreasing in concentration and mass, while increasing in plume area advancing downgradient along the predominant flow direction.

Vinyl chloride and TCE are subordinate components of the former WWTP Area plume. TCE is a relatively minor component even in the source area of this plume. The highest reported concentrations for vinyl chloride occur downgradient of the source area, at MW-4, MW 85, and MW 57. The east edge of the former WWTP Area plume is marked by persistent occurrences of vinyl chloride in Unit 3D wells MW 58, MW 64, and MW 66. However, a westerly groundwater flow direction east of these wells prevents further vinyl chloride migration to the east. Along the northern extent of the WWTP plume, in 2020 monitoring well MW 88 had a detection of vinyl chloride above the Site-specific Commercial/Industrial Tap Water Use Criteria.

The WWTP Area plume extends vertically to bedrock monitoring wells MW 81 and MW 83. Between September and December 2018, GHD completed a bedrock groundwater investigation to delineate vertical and horizontal bedrock groundwater impacts. The results of the investigation indicate that shallow bedrock VOC impacts at MW 81 have not migrated deeper in the bedrock unit. The results also indicate that shallow bedrock VOC impacts have been delineated to the east at MW 99-18 and that there appears to be a western gradient across the east portion of the Site that would not allow for shallow bedrock groundwater impacts to migrate off-Site towards Madison Avenue.

2.7 Current Status of Surface Water Monitoring

Cis-1,2-DCE, trans-1,2-dichloroethene (trans-1,2-DCE) and vinyl chloride were detected at surface water monitoring locations at Meadowbrook Golf Course Pond North and Pond Intake during the November 2020 surface water sampling event. The detected concentrations of vinyl chloride at the Pond North and Pond Intake sampling locations exceeded the recreator screening criteria. No other parameters were detected above the relevant screening criteria at surface water monitors Pond North or Pond Intake. Historically increasing trends incis-1,2-DCE and vinyl chloride concentrations have been identified for the Pond North and Pond Intake locations.

Surface water at the Meadowbrook Golf Course is used for grass irrigation purposes. In 2019 GHD completed an Evaluation of Pond Surface Water Analytical Data for the Meadowbrook Golf Course (GHD, December 17, 2019). The results of the evaluation indicated that there is not a current risk to ecological or human health by using the pond water for irrigation or other non-potable purposes.

3. Groundwater Monitoring Plan

3.1 Routine Groundwater Monitoring

The Groundwater Monitoring Plan is designed to monitor the stability of the two VOC groundwater plumes. The monitoring well network and proposed groundwater sampling plan are summarized in **Table 1**. The proposed monitoring well network is presented on **Figure 13**.

3.1.1 Monitoring Well Network

Table 1 lists 41 monitoring wells and two surface water monitoring points proposed for groundwater and surface water monitoring. The table summarizes the following: well location information, top-of-casing (TOC) elevation, the monitored hydrogeologic unit, the associated VOC plume, and position of monitoring point within the plume. The monitoring points are classified as “source”, “tail”, or “margin” based on relative position within either of the VOC plumes.

Monitoring points characterized as “source” area locations monitor the plume very close to the source area and have historically exhibited high concentrations for at least one VOC parameter. Monitoring points characterized as “tail” are situated in areas downgradient of the plume but have a high frequency of detection for at least one VOC parameter. Monitoring points characterized as “margin” have a high frequency of non-detect values and assist in defining the downgradient plume limits.

There is one private off-Site water supply well (Reference Number 147395 in Indiana’s Water Well Record Database) located north of monitoring well MW 88 (Figure 2). The well is a commercial non-potable private water well that was sampled in 2000 and 2017 as part of GHD’s/RACER Trust’s private water well sampling events. During both events, the results indicated that the water well was free of detectable concentrations of Site contaminants of concern. As a conservative measure, the status of the well will be confirmed, and the well will be sampled during the next monitoring event (April 2022).

3.1.2 Groundwater and Surface Water Monitoring Frequency

To monitor the stability of the two VOC groundwater plumes, 41 monitoring wells and two surface water monitoring points on the Meadowbrook Golf Course will be sampled every 18 months. The first sampling event under this Groundwater Monitoring Plan is proposed for April 2022.

3.1.3 Hydraulic Monitoring

Prior to each sampling event, water levels will be collected from all accessible on- and off-Site monitoring wells (**Figure 13**).

3.2 Field Methodologies

The following sections provide a summary of the Groundwater Monitoring Program field procedures. General field method guidelines related to sample collection, field quality control, sampling handling and shipping, field instrument use and calibration, and equipment decontamination are provided in Appendix **A**.

3.2.1 Water Level Monitoring

During each monitoring event, depth to groundwater measurements will be collected from all accessible on-Site and off-Site monitoring wells.

3.2.2 Monitoring Well Network Maintenance

During water level monitoring activities, the condition of each monitoring wells will be evaluated and documented. Water level monitoring and the assessment on the condition of each monitoring well will be conducted approximately one month prior to collecting groundwater samples to allow for enough time to perform monitoring well repairs (if any).

3.2.3 Groundwater Sampling

Groundwater samples will be collected using a pump and low flow sampling techniques to reduce the volatilization of VOCs during sample collection and minimize suspended solids being introduced into groundwater samples. Each monitoring well will be purged prior to the collection of groundwater samples, which consists of the removal of sufficient well volumes to allow for stabilization of field parameters including conductivity, dissolved oxygen (DO), oxygen reduction potential (ORP), pH, temperature, and turbidity.

Upon stabilization of the field parameters, samples will be collected using low flow techniques and placed directly into pre-cleaned laboratory supplied sample containers. **Table 2** provides details on the sample container, preservation, the holding time, and shipping and packaging requirements.

3.2.4 Surface Water Sampling

Surface water samples will be collected from the central irrigation pond located on the Meadowbrook Golf Course. Samples will be collected at two monitoring points in the pond. Samples will be collected at the irrigation pump intake at the south end of the pond, and from a location at the north end of the pond adjacent to MW-4. Samples will be collected using a clean sample dipper.

3.3 Laboratory Analytical Method

All groundwater and surface water samples will be analyzed for target compound list (TCL) VOCs in accordance with Method 8260 (**Table 3**).

3.4 Laboratory Data Evaluation

Validation of the laboratory data will be conducted. The Quality Assurance/Quality Control (QA/QC) criteria by which the data will be assessed are based on the following guidance document:

- "National Functional Guidelines for Organic Superfund Methods Data Review," United States Environmental Protection Agency [EPA]-540-R-20-005, November 2020

The following information will be reviewed and assessed: sample analysis results forms; Chain-of-Custody forms; reported results of analysis for method blanks; recovery data for lab control samples /matrix spikes/surrogate spikes and field QC data.

The Stage 2A data validation review process includes the following:

- **Sample Handling**: Sample holding times and preservation criteria are reviewed.
- **Sample Contamination**: Method, trip blanks, and field blanks are reviewed to determine the extent and magnitude of sample contamination (if any) introduced during laboratory of field activities.
- **Analytical Precision**: Laboratory spike and matrix spike duplicate samples are used to check analytical precision.
- **Sample Precision**: Results of field duplicate analyses are used to assess sampling and analytical precision.
- **Analytical Accuracy**: Blank spikes are used to assess the analytical method efficiency independent of individual sample matrices. Matrix spikes and/or matrix spike duplicates (MS/MSD) assess analytical accuracy on the specific sample matrix of interest. Surrogate compound recoveries are reviewed to determine analytical efficiency.

4. Data Evaluation

The statistical data evaluation for this Groundwater Monitoring Plan includes the following required elements:

- The statistical evaluation is to be conducted to monitor any changes to the stability of the plumes.
- The principal VOC compounds to be considered in the evaluation are TCE, cis 1,2 DCE and vinyl chloride.

- The evaluation of changes over time is to be carried out using the Mann Kendall trend test following IDEM Risk Integrated System of Closure guidance (IDEM, February 15, 2001). Notably:
  - A minimum of 4 samples is required to perform the trend test.
  - A minimum detection frequency of 75 percent is required to perform the trend test.
  - Non-detects should be assigned a value below the lowest detected value in the data set.
  - Any field duplicate results should be averaged prior to carrying out statistical testing.
- Trend testing is to be carried out using a significance level of (α) 0.10 (i.e., 90 percent confidence).
- A one-tailed trend test is to be performed (i.e., testing for increases only), using the following statistical hypotheses:
  - Null (no effect) hypothesis (H0) = there is no trend or a decreasing trend in chemical concentrations over time.
  - Alternative hypothesis (HA) = there is an increasing trend over time in chemical concentrations.
- Trend tests will be carried out considering two time periods:
  - Overall period (including all data collected to date)
  - Recent period (including the last 8 results)
- Outlier tests
- Alternative group comparison tests for data sets with large temporal gaps in the monitoring record

The following subsections describe the specific approaches to be used in carrying out the statistical data evaluation.

4.1 Mann-Kendall Test

Methods for statistical trend testing of groundwater quality data are discussed in Section 4.3 of U.S. EPA (2006), Chapter 12 of Helsel & Hirsch (USGS, 2002) and other relevant guidance and reference texts. The Mann-Kendall trend test is suitable for general application across a variety of environmental data applications. This test is non-parametric (rank-based) and, therefore, robust with respect to outlying observations. The Mann-Kendall test neither assumes a particular data distribution (e.g., normal) nor data pattern tested (e.g., linear trend), but rather tests for a monotonic (single-direction) trend in the data over time.

As specified in the IDEM Risk Integrated System of Closure guidance (IDEM, February 15, 2001), the Mann-Kendall trend test will be used to evaluate the principal VOC monitoring data for the presence of temporal trends. Computational details for the test may be found in Section 4.3.4.1 of U.S. EPA (2006). The test will be applied for data sets with a minimum detection frequency of 75 percent using a one-tailed formulation and a significance level of 0.1, as described above.

One assumption of the Mann Kendall trend test is that subsequent samples are reasonably equally spaced through time. Where sampling is more frequent during the earlier sampling period, sampling events that did not correspond to the current monitoring program will be excluded from the trend test. In cases where large temporal gaps in the monitoring record are observed, additional testing will be performed using group comparison tests (another method presented in Chapter 12 of USGS, 2002) to evaluate whether the presence of these gaps could be obscuring the detection of significant trends. Parametric Student's *t*-tests will be carried out comparing recent to historic data.

Any individual observations with ambiguous rankings for the Mann-Kendall test (i.e., either a detected value - typically J-qualified - below other detection limits; or an elevated detection limit above other detected values) will be dealt with on a case-by-case basis to obtain the most appropriate trend test. Specifically, to resolve such ambiguities the following approaches will be taken in order to maximize the amount of usable data:

- If a small proportion of non-detects with detection limits higher than some low detected values is present, these non-detects will be removed from consideration, in order to remove ambiguous comparisons while retaining as many actual detected concentrations as possible. Note that this will only be done if a sufficient number of detected and estimated detected values remained (preferably 5-8 or more).

- If a data set contains only a small proportion of low estimated values below non-detects with higher detection limits, these low values will be censored to the highest reporting/quantification limit (per USEPA's *ProUCL Version 5.1.02 Technical Guide*, 2015), as long as the resulting data set contained a minimum detection frequency of 75 percent.
- If a data set contains non-detects with *elevated* and *varying* detection limits above detected concentrations (e.g., due to matrix interference), then the non-detects with elevated detection limits will be removed from consideration (which is preferable to censoring all lower detected values and likely resulting in an untestable data set containing less than 75 percent detection frequency).

4.2 Outlier Testing

Prior to carrying out trend tests, each data set will be screened for the presence of statistical outliers. An outlier is an observation that differs substantially (atypically) from the rest of the population.

Outliers may be identified by graphical or statistical methods. U.S. EPA (2006, 2009) recommends The Extreme Value Test (Dixon's Test) for testing for outliers in data sets containing up to 25 points (the upper limit of this procedure), or Rosner’s Test for data sets containing more than 25 points. Both outlier tests consider both extreme low values and extreme high values. An important element of assessing outliers is identifying the underlying data distribution of a particular data set prior to performing the test. The data may follow a normal (Gaussian) distribution, in which case the original (untransformed) data are subjected to the outlier test. However, if a data set follows another statistical distribution, (i.e., gamma or lognormal) the data must be transformed prior to using Dixon's or Rosner’s tests. In testing data distributions for the principal VOC data sets considered, the Shapiro Wilk W Test (U.S. EPA, 2006, 2009) will applied using original, cube root-transformed [approximating the gamma distribution (USGS, 2002)], and log transformed data sets.

Consistent with the requirements of the IDEM Risk Integrated System of Closure guidance (IDEM, February 15, 2001) for trend testing, outlier tests will be performed only for datasets having 75 percent or more detected values. In addition, due to limited number of samples, outlier tests will not be performed for the recent period.

4.3 Group Comparison Tests

To determine if analyte concentrations between two groups of data are statistically different from each other, comparisons will be conducted using group comparison tests, in which a statistical parameter (e.g., mean/average, median and or percentile) is compared between the two groups of data (e.g., mean of data sampled at a recent period vs. mean of those sampled at an earlier period). The Student *t*-test is recommended by United States Environmental Protection Agency (USEPA) guidance documents (e.g., 2006).

The two-sample *t*-test (Section 3.3.1.1 of USEPA, 2006) tests for differences in the mean of two populations. This test assumes that both populations are normally distributed, or normal using a suitable transformation (e.g., gamma or log transformation) and that the population variances of the two groups are approximately equal. The *t*-test will be utilized when both data sets are found to have a discernible distribution.

In cases where the data did not follow identifiable data distributions, or where the apparent data distributions differed between the groups (e.g., normal Upstream vs. lognormal Adjacent) potentially impacting the statistical power of the *t*-test, the WRS test will be performed (as recommended by USEPA 2006). The WRS test is a non-parametric procedure (i.e., rank based and do not assume a specific data distribution). The WRS test compares two groups of data based on the ranks of their observations. If one group has a much higher rank sum than the other (based on standard tables for specific number of samples and confidence level), then it is concluded to be higher than the other group.

A significance level of (α) 0.10 (i.e., 90 percent confidence) will be used. If the test results in a statistically significant difference between recent periods vs. earlier period (i.e., probability is less than 0.1), the following conclusions will be made:

- If the mean/median of the recent period is higher than the mean/median of the earlier period, an increasing trend will be identified.
- If the mean/median of the recent period is lower than the mean/median of the earlier period, a decreasing trend will be identified.

If the test results in a probability higher than 0.1, it will be determined that there are no statistically differences between the two groups, and no trend was observed.

5. Data Reporting

Data collected as part of the groundwater monitoring program as detailed in section 3.1 will be summarized in a report to be submitted every 18 months. When groundwater monitoring activities are completed in October, the report will be issued by January 31 of the succeeding year. When groundwater monitoring activities are completed in April, the report will be issued by July 31 of the same year. The reports will include the following:

- Summary of field activities and problems encountered during the monitoring well network inspections
- Potentiometric surface elevation maps
- Summary of the analytical data, including data box figures and isoconcentration maps
- Statistical analysis results

As part of each report, the monitoring wells included in the groundwater monitoring program will be assessed to ensure that the monitoring program remains appropriate.

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All of Which is Respectfully Submitted,

GHD

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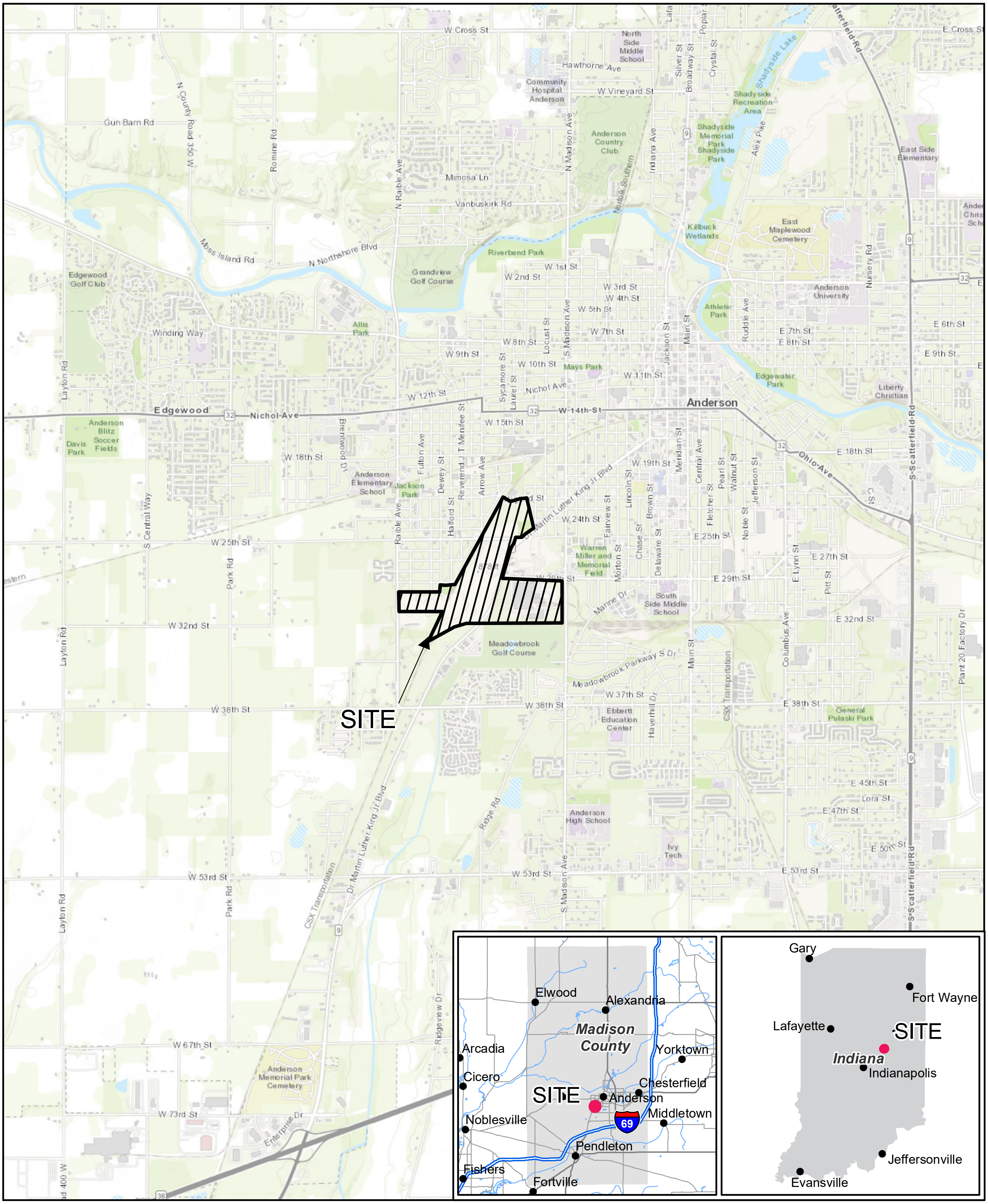
Joanna Niemi

Joanna Niemi, MSc.

Figures



Paper Size ANSI A

0 0.2 0.4 0.6 0.8

Miles

N

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Indiana East FIPS 1301 Feet

REVITALIZING AUTO COMMUNITIES
ENVIRONMENTAL RESPONSE TRUST
2915 DR. MARTIN LUTHER KING JR. BLVD.
ANDERSON, INDIANA
GROUNDWATER MONITORING PLAN

SITE LOCATION MAP

Project No.	**11209506**
Revision No.	**-**
Date	**Jun 17, 2021**

FIGURE 1

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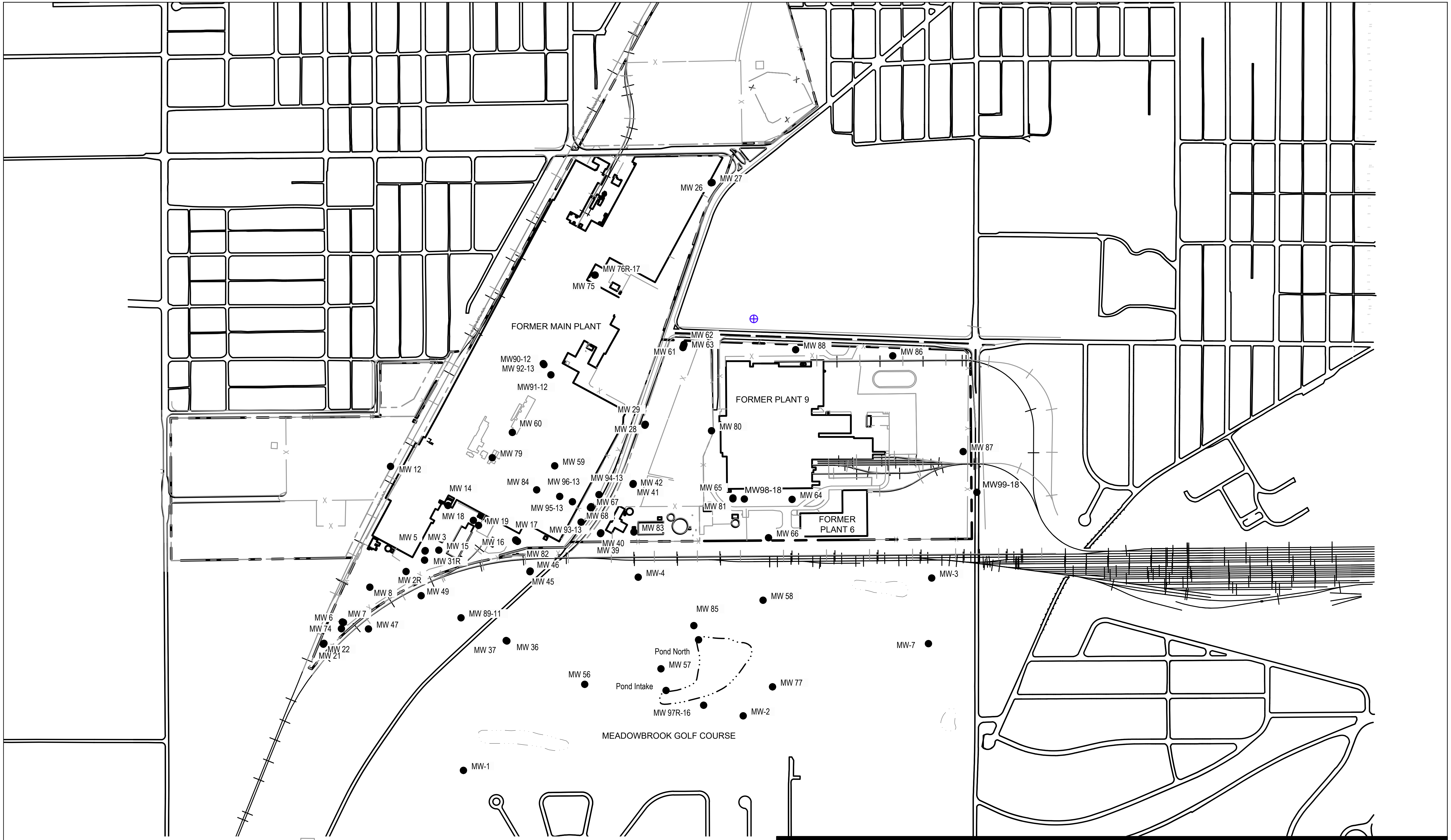
Data source: ESRI Topographic Basemap, Accessed 2021; ESRI Data & Maps 2008 Data Distribution Application (DDA); GHD.



LEGEND

BUILDING

● MONITORING WELL LOCATION

⊕ WATER WELL 147395 (1400 W. 29th STREET)

SITE BOUDNARY

RAILROAD

FENCE LINE

POND BOUNDARY

GHD

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ANDERSON, INDIANA
GROUNDWATER MONITORING PLAN

Project No. **11209506**
Date **March 2022**

SITE PLAN

FIGURE 2

Data Source:AECOM, PROJECT NO. 60163563, DATE 2012-05-15

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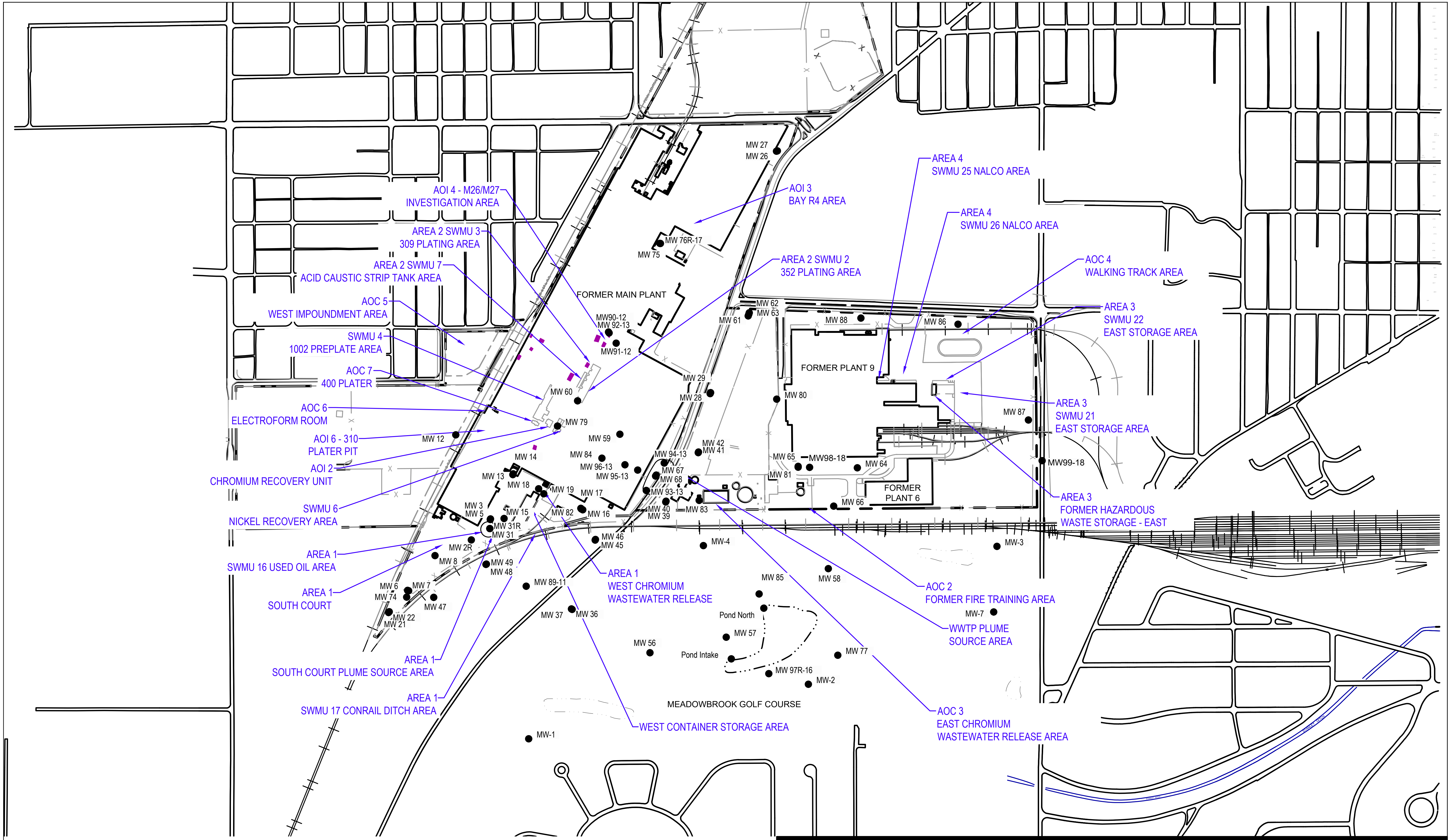

LEGEND

▬ ▬ ▬	SITE BOUDNARY
─┼─┼─	RAILROAD
── x ──	FENCE LINE
─ · · · ─	POND BOUNDARY
▭	BUILDING
●	MONITORING WELL LOCATION
▬	AOI 5 AREA OF STAINED SOIL BENEATH CONCRETE

0 300 600 ft

Coordinate System:
STATE PLANE INDIANA
EAST - NAD83

N

GHD

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AREAS OF INTEREST

Project No. **11209506**
Date **June 2021**

FIGURE 3

Filename: N:\CA\St Catharines\Projects\562\11209506\Digital_Design\ACAD 2020\Figures\RPT-005\11209506-GHD-0000-RPT-EN-0102_WA-005.DWG
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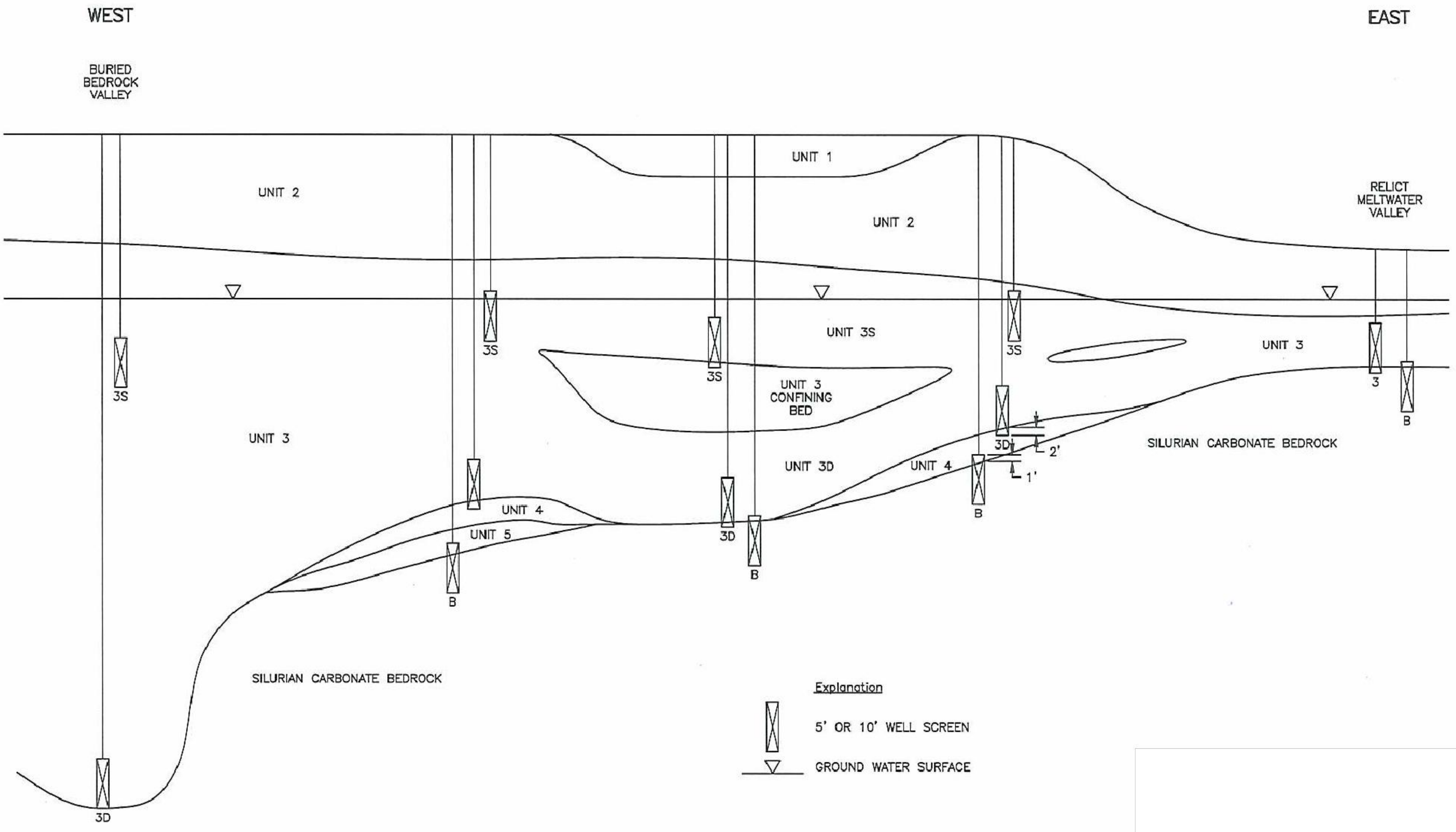

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GROUNDWATER MONITORING PLAN

GENERALIZED HYDROGEOLOGIC CROSS SECTION

Project No. **11209506**
Date **June 2021**

FIGURE 4

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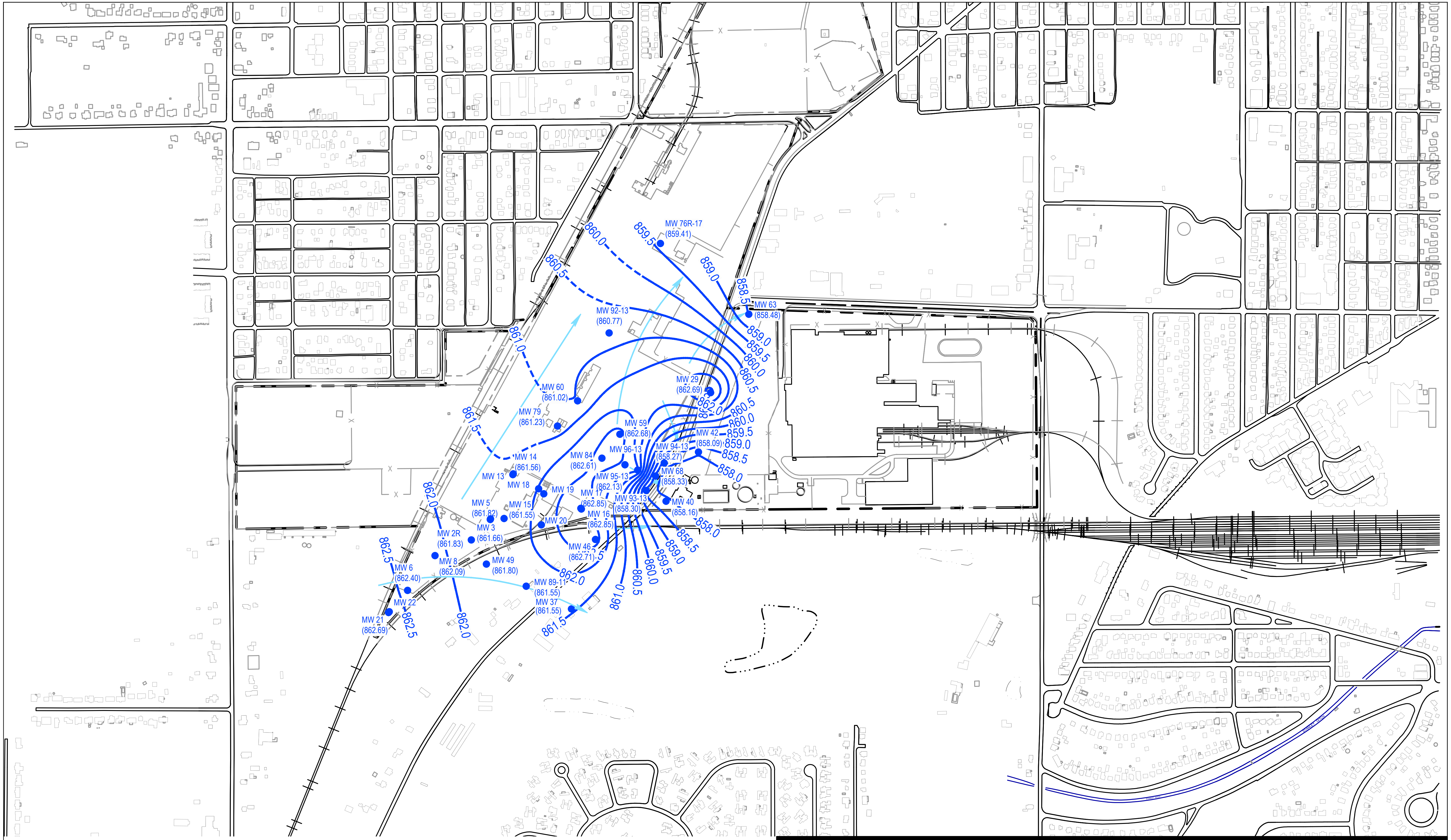

LEGEND

SITE BOUDNARY
RAILROAD
FENCE LINE
POND BOUNDARY
FORMER BUILDING
BUILDING
● MONITORING WELL USED TO DEVELOP CONTOURS
(856.79) GROUNDWATER ELEVATION (FEET NAVD 88)
859.5 GROUNDWATER CONTOUR (FEET NAVD 88)
INFERRED DIRECTION OF GROUNDWATER FLOW

0 300 600 ft

Coordinate System:
STATE PLANE INDIANA
EAST - NAD83

N

GHD

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ENVIRONMENTAL RESPONSE TRUST
2915 DR. MARTIN LUTHER KING JR. BLVD.
ANDERSON, INDIANA
GROUNDWATER MONITORING PLAN

POTENTIOMETRIC GROUNDWATER ELEVATIONS - UNIT 3S, NOV. 2020

Project No. 11209506
Date June 2021

FIGURE 5

Filename: N:\CA\St Catharines\Projects\562\11209506\Digital_Design\ACAD 2020\Figures\RPT-005\11209506-GHD-0000-RPT-EN-0104_WA-005.DWG
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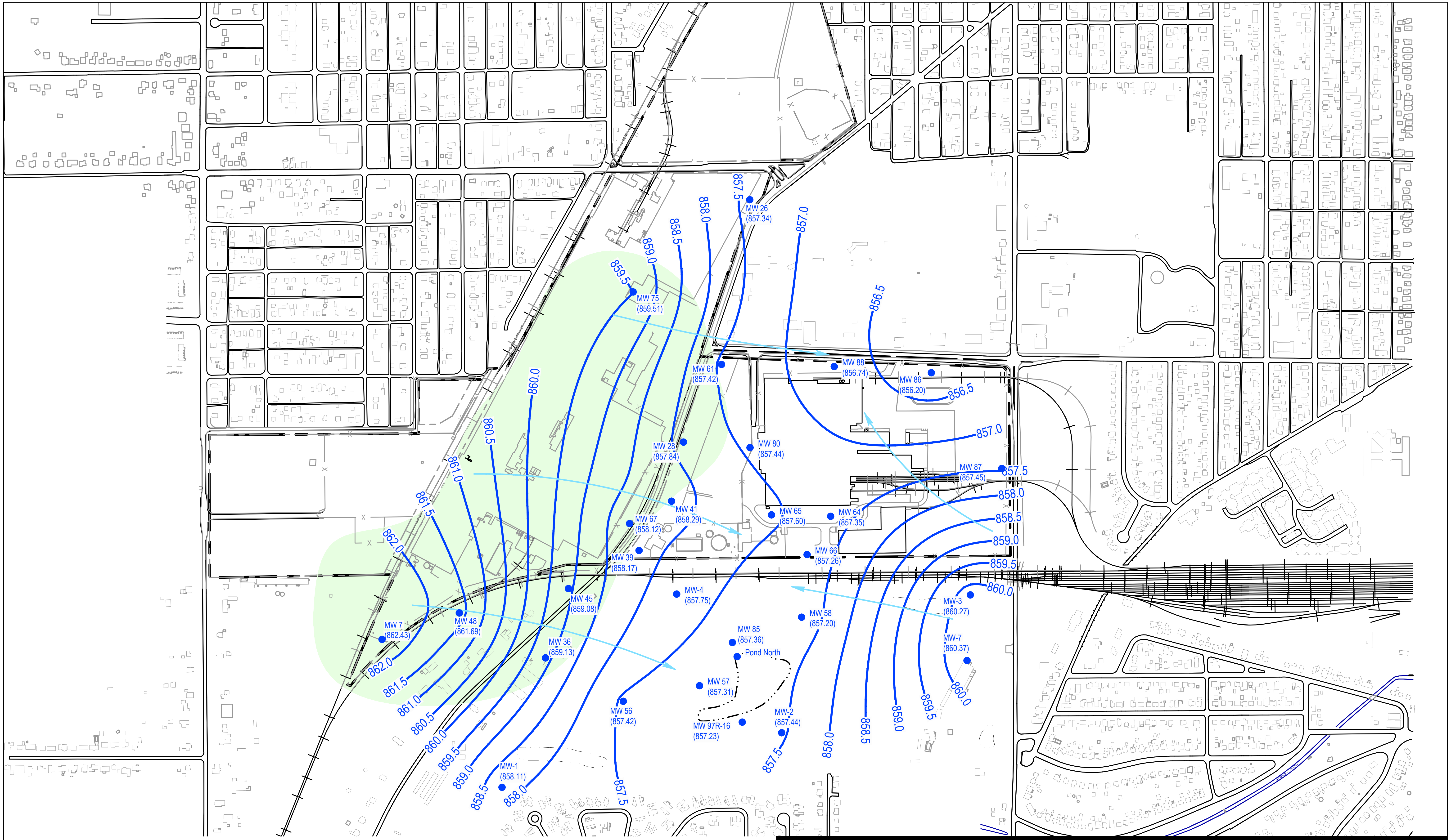

LEGEND

SITE BOUDNARY
RAILROAD
FENCE LINE
POND BOUNDARY
FORMER BUILDING
BUILDING
MONITORING WELL USED TO DEVELOP CONTOURS
BOUNDARY OF AREA WHERE UNIT 3 CLAY CONFINING BED IS PRESENT
(856.79) GROUNDWATER ELEVATION (FEET NAVD 88)
859.5 GROUNDWATER CONTOUR (FEET NAVD 88)
INFERRED DIRECTION OF GROUNDWATER FLOW

0 300 600 ft

Coordinate System:
STATE PLANE INDIANA
EAST - NAD83

N

GHD

REVITALIZING AUTO COMMUNITIES
ENVIRONMENTAL RESPONSE TRUST
2915 DR. MARTIN LUTHER KING JR. BLVD.
ANDERSON, INDIANA
GROUNDWATER MONITORING PLAN

POTENTIOMETRIC GROUNDWATER ELEVATIONS - UNIT 3D, NOV. 2020

Project No. **11209506**
Date **June 2021**

FIGURE 6

Filename: N:\CA\St Catharines\Projects\562\11209506\Digital_Design\ACAD 2020\Figures\RPT-005\11209506-GHD-0000-RPT-EN-0105_WA-005.DWG
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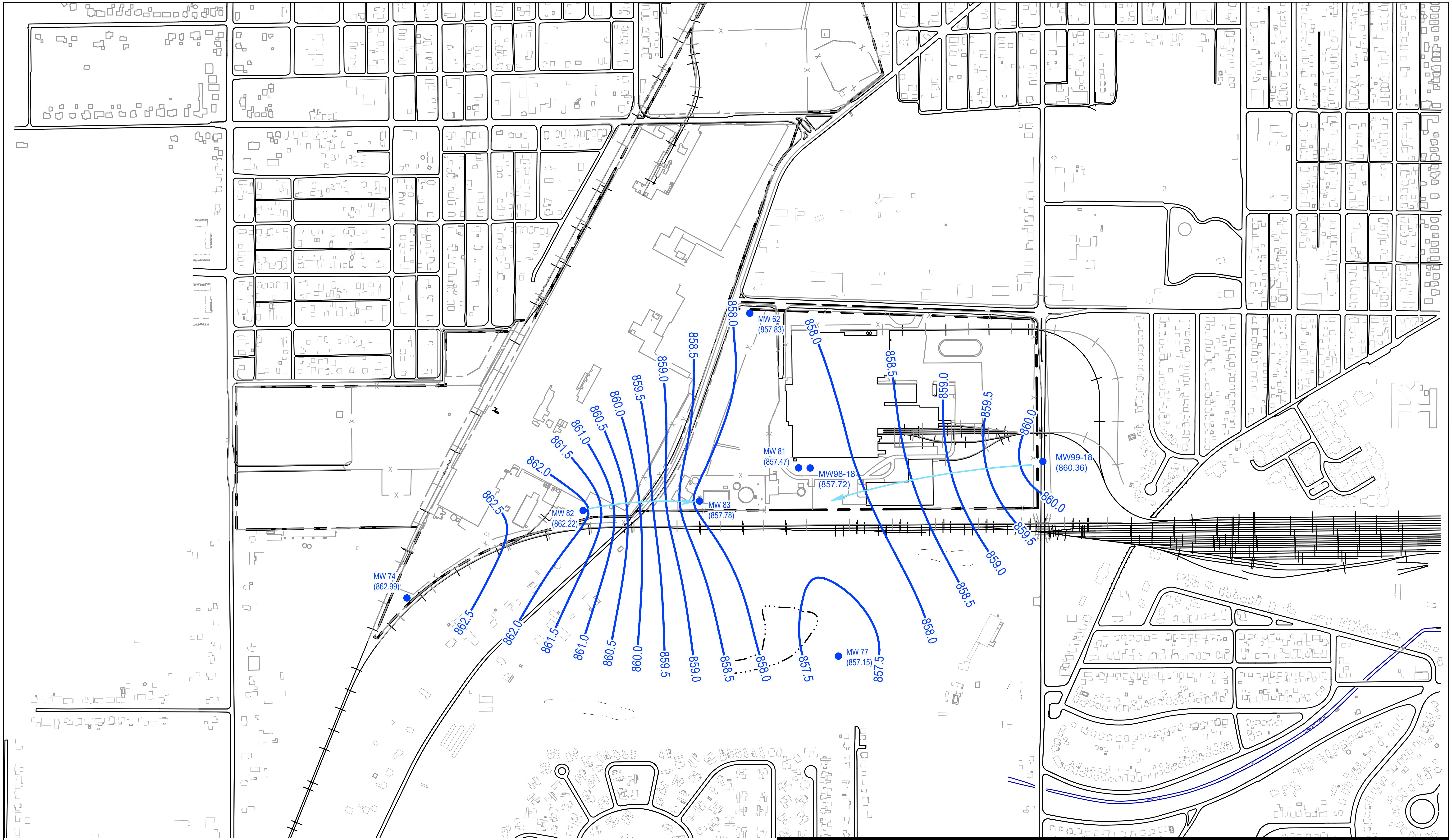

LEGEND

SITE BOUDNARY
RAILROAD
FENCE LINE
POND BOUNDARY
FORMER BUILDING
BUILDING
● BEDROCK MONITORING WELL

(856.79) GROUNDWATER ELEVATION (FEET NAVD 88)
859.5 GROUNDWATER CONTOUR (FEET NAVD 88)
INFERRED DIRECTION OF GROUNDWATER FLOW

0 300 600 ft

Coordinate System:
STATE PLANE INDIANA
EAST - NAD83

N

GHD

REVITALIZING AUTO COMMUNITIES
ENVIRONMENTAL RESPONSE TRUST
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ANDERSON, INDIANA
GROUNDWATER MONITORING PLAN

POTENTIOMETRIC GROUNDWATER ELEVATIONS - BEDROCK NOV. 2020

Project No. **11209506**
Date **June 2021**

FIGURE 7

Filename: N:\CA\St Catharines\Projects\562\11209506\Digital_Design\ACAD 2020\Figures\RPT-005\11209506-GHD-0000-RPT-EN-0106_WA-005.DWG
Plot Date: 17 June 2021 1:18 PM

Data Source:AECOM, PROJECT NO. 60163563, DATE 2012-05-15

MW 79	04/19/2016	10/21/2016	04/17/2017	10/11/2017	04/10/2018	10/02/2018	04/28/2019	11/09/2020
Benzene	0.1 U	0.1 U	0.063 U/0.13 U	0.05 U	0.1 U	0.1 U	0.1 U	0.0005 U
Chloroform (Trichloromethane)	0.1 U	0.1 U	0.063 U/0.13 U	0.05 U	0.1 U	0.1 U	0.1 U	0.003 U
1,1-Dichloroethene	0.1 U	0.1 U	0.063 U/0.13 U	0.05 U	0.1 U	0.1 U	0.1 U	0.0047
cis-1,2-Dichloroethene	2.4 {B}	2.1 {B}	2.3 {B}/2.3 {B}	2.5 {B}	3.5 {B}	2.4 {B}	2.2 {B}	1.5 {B}
trans-1,2-Dichloroethene	0.094 J	0.085 J	0.095/0.088 J	0.096	0.12	0.084 J	0.067 J	0.065
Ethylbenzene	0.1 U	0.1 U	0.063 U/0.13 U	0.05 U	0.1 U	0.1 U	0.1 U	0.001 U
Methylene chloride	0.1 U	0.1 U	0.063 U/0.13 U	0.05 U	0.37 U	0.5 U	0.5 U	0.001 U
Tetrachloroethene	0.1 U	0.1 U	0.063 U/0.13 U	0.05 U	0.1 U	0.1 U	0.1 U	0.001 U
Toluene	0.1 U	0.1 U	0.063 U/0.13 U	0.05 U	0.1 U	0.1 U	0.1 U	0.001 U
1,1,1-Trichloroethane	0.1 U	0.1 U	0.063 U/0.13 U	0.05 U	0.1 U	0.1 U	0.1 U	0.001 U
Trichloroethene	0.1 U	0.1 U	0.063 U/0.13 U	0.05 U	0.1 U	0.1 U	0.1 U	0.001 U
Vinyl chloride	0.18 {AB}	0.15 {AB}	0.19 {AB}/0.19 {AB}	0.2 {AB}	0.31 {AB}	0.31 {AB}	0.6 {AB}	0.44 {AB}

MW 84	10/24/2016	10/13/2017	10/04/2018	10/17/2019	11/09/2020
Benzene	0.001 U	0.001 U	0.001 U	0.001 U	0.0005 U
Chloroform (Trichloromethane)	0.001 U	0.001 U	0.001 U	0.001 U	0.003 U
1,1-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U	0.002 U
cis-1,2-Dichloroethene	0.001	0.001 U	0.001 U	0.001 U	0.001 U
trans-1,2-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Ethylbenzene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Methylene chloride	0.001 U	0.001 U	0.005 U	0.005 U	0.001 U
Tetrachloroethene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Toluene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,1,1-Trichloroethane	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Trichloroethene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Vinyl chloride	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U

MW 51	04/20/2016	10/23/2016	04/18/2017	10/16/2017	04/10/2018	10/04/2018	04/29/2019
Benzene	0.005 U	0.008 U	0.0033 U	0.0033 U	0.0033 U/0.0033 U	0.005 U	0.0057 U/0.005 U
Chloroform (Trichloromethane)	0.005 U	0.008 U	0.0033 U	0.0033 U	0.0033 U/0.0033 U	0.005 U	0.0057 U/0.005 U
1,1-Dichloroethene	0.005 U	0.008 U	0.0033 U	0.0014 J	0.0033 U/0.0033 U	0.005 U	0.0057 U/0.005 U
cis-1,2-Dichloroethene	0.011	0.012	0.015	0.028	0.032/0.034	0.079	0.15/0.16
trans-1,2-Dichloroethene	0.005 U	0.008 U	0.0033 U	0.0033 U	0.0033 U/0.0033 U	0.005 U	0.0057 U/0.0011 J
Ethylbenzene	0.005 U	0.008 U	0.0033 U	0.0033 U	0.0033 U/0.0033 U	0.005 U	0.0057 U/0.005 U
Methylene chloride	0.005 U	0.008 U	0.0033 U	0.065	0.0068 U/0.0054 U	0.025 U	0.029 U/0.025 U
Tetrachloroethene	0.005 U	0.008 U	0.0033 U	0.0033 U	0.0033 U/0.0033 U	0.005 U	0.0057 U/0.005 U
Toluene	0.005 U	0.008 U	0.0033 U	0.0033 U	0.0033 U/0.0033 U	0.005 U	0.0057 U/0.005 U
1,1,1-Trichloroethane	0.005 U	0.008 U	0.0033 U	0.0033 U	0.0033 U/0.0033 U	0.005 U	0.0057 U/0.005 U
Trichloroethene	0.15 {A}	0.14 {A}	0.14 {A}	0.15 {A}	0.087 {A}/0.097 {A}	0.064 {A}	0.046 {A}/0.052 {A}
Vinyl chloride	0.0035 J	0.0053 J {B}	0.0041 {B}	0.0073 {B}	0.0038/0.0046 {B}	0.0035 J	0.0053 J {B}/0.0066 {B}

MW 75	10/23/2016	10/16/2017	10/02/2018	11/23/2020
Benzene	0.001 U	0.001 U	0.001 U	0.001 U
Chloroform (Trichloromethane)	0.001 U	0.001 U	0.001 U	0.001 U
1,1-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
cis-1,2-Dichloroethene	0.0007 J	0.001 U	0.001 U	0.001 U
trans-1,2-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
Ethylbenzene	0.001 U	0.001 U	0.001 U	0.001 U
Methylene chloride	0.001 U	0.013 U	0.005 U	0.005 U
Tetrachloroethene	0.001 U	0.001 U	0.001 U	0.001 U
Toluene	0.001 U	0.001 U	0.001 U	0.001 U
1,1,1-Trichloroethane	0.001 U	0.001 U	0.001 U	0.001 U
Trichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
Vinyl chloride	0.001 U	0.001 U	0.001 U	0.001 U

MW 76R-17	10/18/2017	10/02/2018	11/11/2020
Benzene	0.001 U	0.001 U	0.0005 U
Chloroform (Trichloromethane)	0.001 U	0.001 U	0.003 U
1,1-Dichloroethene	0.001 U	0.001 U	0.002 U
cis-1,2-Dichloroethene	0.0027	0.0028	0.0032
trans-1,2-Dichloroethene	0.001 U	0.001 U	0.00028 J
Ethylbenzene	0.001 U	0.001 U	0.001 U
Methylene chloride	0.001 U	0.005 U	0.001 U
Tetrachloroethene	0.001 U	0.001 U	0.001 U
Toluene	0.001 U	0.001 U	0.001 U
1,1,1-Trichloroethane	0.001 U	0.001 U	0.001 U
Trichloroethene	0.001 U	0.001 U	0.001 U
Vinyl chloride	0.001 U	0.001 U	0.0016

MW 28	04/19/2016	10/22/2016	04/19/2017	10/09/2017	04/12/2018	10/04/2018	04/25/2019	11/05/2020
Benzene	0.033 U	0.05 U	0.025 U	0.04 U	0.05 U	0.067 U/0.067 U	0.04 U	0.067 U
Chloroform (Trichloromethane)	0.033 U	0.05 U	0.025 U	0.04 U	0.05 U	0.067 U/0.067 U	0.04 U	0.067 U
1,1-Dichloroethene	0.033 U	0.05 U	0.025 U	0.04 U	0.05 U	0.067 U/0.067 U	0.04 U	0.067 U
cis-1,2-Dichloroethene	0.77	0.86	0.85	0.92	0.97	1/1	1	1.3 {B}
trans-1,2-Dichloroethene	0.013 J	0.016 J	0.018 J	0.015 J	0.02 J	0.019 J/0.024 J	0.019 J	0.025 J
Ethylbenzene	0.033 U	0.05 U	0.025 U	0.04 U	0.05 U	0.067 U/0.067 U	0.04 U	0.067 U
Methylene chloride	0.033 U	0.05 U	0.025 U	0.04 U	0.05 U	0.33 U/0.33 U	0.2 U	0.33 U
Tetrachloroethene	0.033 U	0.05 U	0.025 U	0.04 U	0.05 U	0.067 U/0.067 U	0.04 U	0.067 U
Toluene	0.033 U	0.05 U	0.025 U	0.04 U	0.05 U	0.067 U/0.067 U	0.04 U	0.067 U
1,1,1-Trichloroethane	0.033 U	0.05 U	0.025 U	0.04 U	0.05 U	0.067 U/0.067 U	0.04 U	0.067 U
Trichloroethene	0.033 U	0.05 U	0.025 U	0.04 U	0.05 U	0.067 U/0.067 U	0.04 U	0.067 U
Vinyl chloride	0.15 {AB}	0.19 {AB}	0.18 {AB}	0.2 {AB}	0.17 {AB}	0.15 {AB}/0.16 {AB}	0.13 {AB}	0.18 {AB}

MW 42	04/19/2016	10/23/2016	04/19/2017	10/09/2017	04/13/2018	10/04/2018	04/26/2019	11/09/2020
Benzene	0.17 U	0.2 U	0.1 U	0.1 U	0.2 U	0.2 U	0.1 U	0.00061
Chloroform (Trichloromethane)	0.17 U	0.2 U	0.1 U	0.1 U	0.2 U	0.2 U	0.1 U	0.003 U
1,1-Dichloroethene	0.17 U	0.2 U	0.1 U	0.1 U	0.2 U	0.2 U	0.1 U	0.023
cis-1,2-Dichloroethene	4.1 {B}	3.2 {B}	2.9 {B}	3.7 {B}	3.9 {B}	3.5 {B}	2.4 {B}	2.9 {B}
trans-1,2-Dichloroethene	0.19	0.14 J	0.08 J	0.095 J	0.14 J	0.15 J	0.1	0.13
Ethylbenzene	0.17 U	0.2 U	0.1 U	0.1 U	0.2 U	0.2 U	0.1 U	0.001 U
Methylene chloride	0.17 U	0.2 U	0.1 U	0.1 U	0.2 U	1 U	0.5 U	0.001 U
Tetrachloroethene	0.17 U	0.2 U	0.1 U	0.1 U	0.2 U	0.2 U	0.1 U	0.001 U
Toluene	0.17 U	0.2 U	0.1 U	0.1 U	0.2 U	0.2 U	0.1 U	0.001 U
1,1,1-Trichloroethane	0.17 U	0.2 U	0.1 U	0.1 U	0.2 U	0.2 U	0.1 U	0.001 U
Trichloroethene	0.17 U	0.2 U	0.035 J	0.1 U	0.2 U	0.2 U	0.1 U	0.0072
Vinyl chloride	0.092 J {AB}	0.1 J {AB}	0.22 {AB}	0.26 {AB}	0.11 J {AB}	0.2 U	0.087 J {AB}	0.22 {AB}

MW 59	10/17/2019
Benzene	0.001 U
Chloroform (Trichloromethane)	0.001 U
1,1-Dichloroethene	0.001 U
cis-1,2-Dichloroethene	0.001 U
trans-1,2-Dichloroethene	0.001 U
Ethylbenzene	0.001 U
Methylene chloride	0.005 U
Tetrachloroethene	0.001 U
Toluene	0.001 U
1,1,1-Trichloroethane	0.001 U
Trichloroethene	0.001 U
Vinyl chloride	0.001 U

MW92-13	10/16/2019	11/05/2020
Benzene	0.001 U	0.001 U
Chloroform (Trichloromethane)	0.001 U	0.001 U
1,1-Dichloroethene	0.001 U	0.001 U
cis-1,2-Dichloroethene	0.0014	0.001 U
trans-1,2-Dichloroethene	0.001 U	0.001 U
Ethylbenzene	0.001 U	0.001 U
Methylene chloride	0.005 U	0.005 U
Tetrachloroethene	0.001 U	0.001 U
Toluene	0.001 U	0.001 U
1,1,1-Trichloroethane	0.001 U	0.001 U
Trichloroethene	0.001 U	0.001 U
Vinyl chloride	0.001 U	0.001 U

MW 29	10/17/2019
Benzene	0.001 U
Chloroform (Trichloromethane)	0.001 U
1,1-Dichloroethene	0.001 U
cis-1,2-Dichloroethene	0.001 U
trans-1,2-Dichloroethene	0.001 U
Ethylbenzene	0.001 U
Methylene chloride	0.005 U
Tetrachloroethene	0.001 U
Toluene	0.001 U
1,1,1-Trichloroethane	0.001 U
Trichloroethene	0.001 U
Vinyl chloride	0.001 U

MW 61	10/22/2016	10/09/2017	10/04/2018	11/09/2020
Benzene	0.001 U	0.001 U	0.001 U	0.0005 U/0.0005 U
Chloroform (Trichloromethane)	0.001 U	0.001 U	0.001 U	0.003 U/0.003 U
1,1-Dichloroethene	0.001 U	0.001 U	0.001 U	0.002 U/0.002 U
cis-1,2-Dichloroethene	0.00035 J	0.001 U	0.001 U	0.001 U/0.001 U
trans-1,2-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U/0.001 U
Ethylbenzene	0.001 U	0.001 U	0.001 U	0.001 U/0.001 U
Methylene chloride	0.001 U	0.001 U	0.005 U	0.001 U/0.001 U
Tetrachloroethene	0.001 U	0.001 U	0.001 U	0.001 U/0.001 U
Toluene	0.001 U	0.001 U	0.001 U	0.001 U/0.001 U
1,1,1-Trichloroethane	0.001 U	0.001 U	0.001 U	0.001 U/0.001 U
Trichloroethene	0.001 U	0.001 U	0.001 U	0.001 U/0.001 U
Vinyl chloride	0.00069 J	0.001 U	0.0013	0.00077 J/0.0011

MW 88	10/22/2016	10/13/2017	10/04/2018	11/04/2020
Benzene	0.001 U/0.001 U	0.001 U	0.001 U/0.001 U	0.001 U
Chloroform (Trichloromethane)	0.001 U/0.001 U	0.001 U	0.001 U/0.001 U	0.001 U
1,1-Dichloroethene	0.001 U/0.001 U	0.001 U	0.001 U/0.001 U	0.001 U
cis-1,2-Dichloroethene	0.001 U/0.001 U	0.001 U	0.001 U/0.001 U	0.001 U
trans-1,2-Dichloroethene	0.001 U/0.001 U	0.001 U	0.001 U/0.001 U	0.001 U
Ethylbenzene	0.001 U/0.001 U	0.001 U	0.001 U/0.001 U	0.001 U
Methylene chloride	0.001 U/0.001 U	0.001 U	0.005 U/0.005 U	0.005 U
Tetrachloroethene	0.001 U/0.001 U	0.001 U	0.001 U/0.001 U	0.001 U
Toluene	0.001 U/0.001 U	0.001 U	0.001 U/0.001 U	0.001 U
1,1,1-Trichloroethane	0.001 U/0.001 U	0.001 U	0.001 U/0.001 U	0.001 U
Trichloroethene	0.001 U/0.001 U	0.001 U	0.001 U/0.001 U	0.001 U
Vinyl chloride	0.0019/0.0018	0.0023	0.0024/0.0023	0.0061 {B}

MW 12	04/21/2016	10/25/2016	04/19/2017	10/06/2017	04/11/2018	10/04/2018	04/25/2019	11/04/2020
Benzene	0.005 U	0.005 U	0.0025 U	0.0033 U	0.0067 U	0.005 U	0.0033 U	0.0025 U
Chloroform (Trichloromethane)	0.005 U	0.005 U	0.0025 U	0.0033 U	0.0067 U	0.005 U	0.0033 U	0.0025 U
1,1-Dichloroethene	0.005 U	0.005 U	0.0025 U	0.0033 U	0.0067 U	0.005 U	0.0033 U	0.0025 U
cis-1,2-Dichloroethene	0.13	0.12	0.11	0.1	0.1	0.08	0.09	0.072
trans-1,2-Dichloroethene	0.0018 J	0.005 U	0.0012 J	0.0012 J	0.0067 U	0.005 U	0.0019 J	0.00089 J
Ethylbenzene	0.005 U	0.005 U	0.0025 U	0.0033 U	0.0067 U	0.005 U	0.0033 U	0.0025 U
Methylene chloride	0.005 U	0.005 U	0.0025 U	0.0033 U	0.0067 U	0.025 U	0.017 U	0.013 U
Tetrachloroethene	0.005 U	0.005 U	0.0025 U	0.0033 U	0.0067 U	0.005 U	0.0033 U	0.0025 U
Toluene	0.005 U	0.005 U	0.0025 U	0.0033 U	0.0067 U	0.005 U	0.0033 U	0.0025 U
1,1,1-Trichloroethane	0.005 U	0.005 U	0.0025 U	0.0033 U	0.0067 U	0.005 U	0.0033 U	0.0025 U
Trichloroethene	0.005 U	0.005 U	0.00085 J	0.0033 U	0.0026 J	0.005 U	0.00048 J	0.00028 J
Vinyl chloride	0.005 U	0.005 U	0.0025 U	0.0033 U	0.0067 U	0.005 U	0.0033 U	0.0005 J

MW 80	10/22/2016	10/06/2017	10/02/2018	11/06/2020
Benzene	0.0018 U	0.002 U	0.002 U	0.0005 U
Chloroform (Trichloromethane)	0.0018 U	0.002 U	0.002 U	0.003 U
1,1-Dichloroethene	0.0018 U	0.002 U	0.002 U	0.002 U
cis-1,2-Dichloroethene	0.025	0.0086	0.015	0.013
trans-1,2-Dichloroethene	0.00078 J	0.002 U	0.001 J	0.00064 J
Ethylbenzene	0.0018 U	0.002 U	0.002 U	0.001 U
Methylene chloride	0.0018 U	0.002 U	0.01 U	0.001 U
Tetrachloroethene	0.0018 U	0.002 U	0.002 U	0.001 U
Toluene	0.0018 U	0.002 U	0.002 U	0.001 U
1,1,1-Trichloroethane	0.0018 U	0.002 U	0.002 U	0.001 U
Trichloroethene	0.0018 U	0.002 U	0.002 U	0.001 U
Vinyl chloride	0.049 {AB}	0.041 {AB}	0.051 {AB}	0.063 {AB}

MW 14	04/19/2016	10/25/2016	04/18/2017	10/13/2017	04/10/2018	10/03/2018	04/29/2019	11/09/2020
Benzene	0.17 U	0.2 U	0.13 U/0.13 U	0.2 U/0.2 U	0.2 U	0.2 U	0.14 U	0.00094
Chloroform (Trichloromethane)	0.17 U	0.2 U	0.13 U/0.13 U	0.2 U/0.2 U	0.2 U	0.2 U	0.14 U	0.003 U
1,1-Dichloroethene	0.17 U	0.2 U	0.13 U/0.13 U	0.2 U/0.2 U	0.2 U	0.2 U	0.14 U	0.031
cis-1,2-Dichloroethene	4.4 {B}	4.4 {B}	4.1 {B}/3.9 {B}	4.1 {B}/4 {B}	4 {B}	4.1 {B}	3.2 {B}	3 {B}
trans-1,2-Dichloroethene	0.17 U	0.2 U	0.13 U/0.13 U	0.2 U/0.2 U	0.2 U	0.2 U	0.14 U	0.024
Ethylbenzene	0.17 U	0.2 U	0.13 U/0.13 U	0.2 U/0.2 U	0.2 U	0.2 U	0.14 U	0.001 U
Methylene chloride	0.17 U	0.2 U	0.13 U/0.13 U	0.2 U/0.2 U	0.2 U	1 U	0.71 U	0.001 U
Tetrachloroethene	0.17 U	0.2 U	0.13 U/0.13 U	0.2 U/0.2 U	0.2 U	0.2 U	0.14 U	0.001 U
Toluene	0.17 U	0.2 U	0.13 U/0.13 U	0.2 U/0.2 U	0.2 U	0.2 U	0.14 U	0.001 U
1,1,1-Trichloroethane	0.17 U	0.2 U	0.13 U/0.13 U	0.2 U/0.2 U	0.2 U	0.2 U	0.14 U	0.014
Trichloroethene	0.17 U	0.2 U	0.13 U/0.13 U	0.2 U/0.2 U	0.2 U	0.2 U	0.14 U	0.001 U
Vinyl chloride	0.14 J {AB}	0.12 J {AB}	0.13 {AB}/0.13 {AB}	0.15 J {AB}/0.15 J {AB}	0.11 J {AB}	0.13 J {AB}	0.1 J {AB}	0.13 {AB}

MW 86	10/22/2016	10/13/2017	10/04/2018	11/04/2020
Benzene	0.001 U	0.001 U	0.001 U	0.001 U
Chloroform (Trichloromethane)	0.001 U	0.001 U	0.001 U	0.001 U
1,1-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
cis-1,2-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
trans-1,2-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
Ethylbenzene	0.001 U	0.001 U	0.001 U	0.001 U
Methylene chloride	0.001 U	0.001 U	0.005 U	0.005 U
Tetrachloroethene	0.001 U	0.001 U	0.001 U	0.001 U
Toluene	0.001 U	0.001 U	0.001 U	0.001 U
1,1,1-Trichloroethane	0.001 U	0.001 U	0.001 U	0.001 U
Trichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
Vinyl chloride	0.001 U	0.001 U	0.001 U	0.001 U

MW 16	10/23/2016	10/12/2017	10/03/2018	10/16/2019	11/10/2020
Benzene	0.001 U	0.001 U	0.005 U	0.63 U	0.00031 J
Chloroform (Trichloromethane)	0.001 U	0.001 U	0.005 U	0.63 U	0.0018 J
1,1-Dichloroethene	0.001 U	0.001 U	0.005 U	0.63 U	0.047
cis-1,2-Dichloroethene	0.001 U	0.0019	0.005 U	9.6 {B}	5.6 {B}
trans-1,2-Dichloroethene	0.001 U	0.001 U	0.005 U	0.63 U	0.081
Ethylbenzene	0.001 U	0.001 U	0.005 U	0.63 U	0.001 U
Methylene chloride	0.001 U	0.001 U	0.025 U	3.1 U	0.001 U
Tetrachloroethene	0.001 U	0.001 U	0.005 U	0.63 U	0.001 U
Toluene	0.001 U	0.00027 J	0.005 U	0.63 U	0.001 U
1,1,1-Trichloroethane	0.001 U	0.001 U	0.005 U	0.63 U	0.00046 J
Trichloroethene	0.001 U	0.0017	0.005 U	0.63 U	0.001 U
Vinyl chloride	0.001 U	0.03 {B}	0.22 {AB}	0.63 U	0.019 {B}

MW 41	04/19/2016	10/23/2016	04/19/2017	10/09/2017	04/13/2018	10/04/2018	04/26/2019	11/09/2020
Benzene	0.2 U	0.33 U	0.2 U	0.2 U	0.33 U	0.33 U	0.2 U/0.2 U	0.00067
Chloroform (Trichloromethane)	0.2 U	0.33 U	0.2 U	0.2 U	0.33 U	0.33 U	0.2 U/0.2 U	0.003 U
1,1-Dichloroethene	0.2 U	0.33 U	0.2 U	0.2 U	0.33 U	0.33 U	0.2 U/0.2 U	0.02 J
cis-1,2-Dichloroethene	6.4 {B}	5.2 {B}	6 {B}	5.4 {B}	5.8 {B}	4.8 {B}	5.1 {B}/5.1 {B}	4.2 {B}
trans-1,2-Dichloroethene	0.1 J	0.33 U	0.093 J	0.068 J	0.33 U	0.075 J	0.07 J/0.064 J	0.064
Ethylbenzene	0.2 U	0.33 U	0.2 U	0.2 U	0.33 U	0.33 U	0.2 U/0.2 U	0.001 U
Methylene chloride	0.2 U	0.33 U	0.2 U	0.2 U	0.33 U	1.7 U	1 U/1 U	0.001 U
Tetrachloroethene	0.2 U	0.33 U	0.2 U	0.2 U	0.33 U	0.33 U	0.2 U/0.2 U	0.001 U
Toluene	0.2 U	0.33 U	0.2 U	0.2 U	0.33 U	0.33 U	0.2 U/0.2 U	0.001 U
1,1,1-Trichloroethane	0.2 U	0.33 U	0.2 U	0.2 U	0.33 U	0.33 U	0.2 U/0.2 U	0.001 U
Trichloroethene	0.2 U	0.33 U	0.2 U	0.2 U	0.33 U	0.33 U	0.2 U/0.2 U	0.001 U
Vinyl chloride	0.45 {AB}	0.35 {AB}	0.44 {AB}	0.38 {AB}	0.3 J {AB}	0.21 J {AB}	0.35 {AB}/0.34 {AB}	0.24 {AB}

MW 82	10/23/2016	10/12/2017	10/10/2018	11/10/2020
Benzene	0.001 U	0.001 U/0.001 U	0.001 U/0.001 U	0.0005 U
Chloroform (Trichloromethane)	0.001 U	0.001 U/0.001 U	0.001 U/0.001 U	0.003 U
1,1-Dichloroethene	0.001 U	0.001 U/0.001 U	0.001 U/0.001 U	0.002 U
cis-1,2-Dichloroethene	0.001 U	0.002/0.002	0.001 U/0.001 U	0.001 U
trans-1,2-Dichloroethene	0.001 U	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U
Ethylbenzene	0.001 U	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U
Methylene chloride	0.001 U	0.001 U/0.001 U	0.005 U/0.005 U	0.001 U
Tetrachloroethene	0.001 U	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U
Toluene	0.001 U	0.0004 J/0.00038 J	0.001 U/0.001 U	0.001 U
1,1,1-Trichloroethane	0.001 U	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U
Trichloroethene	0.001 U	0.00097 J/0.00096 J	0.00012 J/0.00014 J	0.001 U
Vinyl chloride	0.001 U	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U

MW 65	10/19/2016	10/06/2017	10/04/2018	11/06/2020
Benzene	0.001 U	0.001 U	0.001 U	0.0005 U
Chloroform (Trichloromethane)	0.001 U	0.001 U	0.00053 J	0.003 U
1,1-Dichloroethene	0.001 U	0.001 U	0.001 U	0.002 U
cis-1,2-Dichloroethene	0.028	0.02	0.015	0.0082
trans-1,2-Dichloroethene	0.0012	0.0012	0.00069 J	0.00028 J
Ethylbenzene	0.001 U	0.001 U	0.001 U	0.001 U
Methylene chloride	0.001 U	0.001 U	0.005 U	0.001 U
Tetrachloroethene	0.001 U	0.001 U	0.001 U	0.001 U
Toluene	0.001 U	0.001 U	0.001 U	0.001 U
1,1,1-Trichloroethane	0.001 U	0.001 U	0.001 U	0.001 U
Trichloroethene	0.001 U	0.001 U	0.00027 J	0.001 U
Vinyl chloride	0.0014	0.00074 J	0.00074 J	0.00049 J

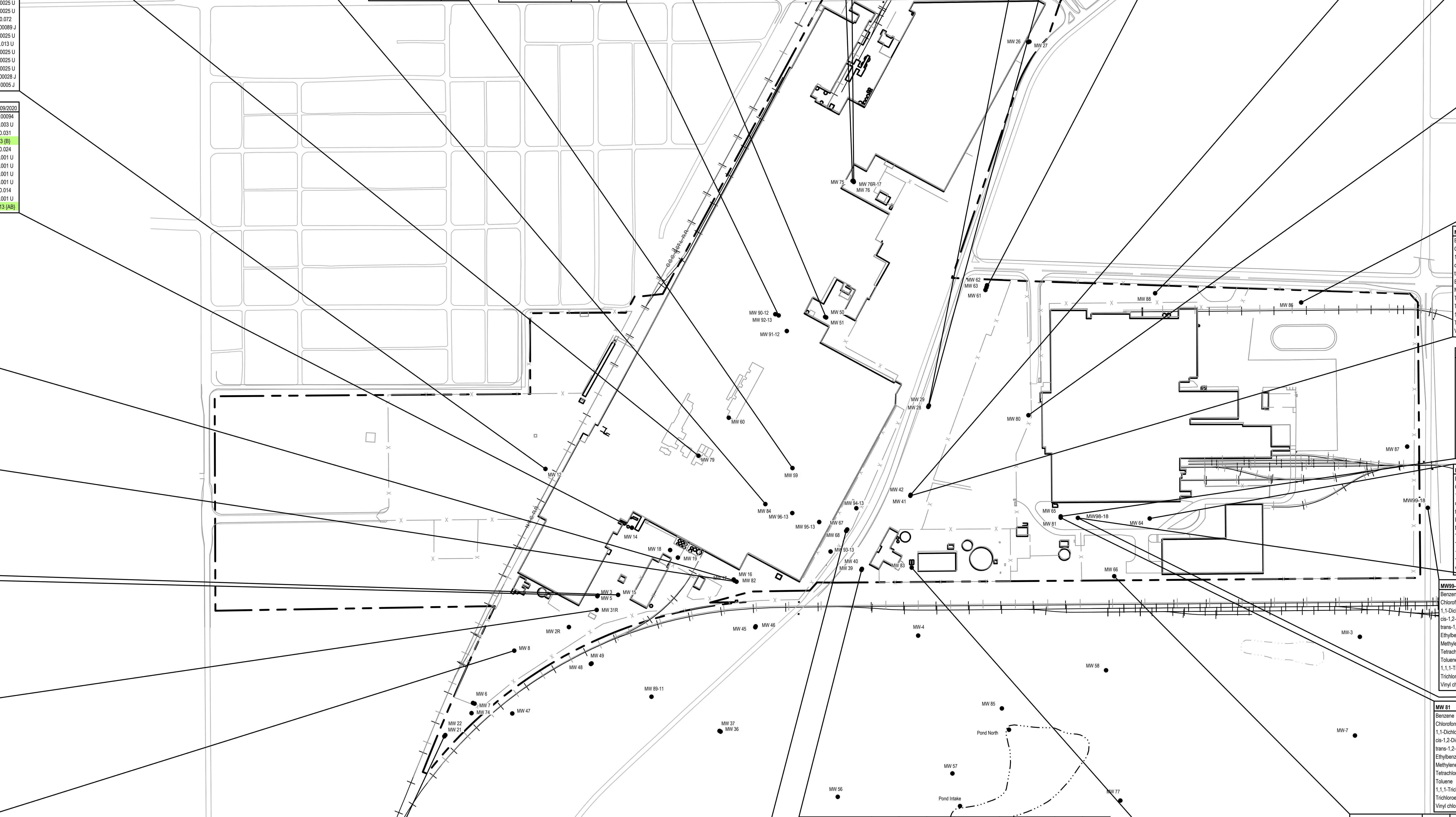
MW 15	10/21/2016	10/11/2017	10/02/2018	11/12/2020
Benzene	0.1 U	0.067 U	0.2 U	0.00028 J
Chloroform (Trichloromethane)	0.1 U	0.067 U	0.2 U	0.0065
1,1-Dichloroethene	0.1 U	0.079	0.049 J	0.029
cis-1,2-Dichloroethene	1.7 {B}	3.5 {B}	5.4 {B}	1.9 {B}
trans-1,2-Dichloroethene	0.1 U	0.042 J	0.056 J	0.027
Ethylbenzene	0.1 U	0.067 U	0.2 U	0.001 U
Methylene chloride	0.1 U	0.067 U	1 U	0.001 U
Tetrachloroethene	0.1 U	0.067 U	0.2 U	0.0027
Toluene	0.1 U	0.067 U	0.2 U	0.001 U
1,1,1-Trichloroethane	0.37	0.32	0.23	0.43
Trichloroethene	2.5 {A}	4.1 {A}	3.7 {A}	2.5 {A}
Vinyl chloride	0.1 U	0.052 J {AB}	0.063 J {AB}	0.041 {AB}

MW 64	10/20/2016	10/10/2017	10/03/2018	11/06/2020
Benzene	0.0025 U	0.0067 U	0.01 U/0.01 U	0.0005 U/0.0005 U
Chloroform (Trichloromethane)	0.0025 U	0.0067 U	0.01 U/0.01 U	0.003 U/0.003 U
1,1-Dichloroethene	0.0025 U	0.0067 U	0.01 U/0.01 U	0.002 U/0.002 U
cis-1,2-Dichloroethene	0.062	0.23	0.21/0.21	0.31/0.32
trans-1,2-Dichloroethene	0.0061	0.024	0.023/0.022	0.028/0.028
Ethylbenzene	0.0025 U	0.0067 U	0.01 U/0.01 U	0.001 U/0.001 U
Methylene chloride	0.0025 U	0.0067 U	0.05 U/0.05 U	0.001 U/0.001 U
Tetrachloroethene	0.0025 U	0.0067 U	0.01 U/0.01 U	0.001 U/0.001 U
Toluene	0.0025 U	0.0067 U	0.01 U/0.01 U	0.001 U/0.001 U
1,1,1-Trichloroethane	0.0025 U	0.0067 U	0.01 U/0.01 U	0.001 U/0.001 U
Trichloroethene	0.0025 U	0.0067 U	0.01 U/0.01 U	0.001 U/0.001 U
Vinyl chloride	0.039 {AB}	0.049 {AB}	0.083 {AB}/0.089 {AB}	0.042 {AB}/0.042 {AB}

MW 3	04/20/2016	10/25/2016	04/18/2017	10/12/2017	04/11/2018	10/03/2018	04/28/2019	11/12/2020
Benzene	0.5 U	0.25 U	0.25 U	0.1 U	0.5 U	0.25 U	0.2 U	0.0005 U
Chloroform (Trichloromethane)	0.5 U	0.25 U	0.25 U	0.1 U	0.5 U	0.25 U	0.2 U	0.0018 J
1,1-Dichloroethene	0.5 U	0.25 U	0.075 J	0.074 J	0.5 U	0.068 J	0.063 J	0.015
cis-1,2-Dichloroethene	7.4 {B}	1.9 {B}	7.4 {B}	1.6 {B}	3.2 {B}	4.8 {B}	2.5 {B}	0.63
trans-1,2-Dichloroethene	0.5 U	0.25 U	0.25 U	0.1 U	0.5 U	0.25 U	0.2 U	0.012
Ethylbenzene	0.5 U	0.25 U	0.25 U	0.1 U	0.5 U	0.25 U	0.2 U	0.01 U
Methylene chloride	0.5 U	0.25 U	0.25 U	0.1 U	0.5 U	1.3 U	1 U	0.001 U
Tetrachloroethene	0.5 U	0.25 U	0.25 U	0.1 U	0.5 U	0.25 U	0.2 U	0.0027
Toluene	0.5 U	0.25 U	0.25 U	0.1 U	0.5 U	0.25 U	0.2 U	0.01 U
1,1,1-Trichloroethane	0.39 J	0.33	0.38	0.25	0.35 J	0.34	0.3	0.28
Trichloroethene	12 {A}	4.9 {A}	11 {A}	4.4 {A}	7.8 {A}	8.5 {A}	7.8 {A}	2.1 {A}
Vinyl chloride	0.5 U	0.25 U	0.25 U	0.1 U	0.5 U	0.25 U	0.2 U	0.026 {B}

MW99-18	10/10/2018
Benzene	0.001 U
Chloroform (Trichloromethane)	0.001 U
1,1-Dichloroethene	0.001 U
cis-1,2-Dichloroethene	0.001 U
trans-1,2-Dichloroethene	0.001 U
Ethylbenzene	0.001 U
Methylene chloride	0.005 U
Tetrachloroethene	0.001 U
Toluene	0.001 U
1,1,1-Trichloroethane	0.001 U
Trichloroethene	0.001 U
Vinyl chloride	0.001 U

MW98-18	10/09/2018
Benzene	0.001 U
Chloroform (Trichloromethane)	0.00025 J
1,1-Dichloroethene	0.001 U
cis-1,2-Dichloroethene	0.001 U
trans-1,2-Dichloroethene	0.001 U
Ethylbenzene	0.001 U
Methylene chloride	0.005 U
Tetrachloroethene	0.001 U
Toluene	0.001 U
1,1,1-Trichloroethane	0.001 U
Trichloroethene	0.001 U
Vinyl chloride	0.001 U



MW 81	10/22/2016	10/06/2017	10/09/2018	11/06/2020
Benzene	0.005 U	0.0033 U	0.004 U	0.0005 U
Chloroform (Trichloromethane)	0.005 U	0.0033 U	0.004 U	0.003 U
1,1-Dichloroethene	0.005 U	0.0033 U	0.004 U	0.002 U
cis-1,2-Dichloroethene	0.077	0.096	0.078	0.057
trans-1,2-Dichloroethene	0.005 U	0.0033 U	0.001 J	0.00031 J
Ethylbenzene	0.005 U	0.0033 U	0.004 U	0.001 U
Methylene chloride	0.005 U	0.0033 U	0.02 U	0.001 U
Tetrachloroethene	0.005 U	0.0033 U	0.004 U	0.001 U
Toluene	0.005 U	0.0033 U	0.004 U	0.001 U
1,1,1-Trichloroethane	0.005 U	0.0033 U	0.004 U	0.001 U
Trichloroethene	0.005 U	0.0033 U	0.004 U	0.001 U
Vinyl chloride	0.026 {B}	0.042 {AB}	0.027 {B}	0.037 {AB}

MW 31R	04/20/2016	10/21/2016	04/19/2017	10/12/2017	04/10/2018	10/02/2018	04/28/2019	11/12/2020
Benzene	0.5 U	0.71 U/0.71 U	0.63 U	0.83 U	1 U	1 U/1 U	5 U	0.0034
Chloroform (Trichloromethane)	0.5 U	0.71 U/0.71 U	0.63 U	0.83 U	1 U	1 U/1 U	5 U	0.003 U
1,1-Dichloroethene	0.5 U	0.71 U/0.71 U	0.63 U	0.38 J	1 U	1 U/1 U	5 U	0.048
cis-1,2-Dichloroethene	15 {B}	18 {B}/18 {B}	18 {B}	69 {B}	20 {B}	33 {B}/32 {B}	95 {B}	16 {B}
trans-1,2-Dichloroethene	0.5 U	0.71 U/0.71 U	0.63 U	0.83 U	1 U	1 U/1 U	5 U	0.053
Ethylbenzene	0.46 J	0.76/0.69 J	0.68	0.74 J	0.36 J	0.65 J/0.59 J	0.66 J	0.57
Methylene chloride	0.5 U	0.71 U/0.71 U	0.63 U	0.83 U	1 U	5 U/5 U	25 U	0.0056
Tetrachloroethene	0.5 U	0.71 U/0.71 U	0.63 U	0.83 U	1 U	1 U/1 U	5 U	0.0011
Toluene	1.5	2/1.9	2	3.6	1.5	2.6/2.4	4.7 J	2.4
1,1,1-Trichloroethane	0.5 U	0.71 U/0.71 U	0.63 U	0.83 U	1 U	1 U/1 U	5 U	0.062
Trichloroethene	0.5 U	0.71 U/0.71 U	0.63 U	0.83 U	1 U	1 U/1 U	5 U	0.038 J
Vinyl chloride	1.5 {AB}	3.4 {AB}/3.4 {AB}	2 {AB}	9 {AB}	1.1 {AB}	2.4 {AB}/2.1 {AB}	5.7 {AB}	3.5 {AB}

MW 8	04/20/2016	10/21/2016	04/18/2017	10/12/2017	04/10/2018	10/02/2018	04/29/2019	11/11/2020
Benzene	0.2 U/0.2 U	0.2 U	0.1 U	0.1 U	0.2 U	0.1 U	0.067 U	0.0005 U
Chloroform (Trichloromethane)	0.2 U/0.2 U	0.2 U	0.1 U	0.1 U	0.2 U	0.1 U	0.067 U	0.003 U
1,1-Dichloroethene	0.2 U/0.2 U	0.2 U	0.1 U	0.049 J	0.2 U	0.1 U	0.067 U	0.014
cis-1,2-Dichloroethene	4.9 {B}/4.9 {B}	4.3 {B}	3.1 {B}	4 {B}	3.6 {B}	2.2 {B}	1.4 {B}	2.2 {B}
trans-1,2-Dichloroethene	0.2 U/0.2 U	0.2 U	0.1 U	0.1 U	0.2 U	0.1 U	0.067 U	0.018
Ethylbenzene	0.2 U/0.2 U	0.2 U	0.1 U	0.1 U	0.2 U	0.1 U	0.067 U	0.001 U
Methylene chloride	0.2 U/0.2 U	0.2 U	0.1 U	0.1 U	0.2 U	0.5 U	0.33 U	0.001 U
Tetrachloroethene	0.2 U/0.2 U	0.2 U	0.1 U	0.1 U	0.2 U	0.1 U	0.067 U	0.001 U
Toluene	0.2 U/0.2 U	0.2 U	0.1 U	0.1 U	0.2 U	0.1 U	0.067 U	0.001 U
1,1,1-Trichloroethane	0.2 U/0.2 U	0.2 U	0.1 U	0.1 U	0.2 U	0.1 U	0.067 U	0.0067
Trichloroethene	0.17 J {A}/0.16 J {A}	0.39 {A}	0.09 J {A}	0.37 {A}	0.15 J {A}	0.17 {A}	0.089 {A}	0.16 {A}
Vinyl chloride	2.1 {AB}/2 {AB}	1.3 {AB}	1.6 {AB}	1.3 {AB}	0.62 {AB}	0.64 {AB}	0.87 {AB}	0.71 {AB}

MW 21	10/21/2016	10/18/2017	10/03/2018	11/11/2020
Benzene	0.001 U	0.001 U	0.001 U	0.0005 U
Chloroform (Trichloromethane)	0.001 U	0.001 U	0.001 U	0.003 U
1,1-Dichloroethene	0.001 U	0.001 U	0.001 U	0.002 U
cis-1,2-Dichloroethene	0.001 U	0.001 U	0.00046 J	0.001 U
trans-1,2-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
Ethylbenzene	0.001 U	0.001 U	0.001 U	0.001 U
Methylene chloride	0.001 U	0.001 U	0.005 U	0.001 U
Tetrachloroethene	0.001 U	0.001 U	0.001 U	0.001 U
Toluene	0.001 U	0.001 U	0.001 U	0.001 U
1,1,1-Trichloroethane	0.001 U	0.001 U	0.001 U	0.001 U
Trichloroethene	0.001 U	0.001 U	0.0013	0.001 U
Vinyl chloride	0.001 U	0.001 U	0.001 U	0.001 U

MW 68	04/19/2016	10/20/2016	04/17/2017	10/11/2017	04/11/2018	10/02/2018	04/26/2019	11/12/2020
Benzene	0.17 U	0.2 U	0.13 U	0.1 U	0.2 U	0.2 U	0.2 U	0.0038/0.0043
Chloroform (Trichloromethane)	0.17 U	0.2 U	0.13 U	0.1 U	0.2 U	0.2 U	0.2 U	0.003 U/0.003 U
1,1-Dichloroethene	0.17 U	0.2 U	0.13 U	0.055 J	0.2 U	0.2 U	0.2 U	0.019/0.02
cis-1,2-Dichloroethene	4.5 {B}	3.5 {B}	3.7 {B}	4.2 {B}	3.7 {B}	4.4 {B}	4.4 {B}	3 {B}/3 {B}
trans-1,2-Dichloroethene	0.12 J	0.14 J	0.15	0.16	0.15 J	0.17 J	0.17 J	0.15/0.17
Ethylbenzene	0.17 U	0.2 U	0.13 U	0.1 U	0.2 U	0.2 U	0.2 U	0.001 U/0.001 U
Methylene chloride	0.17 U	0.2 U	0.13 U	0.1 U	0.2 U	1 U	1 U	0.001 U/0.001 U
Tetrachloroethene	0.17 U	0.2 U	0.13 U	0.1 U	0.2 U	0.2 U	0.2 U	0.001 U/0.001 U
Toluene	0.17 U	0.2 U	0.13 U	0.1 U	0.2 U	0.2 U	0.2 U	0.001 U/0.001 U
1,1,1-Trichloroethane	0.17 U	0.2 U	0.13 U	0.1 U	0.2 U	0.2 U	0.2 U	0.001 U/0.001 U
Trichloroethene	1 {A}	1.7 {A}	1.5 {A}	1.6 {A}	1.7 {A}	1.4 {A}	1.4 {A}	1.1 {A}/1.2 {A}
Vinyl chloride	0.15 J {AB}	0.15 J {AB}	0.13 {AB}	0.16 {AB}	0.099 J {AB}	0.11 J {AB}	0.16 J {AB}	0.22 {AB}/0.23 {AB}

MW 40	04/19/2016	10/20/2016	04/19/2017	10/10/2017	04/13/2018	10/03/2018	04/29/2019	11/12/2020
Benzene	0.2 U	0.25 U	0.13 U	0.13 U/0.13 U	0.33 U	0.2 U	0.2 U	0.0049
Chloroform (Trichloromethane)	0.2 U	0.25 U	0.13 U	0.13 U/0.13 U	0.33 U	0.2 U	0.2 U	0.003 U
1,1-Dichloroethene	0.2 U	0.25 U	0.13 U	0.067 J/0.064 J	0.33 U	0.2 U	0.2 U	0.023
cis-1,2-Dichloroethene	7 {B}	5 {B}	5.4 {B}	5.4 {B}/5.5 {B}	5.8 {B}	5.4 {B}	4.6 {B}	3.1 {B}
trans-1,2-Dichloroethene	0.1 J	0.25 U	0.073 J	0.061 J/0.057 J	0.33 U	0.078 J	0.058 J	0.079
Ethylbenzene	0.2 U	0.25 U	0.13 U	0.13 U/0.13 U	0.33 U	0.2 U	0.2 U	0.001 U
Methylene chloride	0.2 U	0.25 U	0.13 U	0.13 U/0.13 U	0.18 J	1 U	1 U	0.001 U
Tetrachloroethene	0.2 U	0.25 U	0.13 U	0.13 U/0.13 U	0.33 U	0.2 U	0.2 U	0.001 U
Toluene	0.2 U	0.25 U	0.13 U	0.13 U/0.13 U	0.33 U	0.2 U	0.2 U	0.001 U
1,1,1-Trichloroethane	0.2 U	0.25 U	0.13 U	0.13 U/0.13 U	0.33 U	0.2 U	0.2 U	0.001 U
Trichloroethene	0.31 {A}	0.16 J {A}	0.4 {A}	0.36 {A}/0.35 {A}	0.34 {A}	0.28 {A}	0.2 U	0.18 {A}
Vinyl chloride	0.36 {AB}	0.31 {AB}	0.26 {AB}	0.17 {AB}/0.18 {AB}	0.18 J {AB}	0.22 {AB}	0.24 {AB}	0.22 {AB}

MW 83	10/22/2016	10/11/2017	12/13/2018	11/11/2020
Benzene	0.001 U/0.001 U	0.001 U	0.001 U	0.0005 U
Chloroform (Trichloromethane)	0.001 U/0.001 U	0.001 U	0.001 U	0.003 U
1,1-Dichloroethene	0.001 U/0.001 U	0.001 U	0.001 U	0.002 U
cis-1,2-Dichloroethene	0.001 U/0.001 U	0.00041 J	0.001 U	0.001 U
trans-1,2-Dichloroethene	0.001 U/0.001 U	0.001 U	0.001 U	0.001 U
Ethylbenzene	0.001 U/0.001 U	0.001 U	0.001 U	0.001 U
Methylene chloride	0.001 U/0.001 U	0.001 U	0.005 U	0.001 U
Tetrachloroethene	0.001 U/0.001 U	0.001 U	0.001 U	0.001 U
Toluene	0.001 U/0.001 U	0.001 U	0.001 U	0.001 U
1,1,1-Trichloroethane	0.001 U/0.001 U	0.001 U	0.001 U	0.001 U
Trichloroethene	0.001 U/0.001 U	0.00045 J	0.001 U	0.001 U
Vinyl chloride	0.0053 {B}/0.0053 {B}	0.0076 {B}	0.012 {B}	0.015 {B}

MW 66	04/20/2016	10/20/2016	04/19/2017	10/10/2017	04/11/2018	10/03/2018	04/25/2019	11/06/2020
Benzene	0.05 U	0.1 U	0.063 U	0.067 U	0.2 U	0.2 U	0.1 U	0.0005 U
Chloroform (Trichloromethane)	0.05 U	0.1 U	0.063 U	0.067 U	0.2 U	0.2 U	0.1 U	0.003 U
1,1-Dichloroethene	0.05 U	0.1 U	0.063 U	0.067 U	0.2 U	0.2 U	0.1 U	0.00097 J
cis-1,2-Dichloroethene	1.1 {B}	1.8 {B}	2.2 {B}	3 {B}	2.6 {B}	3.4 {B}	3.3 {B}	2.3 {B}
trans-1,2-Dichloroethene	0.052	0.075 J	0.094	0.15	0.13 J	0.18 J	0.11	0.14
Ethylbenzene	0.05 U	0.1 U	0.063 U	0.067 U	0.2 U	0.2 U	0.1 U	0.001 U
Methylene chloride	0.05 U	0.1 U	0.063 U	0.067 U	0.2 U	1 U	0.5 U	0.001 U
Tetrachloroethene	0.05 U	0.1 U	0.063 U	0.067 U	0.2 U	0.2 U	0.1 U	0.001 U
Toluene	0.05 U	0.1 U	0.063 U	0.067 U	0.2 U	0.2 U	0.1 U	0.001 U
1,1,1-Trichloroethane	0.05 U	0.1 U	0.063 U	0.067 U	0.2 U	0.2 U	0.1 U	0.00096 J
Trichloroethene	0.05 U	0.1 U	0.063 U	0.067 U	0.2 U	0.2 U	0.1 U	0.001 U
Vinyl chloride	0.14 {AB}	0.14 {AB}	0.11 {AB}	0.075 {AB}	0.2 U	0.2 U	0.036 J {AB}	0.018 {B}

LEGEND

- SITE BOUNDARY
- LOT LINE
- RAILROAD
- FENCE LINE
- POND BOUNDARY
- BUILDING
- MONITORING WELL LOCATION

MW 61	10/4/2018 3d
Benzene	0.001 U
Chloroform (Trichloromethane)	0.001 U
1,1-Dichloroethene	0.001 U
cis-1,2-Dichloroethene	0.001 U
trans-1,2-Dichloroethene	0.001 U
Ethylbenzene	0.001 U
Methylene chloride	0.005 U
Tetrachloroethene	0.001 U
Toluene	0.001 U
1,1,1-Trichloroethane	0.001 U
Trichloroethene	0.001 U
Vinyl chloride	0.0013

SAMPLE LOCATION

SAMPLE DATE

GEOLOGIC UNIT

WS - SURFACE WATER
1 - UNIT 1, PERCHED GROUNDWATER IN FILL
3S - UNIT 3, SHALLOW GROUNDWATER IN UPPERMOST AQUIFER
3I - UNIT 3, INTERMEDIATE GROUNDWATER IN UPPERMOST AQUIFER
3D - UNIT 3, DEEP GROUNDWATER IN UPPERMOST AQUIFER
B - BEDROCK, GROUNDWATER IN BEDROCK AQUIFER

CONCENTRATION (mg/L)

PARAMETER

0.24 {A} EXCEEDANCE OF ONE OR MORE SCREENING CRITERIA

SCREENING CRITERIA

CHEMICAL NAME	A	B	UNIT
Benzene	0.12	-	mg/L
Chloroform (Trichloromethane)	-	-	mg/L
1,1-Dichloroethene	1.3	5.1	mg/L
cis-1,2-Dichloroethene	-	1	mg/L
trans-1,2-Dichloroethene	-	2	mg/L
Ethylbenzene	-	-	mg/L
Methylene chloride	-	-	mg/L
Tetrachloroethene	0.47	-	mg/L
Toluene	-	-	mg/L
1,1,1-Trichloroethane	54	29	mg/L
Trichloroethene	0.038	29	mg/L
Vinyl chloride	0.035	0.0038	mg/L

A IDEM Vapor Exp Comm/Ind Criteria (2019)
B Site-Specific Closure Level (SSCLCITW)

NOTES:

1. Parameters that do not appear in the databox for a particular sample were not analyzed.
2. Sample results rounded to three decimal places.
3. Screening criteria and sample results are compared to two significant digits. Results equal to screening criteria are not highlighted as exceedances.
4. The concentrations of chlorobenzene (0.15 mg/L J), tetrachloroethene (0.43 mg/L J), and styrene (0.14 mg/L J) in the June 2008 sample from monitoring well MW-40 exceed the drinking water criteria. However, these VOCs were not detected at MW-40 in December 2008, and have been either not detected (chlorobenzene and styrene) or detected sporadically (tetrachloroethene) at other wells in the groundwater monitoring network. Because these VOCs have been detected so sporadically, they have essentially no spatial or temporal distribution, and as such, they have not been added to the databoxes.
5. CITW - Commercial/Industrial Tap Water Use
6. U - Not detected at the associated reporting limit
7. J - Estimated concentration

0 150 300 ft
Coordinate System:
STATE PLANE
INDIANA EAST -
NAD83

N

GHD

REVITALIZING AUTO COMMUNITIES
ENVIRONMENTAL RESPONSE TRUST
2915 DR. MARTIN LUTHER KING JR. BLVD.
ANDERSON, INDIANA
GROUNDWATER MONITORING PLAN

ON-SITE VOC GROUNDWATER RESULTS
(2016 - 2020)

Project No. 11209506
Date June 2021

FIGURE 8

Filename: N:\CA\St Catharines\Projects\562\11209506\Digital_Design\ACAD 2020\Figures\RPT-005\11209506-GHD-0000-RPT-EN-0107_WA-005.DWG
Plot Date: 17 June 2021 1:21 PM

MW 85	04/22/2016	10/24/2016	04/18/2017	10/17/2017	04/12/2018	10/08/2018	04/29/2019	11/03/2020
Benzene	0.5 U/0.5 U	0.56 U	0.33 U	0.2 U	0.5 U	0.5 U	0.2 U	0.33 U
Chloroform (Trichloromethane)	0.5 U/0.5 U	0.56 U	0.33 U	0.2 U	0.5 U	0.5 U	0.2 U	0.33 U
1,1-Dichloroethene	0.5 U/0.5 U	0.56 U	0.33 U	0.2 U	0.5 U	0.5 U	0.2 U	0.33 U
cis-1,2-Dichloroethene	9.9 {ADE}/10 {ADE}	8.4 {ADE}	8.4 {ADE}	8.6 {ADE}	7.3 {ADE}	8 {ADE}	4.4 {ADE}	6.1 {ADE}
trans-1,2-Dichloroethene	0.23 J {A}/0.26 J {A}	0.26 J {A}	0.28 J {A}	0.29 {A}	0.26 J {A}	0.28 J {A}	0.1 J	0.19 J {A}
Ethylbenzene	0.5 U/0.5 U	0.56 U	0.33 U	0.2 U	0.5 U	0.5 U	0.2 U	0.33 U
Methylene chloride	0.5 U/0.5 U	0.56 U	0.33 U	4.3 {A}	0.5 U	2.5 U	1 U	1.7 U
Tetrachloroethene	0.5 U/0.5 U	0.56 U	0.33 U	0.2 U	0.5 U	0.5 U	0.2 U	0.33 U
Toluene	0.5 U/0.5 U	0.56 U	0.33 U	0.2 U	0.5 U	0.5 U	0.2 U	0.33 U
1,1,1-Trichloroethane	0.5 U/0.5 U	0.56 U	0.33 U	0.2 U	0.5 U	0.5 U	0.2 U	0.33 U
Trichloroethene	0.5 U/0.5 U	0.56 U	0.33 U	0.2 U	0.5 U	0.5 U	0.2 U	0.33 U
Vinyl chloride	0.34 J {ABCDE}/0.35 J {ABCDE}	0.42 J {ABCDE}	0.42 {ABCDE}	0.45 {ABCDE}	0.35 J {ABCDE}	0.68 {ABCDE}	0.32 {ABCDE}	0.56 {ABCDE}

Pond North	04/22/2016	07/19/2016	10/24/2016	04/18/2017	07/12/2017	10/19/2017	04/09/2018	07/05/2018	10/09/2018	04/24/2019	10/08/2019	11/03/2020
Benzene	0.005 U	0.0025 U/0.0025 U	0.033 U	0.0067 U/0.0067 U	0.0033 U/0.0033 U	0.01 U	0.011 U/0.01 U	0.0063 U	0.0067 U/0.0067 U	0.005 U	0.005 U/0.005 U	0.01 U/0.01 U
Chloroform (Trichloromethane)	0.005 U	0.0025 U/0.0025 U	0.033 U	0.0067 U/0.0067 U	0.0033 U/0.0033 U	0.01 U	0.011 U/0.01 U	0.0063 U	0.0067 U/0.0067 U	0.005 U	0.005 U/0.005 U	0.01 U/0.01 U
1,1-Dichloroethene	0.005 U	0.0025 U/0.0025 U	0.033 U	0.0067 U/0.0067 U	0.0033 U/0.0033 U	0.01 U	0.011 U/0.01 U	0.0063 U	0.0067 U/0.0067 U	0.005 U	0.005 U/0.005 U	0.01 U/0.01 U
cis-1,2-Dichloroethene	0.12 {A}	0.09 {A}/0.081 {A}	0.5 {A}	0.21 {A}/0.2 {A}	0.11 {A}/0.1 {A}	0.35 {A}	0.21 {A}/0.22 {A}	0.16 {A}	0.13 {A}/0.13 {A}	0.18 {A}	0.1 {A}/0.1 {A}	0.2 {A}/0.2 {A}
trans-1,2-Dichloroethene	0.0053	0.003/0.0027	0.021 J	0.0084/0.0092	0.0041/0.004	0.014	0.0071 J/0.0087 J	0.0095	0.0033 J/0.0037 J	0.0066	0.0025 J/0.0027 J	0.0074 J/0.0071 J
Ethylbenzene	0.005 U	0.0025 U/0.0025 U	0.033 U	0.0067 U/0.0067 U	0.0033 U/0.0033 U	0.01 U	0.011 U/0.01 U	0.0063 U	0.0067 U/0.0067 U	0.005 U	0.005 U/0.005 U	0.01 U/0.01 U
Methylene chloride	0.0053 U	0.0025 U/0.0025 U	0.033 U	0.0067 U/0.0067 U	0.0033 U/0.0033 U	0.01 U	0.011 U/0.034 U	0.031 U	0.033 U/0.033 U	0.025 U	0.025 U/0.025 U	0.05 U/0.05 U
Tetrachloroethene	0.005 U	0.0025 U/0.0025 U	0.033 U	0.0067 U/0.0067 U	0.0033 U/0.0033 U	0.01 U	0.011 U/0.01 U	0.0063 U	0.0067 U/0.0067 U	0.005 U	0.005 U/0.005 U	0.01 U/0.01 U
Toluene	0.005 U	0.0025 U/0.0025 U	0.033 U	0.0067 U/0.0067 U	0.0033 U/0.0033 U	0.01 U	0.011 U/0.01 U	0.0063 U	0.0067 U/0.0067 U	0.005 U	0.005 U/0.005 U	0.01 U/0.01 U
1,1,1-Trichloroethane	0.005 U	0.0025 U/0.0025 U	0.033 U	0.0067 U/0.0067 U	0.00094 J/0.00095 J	0.01 U	0.011 U/0.01 U	0.0063 U	0.0067 U/0.0067 U	0.005 U	0.005 U/0.005 U	0.01 U/0.01 U
Trichloroethene	0.005 U	0.0025 U/0.0025 U	0.033 U	0.0067 U/0.0067 U	0.0071 {A}/0.0073 {A}	0.01 U	0.011 U/0.01 U	0.0063 U	0.0067 U/0.0067 U	0.0011 J	0.005 U/0.005 U	0.01 U/0.01 U
Vinyl chloride	0.0078 {ABDE}	0.0064 {ABDE}/0.0062 {ABDE}	0.033 U	0.01 {ABDE}/0.011 {ABDE}	0.0053 {ABDE}/0.0052 {ABDE}	0.017 {ABDE}	0.014 {ABDE}/0.018 {ABDE}	0.023 J {ABDE}	0.0059 J {ABDE}/0.0064 J {ABDE}	0.0099 {ABDE}	0.0039 J {ABDE}/0.004 J {ABDE}	0.011 {ABDE}/0.0091 J {ABDE}

MW 58	10/25/2016	10/17/2017	10/08/2018	11/03/2020
Benzene	0.05 U	0.05 U	0.2 U	0.14 U/0.14 U
Chloroform (Trichloromethane)	0.05 U	0.05 U	0.2 U	0.14 U/0.14 U
1,1-Dichloroethene	0.05 U	0.05 U	0.2 U	0.14 U/0.14 U
cis-1,2-Dichloroethene	1.1 {ADE}	2.2 {ADE}	3 {ADE}	2.9 {ADE}/2.9 {ADE}
trans-1,2-Dichloroethene	0.025 J	0.081	0.13 J {A}	0.14 {A}/0.14 {A}
Ethylbenzene	0.05 U	0.05 U	0.2 U	0.14 U/0.14 U
Methylene chloride	0.05 U	1.1 {A}	1 U	0.71 U/0.71 U
Tetrachloroethene	0.05 U	0.05 U	0.2 U	0.14 U/0.14 U
Toluene	0.05 U	0.05 U	0.2 U	0.14 U/0.14 U
1,1,1-Trichloroethane	0.05 U	0.05 U	0.2 U	0.14 U/0.14 U
Trichloroethene	0.05 U	0.05 U	0.2 U	0.14 U/0.14 U
Vinyl chloride	0.085 {ABCDE}	0.059 {ABCDE}	0.064 J {ABCDE}	0.13 J {ABCDE}/0.12 J {ABCDE}

MW-4	04/22/2016	10/24/2016	04/18/2017	10/17/2017	04/12/2018	10/08/2018	04/29/2019	11/03/2020
Benzene	0.5 U	0.56 U	0.33 U	0.17 U/0.17 U	0.5 U/0.5 U	0.5 U	0.25 U	0.33 U
Chloroform (Trichloromethane)	0.5 U	0.56 U	0.33 U	0.17 U/0.17 U	0.5 U/0.5 U	0.5 U	0.25 U	0.33 U
1,1-Dichloroethene	0.5 U	0.56 U	0.33 U	0.12 J {A}/0.12 J {A}	0.5 U/0.5 U	0.5 U	0.25 U	0.33 U
cis-1,2-Dichloroethene	9.4 {ADE}	7.9 {ADE}	8.6 {ADE}	8.6 {ADE}/8 {ADE}	8.8 {ADE}/8.3 {ADE}	8.9 {ADE}	6.8 {ADE}	7.8 {ADE}
trans-1,2-Dichloroethene	0.23 J {A}	0.2 J {A}	0.26 J {A}	0.2 {A}/0.19 {A}	0.21 J {A}/0.22 J {A}	0.2 J {A}	0.13 J {A}	0.14 J {A}
Ethylbenzene	0.5 U	0.56 U	0.33 U	0.17 U/0.17 U	0.5 U/0.5 U	0.5 U	0.25 U	0.33 U
Methylene chloride	0.5 U	0.56 U	0.33 U	3.2 {A}/3.5 {A}	0.5 U/0.5 U	2.5 U	1.3 U	1.7 U
Tetrachloroethene	0.5 U	0.56 U	0.33 U	0.17 U/0.17 U	0.5 U/0.5 U	0.5 U	0.25 U	0.33 U
Toluene	0.5 U	0.56 U	0.33 U	0.17 U/0.17 U	0.5 U/0.5 U	0.5 U	0.25 U	0.33 U
1,1,1-Trichloroethane	0.5 U	0.56 U	0.33 U	0.16 J/0.17 U	0.5 U/0.5 U	0.5 U	0.25 U	0.33 U
Trichloroethene	0.8 {ABCD}	1.7 {ABCD}	1.1 {ABCD}	2.4 {ABCD}/2.1 {ABCD}	1.3 {ABCD}/1.4 {ABCD}	1.6 {ABCD}	0.8 {ABCD}	1 {ABCD}
Vinyl chloride	0.53 {ABCDE}	0.63 {ABCDE}	0.84 {ABCDE}	0.73 {ABCDE}/0.66 {ABCDE}	0.68 {ABCDE}/0.65 {ABCDE}	0.68 {ABCDE}	0.5 {ABCDE}	0.56 {ABCDE}

MW 46	10/23/2016	10/16/2017	10/05/2018	10/16/2019	11/05/2020
Benzene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Chloroform (Trichloromethane)	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,1-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
cis-1,2-Dichloroethene	0.001 U	0.001 U	0.001 U	0.0005 J	0.001 U
trans-1,2-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Ethylbenzene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Methylene chloride	0.001 U	0.012 U	0.005 U	0.005 U	0.005 U
Tetrachloroethene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Toluene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,1,1-Trichloroethane	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Trichloroethene	0.001 U	0.001 U	0.00015 J	0.001 U	0.001 U
Vinyl chloride	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U

MW 49	04/21/2016	04/11/2018	10/03/2018	04/25/2019	10/16/2019	11/05/2020
Benzene	0.033 U	0.05 U	0.04 U	0.033 U	0.05 U/0.05 U	0.033 U
Chloroform (Trichloromethane)	0.033 U	0.05 U	0.04 U	0.033 U	0.05 U/0.05 U	0.033 U
1,1-Dichloroethene	0.033 U	0.05 U	0.04 U	0.033 U	0.05 U/0.05 U	0.033 U
cis-1,2-Dichloroethene	0.83 {A}	0.89 {A}	0.89 {A}	0.83 {A}	0.69 {A}/0.7 {A}	0.6 {A}
trans-1,2-Dichloroethene	0.02 J	0.027 J	0.029 J	0.031 J	0.016 J/0.019 J	0.023 J
Ethylbenzene	0.033 U	0.05 U	0.04 U	0.033 U	0.05 U/0.05 U	0.033 U
Methylene chloride	0.033 U	0.05 U	0.2 U	0.17 U	0.25 U/0.25 U	0.17 U
Tetrachloroethene	0.033 U	0.05 U	0.04 U	0.033 U	0.05 U/0.05 U	0.033 U
Toluene	0.033 U	0.05 U	0.04 U	0.033 U	0.05 U/0.05 U	0.033 U
1,1,1-Trichloroethane	0.033 U	0.05 U	0.04 U	0.033 U	0.05 U/0.05 U	0.033 U
Trichloroethene	0.033 U	0.05 U	0.047 {ABC}	0.029 J {AB}	0.05 U/0.05 U	0.021 J {AB}
Vinyl chloride	0.011 J {ABDE}	0.05 U	0.04 U	0.033 U	0.05 U/0.05 U	0.033 U

MW-7	10/18/2017	10/09/2018	11/03/2020
Benzene	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U
Chloroform (Trichloromethane)	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U
1,1-Dichloroethene	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U
cis-1,2-Dichloroethene	0.001 U/0.001 U	0.00018 J/0.001 U	0.001 U
trans-1,2-Dichloroethene	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U
Ethylbenzene	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U
Methylene chloride	0.001 U/0.001 U	0.005 U/0.005 U	0.005 U
Tetrachloroethene	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U
Toluene	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U
1,1,1-Trichloroethane	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U
Trichloroethene	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U
Vinyl chloride	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U

MW89-11	04/20/2016	10/25/2016	04/19/2017	10/17/2017	04/11/2018	10/08/2018	04/25/2019	11/05/2020
Benzene	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Chloroform (Trichloromethane)	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,1-Dichloroethene	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U	0.00059 J	0.001 U	0.00023 J	0.001 U	0.001 U
cis-1,2-Dichloroethene	0.001 U/0.001 U	0.0003 J/0.001 U	0.0033 U	0.00059 J	0.001 U	0.001 U	0.00037 J	0.001 U
trans-1,2-Dichloroethene	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Ethylbenzene	0.001 U/0.001 U	0.001 U/0.001 U	0.00039 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Methylene chloride	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U	0.001 U	0.001 U	0.005 U	0.005 U	0.005 U
Tetrachloroethene	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Toluene	0.001 U/0.001 U	0.001 U/0.001 U	0.00084 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1,1,1-Trichloroethane	0.001 U/0.001 U	0.0019/0.0019	0.00033 J	0.0026	0.00066 J	0.0029	0.00057 J	0.0062
Trichloroethene	0.001 U/0.001 U	0.001 U/0.001 U	0.00036 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Vinyl chloride	0.001 U/0.001 U	0.001 U/0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U

MW97R-16	10/25/2016	10/18/2017	10/09/2018	11/03/2020
Benzene	0.001 U	0.001 U	0.001 U	0.001 U
Chloroform (Trichloromethane)	0.001 U	0.001 U	0.001 U	0.001 U
1,1-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
cis-1,2-Dichloroethene	0.0012	0.001 U	0.001 U	0.001 U
trans-1,2-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
Ethylbenzene	0.001 U	0.001 U	0.001 U	0.001 U
Methylene chloride	0.001 U	0.001 U	0.005 U	0.005 U
Tetrachloroethene	0.001 U	0.001 U	0.001 U	0.001 U
Toluene	0.001 U	0.001 U	0.001 U	0.001 U
1,1,1-Trichloroethane	0.001 U	0.001 U	0.001 U	0.001 U
Trichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
Vinyl chloride	0.001 U	0.001 U	0.001 U	0.001 U

MW-2	10/24/2016	10/17/2017	10/08/2018	11/03/2020
Benzene	0.001 U	0.001 U	0.001 U	0.001 U
Chloroform (Trichloromethane)	0.001 U	0.001 U	0.001 U	0.001 U
1,1-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
cis-1,2-Dichloroethene	0.001 U	0.0014	0.001 U	0.001 U
trans-1,2-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
Ethylbenzene	0.001 U	0.001 U	0.001 U	0.001 U
Methylene chloride	0.001 U	0.001 U	0.005 U	0.005 U
Tetrachloroethene	0.001 U	0.001 U	0.001 U	0.001 U
Toluene	0.001 U	0.001 U	0.001 U	0.001 U
1,1,1-Trichloroethane	0.001 U	0.001 U	0.001 U	0.001 U
Trichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
Vinyl chloride	0.001 U	0.001 U	0.001 U	0.001 U

MW 37	10/23/2016	10/16/2017	10/05/2018	11/04/2020
Benzene	0.001 U	0.001 U	0.001 U	0.001 U
Chloroform (Trichloromethane)	0.001 U	0.001 U	0.001 U	0.001 U
1,1-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
cis-1,2-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
trans-1,2-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
Ethylbenzene	0.001 U	0.001 U	0.001 U	0.001 U
Methylene chloride	0.001 U	0.013 U	0.005 U	0.005 U
Tetrachloroethene	0.001 U	0.001 U	0.001 U	0.001 U
Toluene	0.001 U	0.001 U	0.001 U	0.001 U
1,1,1-Trichloroethane	0.001 U	0.001 U	0.001 U	0.001 U
Trichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
Vinyl chloride	0.001 U	0.001 U	0.001 U	0.001 U

MW 56	10/24/2016	10/18/2017	10/05/2018	11/03/2020
Benzene	0.001 U	0.001 U	0.001 U	0.001 U
Chloroform (Trichloromethane)	0.001 U	0.001 U	0.001 U	0.001 U
1,1-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
cis-1,2-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
trans-1,2-Dichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
Ethylbenzene	0.001 U	0.001 U	0.001 U	0.001 U
Methylene chloride	0.001 U	0.001 U	0.005 U	0.005 U
Tetrachloroethene	0.001 U	0.001 U	0.001 U	0.001 U
Toluene	0.001 U	0.001 U	0.001 U	0.001 U
1,1,1-Trichloroethane	0.001 U	0.001 U	0.001 U	0.001 U
Trichloroethene	0.001 U	0.001 U	0.001 U	0.001 U
Vinyl chloride	0.001 U	0.001 U	0.001 U	0.00066 J

MW 57	10/24/2016	10/18/2017	10/08/2018	11/03/2020
Benzene	0.002 U	0.0033 U	0.001 U	0.05 U
Chloroform (Trichloromethane)	0.002 U	0.0033 U	0.001 U	0.05 U
1,1-Dichloroethene	0.002 U	0.0033 U	0.001 U	0.05 U
cis-1,2-Dichloroethene	0.0042	0.0033 U	0.0082 U	0.18 {A}
trans-1,2-Dichloroethene	0.002 U	0.0033 U	0.001 U	0.05 U
Ethylbenzene	0.002 U	0.0033 U	0.001 U	0.05 U
Methylene chloride	0.002 U	0.0037 U	0.005 U	0.25 U
Tetrachloroethene	0.002 U	0.0033 U	0.001 U	0.05 U
Toluene	0.002 U	0.0033 U	0.001 U	0.05 U
1,1,1-Trichloroethane	0.002 U	0.0033 U	0.001 U	0.05 U
Trichloroethene	0.002 U	0.0033 U	0.001 U	0.05 U
Vinyl chloride	0.046 {ABCDE}	0.096 {ABCDE}	0.02 {ABDE}	0.98 {ABCDE}

Pond Intake	04/22/2016	07/19/2016	10/24/2016	04/18/2017	07/12/2017	10/19/2017	04/09/2018	07/05/2018	10/09/2018	04/24/2019	10/08/2019	11/03/2020
Benzene	0.0025 U	0.0017 U	0.0018 U/0.002 U	0.0017 U	0.004 U	0.002 U	0.005 U	0.0033 U/0.0033 U	0.005 U	0.0033 U/0.0033 U	0.0017 U	0.0025 U
Chloroform (Trichloromethane)	0.0025 U	0.0017 U	0.0018 U/0.002 U	0.0017 U	0.004 U	0.002 U	0.005 U	0.0033 U/0.0033 U	0.005 U	0.0033 U/0.0033 U	0.0017 U	0.0025 U
1,1-Dichloroethene	0.0025 U	0.0017 U	0.0018 U/0.002 U	0.0017 U	0.004 U	0.002 U	0.005 U	0.0033 U/0.0033 U	0.005 U	0.0033 U/0.0033 U	0.0017 U	0.0025 U
cis-1,2-Dichloroethene	0.077 {A}	0.055	0.036/0.034	0.059	0.11 {A}	0.052	0.12 {A}	0.077 {A}/0.072 {A}	0.1 {A}	0.12 J+ {A}/0.1 {A}	0.061	0.076 {A}
trans-1,2-Dichloroethene	0.003	0.0016 J	0.001 J/0.0009 J	0.0023	0.0043	0.0014 J	0.0046 J	0.0019 J/0.0017 J	0.0025 J	0.0041 J+/0.0038	0.001 J	0.0024 J
Ethylbenzene	0.0025 U	0.0017 U	0.0018 U/0.002 U	0.0017 U	0.004 U	0.002 U	0.005 U	0.0033 U/0.0033 U	0.005 U	0.0033 U/0.0033 U	0.0017 U	0.0025 U
Methylene chloride	0.0025 U	0.0017 U	0.0018 U/0.002 U	0.0017 U	0.004 U	0.002 U	0.016 U	0.017 U/0.017 U	0.025 U	0.017 U/0.017 U	0.0084 U	0.013 U
Tetrachloroethene	0.0025 U	0.0017 U	0.0018 U/0.002 U	0.0017 U	0.004 U	0.002 U	0.005 U	0.0033 U/0.0033 U	0.005 U	0.0033 U/0.0033 U	0.0017 U	0.0025 U
Toluene	0.0025 U	0.0017 U	0.0018 U/0.002 U	0.0017 U	0.004 U	0.002 U	0.005 U	0.0033 U/0.0033 U	0.005 U	0.0033 U/0.0033 U	0.0017 U	0.0025 U
1,1,1-Trichloroethane	0.0025 U	0.0017 U	0.0018 U/0.002 U	0.0017 U	0.00092 J	0.002 U	0.005 U	0.0033 U/0.0033 U	0.005 U	0.0033 U/0.0033 U	0.0017 U	0.0025 U
Trichloroethene	0.0025 U	0.0017 U	0.0018 U/0.002 U	0.0017 U	0.0073 {A}	0.002 U	0.005 U	0.0033 U/0.0033 U	0.005 U	0.001 J+/0.0009 J	0.0017 U	0.0025 U
Vinyl chloride	0.0044 {ABDE}	0.0049 {ABDE}	0.0031 {ABD}/0.0029 {ABD}	0.0063 {ABDE}	0.0051 {ABDE}	0.0048 {ABDE}	0.013 {ABDE}	0.0073 {ABDE}/0.0076 {ABDE}	0.005 {ABDE}	0.0089 J+ {ABDE}/0.0086 {ABDE}	0.0039 {ABDE}	0.0039 {ABDE}

LEGEND

- SITE BOUNDARY
- LOT LINE
- RAILROAD
- FENCE LINE
- POND BOUNDARY
- BUILDING
- MONITORING WELL LOCATION

MW97-14	10/20/2015 3d
Benzene	0.001 U
Chloroform (Trichloromethane)	0.001 U
1,1-Dichloroethene	0.001 U
cis-1,2-Dichloroethene	0.001 U
trans-1,2-Dichloroethene	0.001 U
Ethylbenzene	0.001 U
Methylene chloride	0.001 U
Tetrachloroethene	0.001 U
Toluene	0.001 U
1,1,1-Trichloroethane	0.001 U
Trichloroethene	0.001 U
Vinyl chloride	0.001 U

SAMPLE LOCATION
SAMPLE DATE
GEOLOGIC UNIT

WS - SURFACE WATER
1 - UNIT 1, PERCHED GROUNDWATER IN FILL
3S - UNIT 3, SHALLOW GROUNDWATER IN UPPERMOST AQUIFER
3I - UNIT 3, INTERMEDIATE GROUNDWATER IN UPPERMOST AQUIFER
3D - UNIT 3, DEEP GROUNDWATER IN UPPERMOST AQUIFER
B - BEDROCK, GROUNDWATER IN BEDROCK AQUIFER

CONCENTRATION (mg/L)

PARAMETER

🟩 0.24 {A} EXCEEDANCE OF ONE OR MORE SCREENING CRITERIA

SCREENING CRITERIA

CHEMICAL NAME	A	B	C	D	E	UNIT
Benzene	0.005	0.028	0.12	-	-	mg/L
Chloroform (Trichloromethane)	0.08	-	-	-	-	mg/L
1,1-Dichloroethene	0.007	0.3	1.3	24.1	5.1	mg/L
cis-1,2-Dichloroethene	0.07	-	-	1	1	mg/L
trans-1,2-Dichloroethene	0.1	-	-	10	2	mg/L
Ethylbenzene	0.7	-	-	-	-	mg/L
Methylene chloride	0.005	-	-	-	-	mg/L
Tetrachloroethene	0.005	0.11	0.47	-	-	mg/L
Toluene	1	-	-	-	-	mg/L
1,1,1-Trichloroethane	0.2	13	54	818	29	mg/L
Trichloroethene	0.005	0.0091	0.038	0.127	29	mg/L
Vinyl chloride	0.002	0.0021	0.035	0.000848	0.0038	mg/L

A IDEM Residential Tap Water (2019)
B IDEM Vapor Exp Residential Criteria (2019)
C IDEM Vapor Exp Comm/Ind Criteria (2019)
D Site-Specific Closure Level (SSCLRCR)
E Site-Specific Closure Level (SSCLCITW)

NOTES:
1. Parameters that do not appear in the databox for a particular sample were not analyzed.
2. Sample results rounded to three decimal places.
3. Screening criteria and sample results are compared to two significant digits. Results equal to screening criteria are not highlighted as exceedances.
4. The concentrations of chlorobenzene (0.15 mg/L J), tetrachloroethene (0.43 mg/L J), and styrene (0.14 mg/L J) in the June 2008 sample from monitoring well MW-40 exceed the drinking water criteria. However, these VOCs were not detected at MW-40 in December 2008, and have been either not detected (chlorobenzene and styrene) or detected sporadically (tetrachloroethene) at other wells in the groundwater monitoring network. Because these VOCs have been detected so sporadically, they have essentially no spatial or temporal distribution, and as such, they have not been added to the databoxes.
5. CITW - Commercial/Industrial Tap Water Use
6. U - Not detected at the associated reporting limit
7. J - Estimated concentration

0 150 300 ft
Coordinate System:
STATE PLANE
INDIANA EAST -
NAD83

N

GHD

REVITALIZING AUTO COMMUNITIES
ENVIRONMENTAL RESPONSE TRUST
2915 DR. MARTIN LUTHER KING JR. BLVD.
ANDERSON, INDIANA
GROUNDWATER MONITORING PLAN

OFF-SITE VOC GROUNDWATER/SURFACE WATER RESULTS (2016 - 2020)

Project No. 11209506
Date June 2021

FIGURE 9

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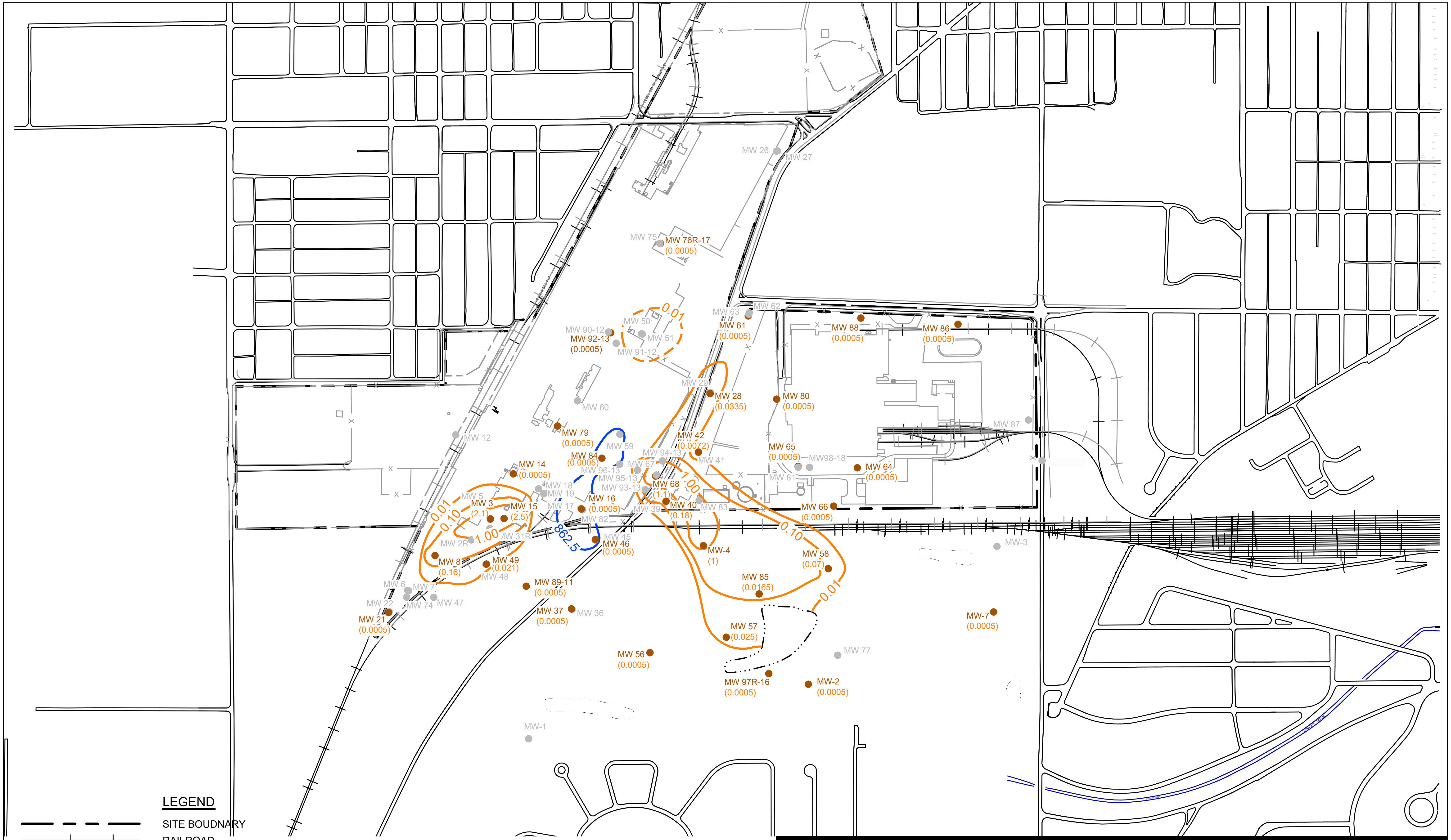

GHD

REVITALIZING AUTO COMMUNITIES
ENVIRONMENTAL RESPONSE TRUST
2915 DR. MARTIN LUTHER KING JR. BLVD.
ANDERSON, INDIANA
GROUNDWATER MONITORING PLAN

CONCENTRATION OF TCE
IN GROUNDWATER - UNIT 3

Project No. **11209506**
Date **June 2021**

FIGURE 10

Data Source:AECOM, PROJECT NO. 60163563, DATE 2012-05-15

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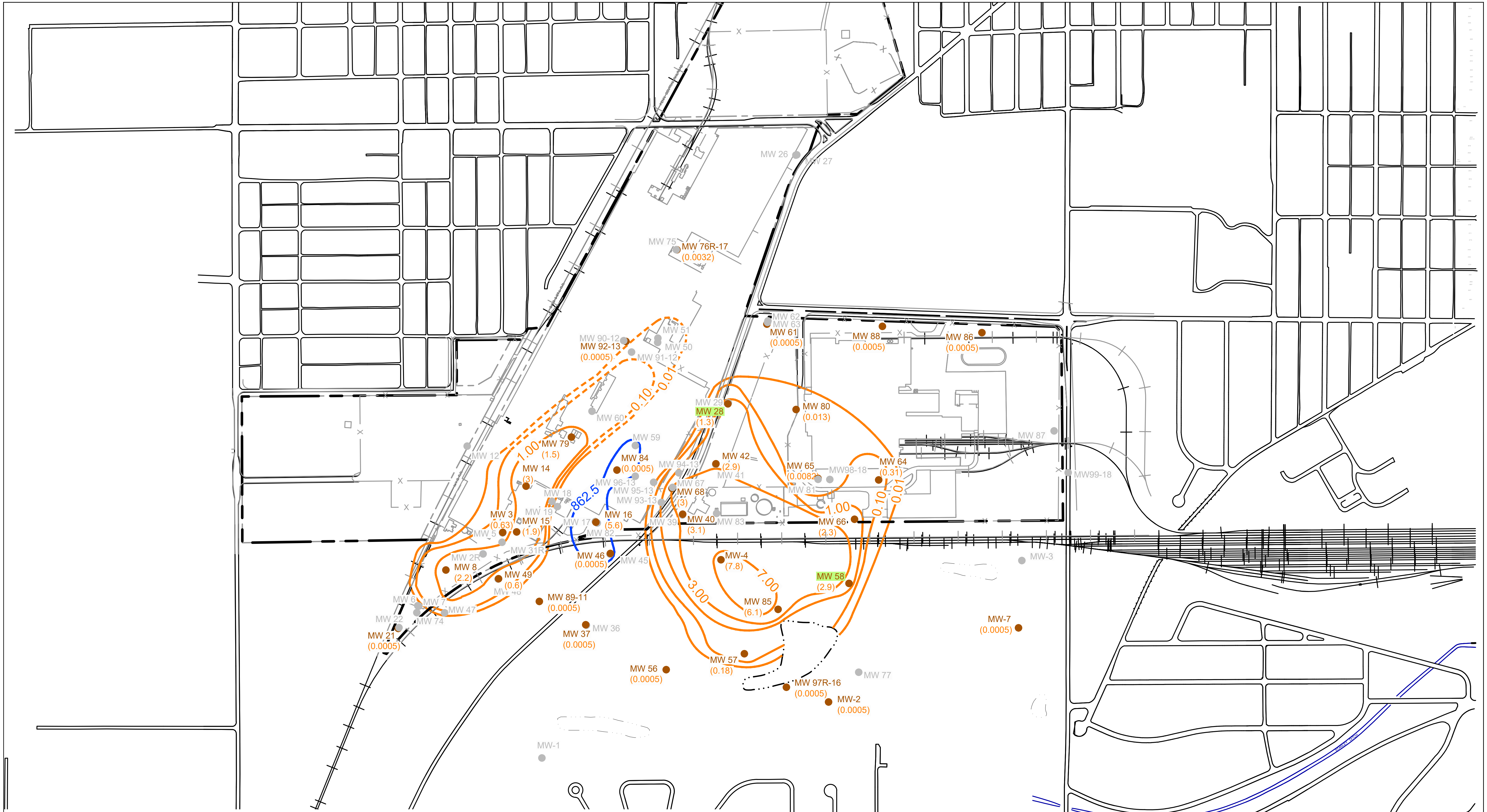

LEGEND

SITE BOUDNARY

RAILROAD

FENCE LINE

POND BOUNDARY

BUILDING

MONITORING WELL LOCATION

🟩 MONITORING WELL EXHIBITS A RECENT INCREASING CONCENTRATION TREND

1.00 ISOCONCENTRATION CONTOUR (mg/L)

863.5 GROUNDWATER MOUND (FEET NAVD 88)

NOTES: NON DETECT RESULTS ARE SHOWN AS HALF THE ASSOCIATED REPORT LIMIT

0 300 600 ft

N

Coordinate System:
STATE PLANE INDIANA
EAST - NAD83

GHD

REVITALIZING AUTO COMMUNITIES
ENVIRONMENTAL RESPONSE TRUST
2915 DR. MARTIN LUTHER KING JR. BLVD.
ANDERSON, INDIANA
GROUNDWATER MONITORING PLAN

CONCENTRATION OF CIS-1,2-DCE IN GROUNDWATER - UNIT 3

Project No. 11209506
Date June 2021

FIGURE 11

Filename: N:\CA\St Catharines\Projects\562\11209506\Digital_Design\ACAD 2020\Figures\RPT-005\11209506-GHD-0000-RPT-EN-0110_WA-005.DWG
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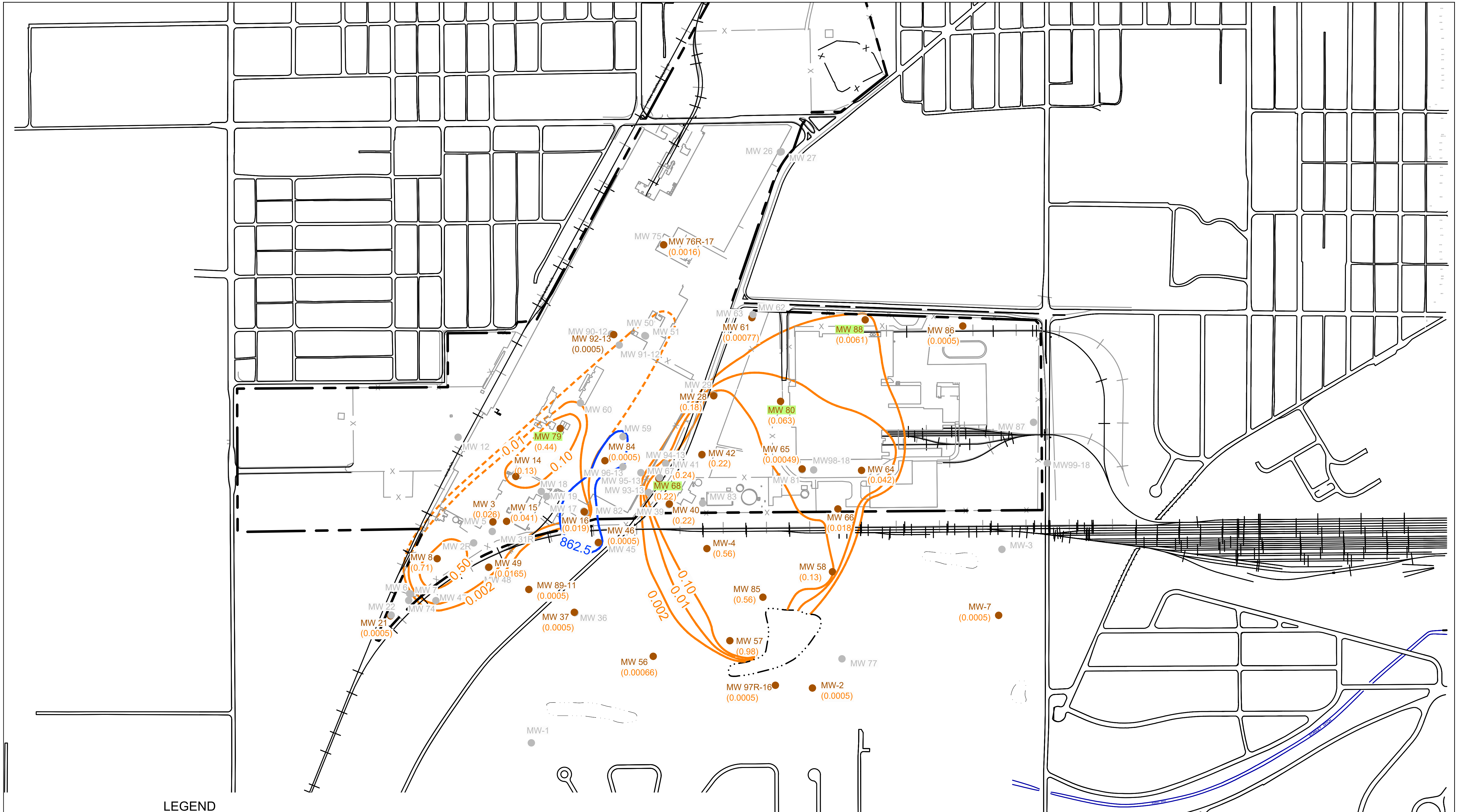
Data Source:AECOM, PROJECT NO. 60163563, DATE 2012-05-15



LEGEND

━ ━ ━	SITE BOUDNARY
─┼─┼─	RAILROAD
──x──	FENCE LINE
─··─··─	POND BOUNDARY
	BUILDING
●	MONITORING WELL LOCATION
🟩	MONITORING WELL EXHIBITS A RECENT INCREASING CONCENTRATION TREND
── 1.00	ISOCONCENTRATION CONTOUR (mg/L)
── 863.5	GROUNDWATER MOUND (FEET NAVD 88)

NOTES: NON DETECT RESULTS ARE SHOWN AS HALF THE ASSOCIATED REPORT LIMIT

0 300 600 ft

Coordinate System:
STATE PLANE INDIANA
EAST - NAD83

N

REVITALIZING AUTO COMMUNITIES
ENVIRONMENTAL RESPONSE TRUST
2915 DR. MARTIN LUTHER KING JR. BLVD.
ANDERSON, INDIANA
GROUNDWATER MONITORING PLAN

CONCENTRATION OF VINYL CHLORIDE IN GROUNDWATER - UNIT 3

Project No. **11209506**
Date **June 2021**

FIGURE 12

Filename: N:\CA\St Catharines\Projects\562\11209506\Digital_Design\ACAD 2020\Figures\RPT-005\11209506-GHD-0000-RPT-EN-0111_WA-005.DWG
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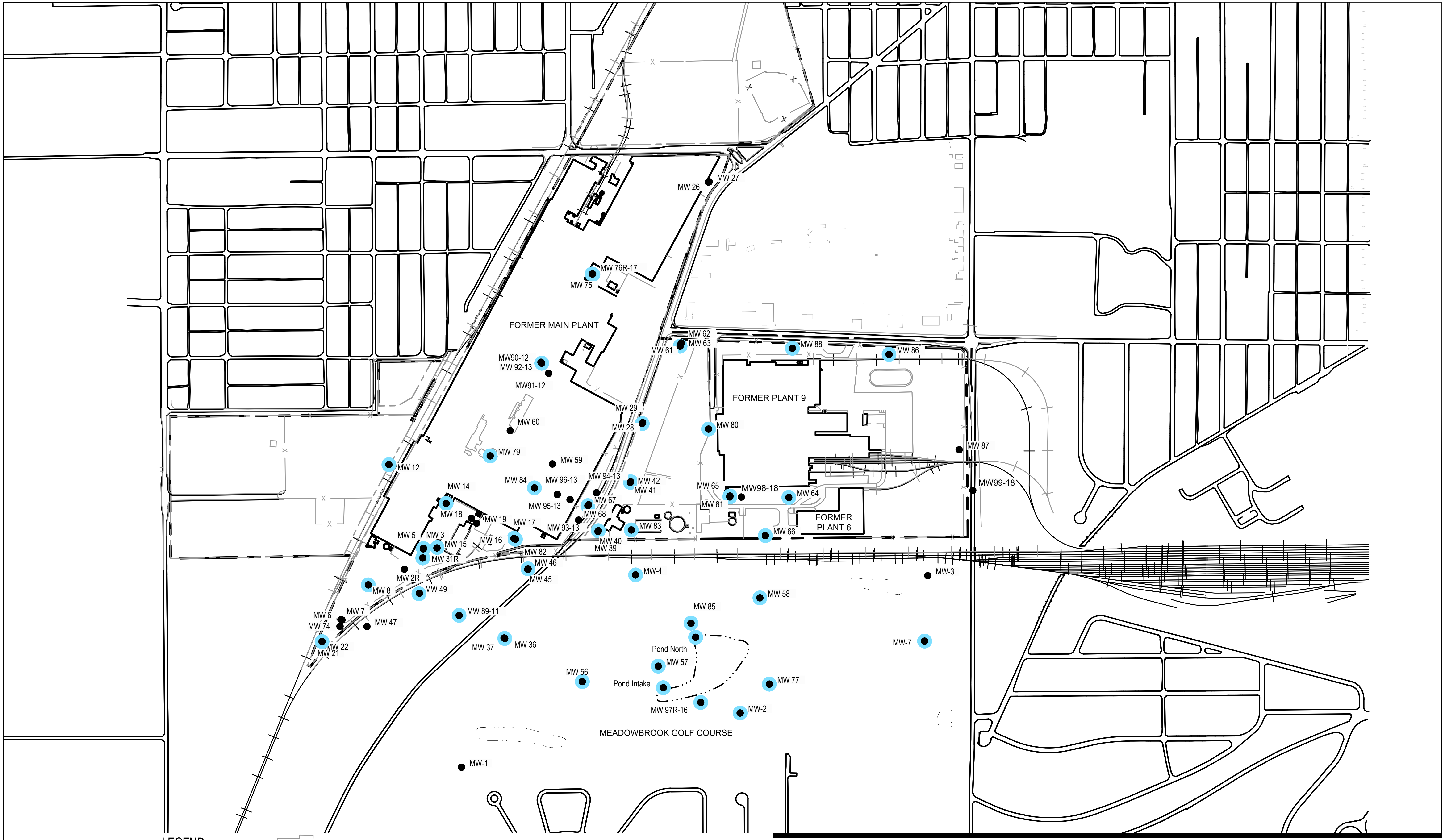

LEGEND

SITE BOUDNARY	BUILDING
RAILROAD	● MONITORING WELL LOCATION
FENCE LINE	● SAMPLING LOCATIONS INCLUDED IN GMP
POND BOUNDARY	

0 300 600 ft

Coordinate System:
STATE PLANE INDIANA
EAST - NAD83

N

GHD

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ENVIRONMENTAL RESPONSE TRUST
2915 DR. MARTIN LUTHER KING JR. BLVD.
ANDERSON, INDIANA
GROUNDWATER MONITORING PLAN

GROUNDWATER MONITORING
WELL NETWORK

Project No. **11209506**
Date **September 2021**

FIGURE 13

Data Source:AECOM, PROJECT NO. 60163563, DATE 2012-05-15

Filename: N:\CA\St Catharines\Projects\562\11209506\Digital_Design\ACAD 2020\Figures\RPT-005\11209506-GHD-0000-RPT-EN-0112_WA-005.DWG
Plot Date: 28 September 2021 12:28 PM

Tables

Table 1

Groundwater Monitoring Program
Groundwater Monitoring Plan
2915 Dr. Martin Luther King Jr. Boulevard, Anderson, Indiana

Monitoring Well Location	*Northing (1)*	*Easting (1)*	*Top of Casing Elevation (Feet) (2)*	*Hydro-Geologic Unit*	*Year Installed*	*Plume Position (3)*	*18-Month Monitoring (4)*
MW-2	1760047.06	319467.27	860.08	3d	2003	WWTP, Margin	X
MW 3	1761137.56	317370.22	880.41	3s	1992	AOC 1, Source	X
MW-4	1760961.86	318774.81	861.67	3d	2003	WWTP, Tail	X
MW-7	1760523.65	320689.67	869.69	3d	2003	WWTP, Margin	X
MW 8	1760895.98	317004.44	878.41	3s	1993	AOC 1, Source	X
MW 12	1761692.76	317141.17	882.78	3i	1993	AOC 1, Tail	X
MW 14	1761435.18	317520.10	881.36	3s	1993	AOC 1, Tail	X
MW 15	1761140.68	317459.53	879.67	3s	1993	AOC 1, Source	X
MW 16	1761203.39	317969.50	879.83	3s	1993	AOC 1, Tail	X
MW 21	1760520.07	316697.99	878.74	3s	2000	AOC 1, Margin	X
MW 28	1761964.87	318819.01	877.44	3d	2000	WWTP, Tail	X
MW 31R	1761074.48	317365.59	879.71	1	2000	AOC 1, Source	X
MW 37	1760543.88	317904.23	869.95	3s	2001	AOC 1, Margin	X
MW 40	1761254.51	318528.40	879.51	3s	2003	WWTP, Source	X
MW 41	1761575.05	318740.73	878.26	3d	2003	WWTP, Source	X
MW 42	1761579.24	318742.21	878.19	3s	2003	WWTP, Source	X
MW 46	1761002.51	318062.71	873.64	3s	2003	AOC 1, Margin	X
MW 49	1760839.93	317343.16	877.93	3s	2003	AOC 1, Tail	X
MW 56	1760254.76	318422.25	859.32	3d	2004	WWTP, Margin	X
MW 57	1760357.35	318925.21	862.52	3d	2004	WWTP, Tail	X
MW 58	1760809.76	319598.52	861.46	3d	2004	WWTP, Tail	X
MW 61	1762477.48	319069.90	876.57	3d	2004	WWTP, Margin	X
MW 64	1761475.47	319789.86	863.97	3d	2004	WWTP, Tail	X
MW 65	1761484.84	319399.81	864.22	3d	2004	WWTP, Tail	X
MW 66	1761222.31	319634.36	861.67	3d	2004	WWTP, Tail	X
MW 68	1761420.80	318459.32	876.98	3s	2004	WWTP, Source	X
MW 75	1762950.00	318486.45	882.39	3d	2004	AOC 1, Margin	X
MW 76R-17	1762955.72	318491.34	882.54	3s	2017	AOC 1, Margin	X
MW77	1760238.33	319661.11	862.77	B	2004	WWTP, Margin	X
MW 79	1761750.49	317811.99	881.92	3s	2004	AOC 1, Tail	X
MW 80	1761928.33	319258.30	865.49	3d	2005	WWTP, Tail	X
MW 81	1761479.01	319399.60	864.38	B	2005	WWTP, Tail	X
MW 82	1761198.31	317978.59	879.70	B	2005	AOC 1, Margin	X
MW 83	1761260.12	318746.50	876.23	B	2005	WWTP, Tail	X
MW 84	1761539.65	318105.07	881.95	3S	2005	WWTP, Margin	X
MW 85	1760642.54	319141.95	866.11	3d	2007	WWTP, Tail	X
MW 86	1762422.91	320453.85	859.12	3d	2010	WWTP, Margin	X
MW 88	1762463.35	319813.49	859.59	3d	2010	WWTP, Tail	X
MW 89-11	1760693.90	317605.91	875.39	3s	2011	AOC 1, Margin	X
MW 92-13	1762364.98	318152.94	884.31	3s	2013	AOC 1, Tail	X
MW 97R-16	1760065.02	319224.15	864.87	3d	2015	WWTP, Margin	X
Pond (Intake)	1760214.40	318958.40	-	Surface Water	N/A	Surface Water	X
Pond (North)	1760549.00	319173.00	857.79	Surface Water	N/A	Surface Water	X

Notes:

(1) Coordinates are Indiana State Plane Coordinate System, 1301 East, NAD 83, US Survey Feet.
(2) Elevation based on level survey relative to USGS Monument PID LA1429 = 882.61 NAVD88.
(3) AOC 1 = VOC plume originating at AOC 1 - South Court
WWTP = VOC plume originating from former WWTP Area
Source = VOC source area well
(4) TCL VOCs - Target Compound List Volatile Organic Compounds
N/A - Not Applicable

Table 2

Container, Preservation, Shipping, and Packaging Requirements for Samples
Groundwater Monitoring Plan
2915 Dr. Martin Luther King Jr. Boulevard,
Anderson, Indiana

Analyses	***Sample Containers***	***Preservation***	***Maximum Holding Time from Sample Collection***	***Volume of Sample***	***Shipping***	***Normal Packaging***
TCL VOCs	Three 40-mL vials with Teflon lined septa	HCl to pH<2 Iced, 4 ^{o}C	14 days for Analysis	Fill completely, no air bubbles	Overnight courier or hand delivered	Bubble wrap or foam chips

Notes:
HCl - Hydrochloric acid
mL - milliliters
TCL VOCs - Target Compound List Volatile Organic Compounds
^{o}C - Degrees Celsius

Table 3

Field and Laboratory Analytical Procedures
Groundwater Monitoring Plan
2915 Dr. Martin Luther King Jr. Boulevard,
Anderson, Indiana

Parameter	*Method Number*
Field Parameters	
pH	(1)
Temperature	(1)
Conductivity	(1)
Oxidation Reduction Potential (ORP)	(1)
Dissolved Oxygen (DO)	(1)
Turbidity	
Laboratory Parameters	
TCL VOCs	Method 8260D or current version

Notes:
(1) Field parameters measured using a multi-parameter meter and flow-through cell or field test kit. The calibration of field meters is checked each day prior to use.
TCL VOCs - Target Compound List Volatile Organic Compounds

Appendices

Appendix A

Field Method Guidelines – Groundwater and Surface Water Monitoring

GHD Field Training Manual

Section 7.0
Water Sampling Standard Operating Procedures
A. Groundwater
B. Residential
C. Surface Water

(T104)

200010 | Report No 2 | Revision 0 | July 1 2015

Please Adhere to the Following Quality System Training Requirements:

- Employees who are required to conduct a specific field activity must be properly certified to do the work.
- This involves reviewing the SOP and completing the online training course and exam.
- Employees must also conduct this field work under supervised conditions on at least three occasions, and must be certified by a qualified mentor. Only then can an employee conduct a specific field activity on their own. This is documented on a Field Method Training Record (QSF-021).
- Complete the QSF-021 and forward it to trainingrecords-northamerica@ghd.com.
- Please note that three topics are discussed in this SOP. A separate QSF-021 is required for each topic:
  - Groundwater Sampling
  - Residential Water Sampling
  - Surface Water Sampling

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SP-05 Groundwater Sampling Equipment and Supply Checklist
SP-06 Well Development, Purging, and Sampling Form
SP-08 Sample Collection Data Sheet - Groundwater Sampling Program
SP-09 Monitoring Well Record for Low-Flow Purging
SP-17 Equipment and Supply Checklist - Surface Water Sampling, Sediment Sampling, and Flow Measurement

Quality System Forms Index

QSF-012 Vendor Evaluation Form
QSF-014 Field Equipment Requisition Form
QSF-019 Property Access/Utility Clearance Data Sheet
QSF-021 Field Method Training Record
QSF-030 Safety and Health Schedule (Canada)
QSF-031 Safety and Health Schedule (U.S.)

7. Water Sampling (Groundwater, Residential, and Surface Water) Standard Operating Procedures

7.1 Introduction

Groundwater, residential, and surface water sampling are conducted in order to characterize the groundwater and surface water quality at a site. Standard Operating Procedures (SOPs) are presented herein for the collection of groundwater and surface water samples from:

- Monitoring wells
- Residential wells
- Surface water bodies

This guideline is not intended to provide the basis for designing a groundwater or surface water monitoring program, but instead assumes that a groundwater and/or surface water monitoring program has already been designed. It is also assumed that a site-specific Work Plan has been established and that a GHD representative is preparing to mobilize to the site.

Groundwater and surface water sampling procedures vary from project to project due to:

- Different chemicals of concern.
- Different guidance provided by local, provincial/state, and/or federal regulatory agencies with jurisdiction at the site.
- The specific objectives of the project.

It is essential that all groundwater, residential, and surface water sampling activities conform to local, state/provincial, and federal regulations. Therefore, it is essential that the GHD representative carefully reviews the Work Plan requirements. The primary goal of groundwater, residential, and surface water sampling is the collection of samples representative of the hydrostratigraphic unit and/or surface water body. It is necessary to use appropriate sampling techniques to collect representative samples that provide reliable and reproducible results in accordance with the Work Plan and all relevant regulations.

The remainder of this section is organized as follows:

- Section 7.2 Background
- Section 7.3 Planning and Preparation
- Section 7.4 Safety and Health
- Section 7.5 Quality Assurance/Quality Control
- Section 7.6 Equipment Decontamination
- Section 7.7 Field Procedures for Groundwater Sampling

- Section 7.8 Field Procedures for Residential Sampling
- Section 7.9 Field Procedures for Surface Water Sampling
- Section 7.10 Follow-Up Activities
- Section 7.11 References

7.2 Background

The objective of a groundwater and residential monitoring program is to obtain samples that are representative of existing groundwater conditions, or samples that retain the physical and chemical properties of groundwater in the hydrostratigraphic unit. Surface water sampling is performed to collect samples that are representative of physical and chemical properties of surface water bodies. Improper sampling and transport practices will cause compounds of interest to be removed or added to a sample prior to analysis. The importance of proper and consistent field sampling methods cannot be over emphasized. It is equally important that proper documentation occurs throughout the sampling program.

The most important aspect of groundwater sampling is the collection of groundwater samples that are free of suspended silt, sediment, or other fine-grained material. Fine-grained material has a variety of chemical compounds sorbed to the particles or has the ability to sorb chemicals from the aqueous phase. This causes a bias in the subsequent analytical results. Reproducible and reliable analytical data are invaluable to a groundwater monitoring program. GHD frequently criticizes the sampling activities completed by others due to the collection and analyses of turbid samples. This SOP discusses sampling protocols that typically achieve sediment-free samples.

When sampling for monitored natural attenuation (MNA) parameters, more stringent protocols are followed to ensure sediment-free samples that are representative of the total mobile load (i.e., dissolved and naturally suspended particles). Low-flow purging (LFP) techniques are strongly recommended, if not mandated, when collecting groundwater samples for MNA parameters. The LFP techniques detailed in Section 7.7.5.3 are in accordance with United States Environmental Protection Agency (USEPA) LFP procedures (Puls and Barcelona, 1996).

Groundwater sampling is required for various reasons, including:

- Investigating potable or industrial water supplies
- Tracking contaminant plumes
- Investigating a site with suspected groundwater contamination

Groundwater is usually sampled from in-place wells, installed either temporarily or permanently. Municipal, industrial, or residential wells may also be sampled during an investigation. When completing residential well sampling it is important that representative samples are collected. Poor or incorrect sampling techniques will result in erroneous results. Incorrect results disclosed to the public will create a false impression, making it difficult to change the perception when correct results are reported.

Groundwater and residential sample collection are performed from non-impacted to most impacted locations. This eliminates the potential for cross-contamination. A review of all historical analytical data is performed to ensure the exact sampling sequence.

Surface water sampling locations are selected based on many factors including:

- The study objectives
- The location of point source discharges
- The location of no-point source discharges and tributaries
- The presence of structures (e.g., bridges, dams)
- Accessibility

Surface water sampling should be performed from downstream to upstream locations. This ensures that surface water sampling activities do not cause suspended sediments to bias samples collected downstream.

7.3 Planning and Preparation

Prior to groundwater, residential, and surface water sampling:

1. Review the Work Plan, project documents, and Site-Specific Health and Safety Plan (HASP) with the Project Manager/Coordinator.
2. Review the Quality Assurance Project Plan (QAPP) with the Project Coordinator and Project Chemist to determine Quality Assurance/Quality Control (QA/QC) and decontamination requirements.
3. Complete a Field Equipment Requisition Form (QSF-014). Assemble all sampling equipment and supplies required per the Groundwater Sampling Equipment and Supply Checklist (Form SP-05). The Project Planning, Completion, and Follow-Up Checklist (Form SP-02) should be used for guidance throughout the project.
4. Assemble the site plan, well logs, and previous sampling/purging data required for the sampling event. Determine the exact number and locations of wells to be sampled.
5. Obtain all forms to record purging and sampling activities (Forms SP-06, SP-08, and SP-09).
6. Confirm with the Project Manager/Coordinator that a Property Access/Utility Clearance Data Sheet (QSF-019) has been completed. For residential sampling, ensure that homeowners have been notified of the intended sampling event. Confirm the presence of any dogs on site, modify the site-specific Job Safety Analysis, if there is a dog.
7. Arrange access to the site. Obtain all well and site keys. Consider site access conditions (e.g., snow).
8. For surface water sampling consider if hazards exist due to deep/fast moving water, difficult access, and if additional GHD personnel are required for safety and health reasons.

9. For residential sampling contact homeowners to make arrangements for a site visit, arrange for site dog to be removed from all areas where a GHD employee will be working. The client of another party may be responsible for making arrangements.
10. Complete a Vendor Evaluation Form (QSF-012) and file in the Project file for any Vendors that do not have full approval status or are not listed on the Approved Vendor List (QSL-004). Completion of a Safety and Health Schedule (QSF-030 for Canadian work; QSF-031 for U.S. work) is necessary for all Vendors who complete field services. Prior to mobilization on site, the Vendor must submit the form to the Regional Safety and Health Manager for review and approval (if not already posted on QSL-004).
11. Contact the GHD Chemistry group to arrange:
    - SSOW (Simplified Scope of Work)
    - Laboratory
    - Sample containers delivery
    - Preservatives if required
    - Filtration information if required
    - Coolers
    - Shipping details
    - Sample starting date
    - Expected duration of sampling program
12. If several sampling events are planned, evaluate with the client the benefit of purchasing and installing dedicated sampling equipment. Dedicated purging and sampling equipment reduces potential cross-contamination and reduces decontamination requirements. At a minimum, sample tubing is dedicated to each well and is left secured in the well for future use. For LFP it is recommended that each well is dedicated with a bladder pump and tubing to eliminate well disturbance.
13. Evaluate sample notification needs with the Project Coordinator. Have the regulatory groups, client, landowner, GHD personnel, and laboratory been notified of the sampling activities?
14. Evaluate containment and disposal requirements for purge waters.
15. Plan sampling activities to ensure that wells that historically go dry or have poor recharge fit into the sampling program. This will reduce the time required for sample collection.
16. Plan the sequence of sampling activities to reduce the potential for cross-contamination. For groundwater sampling, start with clean wells and progress to impacted wells. For surface water sampling, start downstream and progress upstream.

7.4 Safety and Health

GHD is committed to conducting field activities in accordance with sound safety and health practices. GHD adheres to high safety standards to protect the safety and health of all employees, subcontractors, customers, and communities in which they work. The safety and health of our employees takes precedence over cost and schedule implications.

Field personnel are required to implement the Safety Means Responsibility Awareness Teamwork (SMART) program as follows:

- Assure the HASP is specific to the job and approved by a Regional Safety & Health Manager.
- Confirm that all HASP elements have been implemented for the job.
- A Job Safety Analysis (JSA) for each task has been reviewed, modified for the specific site conditions, and communicated to all appropriate site personnel. The JSAs are a component of the HASP.
- Incorporate Stop Work Authority; Stop, Think, Act, Review (STAR) process; Safe Task Evaluation Process (STEP); Observations process; Near Loss and Incident Management process in the day-to-day operations of the job.
- Review and implement applicable sections of the GHD Safety & Health Policy Manual.
- Confirm that all site personnel have the required training and medical surveillance as defined in the HASP.
- Be prepared for emergency situations, locating safety showers, fire protection equipment, evacuation route, rally point, and first aid equipment before you begin working, and make sure that the equipment is in good working order.
- Maintain all required Personal Protective Equipment (PPE), safety equipment, and instrumentation necessary to perform the work effectively, efficiently, and safely.
- Be prepared to call the GHD Incident Hotline at 1-866-529-4886 for all involving injury/illness, property damage, vehicle incident, and/or significant Near Loss.

It is the responsibility of the Project Manager to:

- Ensure that all GHD field personnel have received the appropriate health and safety and field training and are qualified to complete the work.
- Provide subcontractors with a Job Hazard Analysis to enable them to develop their own HASP.
- Ensure that all subcontractors meet GHD's (and the Client's) safety requirements.

7.5 Quality Assurance/Quality Control

A well-designed QA/QC program will:

- Ensure that data of sufficient quality are obtained, for proper site management decisions or remediation design.
- Allow for monitoring of staff and contractor performance.
- Verify the quality of the data for the regulatory agency.

It is important to note that a QA/QC program should be developed on a site-specific basis. QA/QC requirements are discussed in Section 3.9.

7.6 Equipment Decontamination

Equipment decontamination procedures for a groundwater, residential, or surface water monitoring program will be described in detail in the site-specific Work Plan or in the QAPP.

Equipment is decontaminated between sampling locations and prior to leaving the site. Upon completion of the sampling program, all equipment is decontaminated at the site and then returned clean to the appropriate field equipment manager.

For most groundwater, residential, and surface water sampling programs, sampling equipment (e.g., pumps, bailers, water level indicators) is typically cleaned as follows:

1. Wash with clean potable water and laboratory detergent, using a brush as necessary to remove particulates.
2. Rinse with tap water.
3. Rinse with deionized water.
4. Air dry for as long as possible.

If required, the following steps may be added when sampling for Volatile Organic Compounds (VOCs) and metals:

1. Rinse with 10 percent nitric acid (only if samples are to be analyzed for metals).
2. Rinse with deionized water.
3. Rinse with appropriate solvent (pesticide grade isopropanol, methanol, acetone, hexane, if required).
4. Rinse again with deionized water.
5. Air dry for as long as possible.
6. Wrap samplers in aluminum foil to prevent contamination.

Caution:	Check the QAPP to confirm the cleaning protocol. Use of incorrect cleaning protocol could invalidate chemical data.

7.6.1 Purge Water and Decontamination Fluid Disposal

Project-specific disposal methods for purged groundwater and decontamination fluids are determined by the Project Manager during the sampling program's planning and preparation stage (see Section 7.3), but may include:

1. Off-site treatment at private treatment/disposal facility or publicly owned treatment facilities (sanitary sewer).
2. On-site treatment at a client-operated facility.
3. Direct discharge to the surrounding ground surface, allowing infiltration to the underlying subsurface.
4. Direct discharge to an impervious pavement surface allowing for evaporation.

Options 3 and 4 are permitted only after careful review of these practices and the anticipated site conditions. Under no circumstances shall GHD personnel aggravate an existing condition or spread contamination into clean areas.

Decontamination fluids (specifically cleaning solvents/acids) are segregated and collected separately from wash water and purge water. Often small volumes of solvents used during the course of a groundwater, residential, or surface water sampling program will evaporate if left in an open pail. If evaporation is not possible, off-site disposal need to be arranged.

7.7 Field Procedures for Groundwater Sampling

The typical series of events that takes place for a groundwater sampling program is:

1. Well identification and inspection
2. Air monitoring
3. Water level monitoring
4. Well depth sounding
5. Well volume calculation
6. Purging and sampling equipment installation
7. Well purging and stabilization monitoring
8. Sample collection, sample preparation, completion of chain-of-custody, (COC) sample packaging
9. Final water level monitoring (if required), purging, sampling equipment removal, secure the well
10. Equipment decontamination
11. Field note completion and review
12. Sample shipment and COC distribution
13. Purged groundwater and decontamination fluid disposal
14. Sample record documentation, equipment return
15. Completion and distribution of appropriate forms

It is recommended that new plastic sheeting be placed on the ground around the well to prevent contamination of purging and sampling equipment and accessories (e.g., pumps, hoses, rope.).

7.7.1 Well Identification and Inspection

At sites with numerous wells or wells nests, misidentification of wells has occurred. The GHD representative must be alert to the possibility of potential cap switching, mislabeled wells, or unlabeled well locations.

Determine proper well location and identification by comparing the well log details to the measured well depths (i.e., total well depth, casing diameter, casing stick-up, or stick-down distances), field tie-ins, and site plan.

Once well identification has been established, complete a thorough well inspection:

1. Determine if the well cap and lock are secure, and check for vandalism.
2. If no lock is present, dedicate a new lock to the well location.
3. Examine the integrity of the surface seal.
4. Check for cracks, evidence of frost heave, or subsidence in the vicinity of the well.
5. Examine the integrity of the protective casing. Ensure that the casing can be closed and locked.
6. If required, re-label the well to assist in future identification.
7. If the well is installed with dedicated sampling equipment, check for cracks or leaks in tubing, and worn or frayed rope.
8. Record all the well inspection details in the field book to document well conditions and suitability for groundwater sampling activities.
9. Forward the well inspection results to the Project Coordinator, especially if repairs are required.

7.7.2 Air Monitoring

Prior to removing a well cap, measure the breathing space above the well with a photoionization detector (PID) to establish background of undifferentiated organic vapor levels. Repeat this process once the well cap has been removed. If either of the PID levels exceed the air quality criteria established in the HASP, air-purifying respiratory (APR) protection or a supplied air system is required. Also take a PID reading inside the riser pipe. This PID reading is a good indication of elevated chemical or non-aqueous phase liquids (NAPL) presence. Report all elevated PID levels to the Project Coordinator immediately to determine if additional health and safety and personnel protective equipment is required. The HASP will provide the required action levels and PPE.

7.7.3 Water Level Monitoring/Well Depth Sounding

Prior to commencing well purging and groundwater sampling, the water level is measured for hydraulic monitoring and to determine the well volume. Typically, a complete round of water level measurements is taken at a site to establish groundwater conditions prior to initiating well purging or groundwater sampling activities.

A watertight cap provides an airtight seal on the casing and the water level positioned in the casing area. The cap creates a vacuum or pressurized condition in the casing section which can support or depress the water column in the well casing. This can produce an artificially high or low water level in the well casing. This effect can cause a few inches or feet of error in the static water level. Once the cap is removed, allow the pressure to stabilize for about a half hour. Measure the water level frequently to ensure that stabilization of the water level has occurred. Once the water level has stabilized (i.e., is static) the correct water level may be measured.

A number of instruments are available to measure groundwater levels. GHD typically uses:

- Battery-operated water level indicators (i.e., audible and/or visual identification of water level)
- Battery-operated oil/water interface probes (i.e., audible and/or visual identification of water levels and presence of NAPL)
- Electronic transducers (numerous manufacturers) and recording devices for long-term hydraulic monitoring
- Stevens™ recorders (both float and electronic instrumentation) for long-term hydraulic monitoring

Section 8.0 describes in detail the equipment and monitoring techniques for water level measurements.

Well depth sounding is often required to confirm well identification, evaluate the accumulation of sediment in the well bottom, or assist in determining the standing well volume. Sounding is performed using a water level indicator or a measuring tape with a weighted end. The water level indicator or weighted tape is lowered to the bottom of the well and a comparison is made of the installed well depth versus the measured well depth. The presence of excessive sediment or drill cuttings may warrant redevelopment of the well prior to well purging and groundwater sampling activities.

The total well depth is compared to the original installed total well depth. If the well screen is more than 50 percent blocked by accumulated sediment, the well is redeveloped prior to the next groundwater sampling event. Report all wells requiring redevelopment to the Project Coordinator. Well depth sounding is performed on an annual or biannual basis if the well is equipped with a dedicated pump.

For LFP, well depth measurement is performed to ensure proper pump intake placement. The used of a wide-based probe, such as a weighted tape, is necessary to minimize penetration and disturbance of accumulated sediment. The measuring device is lowered slowly through the water column to the well bottom to minimize mixing of the stagnant well casing water and disturbance of sediment.

Note: Don't forget that decontamination procedures apply to the water level monitoring equipment as well as the groundwater sampling equipment. If well sounding is performed, the entire measuring device must be thoroughly decontaminated prior to re-use. Measuring the well depth with certain water level indicators may damage the probe seal. Therefore, a tape with a weighted end should be used to measure well depth.

7.7.4 Well Volume Calculation

Prior to commencing well purging, the volume of water in the well must be known to determine the volume of groundwater to be removed. A well volume is defined as the volume of water contained in the well screen and casing (and in the case of an open bedrock hole, the volume of water in the open corehole and possibly in the well casing). To determine the standing water volume in a well:

1. Calculate the distance from the bottom of the well to the static water level.
2. Measure the inside diameter of the well or casing. Obtain the volume of standing water in the well using the following formula:

$V = \pi r^2 h$ (7.48 U.S. gallons/cubic feet) (1 liter/1,000 cubic centimeters)

Where:

V = volume of water in gallons or liters

π = 3.142

r = radius of well casing (feet or meters)

h = depth of water column in the well (feet or meters)

Typical 1 - Foot Casing Volumes	
Diameter (inches)	Gallons (U.S.) of Water Per Foot of Casing
1.5	0.09
2	0.16
3	0.37
4	0.65
6	1.47

Typical 1 Meter Casing Volumes		
Diameter		Litres per Meter of Casing
(inches)	6 (cm)	
1.5	3	1.14
2	5	2.02
3	8	4.56
4	10	8.11
6	15	18.24

7.7.5 Well Purging and Stabilization Monitoring

7.7.5.1 Typical Method

Prior to initiating groundwater sample collection, the wells is purged of the standing stagnant groundwater volume. This volume is not representative of the groundwater in the hydrostratigraphic unit. Purging is performed until the water in the well is representative of the actual conditions in the hydrostratigraphic unit. Stabilization is usually achieved by the removal of three to five times the volume of standing water in the well (USEPA convention). Purging is considered complete once purged groundwater is free of sediment and field parameters including specific conductance, temperature, and turbidity are stable. Stabilization is achieved when field measurements for specific conductance and temperature are within a range of plus or minus 10 percent of the average for the last three readings. Field measurement for pH should be within a range of plus or minus 0.1 pH unit of the average for the last three readings, and groundwater turbidity values should be less than 5 nephelometric turbidity units (NTU) (guidance value only). Once the number of well volumes required to achieve stabilization is established, the volume required to reach stabilization for future sampling events is reduced or eliminated. Extended purging of a well will generally result in achieving sediment-free groundwater conditions.

During purging, if stabilization has not occurred after removal of five well volumes, purging is continued until ten well volumes have been removed. If stabilization still has not been achieved, stabilization may be dropped as a pre-condition to groundwater sampling. The Project Coordinator should be notified that stabilization has not occurred after the removal of ten well volumes.

At high yielding wells, removing three to five well volumes is usually sufficient prior to initiating groundwater sampling. For low yield wells (i.e., wells that pump dry after one well volume) it is necessary to purge the well dry on three successive days, unless the well recovers to full static conditions in a shorter time. If the recharge is relatively high, groundwater sampling will be initiated once the well has fully recovered to static groundwater conditions, or to a level that is sufficient to collect the necessary groundwater sample volume.

Note: Purging of dry wells should be scheduled to begin on Monday or Tuesday, to reduce weekend requirements.

Turbidity of purged groundwater is evaluated by a visual examination for sediment/silt presence or by using a nephelometer which physically measures groundwater turbidity in NTUs. Generally, a turbidity value of 50 NTU or less is acceptable, although some regulatory agencies have established lower criteria (i.e., less than 5 NTU). If 50 NTU is not achieved, filtration of samples may be required. LFP can generally result in turbidity values less than 5 NTU.

Note: Agitation of the water column within the well will increase turbidity. Therefore, bailers and inertia pumps (Waterra™) are of limited use for collecting sediment-free samples. The tubing of peristaltic pumps must be secured to prevent movement of the tubing within the water column which would disturb sediment. The best method to reduce sediment disturbance is low-volume non-agitation pumping (i.e., bladder pump).

Well purging is accomplished using dedicated equipment or by using either peristaltic, bladder, or other approved purging methods. Purging and sampling equipment are dependent on the total well depth. Bailing can be used for well purging but this method stirs up sediment and increases the purging effort required before stabilization is achieved. Equipment available for well purging is discussed in Section 7.7.7. Monitoring equipment used during well purging includes a water level indicator, pH meter, thermometer, conductivity meter, and turbidity meter.

7.7.5.2 Purging Entire Water Column

The purging equipment is lowered into the top of the standing water column. Well purging is completed from as close to the top of the water column as possible, not from the well bottom, unless poor well recovery occurs. Purging from the top of the water column moves water from the formation through the well screen of the well and into the well casing. This allows for the entire static volume to be removed. Purging at depth in the water column does not remove water above the pump intake and results in the collection of unrepresentative samples.

If required, the pump intake can be adjusted. If the recovery rate is greater than the pumping rate, the pump should remain suspended until the required purged volume has been removed. If the recovery rate is less than the pumping rate, the pump should be lowered to ensure the removal of the required well volume.

7.7.5.3 Low-Flow Purging (LFP) Technique

LFP purging results in minimal drawdown during well purging, so less purging is required before formation water is removed. The volume required for purging using LFP is significantly reduced. LFP results in less agitation and mobilization of sediments compared to traditional sampling techniques.

A pre-cleaned stainless steel bladder pump equipped with a Teflon™ bladder is strongly recommended for LFP. The discharge line should be polyethylene or Teflon™ lined tubing with an inside diameter of 1/4 or 3/8 inch (6 or 10 mm). Check the Work Plan or QAPP to ascertain the proper bladder and discharge tubing. Smaller discharge tubing ensures that the tubing remains filled with water and reduces air bubbles at low purging rates. The airline to the pump is generally 1/4-inch (6 mm) inside diameter polyethylene tubing. The pump is secured to nylon rope and positioned in the well so that the pump intake is set at the mid-point of the well screen, or a minimum of 2 feet (0.6 m) above the bottom of the well or accumulated sediment level. It is important that the rope, airline, and discharge tubing are measured prior to installation in the well. The bladder pump and tubing are lowered very slowly through the water column to minimize mixing of the stagnant well casing water and to minimize the agitation of sediment into suspension, which would increase the purging time. It is recommended, and in some instances regulated, that pump installation occurs at least 24 hours prior to initiating LFP. It is recommended that a bladder pump be dedicated to the well for regular monitoring events.

During LFP, the pumping rate should be between 100 and 500 milliliters per minute (mL/min). It is recommended that initial pumping be conducted at a lower rate to limit drawdown in the well. During purging, groundwater levels are measured to maintain a maximum 0.4 foot (0.1 m) of drawdown. The pumping rate can be gradually increased during LFP. Pumping rate increases will be dependent on the drawdown and the stabilization of field parameters discussed below. Pumping rate adjustments should occur in the first 15 minutes of purging. After this time the pumping rate should remain constant and flow rate adjustments should be avoided. During purging, the pumping rate and groundwater level should be measured at least every 10 minutes. It is recommended that water level measurements occur at 5-minute intervals.

During LFP, stabilization of the purged groundwater is required to ensure the collection of representative groundwater samples from the formation and not from the stagnant water in the well casing. Field parameters including pH, temperature, specific conductance, oxidation-reduction potential (ORP), dissolved oxygen (DO), and turbidity should monitored during LFP. The measurement of these field parameters is used to evaluate if stabilization of the purged groundwater has occurred prior to the collection of groundwater samples. The field measurements should be measured and recorded at 5-minute intervals. Groundwater stabilization is considered achieved when three consecutive readings for each of the field parameters, taken at 5-minute intervals, are within the following limits:

pH	±0.1 pH units of the average value of the three readings
Temperature	±3 percent of the average value of the three readings
Conductivity	±0.005 milliSiemen per centimeter (mS/cm) of the average value of the three readings for conductivity <1 mS/cm and ±0.01 mS/cm of the average value of the three readings for conductivity >1 mS/cm
ORP	±10 millivolts (mV) of the average value of the three readings
DO	±10 percent of the average value of the three readings
Turbidity	±10 percent of the average value of the three readings, or a final value of less than 5 NTU

During LFP, field parameters are measured using a flow-through cell apparatus. At the start of LFP the purge water is visually inspected for clarity prior to connecting to the flow-through cell. If the purge water is turbid, LFP continues until the purge water is visually less turbid prior to connecting to the flow-through cell. Field parameters may be obtained using individual meters or a multiple meter unit; however, the use of a flow-through cell is highly recommended. All meters must be calibrated daily in accordance with the manufacturer's and GHD's calibration instructions, and a calibration record maintained in a standard GHD field book.

During LFP the meter readings are monitored for evidence of meter malfunction. The following are common indicators of meter malfunctions:

- DO above solubility (e.g., oxygen solubility is approximately 11 milligrams per liter (mg/L) at 10°C) may indicate a DO meter malfunction.
- Negative ORP and DO less than 1 to 2 mg/L may indicate either an ORP or a DO meter malfunction (i.e., should have positive ORP and DO less than 1 to 2 mg/L under oxidizing conditions).
- Positive ORP and DO less than 1 mg/L may indicate either an ORP or a DO meter malfunction (i.e., should have a negative ORP and DO less than 1 mg/L under reducing conditions).

Meter calibration fluids should be available for meter recalibration in the field. Spare meters should also be available for meter replacement if necessary.

Note: DO levels exceeding the solubility of oxygen in water are erroneous and are indicative of meter malfunction or poor sampling techniques causing turbulence and aeration. DO concentrations cannot exceed:

9 mg/L at 20°C	10 mg/L at 15°C	11 mg/L at 10°C	14 mg/L at 1°C

Stabilization will be considered complete when the field parameters have stabilized as indicated in the above table. Purging will continue if stabilization does not occur, until a maximum of 20 screen volumes has been removed. LFP causes groundwater to be drawn from a significant distance above or below the pump intake. Therefore, the screen volume is based on a 5-foot (1.5 m) screen length. After the removal of 20 screen volumes, purging will continue if the purged water remains visually turbid and appears to be clearing. Also purging will continue if the field parameters vary only slightly outside of the stabilization criteria and appear to be approaching stabilization.

If the recharge to the well is insufficient to conduct LFP, the well should be pumped dry and allowed to recharge sufficiently for the collection of the groundwater sample volume. Wells purged dry are required to meet the stabilization criteria detailed above.

7.7.5.4 Sampling Techniques

Upon completion of purging, with groundwater stabilization and clarity meeting the applicable protocol described above, groundwater sample collection can proceed. Generally the field parameters of pH, temperature, and specific conductance are monitored first, then any other required field measurements.

Samples are collected directly from the purging pump, when possible, or an alternate device (i.e., pump or bailer) may be installed or used. If new sampling equipment is installed, the first few bails or discharge volumes should be discarded to allow acclimation of the sampling equipment with the groundwater.

Samples are typically collected from the pump or bailer with the discharged groundwater collected directly in the appropriate sample containers. The interior of the bottle or cap must not be touched or handled in anyway. New gloves (i.e., disposable nitrile gloves or equivalent) should be worn for the collection of each sample. Caps from sample bottles must not be placed on the ground or in pockets to eliminate the possibility of cross-contamination.

Descriptions of the various equipment and sampling methods for the collection of groundwater samples are contained in Section 7.7.7.

The following describes the main activities involved in the collection of groundwater samples.

7.7.5.5 Order of Sample Collection

Groundwater samples are collected and containerized in the order following volatilization sensitivity:

1. VOCs
2. Semi-volatile organic compounds (SVOCs)
3. Total organic carbon
4. Total organic halides
5. Extractable organics
6. Total metals
7. Dissolved metals
8. Phenols
9. Cyanide
10. Sulfate and chloride

11. Nitrate and ammonia
12. Microbiological parameters
13. Radionuclides

QA/QC requirements for groundwater sampling are described in detail in Section 3.9.

7.7.6 Sample Acquisition and Transfer

If groundwater sample collection is performed using a pump, the flow rate must not exceed 100 mL/min during the collection of groundwater samples for VOCs. The low flow rate will reduce the possibility of degassing samples. During the collection of groundwater into the sample container or filtration device, minimize agitation and aeration of the sample. Groundwater samples are transferred directly into the sample container for submittal to the laboratory. Groundwater samples should not be collected in larger containers and subsequently transferred to smaller sample containers; however, on occasion this will be required for filtration or sample composting. During VOC sample collection, samples must not be collected, handled, or containerized near or in the vicinity of a running motor or exhaust which may contaminate the samples.

Groundwater samples for VOCs are collected in laboratory supplied 40 mL glass vials. The vials are filled to the top until a meniscus is formed, then topped with a Teflon™-lined cap. To prevent the loss of volatiles, it is important that no air bubbles or headspace are present in the sample container. Inverting and tapping the vial will check for the presence of air bubbles. If air bubbles are present, the sample should be topped off again and resealed. This process may only be performed a maximum of twice, at which time the sample must be discarded and the sample retaken. If preservatives were present in the bottle from the laboratory, a new sample vial must be used.

Note: Gas bubbles that appear in VOC containers after sample collection may be a result of degassing or reaction with preservative. If this occurs, note this occurrence on the chain-of-custody. Re-sampling is not required in most cases.

During sample collection ensure groundwater samples are preserved according to laboratory requirements. If required and supplied by the laboratory, preserve the samples in accordance with the QAPP. Some laboratories pre-preserve bottles so that once the groundwater sample is added the preservation is completed. In either case, it is advisable to check sample preservation using litmus paper. Using litmus paper ensures that groundwater sample preservation has been completed to the proper pH as required by the QAPP. If preservation of a sample does not meet the requirements of the QAPP, it may be necessary to add additional preservative, or note on the chain-of-custody that incomplete sample preservation has occurred.

Once sample collection is complete, samples are placed in a cooler on ice to maintain a sample temperature no more than 4°C.

7.7.6.1 Sample Labels/Sample Identification

Label all groundwater samples with the following, written in indelible ink:

1. A unique sample number (see Section 3.9 for guidance)
2. Date and time
3. Parameters to be analyzed
4. Job number
5. Sampler's initial

Secure the label to the bottle. It is recommended that bottle labels be covered with wide clear tape to protect the label during sample packing and shipment. Pack glassware in appropriate packing material to deter breakage during sample packing and shipment. Sample labels can be prepared in advance in GHD offices that have label-generating programs.

An example of a groundwater sample log entry is provided on Figure 3.8.

Section 3.9 details sample labeling requirements for environmental sampling programs. Section 3.9 also details COC requirements and sample shipment requirements.

7.7.7 Purging/Sampling Equipment

GHD maintains a wide variety of purging and sampling equipment for well purging and groundwater sample collection. The groundwater sampler should be familiar with purging and sampling equipment and understand equipment limitations and proper use. Some equipment is very useful for well purging (i.e., high flow rates) but is not permissible for LFP or for sampling sensitive parameters (e.g., VOCs cannot be collected with a submersible (turbine) or suction pump). If the groundwater sampler understands the various equipment operation and limitations, the proper selection of purging and sampling equipment is made, which will minimize the purging and sampling duration and maximize productivity.

Caution: Gas powered equipment requires special attention to ensure that staff hauling these units do not cause equipment or sample contamination. Frequent changes of disposable glove as well strict separation of sampling crew tasks (i.e., those handling pumps and hoses do not contact generator or are involved in any refueling activities) are required.

The following subsections describe the equipment available for groundwater sampling, the equipment use, approximate flow rates, and advantages and disadvantages of the equipment.

7.7.7.1 Peristaltic Pumps

A peristaltic pump is acceptable for purging wells and for most groundwater sample analytes. The groundwater sampler must ensure that a peristaltic pump is acceptable to regulatory agencies with local jurisdiction for VOC and SVOC sample collection. The QAPP will provide sampling requirements.

A peristaltic pump is capable of lifting water from a maximum depth of 25 feet (7.6 m) below ground surface or the pump, whichever is greater. A peristaltic pump is a self-priming, low volume, suction pump which consists of a rotor with ball bearing rollers. Flexible silicon tubing is inserted around or in the pump rotor and squeezed in place by the heads as they revolve in a circular pattern. The section of silicon tubing must not exceed 3 feet (0.9 m) in length. Additional rigid polyethylene or Teflon™ tubing is attached to the flexible tubing and placed in the well. Another piece of rigid tubing is attached to the discharge end of the flexible silicon tubing to facilitate sample collection. The entire length of rigid and flexible silicon tubing is dedicated to the well for future use. The tubing is typically tied and suspended in the well. The flexible or rigid tubing is not reused in other wells because cross-contamination will occur.

Note: Often a length of tubing is accidentally dropped into a well and can be difficult to retrieve. Retrieval can be accomplished by sending another piece of tubing down the well overlapping the lost section of tubing. Once in place, rotate the tubing, essentially wrapping or corkscrewing the lost tubing and new tubing together. After a number of turns are completed pull the tubing, hopefully with the lost section wound around the new piece. Repeat the procedure until successful.

Liquid is pulled into the tubing by the peristaltic pump through the creation of a vacuum as the rotor head turns. An advantage of using a peristaltic pump is that no pump parts come in direct contact with the sample. A peristaltic pump is capable of providing low flow sampling rates (i.e., typically less than 500 mL/min) with less agitation than other suction pumps. However, it is important that the tubing is secured during pumping to prevent the tubing from moving and causing agitation. A peristaltic pump also allows for regulation of the flow rate by increasing or decreasing the rotor head speed.

Peristaltic pumps are small and easily mobilized to remote sample locations. They require minimal setup, and do not require decontamination between sample locations. The disadvantages of a peristaltic pump are its limited lift and flow capabilities and the limited ability to collect VOC and SVOC samples. If VOC or SVOC sampling, check the QAPP to see if sampling with a peristaltic pump is allowed. Also check with regulatory agencies with local jurisdiction to see if the use of a peristaltic pump for collection of VOC and SVOC samples is acceptable. If using a peristaltic pump for purging, and the collection of VOCs and SVOC samples with the peristaltic pump is not acceptable, it is common to collect the initial VOC and SVOC analytes with a stainless steel bottom loading bailer. The peristaltic pump can then be used to collect the remaining sample analytes.

Peristaltic pumps are becoming more popular for LFP. However, it should be noted that a peristaltic pump may cause degassing, pH modification, and possible VOC loss.

7.7.7.2 Suction Pumps

A number of suction pumps (e.g., centrifugal) exist that can be used for purging applications only. A suction pump draws water through a suction line by creating a vacuum in the suction line or hose. Once drawn into the pump, the groundwater comes into direct contact with the pump rotor/pumping chamber area and it is therefore undesirable for groundwater sampling due to high groundwater agitation. Decontamination of suction pumps is extremely difficult. As with peristaltic pumps, most suction pumps have a limited lift capability of about 25 feet (7.6 m). Larger suction pumps, like

2-inch (5 cm) trash pumps, can achieve high flow rates under low hydraulic head. Flow rates of 15 to 20 U.S. gallons per minute (USgpm) (57 to 76 liters per minute [L/min]) can be achieved. This high flow rate minimizes purging time. New or dedicated suction line should be used at each well if a suction pump is used for purging.

Large suction pumps are also useful for well development, in conjunction with agitation and surging.

Large suction pumps are not suited for LFP due to degassing, pH modifications, VOC loss, and lack of flow adjustment.

Caution: The groundwater sampler must prevent the siphoning of purged water from a bulk container back into the well. For example, the following scenario is possible: Joe Sampler has completed purging well 'xyz' and has turned off the 2-inch trash pump. The trash pump discharge line is inserted into a wastewater tank and is submerged below the tank water level. As Joe prepares his glassware and sample pump, the wastewater tank contents are siphoned back into the well. This can result in cross contamination with water from other sites/wells which have been purged either:

- into the tank
- through the pump
- through the discharge line

All discharge lines/groundwater purge pumps must be provided with a check valve to prevent this situation.

Drilling rig pumps including Moyno, progressive cavity, bean, and mud pumps can be used for well purging and well development.

Suction pumps are a useful tool for high rate purging and well development. They require no additional equipment other than a suction line and discharge line for each well. They are mobile and easily transported around and between sites. Suction pumps are limited to use in wells with less than 25 feet (7.6 m) of lift, are difficult to decontaminate, and are unsuitable for sample collection. Large suction pumps are not suitable for LFP.

7.7.7.3 Submersible Pumps

A submersible pump generally provides high discharge rates for purging at depths beyond the capabilities of a suction pump. Based on its size, a submersible pump can pump water from substantial depths at very high pumping rates and can provide higher groundwater extraction rates than other methods. At high pumping rates, a submersible pump can cause agitation and aeration. This results in some submersible pumps not being suitable for the collection of groundwater samples for VOC and SVOC analysis.

Adjustable rate submersible pumps, constructed of stainless steel or Teflon™, are suitable and approved for LFP provided low flow rates are maintained.

The submersible pump, including the electrical cable and lowering cable, must be decontaminated between wells in accordance with the Work Plan or QAPP.

A submersible pump installed in bedrock or in a deep well should be attached to rigid piping (i.e., 3/4-inch (1.9 cm) steel) to allow for pulling or pushing of the pump. The pump may need to be pushed or pulled to the appropriate installation depth, past tight spots in the well, and when affixing the electrical cable and lowering the cable/safety line. Even when rigid piping is used, a safety line must be attached to the pump in case the piping becomes unthreaded or the pump connection is lost.

Submersible pumps can provide high flow rates that are useful for deep well or large diameter well purging activities. They tend to be labor intensive because of decontamination problems, power supply, and discharge piping size. Some submersible pumps are not suitable for some sample analytes. Small submersible pumps (i.e., 2-inch (5 cm) Grundfos™) have the proper construction and have adjustable flow rates, making them suitable for LFP.

7.7.7.4 Air Lift Pumps

An air lift pump operates using compressed air or nitrogen. The compressed air or nitrogen comes into direct contact with the groundwater and forces groundwater from the pump chamber through a series of check balls into the discharge line. An air lift pump operates on alternate pump discharge and pump recharge cycles. The pump and recharge cycles are controlled using a control box at ground surface. Air lifting is possible from deep depths with moderate to low flow rates (2 to 3 USgpm [7.6 to 11.5 L/min]) depending on the pump installation depth, static head, discharge tubing diameter, and air supply pressure.

Since the air or nitrogen comes in direct contact with the groundwater, an air lift pump should not be used for the collection of groundwater samples for VOC and SVOC analysis.

An air lift pump is a good tool for deep well purging and development. If an air lift pump is used for purging, an alternate sampling method will be required (e.g., bailers or bladder pump) for the collection of VOC and SVOC groundwater samples.

7.7.7.5 Bladder Pumps

Bladder pumps, as with air lift pumps, are driven by compressed air or nitrogen but the air or nitrogen does not come in contact with the groundwater. The contact between the air or nitrogen and the groundwater is eliminated by the presence of a Teflon™, polyethylene, or natural rubber bladder. The pump operation, as with the air lift pump, is cyclic and is controlled using a control box at ground surface. The control box controls the pump filling and discharge time. Because the air or nitrogen does not come in direct contact with the groundwater, and there is limited groundwater agitation and degassing, a bladder pump is the best sampling equipment for the collection of groundwater samples for VOC and SVOC analysis.

Bladder pump operation is very quiescent, causing little formation and well disturbance. By using a bladder pump, collecting a sediment-free groundwater sample is easily achieved. An adjustable rate bladder pump should be used for LFP. Bladder pumps generally are only able to achieve a maximum pumping rate of 1.5 USgpm (5.7 L/min). It is important to note that flow rates should be reduced in deep well applications.

Well purging and sampling can be performed using a bladder pump. Once sampling is completed, the pump should be disassembled and decontaminated in accordance with the Work Plan or QAPP prior to use in other wells. The sample tubing is generally 1/4- or 3/8-inch (6 or 10 mm) diameter polyethylene or Teflon™ lined polyethylene tubing. The air line is generally 1/4-inch (6 mm) polyethylene tubing. The sample and air line tubing are typically suspended in the well for future use (dedicated). At some sites a complete sampling system (bladder pump, discharge tubing, and air line) is dedicated to each well.

Bladder pumps provide excellent sample quality and are useful in deeper sampling applications. There are no analyte restrictions. Bladder pumps are strongly recommended for LFP applications.

Bladder pumps require additional equipment including control box, compressed air or nitrogen, and tubing. The setup of a bladder pump is quite labor intensive unless a dedicated system is in place. Decontamination of a bladder pump requires pump disassembly and re-assembly. Finally, bladder pumps are not capable of high flow rates, thus purging times tend to be increased slightly.

7.7.7.6 Inertia Pumps

An Inertia pump or Waterra™ pump is a manually operated or mechanically driven pump which uses only a foot valve on the sample/purge tubing. "Jerking" the sample/purge tubing with the attached foot valve removes groundwater from the well. The rapid lifting and lowering action of the tubing imparts an inertia to the water column within the sample/purge tubing. This causes the water column to rise to ground surface and discharge from the end of the sample/purge tubing. The foot valve holds the water column in the tubing during the lifting process and allows groundwater to enter the sample/purge tubing during the lowering, or down stroke.

GHD owns both manual and mechanical gas-powered inertia systems. Flow rates with inertia pumps are variable and are dependent on cycle speed, tubing size, foot valve size, well depth, and depth to groundwater. The inertia pump is a useful method for purging and for collection of most groundwater sample analytes. Acceptability of VOC and SVOC sampling with inertia pumps is gaining approval in selected areas. Prior to using an inertia pump as a sampling device, check the sampling requirements in the QAPP, or obtain approval from the Project Coordinator.

Inertia pumps are useful for the extraction of dense non-aqueous phase liquids (DNAPL). The only equipment that is exposed to the gross contamination is the foot valve and a small section of the sample/purge tubing. On most projects, the foot valve and sample/purge tubing are dedicated to the well.

Inertia pumps tend to cause extensive disturbance to the water column. The vigorous lifting and lowering of the inertia pump tends to make it difficult to collect sediment-free groundwater samples. Therefore, inertia pumps are not suitable for LFP.

7.7.7.7 Bailers

A bailer is a manual sampling device consisting generally of a hollow tube (e.g., Teflon™, PVC, or stainless steel) with a lower check ball that permits water entry and prevents water loss. The bailer is lowered slowly into the well. This allows water to enter the bailer through the bottom, and the weight of the water inside the bailer closes the check ball when the bailer is retrieved from the well.

A rope or cable is affixed to the bailer to allow the lowering and retrieval of the bailer from the well. Bailing tends to be disruptive to the water column and formation. Obtaining sediment-free groundwater samples using a bailer tends to be difficult, if not impossible. VOCs and SVOCs, as well as other analytes can be collected using a bailer, but it is important that these analytes be as sediment-free as possible. The compatibility of the bailer material and groundwater analytes should be reviewed and approved prior to using a bailer for the collection of groundwater samples. Generally, Teflon™ bailers are acceptable for the collection of most analytes.

Power winches with overhead tripods are available to assist in purging and sampling deep or large volume wells.

Flow rates attained using a bailer is a function of the bailer size and retrieval frequency. Retrieval frequency is dependent on well depth, water depth, and well recharge rate. Bailing is not practical for deep wells or for the removal of large well volumes.

A bailer is a useful tool for well development as the surging action from the bailer insertion and removal from the well promotes sediment suspension and subsequent removal. However, obtaining completely sediment-free samples, or samples below 50 NTU, is difficult if not impossible using a bailer.

A bailer provides representative samples once the well has been adequately developed and purged. A bailer is not suitable for LFP. Rope used for bailing must be kept off the ground and free of other contaminating material that could be introduced to the well. Rope can either be dedicated to the well for future use or discarded.

7.7.7.8 Passive Diffusion Bags

When sampling with diffusion bags the well must be fully developed using an alternate method.

A diffusion bag is a polyethylene bag that contains deionized water. The bag is attached to an appropriate length of rope or cable in order to be submerged to the appropriate depth (indicated in the Work Plan, QAPP, or as instructed by the Project Coordinator). Cable or rope used to suspend diffusion bags can be dedicated to the well for future use or discarded.

Once submerged to the appropriate depth, the diffusion bag is left in the well for an extended period of time, usually 14 days, to allow the bag to equilibrate with the water in the well. The use of diffusion bags eliminates well purging prior to sampling. Placement of multiple diffusion bags in a well allows for vertical groundwater profiling.

Diffusion bags are a low cost method for the collection of groundwater samples. Advantages include:

- No purge water to dispose of.
- No equipment decontamination between wells.
- Simple logistics and operation.
- Reduction in personnel and exposure times.
- Samples collected are representative of formation water adjacent to well.

- Allow for vertical profiling of water column.
- Appropriate for long-term monitoring programs.

The disadvantage of diffusion bags is the length of equilibrium time, generally 14 days. Currently, there are membranes available for diffusion bags suitable for the collection of groundwater samples for select SVOC, and metals analyses. However, there are no membranes currently available for polychlorinated biphenyls (PCBs).

Note: Handle diffusion bags only when wearing clean nitrile or surgical gloves.

7.7.8 Filtering of Groundwater Samples

Filtering is an important process to remove suspended particulate that affect sample results. Filtration of groundwater samples is generally limited to metals analysis.

Filtering can be completed in the field using in-line filters or a vacuum filter kit. Filtering of samples can also be completed by the laboratory, in which case the samples must not be preserved and must be at the laboratory in at least 24 hours of sample collection.

7.8 Field Procedures for Residential Sampling

7.8.1 General

When sampling potable water supply wells it is important to ensure that the samples collected are representative of the aquifer being sampled. Poor or incorrect sampling techniques will result in erroneous sample results that can be disclosed to the public. Incorrect sample results may make any changes in the public perception hard to accomplish when correct results are reported.

7.8.2 Field Procedures

The requirements of a residential well sampling program should be reviewed with the Project Coordinator prior to initiating sampling activities. While similar field procedures used in groundwater sampling (including documentation, sample identification, date, time, etc.) are required in residential well sampling, additional procedures are also required.

Prior to collection of groundwater samples from a residential well, the well must be purged to ensure that samples collected are representative of the formation. Purging removes standing water from the well casing, pipes, and pressure or holding tank. Purging of a residential well requires the removal of one well volume. If access to the well is not available to determine the well volume, purging for a period of 15 to 30 minutes is generally sufficient. Field measurements for pH, conductivity, and temperature are recorded during purging activities until the readings indicate that stabilization has occurred.

Sampling of residential wells is generally performed using the existing pumping system. However, GHD purging and sampling equipment can be used. It is important that only designated **clean** purging and sampling equipment be used for residential well sampling. The use of the existing pumping system is preferred, as this is more representative of the water quality provided to the residence. Using the existing pumping system also minimizes the possibility of damaging the well and existing pumping system when installing additional purging and sampling equipment.

If GHD equipment is used for residential well sampling, it must be cleaned prior to and between use with a bleach and deionized water solution wash followed by a thorough deionized water rinse.

> Note: In addition to the special technical procedures noted, GHD personnel must be aware of this unique situation of conducting sampling at private residences. Special care must be taken to be polite and courteous at all times. Offer only necessary information and maintain a clean work area that is returned to pre-sampling conditions. Personnel should have proper identification available, and only remain in areas long enough to complete the required tasks.

Taps selected for residential well sampling should be located as close to the well as possible. Locate the taps before any treatment systems and, if possible, the pressure tank. It is important to note, if possible, all water treatment devices in operation at the residence including:

- Water softeners
- Filtration units
- Ultraviolet light
- Reverse osmosis
- Distillers
- Chlorinators

Leaking taps that allow water to flow from the stem of the valve handle and around the tap should not be used as sampling locations. Aerators, strainers, and hose attachments should be removed prior to sampling. Maintain a steady flow of water during sampling activities to avoid pressure fluctuations that may cause sheets of microbial growth lodged in the pipes to break loose. Open the cold water tap for a period of 15 to 30 minutes to allow for the complete purging of the pumping system. Maintain a smooth-flaring water stream at a low to moderate pressure without splashing. Do not change the flow rate. Changes in the flow could dislodge particles in the pipes or faucet.

When sampling for microbiological parameters, the end of the faucet must be flame sterilized. During residential well sample, never place caps from sample containers on the ground or in a pocket. Instead, hold the sample container in one hand and the sample container cap in the other. Be very careful not to touch the inside of the sample container cap. Wear new disposable gloves at each sampling location and following contact with a potential contaminant source. The inside of the sample bottle must not be touched with bare hands or allowed to contact the surface of the faucet.

7.8.3 Field Notes for Residential Sampling

Full documentation of each residential well is required and includes:

1. Well depth
2. Casing construction and diameter

3. Well installation date if known
4. Pumping system configuration
5. Piping system construction (e.g., copper, lead-joint, ABS)
6. Presence of treatment devices

Obtain the name and exact mailing address for all residence or well owners, as well as home and work telephone numbers. This information is required to inform the residence or well owner of the results of the sampling activities.

Document residential well sampling activities in a standard GHD field book. Figure 3.8 provides typical residential well sampling field note requirements. Note that additional documentation of well details, treatment devices, piping system, and special circumstances are required in the field book in addition to the sample log entry.

7.9 Field Procedures for Surface Water Sampling

7.9.1 General

Surface water sampling is performed to obtain samples for surface water bodies that are representative of existing surface water conditions.

Surface water sampling locations for surface water quality and groundwater interaction studies are selected based on the following:

1. Study objectives
2. Location of point surface discharges
3. Non-point source discharges and tributaries
4. Presence of structures (e.g., bridge, dam)
5. Accessibility

During surface water sampling it is important to obtain samples that are not impacted by the re-suspension of sediment produced because of improper or poor surface water sampling techniques.

7.9.2 Surface Water Sample Location Selection

Prior to conducting surface water sampling activities, the first requirement is the consideration and development of surface water sampling locations. It is important that all surface water sampling locations be selected in accordance with the Work Plan and described to and discussed with the Project Coordinator.

Bridges and piers are good locations for surface water sampling locations since they provide easy access and permit water sampling across the entire width of the surface water body. The JSA for sampling from bridges must include a traffic management plan to assure the employee has considered using a spotter, signage, cones, and flags to warn car traffic of the work adjacent to the roadway. Wading for surface water samples increases the chances of disturbance of sediments from the floor of the surface water body.

When wading for surface water samples in lakes, ponds, streams, and slow moving rivers be aware of potential safety and health risks. A life vest and safety line must be worn at all times where footing is unstable or when sampling in fast moving or more than 3 feet (0.9 m) deep. A two-person team is required for most surface water sampling activities, a Project Manager must approve a one person sampling team. If the site conditions require the use of the life vest and safety line, the two people involved in the sampling must be competent swimmers.

Surface water samples must be collected with no suspended sediments. Surface water samples are collected commencing with the furthest downstream location to avoid sediment interference with upstream locations.

7.9.2.1 Rivers, Streams, and Creeks

Surface water samples are generally collected in areas of surface water bodies that are representative of the surface water body conditions. Representative surface water samples will usually be collected in sections of surface water bodies that have a uniform cross section and flow rate. Mixing is influenced by turbulence and water velocity, therefore the selection of surface water sampling locations immediately downstream of a riffle area (i.e., fast flow zone) will ensure good vertical mixing. These locations are also likely areas for deposition of sediment since this occurs in areas of decreased flow velocity.

Surface water sampling locations should not be established in areas near point source discharges including tributaries, industrial effluents, and municipal effluents. Surface water sampling of these source discharge points can be performed to assess the impact of these source areas on overall surface water quality.

Sample tributaries as close to the mouth as possible. It is important to select surface water sample locations considering the impact downstream, including tributary flow and sediment.

In all instances, properly document all surface water sampling locations in a standard GHD field book. Documentation may include photographs and tie-ins to known structures.

7.9.2.2 Lakes, Ponds, and Impoundments

The surface water in lakes, ponds, and impoundments has a greater tendency to be stratified than water in rivers and streams. Lack of mixing in these surface water bodies may require additional surface water sample collection. Extreme turbidity variances may occur where highly turbid surface water courses enter a lake or pond. Therefore, each layer of the stratified surface water column may need to be considered separately. Stratification is generally a result of water temperature differences, with cooler heavier water being trapped below warmer water.

Surface water sample locations for lakes, ponds, and impoundments should adequately represent the conditions of the surface water body. All intakes and outflows that may provide biased surface water representation should be identified and documented. Surface water sample locations with adjacent structures (e.g., banks, piers) may also provide biased samples, as the potential for boundary flow and eddies exists.

The number of surface water sample locations on lakes, ponds, or impoundments will vary depending on the purpose of the investigation, as well as the size and shape of the surface water body. In ponds and small impoundments a single surface water sample should be collected at the deepest point. In naturally formed ponds, the deepest point is usually near the center of the surface water body. In impoundments the point is usually near the dam.

In lakes and larger impoundments, several sub-samples should be taken to form a single composite sample. These vertical surface water sampling locations are collected along a pre-determined grid.

In irregular shaped lakes with several bays and covers that are protected from the wind, additional surface water samples are required to properly represent surface water quality at various locations in the lake. Additional surface water samples should be taken at discharges, tributaries, and other factors or sources that are suspected of affecting the surface water quality.

In all instances, properly document all surface water sampling locations in a standard GHD field book. Documentation may include photographs and tie-ins to known structures.

7.9.3 Sampling Equipment and Techniques

When collecting surface water samples, direct dipping of the sample container into the stream or water is acceptable unless the sample container contains preservatives. If preserved, a pre-cleaned unpreserved sample container should be used to collect the surface water sample. The surface water sample is then transferred to the appropriate preserved sample container. When collecting surface water samples, submerse the inverted bottle to the desired sample depth and tilt the opening of the sample container upstream to fill. During surface water sample collection, wading or movement may cause sediment deposits to be re-suspended and can result in biased samples. Wading is acceptable if the stream has a noticeable current and the samples are collected directly in the sample container when faced upstream. If the stream is too deep to wade in or if addition samples must be collected at various depths, additional sampling equipment will be required. Surface water samples should be collected about 6 inches (15 cm) below the surface, with the sample bottles being completely submerged. Taking the surface water sample at this depth eliminates the collection of floating debris in the sample container.

Surface water sample collection where the flow depth is less than 1 inch (<2.5 cm) requires the use of special equipment to eliminate sediment disturbance. Surface water sampling may be conducted with a container then transferred to the appropriate sample container, or collection may be performed using a peristaltic pump. A small excavation in the stream bed to create a sump for sample collection can also be considered but should be prepared in advance to allow all the sediment to settle prior to surface water sampling activities.

Teflon™ bailers can be used for surface water sampling if it is not necessary to collect surface water samples at specific depths. A bottom loading bailer with a check ball is sufficient. When the bailer is lowered through the water, the water is continually displaced through the bailer until the desired depth is reached. The bailer is retrieved and the check ball prohibits the release of the collected surface water sample. Bailers are not suitable in surface water bodies with strong currents, or where depth-specific sampling is required.

For discrete and specified depth surface water sampling, and the parameters to be monitored do not require a Teflon™ coated sampling device, a standard Kemmerer or Van Dorn sampler can be used. The Kemmerer sampler is a brass cylinder with rubber stoppers that leave the sampler ends open while the sampler is being lowered. The sampler is lowered in a vertical position to allow water to pass through. The Van Dorn sampler is plastic and is lowered in a horizontal position. For both samplers, a messenger is sent down a rope when the sampler has reached the required depth. The messenger causes the stopper on the sampler to close. The sampler is then retrieved and the surface water sample can be collected through a valve. DO sample bottles can be filled by allowing overflow using a rubber tube attached to the valve. During depth-specific surface water sampling, take care not to disturb bottom sediments.

Glass beakers or stainless steel cups may also be used to collect surface water samples if parameter interference does not occur. The beaker or cup must be rinsed at least three times with the surface water sample prior to sample collection.

All equipment must be thoroughly decontaminated as outlined in Section 7.6.

7.9.4 Field Notes for Surface Water Sampling

Use a standard GHD field book to record daily surface sampling activities, describe surface water sampling locations, sampling techniques, and, if applicable, provide a description of photographs taken. Visual observations are important and provide valuable information when interpreting surface water quality results. Observations include:

1. Weather conditions
2. Stream flow directions
3. Stream physical conditions (width, depth, etc.)
4. Tributaries
5. Effluent discharges
6. Impoundments
7. Bridges
8. Railway trestles
9. Oil sheens
10. Odors
11. Buried debris
12. Vegetation
13. Algae
14. Fish and other aquatic life
15. Surrounding industrial areas

The following factors should be considered for surface water sampling:

1. Predominant Surrounding Land Use: Observe the prevalent land use type in the vicinity and note any other land uses in the area which, although not dominant, may potentially affect surface water quality.
2. Local Watershed Erosion: Note the existing or potential erosion of soil in the local watershed and its movement into the stream. Erosion can be rated through visual observation of watershed stream characteristics including increases or decreases in turbidity.
3. Local Watershed Non-Point Source Pollution: This refers to problems or potential problems other than erosion and sedimentation. Nonpoint source pollution can be diffuse agricultural and urban runoff. Other factors may include feed lots, wetlands, septic systems, dams, impoundments, and mine seepage.
4. Estimated Stream Width: The estimated distance from shore at a transect representative of the stream width in the area.
5. Estimated Stream Depth: Riffle (rocky area), run (steady flow area), and pool (still area). Estimate the vertical distance from the water surface to the bottom of the surface water body at a representative depth at three locations.
6. High Water Mark: Estimate the vertical distance from the bank of the surface water body to the peak overflow level, as indicated by debris hanging in bank or flood plain vegetation, and deposition of silt. In instances where bank flow is rare, high water marks may not be evident.
7. Velocity: Record or measure the stream velocity in a representative run area.
8. Dam Present: Indicate the presence or absence of a dam upstream or downstream of the surface water sampling location. If a dam is present, include specific information detailing the alteration of the surface water flow.
9. Channelized: Indicate if the area surrounding the surface water sampling location is channelized.
10. Canopy Cover: Note the general proportion of open to shaded areas which best describes the amount of cover at the surface water sampling location.

7.10 Follow-Up Activities

The following should be performed once groundwater, residential, and surface water sampling is completed:

1. Double check the Work Plan and QAPP to ensure all samples and QA/QC samples have been collected and confirm with the Project Coordinator.
2. Decontaminate all equipment at the site then return clean to the appropriate office equipment manager.
3. Dispose of purge water and cleaning fluid as specified in the Work Plan.
4. Notify the contract laboratory when the samples should arrive. Enclose a completed chain-of-custody in each cooler.

5. Complete and file the appropriate forms and data sheets. Also file the field notes. For groundwater, residential, and surface water sampling these forms include:
   - Project Planning, Completion, and Follow-Up Checklist (Form SP-02)
   - Well Development, Purging, and Sampling Form (Form SP-06)
   - Sample Collection Data Sheet - Groundwater Sampling Program (Form SP-08)
   - Monitoring Well Record for Low-Flow Purging (if performed) (Form SP-09)
6. Return site and well keys.

7.11 References

For additional information pertaining to groundwater sampling activities the user of this manual may reference the following:

ASTM D5474	Guide for Selection of Data Elements for Groundwater Investigations
ASTM D4696	Guide for Pore-Liquid Sampling from the Vadose Zone
ASTM D5979	Guide for Conceptualization and Characterization of Groundwater Systems
ASTM D5903	Guide for Planning and Preparing for a Groundwater Sampling Event
ASTM D4448	Standard Guide for Sampling Groundwater Wells
ASTM D6001	Standard Guide for Direct-Push Water Sampling for Geoenvironmental Investigations.

For additional information pertaining to surface water sampling, the user of this manual may reference the following:

ASTM D5358	Practice for Sampling with a Dipper or Pond Sampler
ASTM D4489	Practices for Sampling of Waterborne Oils
ASTM D3325	Practice for the Preservation of Waterborne Oil Samples
ASTM D4841	Practice for Estimation of Holding Time for Water Samples Containing Organic and Inorganic Constituents
ASTM D4411	Guide for Sampling Fluvial Sediment in Motion
ASTM D4823	Guide for Core-Sampling Submerged, Unconsolidated Sediments
ASTM D3213	Practice for Handling, Storing, and Preparing Soft Undisturbed Marine Soil
ASTM D3976	Practice for Preparation of Sediment Samples for Chemical Analysis
ASTM E1391	Guide for Collection, Storage, Characterization, and Manipulation of Sediments for Toxicological Testing
ASTM D4581	Guide for Measurement of Morphologic Characteristics of Surface Water Bodies
ASTM D5906	Guide for Measuring Horizontal Positioning During Measurements of Surface Water Depths
ASTM D5073	Practice for Depth Measurement of Surface Water

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